European Union Emissions Trading System – Implications of the Year 2023 reform and prospects for the decade starting in 2030

Policy Brief

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MISTRA CARBON EXIT

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Summary

Through the *Fit for 55* climate package, the **EU Emissions Trading System (EU ETS) has been strengthened significantly**. A much higher linear reduction factor (up to 4.4% instead of 2.2%) creates a steep downwards trajectory for greenhouse gas (GHG) emissions. It is envisaged that free allocation will be phased-out in combination with the introduction of a Carbon Border Adjustment Mechanism (CBAM). Allowance prices have exceeded 100 EUR and are expected to increase further. This incentivizes the green transition. This landmark reform was introduced despite the pandemic, the energy crisis, and the Russian war against Ukraine. While these momentous political and societal events certainly affected the policymaking process, the reformed ETS and CBAM legislation are, to remarkable extents, consistent with the original ideas set out in the European Green Deal by the EU Commission in 2019.

Endgame of the EU ETS. With the new linear reduction factor (up to 4.4% per year), the cap will reach zero in Year 2039. As we get closer to the year with zero allocation, there will likely be residual emissions, for instance in the aviation, shipping and agricultural sectors, for which abatement will be very expensive and/or technically difficult. We see three ways to deal with this problem:

1. **Retire and replace.** Replace the EU ETS with a command-and-control regulation. However, this would lead to a loss of the efficiency gains that come with the heterogeneity of abatement costs and trading. An alternative would be to replace the ETS with a carbon tax. However, experience shows that taxes are challenging to introduce in the EU and it would most likely be difficult to achieve consensus on an appropriate tax level.
2. **Eternal life with a small cap.** The cap is reduced until it reaches a minimum level. This level corresponds to what is technically/economically possible for the emissions sources in the system. There is no assigned year for allocation ending. A difficulty with this approach is to determine an appropriate size for the cap and to devise ways to update it as new technologies that decrease emissions emerge. It also requires an equal volume of carbon removals to offset ongoing emissions.
3. **Zero cap and credits**. The cap is decreased until it reaches zero, i.e., no allocation of allowances. When remaining allowances are used (which can be several years after 2039), residual emissions are offset using credits that represent carbon removals from for instance BECCS or DACCS. However, imports of credits need to be treated with caution, as they could lead to firms buying credits instead of reducing emissions, whereas the priority should be to reduce emissions.

Reaching the EU target of net-zero GHG emissions by the Year 2050 requires that emissions are reduced as much as possible and that the residual emissions are offset by negative emissions, also called carbon dioxide removals (CDR). However, there are currently almost no incentives for creating negative emissions – so these need to be created.

We see the following potential frameworks for creating incentives and funding for carbon dioxide removals:

1. Establishment of an EU central system for CDR production. Targets/budgets would be set up for different types of CDR, i.e., BECCS, DACCS and carbon sequestration in forests and agriculture. Funding could, for instance, come from the central EU budget (originating from the Member States) or from the Innovation fund (originating from sales of EU ETS allowances).
2. Quota obligation. Impose an obligation on companies that are emitting GHGs to purchase CDR credits corresponding to their GHG emissions. It is not obvious for which sectors and emitters a quota obligation system would be an efficient policy instrument. The transport sector could be targeted, as it has GHG emissions that are high and challenging to reduce. In the longer term, it would be logical to apply the quota obligation system towards sectors with residual emissions, such as those linked to waste, agriculture, and aviation. The advantage of a quota approach is that it reduces costs for the EU Member States (compared to option 1), which could translate into increased public acceptance.
3. Allow participants of the EU ETS to use CDR credits (for instance from BECCS or DACCS) for compliance. As mentioned above, it will be important to ensure that credits are not used in place of emissions reductions, albeit only when emissions reductions are highly difficult technically or expensive. Therefore, there should be dual targets – one for mitigation and one for carbon removal.

Assignment of responsibility for achieving negative emissions to the Member States. The three models described above are models implemented at the EU level. Alternatively, the responsibility for implementing negative emissions could be foisted on the Member States. It would then be up to each Member State to implement appropriate CDR programs to reach their targets (for instance, by applying Model 1 or Model 2, as described above). The assignment of responsibility on Member States could be based on residual emissions or on capabilities (GDP/capita).

