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20 years of EU ETS

Steering by Scarcity

Table of contents

1. Introduction

The EU introduced the first-ever greenhouse gas emissions trading scheme in 2005: the *European Union Emission Trading System* or EU ETS for short. Accounting for almost 50% of the EU's total greenhouse gas emissions, it is often referred to as the cornerstone of European climate policy. The EU ETS covers the power sector, heavy industry and continental flights. Heavy industry in turn consists, for example, of companies in the chemical, metal and stone industries.

The EU ETS has now been in operation for almost two decades. In these 20 years, the system has endured a number of profound economic, political and social changes. For instance, we faced a global economic crisis in 2008, the Paris Agreement was signed in 2015, after which global climate policy really gained momentum, and we faced a pandemic in 2020. In all this time, the core of the EU ETS remained intact: emissions are priced and GHG emissions from ETS sectors decline to zero.

An (international) emissions trading system with a decreasing number of emission allowances is one of the most cost-efficient ways to reduce emissions. A predetermined decreasing emissions cap gives companies certainty that emissions across the sector must go to zero. At the same time, participating parties can trade allowances among themselves, creating a price for allowances. That price ensures that emissions are reduced where it is cheapest to do so. Moreover, emission rights are becoming increasingly scarce. This creates upward price pressure on the market from the supply side. Following the EU's lead, other countries and regions in different parts of the world have also set up emissions trading systems for greenhouse gas reductions.

Currently, the policy framework is such that no more allowances will be issued from 2040 onwards. So the system has been operating for about 20 years, and will serve for at least 15 more under current plans. In recent years the system’s emission cap has been reduced more quickly than ever before. Furthermore, voices are already emerging in the current debate for a lifetime extension of the ETS beyond 2039. This could eventually create a market for negative emissions.

Over 20 years, the EU ETS has made an indispensable contribution to the energy transition. The system has ensured that the cheapest emission reduction options have taken place. This inherently also means that the necessary more expensive choices for emission reduction have yet to take place. The emission price is guiding these choices. From 2027, a second, stand-alone emissions trading system will come into force: ETS-2. This ETS will oversee emission reductions from the transport sector, the built environment and smaller industry.

This thematic report provides an overview of the historical policy and price developments of the EU ETS. In addition, it provides interpretation on sustainability within the EU ETS and what possible implications there may be for the market. Finally, it provides insight into developments regarding ETS-2.

2. Establishment of emissions trading

Global climate policy has its roots in 1992 when the so-called '*Earth Summit*' was held in Rio de Janeiro. At this summit, 178 participating countries signed the '*Framework Convention on Climate Change*'. Although this summit did not directly lead to practically implementable climate policy, it was agreed to organise an annual conference from 1995 onwards to shape, evaluate and adjust global climate policy. The so-called '*Conference of the Parties*', or 'COP' for short, was born.

The third COP, in Kyoto in 1997, established for the first time that certain countries would be given binding emissions reduction targets. Thus, 'developed' countries were given the goal of reducing their emissions by an average of 5.2% over the period 2008-2012 compared to 1990 levels. Besides setting reduction targets, it was also stipulated that flexible mechanisms could be used to meet the reduction targets. International emissions trading was part of these flexible mechanisms.

What is emissions trading?
An emissions trading system is a policy instrument that achieves emissions reductions of companies in a cost-effective manner. The EU ETS is a *cap-and-trade* system. That means that there is a cap on the total emissions of all companies participating in the system. At the same time, participating companies can trade emission allowances among themselves. Through that trading, a price per allowance emerges. In theory, this price represents the marginal abatement cost of the ETS. On the basis of this ETS price and (internal) expectations of the future price, companies make the choice to become more sustainable, or to buy emission rights.

The cap of the EU ETS is phased out in a linear fashion on paper (Chapter 6 shows how reality deviates from this). Thus, fewer allowances are issued each year. So participating companies have to compete with each other to distribute the decreasing number of allowances. As the supply of allowances decreases each year, upward price pressure on the ETS price arises from the supply side.

The EU had ratified the Kyoto Protocol requiring it to meet the agreed reduction target by 2012. In line with the possibility of flexible mechanisms, the EU would enable international emissions trading by being the first in the world to set up a greenhouse gas emissions trading system. As such, the EU ETS started in 2005.

As the emission reduction target was only to be met in the period 2008 - 2012, a three-year pilot phase was first set up from 2005 to 2007. The main purpose of this pilot phase was to test the preconditions for a well-functioning system and to gain insight into the formation of the emission price. This emission price is paid per tonne of CO2 equivalent emitted. The emission allowances are called *'European Union Allowances'* (EUAs).

When the EU ETS was set up in 2005, the system included more than 11.000 companies. At the time, total emissions from companies under the system amounted to about 45% of all European greenhouse gas emissions. Besides CO2 emissions, N2O emissions and perfluorocarbon emissions are also regulated under the EU ETS. National emissions authorities, such as the Dutch Emissions Authority (NEa), oversee compliance with monitoring and reporting of emissions from companies.

The deadline for handing over the number of emission allowances corresponding to a company's emissions was initially set at 30 April of the year following the 'emission year'. This deadline has since been moved to 30 September.

3. Policy framework and price development by phase

The EU ETS is divided into phases. Phased implementation has a number of advantages. For instance, it offers more flexibility and opportunities to make adjustments in between. This may be desirable due to changing technologies, economic conditions and scientific insights. Moreover, the division into phases - with the corresponding measures and adjustments - creates clarity for companies in the EU ETS. The rest of the chapter describes the development of the EU ETS per phase.

Phase 1 – (2005-2007)

The first implementation phase of the EU ETS can be seen as an experimental phase that tested whether companies and overseeing authorities had the right infrastructure to monitor, report and verify emissions. It also gained important knowledge on how to price an emissions allowance market. During this phase, almost all allowances were allocated free of charge to companies. The small number of allowances auctioned was mainly to test the auction system.

The amount of allowances allocated was based on a company's historical emissions. This method of allocation is called *grandfathering*. No top-down European emissions cap existed at this stage. Instead, member states themselves set their own emissions cap, within which they then distributed allowances among participating companies (*National Allocation Plans*). Companies with insufficient allowances to cover their emissions paid a EUR 40/t CO2 penalty, on top of the surrender of the required number of allowances.

Price progression phase 1

Source: LSEG Eikon

The graph above shows an upward trend in price development at the beginning of phase 1. The relatively large price fluctuations were partly a consequence of the hitherto limited market liquidity. At the end of April 2006 the price suddenly dropped sharply. This was related to the EU ETS compliance deadline. At the time, companies had to surrender their required allowances on 30 April to verify the number of emissions. The number of allowances issued turned out to be far above the number of verified emissions. Moreover, allowances in phase 1 were not allowed to be stored for use in subsequent phases (*banking*), so the allowances lost their value. This led to the price falling even further and reaching almost EUR 0/tonne by the end of 2007.

Phase 2 – (2008-2012)

In phase 2, the EU ETS was brought into line with the targets in the Kyoto Protocol. The emissions cap was 6.5% lower than in phase 1. In addition, the number of free allowances was also reduced, to 90% of the total. The penalty for a shortage of allowances went up to EUR 100/tonne. Furthermore,

banking was allowed from this phase on, meaning that allowances from phase 2 could be carried over to phase 3 and beyond.

The EU ETS was also broadened to cover a larger number of sectors, installations, countries and greenhouse gases. Finally, companies were given the possibility to claim allowances by achieving reductions abroad, which was in line with Kyoto Protocol commitments and should make the approach cost-effective. This also created a trade in these secondary emission rights, although it was limited by regulations.

Price progression phase 2

Source: LSEG Eikon

With the start of phase two, the total number of allowances in circulation was significantly reduced. As a result, the ETS price started at over EUR 20/t at the start of phase 2, from which it continued to rise to almost EUR 30/t in 2008. However, the financial crisis put an end to this upward trend. Consumers spent less and industrial production decreased. As a result, associated industrial emissions fell and so did the demand for emission allowances.

Following this, the price dropped sharply as well, followed by a slow recovery in the following two years. In mid-2011, the recovering trend was then broken again and the price dropped to around EUR 7/tonne, its lowest point during phase 2. This was mainly due to a surplus of allowances resulting from still low economic activity in Europe, but also due to the slowly emerging share of renewables. A testament to the system working well. Only the low price meant that the incentive to become more sustainable was felt less. Something that did not match the political ambition for acceleration in the short term.

Phase 3 – (2013-2020)

Phase 3 introduced an EU-wide emissions cap, which has been decreasing annually in a linear fashion ever since. Initially, the Linear Reduction Factor (LRF) was set at 1.74%. This achieved an emission reduction of 21% at the end of phase 3, compared to 2005. In addition, more and more allowances were auctioned.

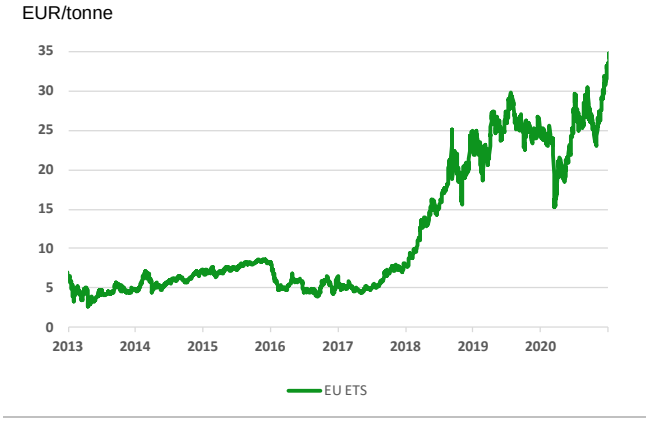
Free allowances remained available to companies and installations with a high risk of carbon leakage. Sectors face a leakage risk when they compete on an international level. The purchase of allowances then represents an additional cost that competitors in other parts of the world do not have. The consequence of this competitive disadvantage would then be that companies in these sectors go out of business or relocate, practically exporting and possibly exacerbating emissions if consumption remains the same. This is detrimental to both the European economy and the climate, which explains free allowances for the steel and fertiliser industries, for example.

Another important development was the introduction of the *New Entrants Reserve* (NER), which reserved free allowances for new industrial plants and existing plants that could expand significantly. Finally, the possibility of claiming international emission reductions - born out of the Kyoto Protocol - became subject to stricter standards, resulting in less and less use of it in practice.

A surplus of allowances in the market was assumed at the beginning of phase 3. The measures taken by the EC played a role in the further evolution of the ETS price. These were the introduction of the *backloading* mechanism and the *Market Stability Reserve (*MSR*)*. These measures were emphatically not part of the initial plans for this phase. Instead, these were interim policy interventions.

The idea of *backloading* was initially to push up the price by taking allowances out of the market in 2014, 2015 and 2016 and then putting them back on the market as 'extra' allowances in 2019 and 2020. The former happened in practice, but with the introduction of the MSR, allowances from the deferred auctions were not reduced. The MSR is a mechanism whereby the number of auctioned allowances can be increased (in case of a shortfall in the market) or reduced (in case of a surplus in the market). It is triggered automatically when the total number of *allowances* in circulation (*Total Number of Allowances in Circulation;* TNAC for short) reaches an upper or lower limit and is designed to give more price stability.

Price progression phase 3



Source: LSEG Eikon

The effect of *backloading* can be seen in the price chart above, with a slight price increase in 2014 and 2015. From summer 2017, the ETS price started to rise more sharply, from EUR 5/t to an average of EUR 25/t in 2019. In other words, a price increase of some 400% in two years.

This was particularly related to the announced reforms that were to take place in phase 4. For instance, it was announced that the emissions cap would be reduced more quickly. At the same time, the MSR scheme would be further strengthened, notably by increasing the percentage of allowances to be withdrawn from the market in case of surplus. This became 24% from phase 4, where before it was 12%. In addition, the *cancellation procedure* was introduced. This mechanism ensures that allowances in the MSR can be permanently cancelled, reducing the supply of allowances in the long term.

The rapid price rise at the end of phase 3 can thus be seen as anticipation of the announced policy framework for phase 4. Although the COVID-19 pandemic caused a significant price dip in 2020, the price also recovered quickly as a result of the aforementioned reasons.

Phase 4 – (2021-2030)

Currently, the EU ETS is in its fourth phase. The reforms initiated with the start of this phase will ensure a 62% emission reduction within the EU ETS sectors in 2030, compared to the starting year in 2005. With this, the EU ETS contributes significantly to meeting the EU target of reducing total emissions by 55% in 2030 compared to 1990. The proposed adjustments stem from the *Fit-for-55 package of measures*.

This package included an increase in the LRF, which rose from 1.74% to 2.2%. From 2024, the LRF was increased again to 4.3%. In addition, the MSR mechanism was also revised. The provision of free allowances became subject to stricter rules, with only companies with the highest risk of carbon leakage still receiving 100% of their allowances for free. Companies where this risk is lower are allocated up to 30% of their allowances for free. Finally, the maritime sector has been added to the EU ETS.

Price progression phase 4 (so far)

Source: LSEG Eikon

Tightened rules, particularly the supply reduction of emission allowances, meant that the rise in the ETS price at the end of phase 3 continued into the beginning of phase 4. In addition, rising energy prices due to the energy crisis provided more upward momentum. The high gas price made coal relatively more attractive than natural gas for power generation. As coal is about twice as emission-intensive as natural gas, this boosted demand for allowances. This combination also made the ETS market more attractive to institutional and speculative investors. The ETS price reached a level of EUR 100/tonne for the first time in 2022.

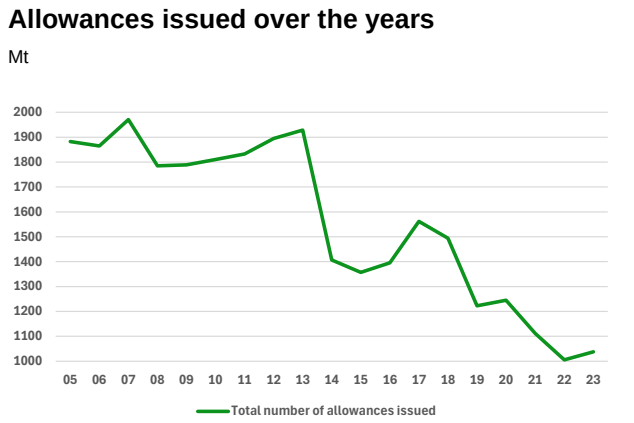
From 2023, the upward price trend turned into a downward one. In the first months of 2024, the ETS price floated just above EUR 50/tonne. Disappointing economic growth (due to higher energy prices), combined with the bringing forward of auctions to finance the RePowerEU programme, is largely to blame. Currently, the ETS price hovers around EUR 65/tonne.