Linking the current ETS with the new ETS regarding transportation and heating (ETS2) has both pros and cons. The main argument for linking the two systems is effectiveness in that it lowers the total costs. Merging will also provide liquidity for participants in the EU ETS at a time when allowances may be scarce. Another argument for the inclusion of road transport is linked to the rapid expansion of electric vehicles. Since power generation is already included in the EU ETS, electric vehicles and electric trains are already indirectly included in the EU ETS. An argument against including road transport in the EU ETS has been the risk that the transport sector would simply buy allowances rather than reduce emissions. But this argument can be turned around – is possible that participants in the current ETS (industry, aviation and later on shipping) may buy allowances from participants in the new ETS2 (road transports and heating).

Each EU Member State government should start formulating an opinion on the ETS endgame and the creation of a market for BECCS and DACCS. Even if formal policy integration will take some time, initial decisions may need to be made by the next Commission (and co-legislators), whose term will start in November 2024.

1. Introduction

The EU Emissions Trading System (EU ETS) is almost 20 years old and now in its fourth trading phase. A comprehensive new set of rules – as well as expansion of the carbon pricing system to new sectors and a carbon border adjustment mechanism (CBAM) – have recently been agreed (EU Parliament and EU Council, 2023). Agreeing on a reform between the EU's 27 Member States, the European Parliament and the European Commission (EC) is no small achievement against the backdrop of a pandemic, a war, and an energy price crisis in Europe.

While these momentous political and societal events certainly affected the policy-making process – and indeed led to significant policy innovation through RePower EU (European Commission, 2022)– the reformed ETS and legislation and the CBAM still reflect to a remarkable extent the ideas set out in the European Green Deal by EC President von der Leyen when she took office in 2019 (European Commission, 2019).

As the EC started to respond to the high energy prices in 2021, a policy strategy was formulated that comprised higher targets for renewables and energy efficiency, while existing targets continued to be implemented. Permitting processes for renewables projects were re-emphasized as a bottleneck in the RePowerEU communication (a plan proposed by the EC to decrease rapidly the EU's dependency on Russian fossil fuels). Indeed, every unit of renewable energy deployed supports the EU in its emissions reduction and energy security objectives. With energy security taking center stage after Russia's invasion of Ukraine, even weather patterns are increasingly important for the EU's energy and carbon markets. In this regard, the mild winter of 2022 provided some relief by mitigating the demand for gas for heating.

In this policy brief, we revisit some of the key challenges for the EU's carbon pricing policy that were identified at the start of the von der Leyen Commission, and we compare them to the newly agreed legislation. In light of the new realities created by the trans-atlantic competition in relation to industrial policy, we also consider how the ETS and industrial decarbonization may fare over the next decade. We also discuss the different pathways that the ETS might follow in the 2030s, bearing in mind that the cap is expected to reach zero in Year 2039.

US Inflation Reduction Act response – Industrial policy renaissance or subsidy race?

Besides actions on emissions trading, the EU has been forced to respond to the US Inflation Reduction Act (IRA), which with its generous operational subsidies is seen as a threat to both the competitiveness of European industries and the attractiveness of Europe as a place to invest in cleantech and low-carbon industries.

With the Green Deal Industrial Plan (GDIP), the EU is responding to the IRA with a new industrial strategy of its own. The GDIP has two new legislative proposals and an updated state aid framework. The two legislative proposals encompass: 1) the Critical Raw Materials Regulation, which targets the security of supply and resilience concerns; and 2) the Net-Zero Industry Act, which targets the manufacturing capacity for cleantech production in Europe, including the regulatory market framework.

Notably absent from these proposals is a budget dedicated to attaining the ambitious manufacturing and resilience goals. This contrasts starkly with the US IRA, which as a fiscal policy is, in principle, unlimited. The state aid framework, therefore, plays a critical role because it allows – and arguably encourages – Member States to finance the EU's green industrial policies.

The strength of the IRA's tax credits scheme is that it provides a form of deployment support. The funding is granted not only for early-stage R&D or demonstration projects, but also for further deployment of low-carbon technologies, provided that the company meets a set of predetermined criteria. Granted, the US needs to offer generous 'carrots' to compensate for the absence of stronger 'sticks', such as those applied by the EU with its carbon pricing. Nevertheless, continuous deployment of low-carbon technologies supports economies of scale and cost reductions through a learning process. The EU lacks such dedicated deployment support for low-carbon technologies that need to compete with – for now – cheaper conventional technologies.

What the US does with investment and production tax credits, EU Member States could do using state aid. In the past, such measures might have been deemed distortionary and ruled to be incompatible with the internal market. While the EU's competition authorities may still have strong views on the design of Member State subsidy mechanisms, it is undoubtedly easier to implement such schemes today, as compared to during the pre-pandemic era when the control of state aid was stricter. A key element is that Member States are allowed to provide more-generous state aid explicitly in response to another region providing subsidies of its own.

However, the capacities and propensities of Member States to offer state aid differ significantly. There is also a good reason why the EU has restricted state aid since the inception of the internal market: a subsidy race between Member States compromises the level-playing field in the internal market and this tends to favor those with the deepest pockets.

A solution to this could be found in joint EU-level financing, which is somewhat challenging given the contentious politics of the EU budget. The EC President initially raised the idea of a European Sovereign Fund, funded through common EU debt (as was done, for the first time, for the EU's pandemic recovery package). However, no political consensus was found, and the alternative "Strategic Technologies for Europe Platform" (STEP) builds on existing funding instruments, such as InvestEU, Horizon Europe, and Cohesion Funds.

It remains to be seen whether the EU will be able to fund low-carbon technology deployment in a manner similar to that of the US IRA, uniformly across the EU. In any case, unlike the US IRA, EU funding will most likely always be capped. Therefore, there is the possibility that any subsidies would 'run out' if the funds were depleted. In addition, the geographic economy of the clean energy and industry transitions needs to be considered. Certain Member States may have better potentials for renewables or possess low-carbon infrastructures linked to carbon capture and storage (CCS) and hydrogen. If EU funds were not to be equitably distributed among the Member States, this could affect either the political bargaining process or the effectiveness of a more-expansive strategy.

2. Main components of the reform and implications thereof

2.1 Increased ambition

As the last ETS revision was concluded in early 2018 (significantly strengthening the system), the ETS quickly regained credibility – and the ETS price rose steadily from single digits to over 40 EUR/t (ICAP, 2023). ETS power sector emissions decreased significantly as coal was pushed out of the EU electricity system in favor of using gas and renewables. The upward trend briefly seemed to be irrevocably broken as the pandemic induced economic anxiety. In fact, the ETS price recovered quickly; by Year 2021, the economic recovery was further supporting the ETS price. In the second half of Year 2021, energy prices in Europe began to rise rapidly, due not only to strong global demand for gas, but also because Russia began acting strategically in the market in preparation for a new invasion of Ukraine. With gas prices soaring, the ETS price breaking new highs, and energy security uncertain, many people were resigned to seeing increased ETS emissions again. These fears have not materialized for now – and the question is: Why is this so?

ETS emissions did rebound in Year 2021, following a year of strict lockdowns in Europe. However, as energy prices started to rise, energy demand dropped. Some of these savings are the result of economic pain for households and businesses and are, therefore, not to be greeted with enthusiasm. Nevertheless, they have contributed to emissions reductions.

As this situation developed, EU legislators resisted the temptation to loosen the cap. While some stakeholders argued for a more-relaxed climate policy in the face of crisis, the ambition level of the ETS has strengthened again in line with the Green Deal strategy announced in Year 2019 before the various crises unfolded. Some minor interventions were made / actions were taken in terms of using 27 million allowances in the Market Stability Reserve (MSR) for innovation funding, as part of a deal to fund the post-pandemic Recovery and Resilience Facility[1].

The **cap trajectory** is one of the main determinants of the ETS supply. A much-higher linear reduction factor (up to 4.4% instead of 2.2%) creates a steep downward trajectory, which, if sustained, will result in zero emissions by Year 2039 (instead of Year 2058). The new ETS legislation will also adjust the cap to account for actual emissions levels – so-called rebasing. The MSR will continue to adjust the ETS supply on an ongoing basis, provided sufficient allowances remain in circulation to trigger adjustments.