4. Development of ETS sector sustainability

Zooming in on emission reductions over the years, we can discern several patterns. Further analysis of these patterns provides insights for future market expectations. In this chapter, we interpret the overall emission reduction of the EU ETS and then look at the differences between sectors. Finally, we offer an overview of what these insights tell us about future sustainability in the ETS sectors.

Cap of ETS does not decrease linearly in practice

The EU ETS policy framework states that the cap decreases by a linear reduction factor in phase three and four. In practice, the cap is nothing other than the total number of allowances put into circulation. So that is the number of allowances allocated for free (to existing entities and to the NER) plus the number of allowances auctioned. Although based on the LRF a linear decrease in the emissions cap would make sense, in reality this is not the case.



Source: European Union Transaction Log

The fact that the number of allowances issued does not decrease linearly in practice has a number of reasons. For instance, the issuance of hundreds of millions of allowances was delayed with the entry into force of the backloading mechanism in the years 2014, 2015 and 2016. Another reason is the fact that new EU member states participated (Bulgaria, Romania, Croatia) and another left (UK).

Yet these developments were exceptional external factors. From Phase 4 onwards, an important 'internal' factor was added that could cause the actual number of allowances issued not to align with the cap 'on paper'. The factor in question is the MSR. If there are 'too many' allowances in circulation at the end of the calendar year – because the supply of allowances was apparently greater than the number needed for compliance obligations – some of the auction-allocated allowances are placed in the MSR the following year. This creates a deviation from the LRF.

Progress on overall emission reduction

Despite the fact that the number of allowances put into circulation differs each year from the theoretical emission cap, emission reductions within the EU ETS are broadly following the planned pathway. The target emission reduction is (logically) achieved every phase. After all, over an entire phase, the emission cap runs at least in line with the target emission reduction.

For example, verified emissions at the start of the EU ETS in 2005 counted around 1.800 Mt, according to the European Union Transaction Log[1] , while in 2023 it was less than 1.100 Mt. In other words, the EU ETS has achieved an emission reduction of about 40% in almost 20 years. By 2030, in line with the cap, the emission reduction will be at least 62%.

Current plans call for the EU ETS cap to reach zero in 2039. In other words, no new emission allowances will be issued after 2039. However, the policy framework is currently such that companies may still use emission allowances to hedge emissions after 2039. This provides flexibility for

[1] The '*scope'* of the European Union Transaction Log (EUTL) data is different from that used in European Commission publications on the EU ETS.

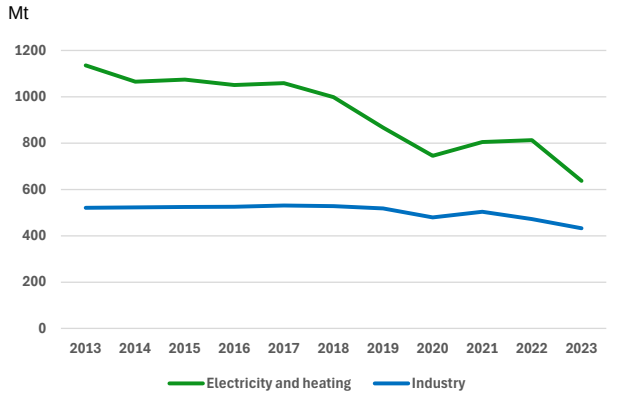
companies after 2039 should it turn out that net zero emissions from these companies have not been achieved by then.

Progress on sectoral emissions reduction

Although the ETS sectors collectively achieve the targeted emissions reductions, the chart below shows that the bulk of the reduction is achieved in the electricity sector for now. This coincides with the fact that the electricity sector's marginal abatement costs are generally the lowest: the low-hanging fruit.

Currently, on a yearly basis, about half of the electricity generated in the EU is renewable. Storage of electricity from renewable sources is not yet crucial for security of supply in most countries, but towards 2030 it becomes increasingly relevant. Because storage options are (still) relatively expensive investments, their marginal abatement costs are higher. This could eventually create upward price pressure in the EU ETS.

Emission reductions take place mainly in electricity sector



Source: European Union Transaction Log

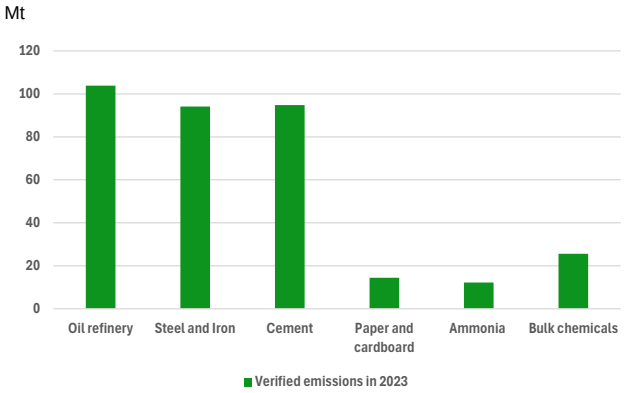
Emissions in industry have remained relatively stable. Although the graph above shows that significant emission reductions also took place in this sector from 2020 onwards, the question is to what extent this is due to the increasing sustainability of the sector. In 2020, the COVID-19 pandemic broke out, drastically reducing economic demand. This resulted in a drop in industrial emissions. The emission reduction from 2022 can be largely attributed to high energy prices due to the energy crisis.

A key question for the coming years is how industrial production develops. If normalising energy prices cause industrial production to recover, demand for allowances from industry will increase. However, so far we still see an industrial sector in financial difficulty in large parts of Europe. Moreover, gas and electricity prices have experienced an upward price trend since early 2024, returning to around 2023 levels. With that, gas and electricity prices are still 2-2.5 times higher than before the energy crisis. Partly because of this, we have already seen production stay lower and sometimes even factory doors close.

For industry, electrification is by no means always possible or the most suitable option to achieve sustainability. Renewable energy in the form of molecules is therefore necessary. The lack of this is the biggest challenge for industry as a whole. Although industry is usually labelled as one sector, there are major differences between industries. These different sectors have their own challenges towards sustainability. What is striking is that almost 70% of total industry emissions are accounted for by three

sectors. Namely (1) oil refining, (2) steel and iron sector and (3) cement sector. The chart below shows the 2023 emissions of the larger industrial sectors.

Oil refining, steel and cement sectors represent bulk of emissions industry



Source: European Union Transaction Log

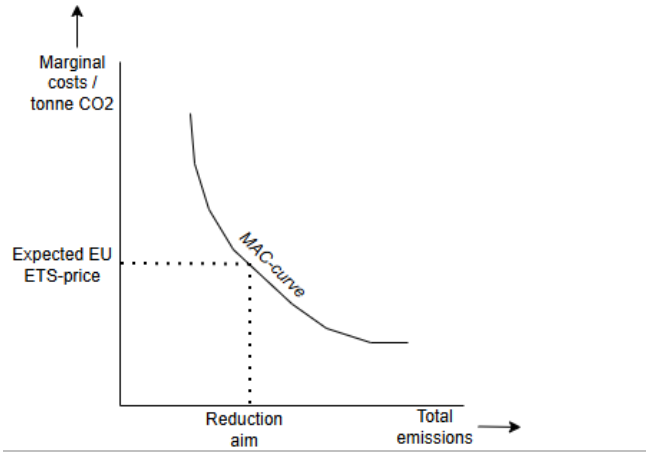
Although until now emission reduction has mainly taken place in the electricity sector, the pressure for industry to reduce their emissions is already high as well. After all, lead times of (major) investment decisions are long. '*Financial investment decisions*' (FIDs) are needed now to see results after 2030. Over the years, it will become increasingly clear which industry sectors can most easily reduce emissions. Further in this chapter, we discuss the marginal cost of sustainability in the ETS and its relationship to the market.