Undoubtfully, the EU ETS is playing a key role in decarbonizing the EU. Following the Year 2018 revision, prices exceeding 40 EUR/t contributed to the phasing out of coal in the power sector. With the new revision, the carbon price has exceeded 100 EUR/t (see Figure 1), and futures (Year 2029) have been sold at 120 EUR/t (ICAP, 2023). The

1 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2023.063.01.0001.01.ENG&toc=OJ%3AL%3A2023%3A063%253

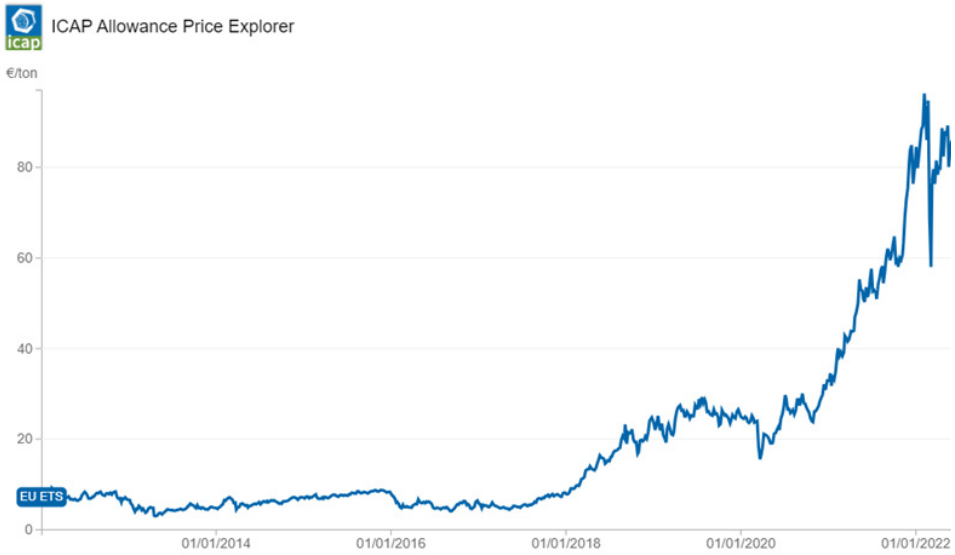

Figure 1. *Price emissions allowances in the EU Emissions Trading System from 1 January 2012 to 31 March 2023 (ICAP, 2023).*

carbon price of 100 EUR/t is described by the cement industry as a game changer when it comes to incentivizing a shift from traditional cement making to the production of zero-carbon cement[2].

2.2 Phase-out of free allocation

Another key feature of the Fit for 55 package is the phasing out of free allocation, with the last free allowance to be allocated in Year 2033. Figure 2 shows the evolution of free allocation over the coming decade. The reduction in free allocation is the result of the CBAM, which is being gradually phased in, mirroring the gradual phasing out of free allowances. The phase-out starts slowly, but after Year 2028 it will accelerate rapidly. This will have major repercussions for low-carbon investments and the competitiveness of low-carbon producers, with the latter being at a relative advantage once free allocation are reduced.