Marginal abatement costs co-determine ETS price

A company's demand for allowances depends on the marginal abatement costs it faces. Here, the expectation regarding the ETS price in the future is in many cases leading in taking an FID. This leads to the (expected) EU ETS price ultimately reflecting the cost of the cheapest measure to save a tonne of CO2, or *Marginal Abatement Costs* (MAC). These are the costs incurred by a company to reduce one extra tonne of CO2. Here, each technology or measure has different marginal abatement costs. Putting these together creates a curve showing the most cost-effective measures for CO2 reduction.

Marginal abatement costs increase as the low-hanging fruit with solar and wind power is picked. This makes CCS attractive for companies in, for instance, the concrete, steel, and chemical industries as a cost-effective method to achieve CO2 reductions. Another technology coming into the picture is green hydrogen. Although green hydrogen is not cost-effective with current production costs and ETS price, this may change in the future.

Fictitious marginal reduction curve



Source: PZ ERS

5. How the MSR affects future market dynamics

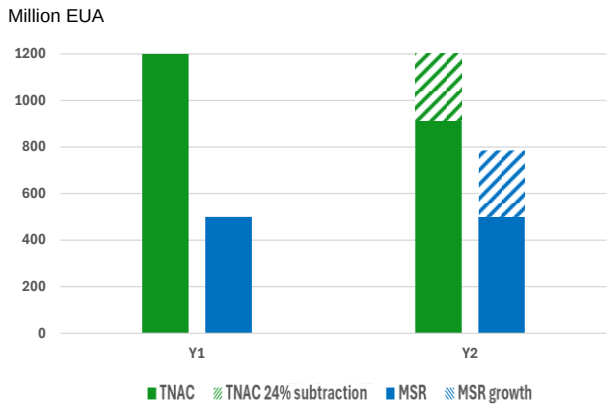
Chapter 3 introduced the functioning of the *Market Stability Reserve* (MSR). This chapter describes the impact of the MSR on the EU ETS market. The MSR plays a role in the supply-demand dynamics of the EU ETS.

Functioning of the MSR

The supply of allowances is in principle equal to the emissions cap. The demand for allowances is influenced by a number of factors, such as renewable energy generation, heat demand and macroeconomic factors. The MSR is a link between supply and demand. The MSR was created to dampen demand shocks in the ETS market and thus better ensure price stability. This makes it primarily a mechanism influenced by the demand for allowances. The demand for allowances is valued each year by calculating the number of allowances in circulation. This is the number of allowances held by companies (and thus not handed over directly for compliance obligations). This is referred to in official documents as TNAC: total number of allowances in circulation.

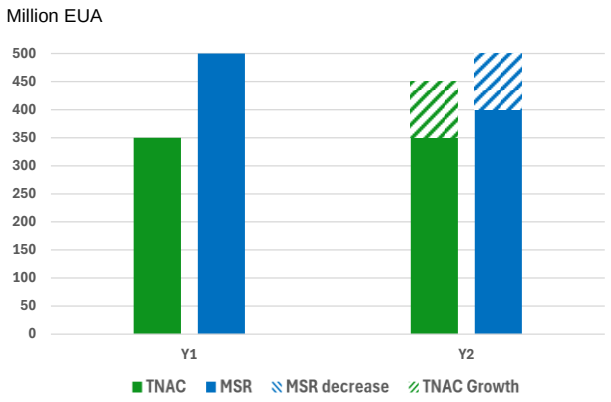
When the number of allowances in circulation exceeds 833 million allowances, the number of allowances to be auctioned is reduced the following year. When there are between 833 million and 1.096 million allowances in circulation, the number of allowances in circulation is reduced to 833 million. When there are more allowances in circulation, a 24% reduction takes place. For example, when there are 1.200 million allowances in circulation, the number of allowances to be auctioned in the following year decreases by 288 million allowances. This number is then no longer auctioned (directly), but is placed in the MSR.

Functioning MSR: excess supply



Source: PZ ERS

Functioning MSR: excess demand



Source: PZ ERS

If the number of allowances in circulation falls below 400 million allowances, 100 million allowances are withdrawn from the MSR to be auctioned. Thus, a demand surplus in the market is offset by a supply reduction a year later, and vice versa. The schematic below illustrates how a demand- or supply surplus affects the MSR and the number of allowances to be auctioned.

Market effects of the MSR

In this way, the MSR 'stabilises' demand shocks from the market. To analyse possible effects of the MSR's operation on market prices, we look at the most recent data on the TNAC. At the end of 2023, there were 1.112 million allowances in circulation. In the same year, the number of verified emissions equalled 1.087 million allowances. In other words, the number of allowances companies had 'on the shelf' in 2023 exceeded the number of allowances companies had to hand over to hedge their emissions. This gave the market a '*forward inventory*' of 374 days. By comparison, the oil market typically maintains a 50-day inventory. The number of allowances in circulation has built up steadily over the past few years.

With this TNAC, the number of allowances in circulation exceeded the upper limit of 833 million. As a result, the number of allowances to be auctioned in the 2024 –2025 compliance year decreases by 267 million in favour of the MSR[2] . The supply reduction counterbalances the demand surplus of the previous year. Thus, there is a self-correcting system. Nevertheless, there is an important mechanism built in that can enhance the MSR's effect on the market. That is the cancellation procedure.

The cancellation procedure ensures that allowances in the MSR can be permanently cancelled. For this purpose, a threshold of 400 million allowances is enforced. The number of allowances in the MSR above 400 million will be cancelled at the end of every calendar year. Currently, the MSR is already filled to this upper limit. Moreover, as a result allowances have already been definitively cancelled last year. Furthermore, more allowances will be cancelled from the MSR if the TNAC were to exceed the cap of 833 million allowances next year as well. With the cancellation of 267 million allowances last year, the impact of the cancellation procedure should not be underestimated. This is equivalent to about 20% of the supply of allowances in 2024.

[2] Because allowances were '*frontloaded*' at the same time in practice, the net change in the number of allowances auctioned deviated from this 133 million.

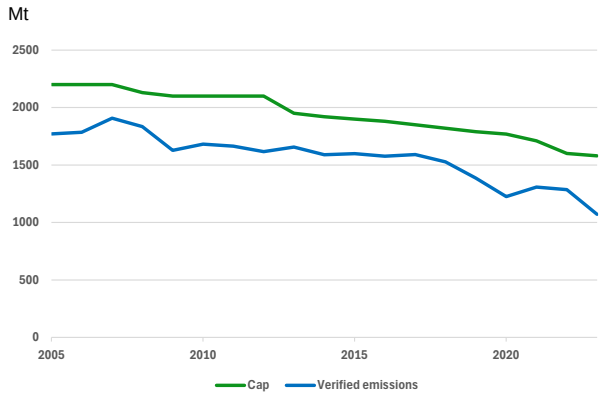
Short-term supply tightening at the expense of long-term definitive tightness

The supply in the compliance year 2024 – 2025 is thus significantly lowered due to the operation of the MSR. The self-correcting effect of the MSR should ensure that the number of allowances in circulation decreases. Yet the EC has undermined this self-correcting effect. Indeed, to finance REPowerEU plans, the (previous) EC decided to put more than 85 million additional allowances on the market by 2024. Moreover, it will auction even more additional allowances in the coming years. With this, the Commission aims to raise EUR 20 billion. At an ETS price of EUR 65/t, this amounts to over 300 million allowances.

Thus, the actual supply reduction is much smaller than the 20% that would result from the operation of the MSR. *Frontloading* by the EC creates additional allowances in circulation in the short term. The current TNAC is still above the cap of 833 million after supply reduction in 2024, ceteris paribus. Thus, the additional allowances auctioned by the EC in the short term will contribute to an increase in the TNAC and thus also to a final cancellation of allowances next year.

The EC is opting for artificial supply expansion in the short term at the expense of definitive tightness in the long term. Moreover, the chart below shows that every year so far fewer allowances have been surrendered for compliance obligations than have been issued (free and auctioned). Based on this, it is hard to escape the impression that there will be another "surplus" of allowances on the market this year. Moreover, the still high energy prices are also driving down emissions and hence demand for allowances.

Emission cap consistently higher than actual emissions



Source: European Union Transaction Log

It is complex enough for companies to adopt a purchasing strategy based on market expectations of financial products (such as natural gas and oil). Emission rights are a political product traded on financial markets. This can have a major impact on price movements. Policymakers can turn the dials to bring about supply changes.

The MSR was introduced to promote market stability. However, the operation of this policy instrument in the ETS market is complex. This complexity is compounded by unpredictability when the EC implements additional policies regarding the issuance of allowances. The question is therefore whether the market (and politicians) have sufficient insight into side effects of supply changes, such as *frontloading* of allowances. As described above, at the current state of the TNAC and MSR, this leads to a final cancellation of allowances.

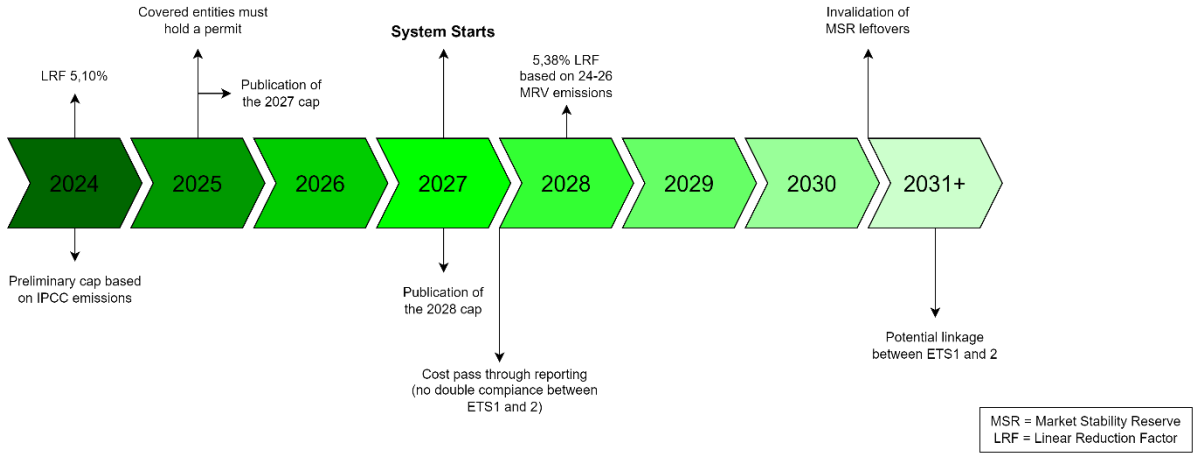
6. ETS-2 will start in 2027

From 2027, European climate policy will be expanded to include a second emissions trading system, ETS-2. This is a separate system, in addition to the already existing EU ETS. It will include road transport, the built environment and small industry[3] . ETS-2 revenues, together with the proceeds of 50 million allowances from ETS-1 and a mandatory 25% contribution by member states, will provide funding for the *Social Climate Fund* (SCF). The SCF is a fund set up hand-in-hand with ETS-2, to keep the costs of ETS-2 from falling on those most vulnerable. Member states can submit plans to the EC until June 2025 to claim a share of the fund. A total of EUR 86.7 billion is expected to be available between 2026 and 2032.

The introduction of ETS-2

ETS-2 is one of the measures that is part of the European *Green Deal* and should contribute to the goal of climate neutrality by 2050. The policy should further reduce CO2 emissions through pricing in the ETS-2 sectors.

In the 2024-2026 phase, regulated companies will have to monitor and report their emissions. From 2027, auctioning of allowances will begin. No free allowances will be used within ETS-2. The ETS-2 cap should ensure that a 43% emission reduction is achieved compared to 2005. To achieve this, an LRF will be determined based on emissions in the period 2024-2026. Currently, it is estimated that the number of allowances needs to decrease by 5.38% from 2028 to meet the 2030 reduction target. The LRF can be adjusted later if it turns out that emissions deviate significantly from expectations.

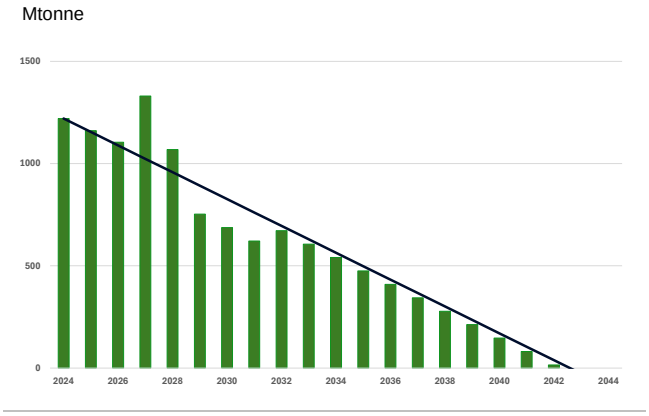


Source: Vertis

In principal, the cap introducing ETS-2 is below the current level of CO2 emissions of the relevant sectors. Moreover, with a reduction factor of 5.38% from 2028, a relatively high reduction factor has been chosen compared to the regular EU ETS. However, to alleviate the tightness in the market in the early years, additional allowances will be auctioned (*frontloading*) in 2027 and 2028 at the expense of the number of allowances to be auctioned in years '29, '30 and '31. In this way, liquidity in the market is promoted. This implies some 1.3 billion allowances to be auctioned in 2027. For 2028 and 2029, it is 1.1 billion and 830 million allowances, respectively.

[3] Industry not covered by the current ETS because they do not meet the threshold of a total thermal input power of 20 MW. A thermal input power is the maximum amount of fuel that can be combusted.