2 https://www.svd.se/a/WR8jK2/klimathotet-kan-cementindustrin-gora-det-omojliga

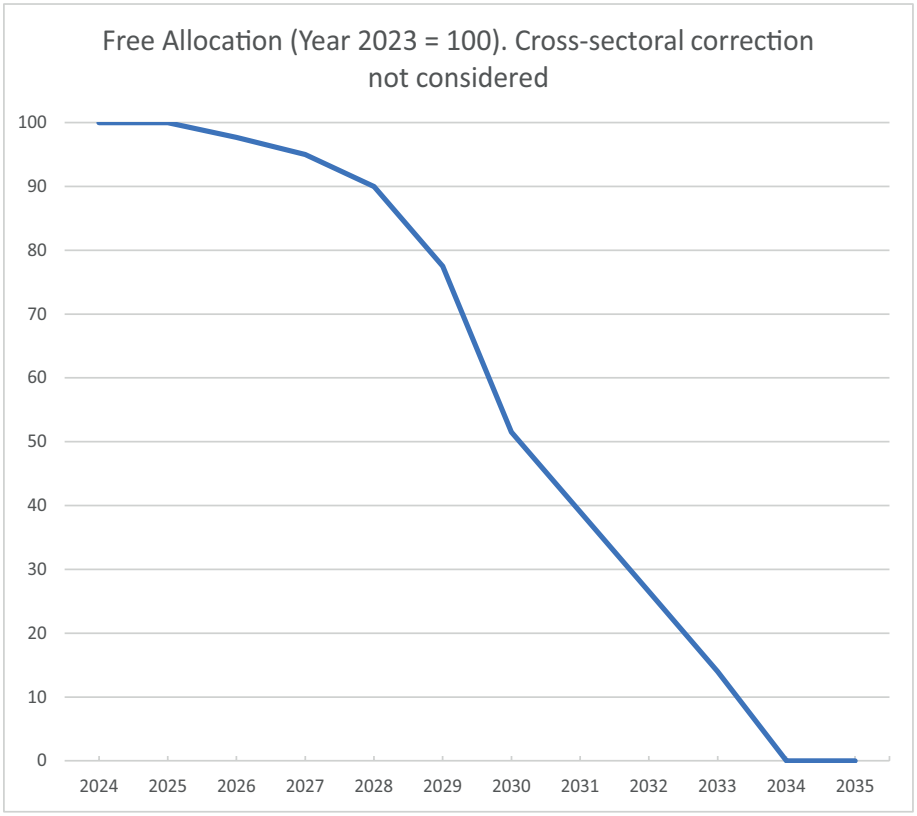

Figure 2. *Phase-out of free allocation from 2025 to 2033 (EU Parliament and EU Council (2023).*

3. ETS developments towards Years 2030 and thereafter

Following Article 30 the EU ETS Directive is subject to continuous review and. in the light developments in other economies than EU, can be revised again. In this section, we address some issues that can lead to future revision of the ETS.

3.1 Will liquidity be low in Year 2030?

With the ETS supply declining rapidly in line with the stronger linear reduction factor, emissions reductions from the power sector may no longer be sufficient to maintain emissions levels below the cap (banked allowances notwithstanding). Therefore, GHG emissions from energy-intensive industries should also start to decline rapidly, ideally driven by the concomitant deployment of low-carbon technologies and the closing down of the most-carbon-intensive plants. This period of heightened scarcity overlaps with the phase-out of free allowances (and phase-in of CBAM), ensuring stronger incentives for the industry to transform.

Should the deployment and scale-up of low-carbon technologies for energy-intensive industries occur slowly, it is likely that slower emissions reductions will push up ETS prices rapidly. Depending on the general economic conditions in Europe, this may lead to a desire among stakeholders to ensure greater liquidity in the system (or, alternatively, to mitigate the impact of high carbon prices). Potential solutions to address this include:

- Linkage of the ETS with the new ETS for heating, transport fuels and smaller industries (ETS2).
- A return to the use of international carbon credits in the EU ETS, facilitated by Article 6 of the Paris Agreement, or – if price is the primary concern – more-direct regulation of the carbon price level. The inclusion of carbon removals seems more likely, given that there will most likely be some residual emissions in the ETS at the end of the 2030s (i.e., allowing CDR credits for ETS compliance), although the linkage with the ETS need not necessarily be direct. See Section 3.4 for more on the markets for negative emissions.

The energy crisis – even if less acute at the time of writing – will likely leave a permanent mark on EU climate and energy policymaking decisions. The energy trilemma – where security of supply, affordability, and sustainability need to be balanced – will be central to this effect. Thus, coal use could rebound in cases of high gas prices, although greater deployment of renewables makes this unlikely. Even while energy price increases are driven mainly by the prices of fossil fuels themselves, the ETS reform did enact some changes regarding how the short-term supply of allowances could be affected by carbon price movements. As for sustainability, the ETS cap trajectory ensures that emissions reduction targets continue to be met in principle.

The MSR has been a significant factor in restoring the credibility and effectiveness of the EU ETS since 2017. The late-2022 reform includes some minor changes to the MSR

operating parameters. There is no longer a "surplus range" within which no supply interventions occur. Instead, if the "total number of allowances in circulation" is >400 million, allowances will be taken off the auction schedule, while if the number is <400 million, allowances will be added. More important, however, is the invalidation of allowances. This invalidation mechanism addresses the ETS surplus by 'permanently'[3] removing allowances from the market. Since early-2023, it is no longer theoretical, with 2.51 billion allowances being officially invalidated, as confirmed by the EC's annual MSR update[4].