EU ETS-2 Cap



Source: EU Directive 2023/959

The ETS-2 MSR

In ETS-2, the MSR is also an important mechanism. There are three scenarios in which additional allowances can be put on the market from the ETS-2 MSR during the first three years after the start of the system. In the first scenario, 20 million additional allowances will be placed on the market if the price of ETS-2 allowances remains above EUR 45/tonne for two consecutive months. However, the question is to what extent an addition of 20 million allowances out of a total of 1.300 million will make a difference.

This could also bring the second scenario into view. This scenario becomes reality when the average price of three consecutive months is twice as high as the average of the previous six months. An additional 50 million allowances from the ETS-2 MSR could then be put on the market. However, an injection of additional allowances from the MSR already becomes a reality for 2027 and 2028 when the three-month average price is 'only' one and a half times higher than the six months before.

A final scenario becomes reality when the average price is three times higher than the previous six months. An additional 150 million allowances are then auctioned. One of these scenarios may occur once a year. If it occurs more frequently, the EC will review the functioning of the MSR.

Although price estimates are difficult for a market that does not yet exist, the EC estimates that the price of an ETS-2 allowance will be EUR 48/tonne in 2030. Converted to the price of petrol, diesel and natural gas, this will be around 11 cents per litre, 13 cents per litre and 10 cents per m3 respectively. Moreover, the introduction of ETS-2 could be delayed if there are exceptionally high gas and/or oil prices. For TTF gas, this involves a price above EUR 100/MWh. For Brent oil, the threshold is USD 140/barrel.

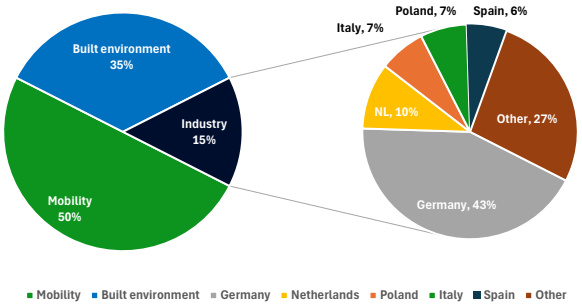
Scope, policy choices and possible adjustments ETS-2

The largest sector that will be covered by ETS-2 is the mobility sector. Fuel suppliers have the compliance obligation to surrender allowances. The built environment will comprise about 35% of ETS-2 emissions. Here, energy suppliers have compliance obligations. (Small) industry accounts for the remaining 15%.

Of total emissions from ETS-2 industries, the vast majority takes place in Germany; some 43%. The Netherlands is in second place with 10%. This is followed by Poland and Italy with 7%, and Spain with 6% of emissions.

Estimated ETS-2 emissions

%



Source: Vertis

Furthermore, member states can add sectors to the EU ETS-2. The Netherlands has opted for a broad interpretation of the system. That is, it includes the transport sector, defence and parts of agriculture. The transport sector includes road transport, rail, inland navigation and recreational boating. Aviation and maritime shipping will not be covered by ETS-2 as they are already covered by the current ETS.

From 2031, there is a possibility that ETS-2 will be linked to the current ETS. The EC will then report to the EP on, among other things, the effectiveness of the system. By 31 October 2031, a decision will then be taken on whether the ETS-2 sectors can be integrated into the EU ETS.

7. The EU ETS - a look ahead

Whereas the supply of allowances is a political tool, demand is determined by a multitude of factors. The main factors that may influence the demand for allowances in the coming years are highlighted below.

Energy prices

In electricity generation, energy prices directly affect the demand for allowances. One of the main rules of thumb here is that the CO2 price is generally positively correlated with the gas price. Gas and coal are (still) important for electricity production in many European countries. If the gas price rises, this means that coal becomes relatively more attractive to generate electricity with. As coal has a higher carbon intensity per megawatt-hour generated, this means more demand for allowances.

Although the record prices of the energy crisis seem to be behind us, Europe is still struggling with relatively high gas and electricity prices. On a global level, the gas market remains tight for now. From 2026, this pressure is expected to ease as new LNG projects currently under construction will provide increased supply. Until then, the gas price will remain relatively high and volatile, which may make coal more attractive for power generation, thereby driving up the price of emission allowances. Coal has potential to represent a larger share of the electricity mix, especially in the winter months. This is when gas prices tend to be at relatively high levels, while solar electricity generation is lower.

Political and economic expectation

EU climate ambitions are a major factor driving market developments. Currently, the statutory targets of a 55% emission reduction by 2030 compared to 1990 and climate neutrality by 2050 are leading. If emission targets are tightened in the future, this will impact the LRF. With the European Parliament (EP)'s pull to the right in the 2024 elections, there is little chance of further tightening of the LRF in the next five-year mandate.

On the economic front, some recovery seems possible in the short term. High inflation due to the energy crisis is easing. This has led to three interest rate cuts by the European Central Bank (ECB) in 2024. The general market expectation is a fourth interest rate cut (to 3%) in December. Lower interest rates increase economic activity in Europe, thereby theoretically increasing demand for allowances. For the time being, however, energy prices (which are still relatively high) seem to harm many ETS companies, signs of the difficult recovery of industrial production in Europe.

Review of the policy framework

The EC will publish a review of both the EU ETS and the MSR in 2026. For example, the EC is evaluating the option of bringing aviation to and from countries outside the European Economic Area (EEA) under the EU ETS. This will consider environmental and climate impacts, social consequences in the aviation sector and carbon leakage risks. Furthermore, the feasibility of (household) waste incineration to the EU ETS is evaluated.

Another issue that will be evaluated is the possible extension of the EU ETS to other emissions trading systems. Here, the relative size of the systems is decisive in how ETS prices will average in both systems. Currently, the EU ETS is only linked to the Swiss ETS. This has been the case since 1 January 2020. In addition, re-linking to the UK ETS is a possibility. Linking ETS systems requires full harmonisation of rules and requirements. This makes integrating ETS systems on a global scale a complicated process. However, the introduction of CBAM may accelerate this.

The review also considers non-permanent *Carbon Capture and Utilisation* (CCU). Here, CO2 is captured and used in products. However, the CO2 eventually returns to the atmosphere. In the evaluation, the EC will assess the extent to which these emissions can be registered in the system.

In 2026, the EC will also present its five-year evaluation of the MSR. This evaluation will focus on the economic impact of the MSR. Based on this evaluation, the EC may propose adjustments to the functioning of the MSR.

A possible role for negative emissions

The review will also look at the potential role of negative emissions in the EU ETS. Here, explicit criteria will be set on the scope and conditions for the use of negative emissions. Negative emissions may start to play an important role towards 2039.

From 2039, the cap of the EU ETS will be zero, requiring all remaining emissions from ETS sectors to be offset with negative emissions or with banked allowances. Moreover, it may be decided in the future that the cap should even drop below zero after 2039 to offset previously excess emissions. Here, negative emissions will be vital. However, it is still unclear whether and how this will happen.

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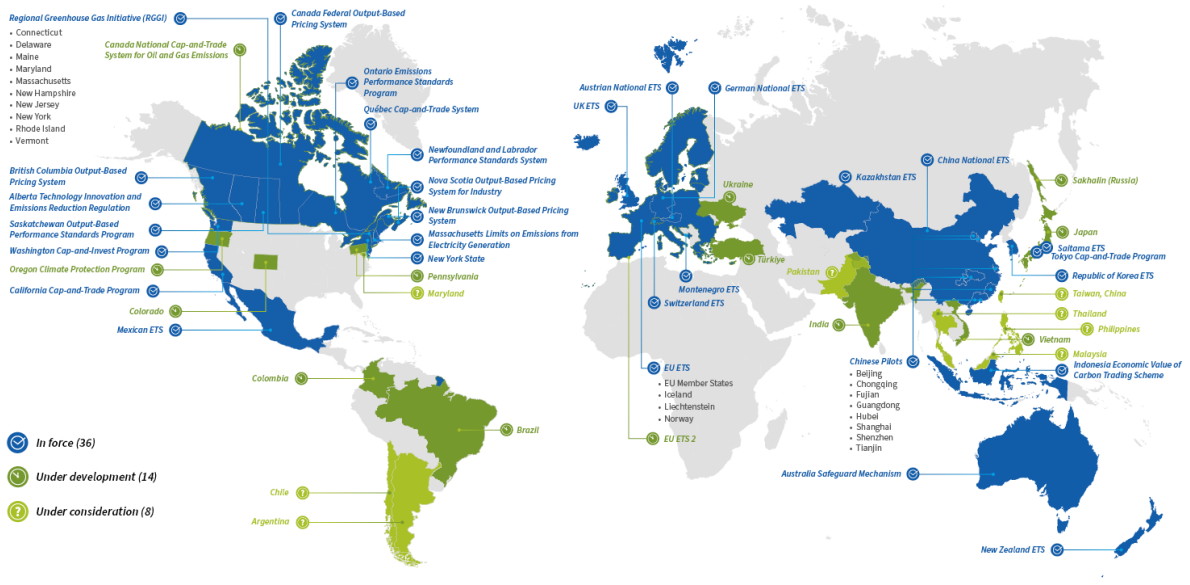
8. Appendix - Other emissions trading schemes;

Emissions trading schemes have also been set up in the rest of the world in recent years. Currently, 36 regional or national variants of an ETS are active, with 22 more in preparatory stages. See the map below for a complete overview. Here we will explain the three emissions trading systems that are most relevant from the EU perspective: the UK, China, and the US. We will then briefly cover other important emissions trading schemes.



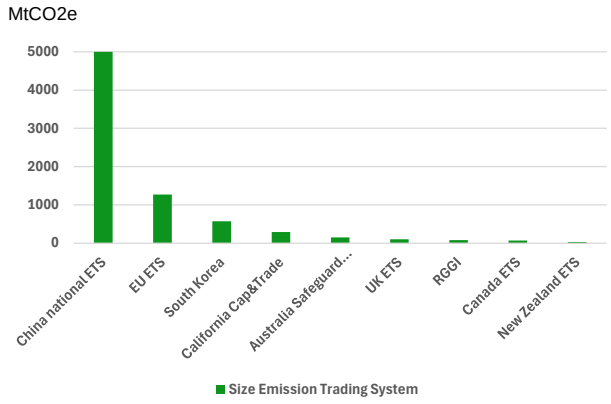
Source: International Carbon Action Partnership

Split-off United Kingdom

With its departure from the EU in 2020, the United Kingdom (UK) also left the EU ETS. To replace it, the UK ETS entered into force from January 2021. Logically, the participating sectors are the same as those under the EU ETS, except for maritime activities. These only fall under the UK ETS from 2026. In total, 25% of UK emissions are covered by the UK ETS. This is relatively little compared to the EU ETS, which covers around 45% of total European emissions.

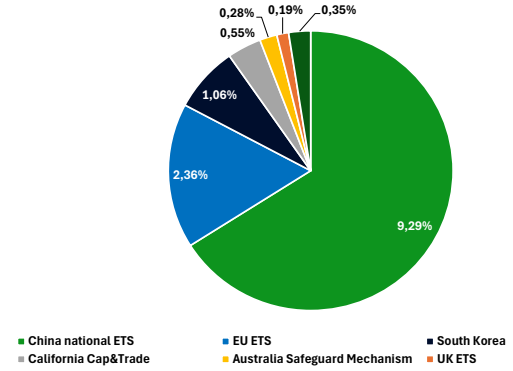
For the most part, the UK ETS mirrors phase 4 of the EU ETS to give businesses as much stability as possible. However, the emissions cap in the UK ETS was initially 5% lower than the UK cap under the EU system. In 2024, 69 MtCO2e of allowances were auctioned, accounting for 54% of the allowances issued this year. The number of auctioned allowances will be reduced in the coming years to 24 MtCO2e in 2030. The remainder of allowances will be allocated for free. These free allocations – and their phase-out – follow the same course as described in phase 4 of the EU ETS. However, the UK Emissions Authority did announce in July 2023 to phase out aviation's free allowances from 2026 because the risk of carbon leakage would be low. The low risk of carbon leakage is partly due to the UK's geographical characteristics as an island. This gives the UK aviation sector an advantage over other forms of transport, for which there is limited capacity to reach the UK. Until 2025, the free allocation of allowances to the aviation sector will continue according to existing agreements. From 2026, the sector will have to buy its allowances at market value.

Scope of emissions trading schemes



Source: Our World In Data, International Carbon Action Partnership

Emissions trading systems as % global emissions



Source: Our World In Data, International Carbon Action Partnership

ETS China

China has already been implementing eight regional pilot ETS programmes in some of its largest cities since 2011. Following the pilots, the country launched a national ETS in 2021. Under this national system, all electricity producers with annual emissions of at least 26,000 Mt of CO2 will be covered. As a result, by 2022, about 5,000 Mt of CO2 per year, accounting for 44% of China's CO2 emissions, were covered by the national ETS. This includes only the greenhouse gas CO2.

Expressed in CO2 equivalent, the national system covers just under 36% of all greenhouse gas emissions. The regional pilots and the national ETS will coexist in parallel in the coming years. Where a regional system and the national system overlap, the regional pilot will be integrated with the national ETS in the coming years. Where a pilot extends beyond the national system, it will work complementary to the national ETS.

Unlike the EU ETS, no allowances are auctioned in the Chinese system. Instead, all allowances are allocated for free based on emission intensity. Here, coal plants are divided into three categories and gas plants fall under one category. Each power plant is allocated enough allowances for the average emission intensity of its category.

The result is that efficient power plants are left with a surplus of allowances to sell, while less efficient plants have to buy their deficit or pay a penalty. The Chinese ETS also differs from the EU ETS in the way the total volume is determined. Unlike the EU ETS, the Chinese system has no cap, but instead determines how many allowances are allocated per emitter. The total size of the system is the sum of all emitters.

The peculiarity of the Chinese system is that emission benchmarks are only determined ex post. Until 2024, benchmarks were set only after the end of the compliance period. From 2025, the cap will be set annually, no later than six months before the end of the period. As a result, companies will only know afterwards how much of their emissions they have to offset. This means that companies cannot anticipate the cost of allowances, or the measures needed to meet the standards. The accompanying uncertainty also reduces incentives to plan long-term investments in emission reduction. The Chinese authority does say that as a guiding principle, they are aiming for *break-even* for most companies, with a slight deficit for the system as a whole. However, this does not provide certainty for the future. Moreover, many exceptions are made, mainly for gas power plants.

By setting emission intensity benchmarks only after the fact and by not having an absolute emission cap, China clearly prioritises economic growth over emission reduction. After all, if economic growth is disappointing in a year, China can choose to relax that year's benchmarks. This reduces CO2 costs for Chinese electricity producers, which stimulates economic growth in China. With this operation of the ETS, China seeks to create incentives for energy efficiency among power producers without hampering its economic development.