3.2 Linking the EU ETS with the ETS2

The *Fit for 55* package includes the implementation of a second ETS (referred to as 'ETS2'), which targets ground transportation and heating of buildings (EU Parliament and EU Council, 2023). The system is planned to be operational from Year 2027. The regulated entity in the ETS2 will be the fuel provider. Interestingly, by regulating the fuel provider, the new ETS will not only cover the transportation and heating sectors, but all users of fossil fuels, including the car industry, the food industry, and producers of consumer goods and electronics. The system will also include fuel that is used for installations from sectors covered by the current ETS but where the installations are too small to be included today (e.g., small power- and heat-generating plants). Allowances will be auctioned. The cap will be reduced at a pace of 5.1%, which is faster than for the EU ETS (EU Parliament and EU Council, 2023). Although taxes on petrol and diesel are among the highest in the world, the levels of transport-related emissions have shown little tendency to decrease. To policymakers, a cap-and-trade program is, therefore, an attractive option, since it will force a decrease in emissions over time.

The idea of including transportation in the EU ETS is not new. These discussions started shortly after the ETS was initiated in 2005 (CE Delft 2006, Holmgren et al. 2006, Kågesson et al. 2008). The main argument for the inclusion of transportation is efficiency – the more participants there are that can provide emissions reductions, the cheaper it will be for Society to reach the emissions target. However, an argument against including road transport in the EU ETS is the risk that the transport sector will simply buy allowances instead of reducing emissions. But this argument can be turned around – it is possible that participants in the current ETS (industry, aviation and shipping) may buy allowances from participants in the new ETS2 (road transports and heating). Sweden has a separate emissions target for domestic transport: emissions in Year 2030 shall be at least 70% lower than in Year 2010. If EU road transportation was to be included in the EU ETS, this would run the risk that Sweden's road transport sector (including fuel suppliers) would simply buy allowances from other EU Member States instead of reducing emissions in Sweden, such that Sweden's transport emissions target would be missed. However, this can also be construed as an argument in favor, in that the relative underperformance of abatement in one sector should ideally lead to accelerated abatement efforts in another sector. A single ETS ensures this situation. Furthermore,

3 Strictly legally speaking, "invalidation" is not the same as "cancellation" as invalidated allowances could in theory always be "revalidated". However, politically speaking this may not matter as much, as carbon markets are inherently a political and regulatory construct in any case. https://climate.ec.europa.eu/news-your-voice/news/ets-market-stability-reserve-reduce-auction-volume-over-272-million-allowances-between-september-2023-05-15_en

4 https://climate.ec.europa.eu/news-your-voice/news/ets-market-stability-reserve-reduce-auction-volume-over-272-million-allowances-between-september-2023-05-15_en

the industrial sectors included in the ETS today differ, ranging from large blast furnaces to breweries. Since Year 2012, intra-European aviation is included in the EU ETS and, starting in Year 2026, shipping will be included in the EU ETS.

Looking towards Year 2030 and beyond, an additional argument for the inclusion of road transport emerges. Since power generation is included in the EU ETS, electric vehicles and electric trains are already included (albeit indirectly) in the EU ETS. The expected rapid expansion of electric vehicles will, over time, move more and more transport-related emissions to the power sector, and with the ban on fossil fuel combustion engines from Year 2035 and with most new vehicles being electric, it makes little sense to exclude transportation from the EU ETS.

Another argument for linking the EU ETS and ETS2 relates to liquidity (see previous section). A rapidly decreasing cap in the EU ETS combined with the possibility of stalled industrial decarbonization could lead to allowance prices increasing rapidly. By merging the EU ETS with ETS2, more allowances will be available, which may reduce price volatility.

3.3 Endgame of the ETS

With the reforming of the EU emissions trading system in Year 2023, the EU ETS cap will be reduced by up to 4.4% per year. At this pace, the cap will reach zero in Year 2039, which means that the last emission allowance will be issued in Year 2039. As we get closer to the year with zero allocation, there will likely be residual emissions, for which abatement will be very expensive and/or technically difficult. In addition, the implementation of CCS to tackle emissions from fossil fuels, the application of which is foreseen to to mitigate process emissions from industries (e.g., the cement industry), will not entirely eliminate emissions due to the capture rates being less than 100%. The aviation sector —of which intra-European aviation is included in the EU ETS—may likewise continue to emit GHGs well into the future.