Between 2024 and 2026, China's national ETS will be extended to the production of steel, cement and aluminium. With this, the extension of the Chinese ETS runs parallel to the introduction of CBAM in Europe. It has also been proposed to bring (petro-)chemicals, building materials, paper and domestic flights under the Chinese ETS, although there is no official timeline for this yet. Finally, '*borrowing*', whereby a company receives its freely allocated allowances from future years early, will no longer be allowed from 2025 and fines for non-compliance will be increased.

China's national ETS thus has two sides and is somewhat contradictory. On the one hand, it provides some incentives for reducing CO2 emissions. On the other hand, the system clearly prioritises economic development and emissions reduction becomes secondary if it harms economic growth (too much).

ETS United States

The United States (US) does not have a national ETS, nor are there plans for one. However, several states have set up their own or regional ETSs. We highlight the main two here: the *Regional Greenhouse Gas Initiative* (RGGI) and the *California Cap-and-Trade system*.

Under the country's largest ETS - the California Cap-and-Trade system - the sectors of transportation, built environment, industry and power generation are covered. The participation of the transport sector sets this ETS apart from other systems. These costs are charged to fuel suppliers. When they sell fossil fuels, they are taxed for the emissions associated with the final use of these fuels.

All parties within these sectors with annual emissions of at least 25.000 tCO2e are covered by the system. Moreover, this also applies to all imported electricity. This amounts to about 450 companies, which together account for almost 85% of California's total emissions. In 2024, the cap stood at 280.7 MtCO2e, with an annual decrease of around 13.4 MtCO2e to a cap of 200.5 MtCO2e in 2030.

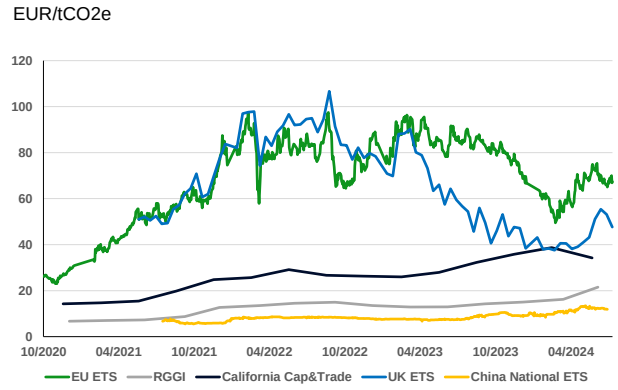
Here, 70% of all allowances are auctioned publicly, while the remaining 30% are allocated for free to emissions-intensive producers based on leakage risks. Moreover, California's system is the most comprehensive in the world in terms of types of greenhouse gases. Partly because of this, 76% of all the state's emissions are covered by the *cap-and-trade* system. By comparison, in addition to the five gases also covered by the EU ETS, methane, nitrogen trifluoride and more fluorinated gases are also covered by the Californian system. However, it should be noted here that the EU introduced other legislation earlier this year to reduce methane emissions.

On the other side of the US is the RGGI. This is a collaboration of now 10 eastern states in which they have linked their emissions trading systems. The system covers only the electricity sector and participation is mandatory for all fossil fuel-driven power plants with a capacity of 25MW or more. They have to offset half of their emissions with emission allowances. Added together, the volume of RGGI allowances thus accounts for 14% of CO2 emissions in these states. In 2024, the ceiling stood at 63 Mt CO2. This will decrease by about 3% annually until 2030 compared to 2020. The RGGI is also

open to further expansion to other states. For instance, Pennsylvania is currently in the process of harmonising its ETS with the RGGI to be allowed to participate.

In terms of allowance allocation, 94% of allowances are auctioned publicly. The rest are sold at a fixed (often lower) price to vulnerable emitters, invalidated, or placed in a *Cost Containment Reserve* (CCR). Allowances in the CCR are auctioned again when the price rises above a ceiling - USD 15.92 in 2024. At the same time, allowances are withheld from auction and placed in the *Emission Containment Reserve* (ECR) when the price falls below a minimum - USD 7.35 in 2024. Like the MSR in the EU ETS, these reserves serve to keep the emissions price relatively stable.

Price developments ETS programmes



Source: International Carbon Action Partnership.
* China's national ETS price as shown here is based on secondary market prices as these allowances are not initially auctioned. The other prices shown are those from the original public auctions.

Other ETS

Globally, in addition to the emissions trading schemes discussed, there are altogether more than 20 countries where an ETS is in place, or where preparations for an ETS are underway. These can all be seen on the map at the beginning of this chapter. Here we briefly discuss the main developments in the rest of the world.

We start with Switzerland. Its ETS covers 12% of Swiss emissions. The ETS complements the existing emissions tax, which covers about 35% of all the country's emissions. ETS participants have an exemption from the emissions tax. Under the emissions tax, parties are subject to stricter conditions. Participation in the ETS thus gives emission-intensive parties more room to make themselves more sustainable. Since 2020, the Swiss ETS has been linked to the EU ETS. This means that Swiss and European allowances can be traded with each other.

Across the ocean, in Canada, all provinces have had a harmonised ETS since 2022. Several provinces previously had their own ETS. The national cap-and-trade system prescribes minimum stringency standards that provinces must adapt their own system to, or they can choose to adopt the national system directly. Furthermore, like Switzerland, Canada combines its ETS with an emissions tax.

In contrast, Australia's *Safeguard Mechanism* is more similar to the Chinese system. Here, the country's 200+ most-emitting facilities are given a threshold of emissions intensity. If they go over this baseline, they have to compensate by buying additional allowances. In addition, if we look at New Zealand's ETS we see that it is unique in its scope. The nine most emitting sectors are covered by the

system, resulting in 48% of national emissions being covered by the ETS. The most notable sectors here are forestry, fossil fuels from the transport sector, waste treatment and synthetic greenhouse gases.

In the same vein, South Korea's ETS is also far-reaching. This system covers 89% of all the country's greenhouse gas emissions. In return, up to 90% of allowances are allocated for free, although this percentage also varies by sector. In December 2024, the South Korean authority will publish a new long-term plan to phase out the emissions cap.

A number of countries are also preparing for the entry into force of an emissions trading system. In Brazil, for example, a legislative proposal for a national cap-and-trade system is in the final stages of development. The proposal is expected to be approved by parliament this year, after which it will take another five years for the system to become fully operational.

In India, the existing *Perform, Achieve, and Trade* (PAT) system, a national programme which regulates energy consumption in energy-intensive industries, will be expanded to a *Carbon Credit & Trading Scheme* (CCTS) in the coming years. Unlike the EU ETS, this scheme will be based on reducing emission intensity of the Indian economy. Indian authorities say the CCTS is expected to come into force in 2026. This would therefore make the introduction of the CCTS parallel that of CBAM in the EU. However, official publications on the exact timeline of the CCTS, or on the exact mechanisms of the system are still awaited.

Finally, Japan is working on expanding their "GX-ETS". Currently, the GX-ETS still operates on a voluntary basis. From 2026, participation in this system will be mandatory for large emitters, although it is not yet clear exactly which companies this will include. From 2033, free allocation of emission allowances for power generators will be phased out. In conjunction, a tax on fossil fuel imports will be introduced from 2028.