As the supply of allowances approaches zero, the allowance price may become volatile. The reduced supply may, in part, be cushioned if there are significant volumes of unused allowances, and counterbalanced by the MSR, which withdraws some of the surplus allowances. Sooner or later, however, the supply of allowances will be exhausted. We envisage the following three options for dealing with the situation when the cap reaches zero:

1. Retire the EU ETS and replace it with regulation. With this option the emissions trading program is retired and replaced with a regulation that limits emissions to low levels. The disadvantage of this is that trade between participants stops. Heterogeneity with respect to abatement costs among participants drives trade, leading to cost-effectiveness (achieving the emissions target at the lowest cost). So, without trade, costs will increase. Although a carbon tax can abate this development, introducing a carbon tax at the EU level would require support from all EU Member States, which has previously proven to be difficult. A second challenge would be to find an appropriate tax level. Since the EU ETS target is likely to be determined in terms of volume (for instance, x $MtCO_2$ by Year 2040), it will be challenging to set a tax level that corresponds to this volume level.

A third challenge relates to what will happen to allowances that are already allocated to firms but not used. These volumes could be substantial. Invalidating these allowances would be like withdrawing a property right, which is likely to be controversial. Purchasing them from the owners would be expensive for the Member States. If a net-zero emissions target is to be achieved, this approach will require that a volume of carbon removals is produced outside of the EU ETS to offset ongoing emissions within the EU ETS.

2. Eternal life with a small cap. The cap is reduced until it reaches a minimum level. This level corresponds to what is technically/economically possible for the emissions sources in the system. There is no assigned year for allocation ending. A difficulty with this approach is to determine an appropriate size for the cap and to devise ways to update it as new technologies that decrease emissions emerge. It also requires an equal volume of carbon removals to offset ongoing emissions.

3. Zero cap and credits. The cap is decreased until it reaches zero, i.e., no allocation of allowances. When remaining allowances are used (which can be several years after 2039). Residual emissions are offset using credits that represent carbon removals from for instance BECCS or DACCS. An advantage of this approach is that it will create strong incentives for the development of carbon removal technologies, which are needed not only for the EU ETS, but for the EU overall. A risk associated with allowing credits to be used in the EU ETS is that it could lead to firms buying credits instead of reducing emissions, sometimes referred to as moral hazard. It is important that emissions are reduced as much as possible before turning to offsets. In addition, unrestricted use of credits in the EU ETS in combination with a high carbon price may trigger the production of large volumes of poor-quality carbon removals flooding the EU ETS, similar to what occurred in Phase 2 (2008–2012) when CDM-based CER credits flooded the EU ETS. Therefore, both the volumes and types of CDR credits need to be restricted (see also Section 3.4).

3.4 Creating markets for negative emissions in the EU

Reaching the EU target of net-zero GHG emissions by Year 2050 will require that emissions are reduced as much as possible and that the residual emissions are offset by carbon dioxide removals (CDR). In general CDR can include afforestation, increased carbon sequestration in established forests or agricultural land, bioenergy-CCS (BECCS), biochar, Direct Air Carbon Capture and Storage (DACCS) or enhanced weathering. In the context of the EU ETS, removals that are most likely to come into question include BECCS and DACCS.

However, there are currently almost no incentives for creating negative emissions. Such incentives need to be created. The *polluter pays* principle is not applicable since there is no pollution, but instead a common benefit (or a positive externality). Since carbon removal results in a common benefit, it can be argued that it should be funded from state

budgets (however, for this global common benefit, there are no corresponding global "state budgets"). One could also argue that those that emit GHGs should contribute to funding negative emissions. This resonates well with recent demands for imposing a carbon takeback obligation on fossil fuel companies[5].

Based on these principles, we envisage three models to establish incentives for carbon removal measures in the EU:

1. Establishment of an EU central system for CDR production. Targets/budgets would be set up for different types of CDR, i.e., BECCS, DACCS and carbon sequestration in forests and agriculture. Funding could, for instance, come from the central EU budget (originating from the Member States) or from the Innovation fund (originating from sales of EU ETS allowances).

2. Quota obligation at the EU level. Firms that emit GHGs are obliged to purchase CDR credits corresponding to their GHG emissions. Such an obligation can be implemented on a one-for-one basis, meaning that 1 tonne of emitted GHG requires the purchase of 1 tonne of CDR. It is not immediately obvious for which sectors and emitters a quota obligation system would be an efficient policy instrument. Nevertheless, directing this obligation towards sectors with high levels of emissions, such as the transport sector, would seem to be a reasonable strategy. The advantage of this model is that it reduces costs for the EU/Member States, which could translate into increased public acceptance, although this will also depend on which specific sectors are targeted. It also enhances the incentives for reducing the use of fossil fuels in the transport sector. An associated challenge is that as emissions from the transport sector are reduced (as expected), so will the revenues from the transport-based quota system. Thus, in the longer term, as we get closer to Year 2050, it would be logical to direct the quota obligation towards sectors with residual emissions, such the waste, agricultural, aviation and shipping sectors. A disadvantage is that with a quota obligation that is one-for-one, it will only be possible to reach net-zero emissions, and not net-negative emissions. A way to allow for net-negative emissions is to implement an exchange rate, for instance two-for-one, meaning that each tonne of emissions needs to be compensated by two tonnes of negative emissions.

3. Allow participants of the EU ETS to use CDR credits (for instance BECCS and DACCS) for compliance. As the cap is reduced in the EU ETS and emissions decline accordingly, there will likely be residual emissions, for which abatement will be expensive and/or technically difficult. With the recently decided reduction factor of 4.3%–4.4%, the cap will reach zero in Year 2039, meaning that no allowances will be allocated thereafter. An emissions trading system with no further allocation of emissions allowances could still be possible if there exist credits that represent carbon removals and that can be used to counterbalance the residual emissions in the ETS. Eventually, this would bring down the costs for participants in the EU ETS, since it offers an alternative to reduce emissions. Under current rules, however, imports of credits are not allowed in the EU ETS

5 https://www.theguardian.com/environment/2023/jan/12/fossil-fuel-producers-must-be-forced-to-take-back-carbon-say-scientists

(EU Commission, 2013). A risk linked to allowing credits to be used in the EU ETS is that it could lead to firms buying credits instead of reducing emissions. It is important that emissions are reduced as much as possible before turning to compensation. This risk could be mitigated by limiting the number of credits that can be used for compliance with the EU ETS. Another way to avoid the overuse of credits in the EU ETS is to apply an exchange rate, for instance two-for-one, meaning that one tonne of emissions needs to be compensated by two tonnes of negative emissions. This would create stronger incentives for emissions abatement than for compensation. For BECCS and DACCS costs are already high so the risk of overuse is low today, although this may change as costs for BECCS and DACCS are likely to go down and the price of allowances is likely to go up. If CDR credits, from for instance forest- and agriculture would be considered for use in the EU ETS this is more likely to require an exchange rate of two-for-one or even higher to avoid overuse and flooding the ETS market.

Assignment of responsibility for achieving negative emissions to the Member States. The three models described above are models implemented at the EU level. Alternatively, the responsibility for implementing negative emissions could be foisted on the Member States. It would then be up to each Member State to implement appropriate CDR programs to reach their targets (for instance, by applying Model 1 or Model 2, as described above). Such domestic CDR programs are already underway. For instance, Sweden is currently implementing a support program for BECCS, funded by the Government of Sweden. The Member States could alternatively impose a national quota obligation program on sectors that have residual emissions, as described above.

Distributing CDR efforts across Member States, similar to the Effort Sharing Regulation, would require some kind of distribution key. Effort sharing in relation to CDR can be done following different principles, for instance:

A. Based on residual emissions. Each Member State would be required to produce or purchase CDR outcomes that correspond to some share of their residual emissions. This target will be increased over time. The sum of these efforts will correspond to the volume of CDRs that the EU will need to reach its overall net-GHG target for each given year.
B. Based on differentiated capabilities. Each Member State would be required to produce CDR outcomes based on their technical potential and financial capability (i.e., relative GDP per capita). Furthermore, the sum of these efforts will correspond to the volume of CDRs that the EU needs for each given year. This option corresponds to how the Effort Sharing framework has operated since Year 2013 to share the burden of non-ETS emissions reductions.

Flexibility could be provided by allowing Member States to trade CDR outcomes, so that Member States with surplus CDR outcomes can sell them to Member States that have a shortage. This flexibility would decrease the overall costs and increase the effectiveness of the system. Effort sharing is likely to prove contentious, as it will have significant implications for how the costs for CDR are distributed across Member States. Therefore, effort sharing will be subject to political negotiations.

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Abbreviations

BECCS	Bioenergy Carbon Capture and Storage
CBAM	Carbon Border Adjustment Mechanism
CCS	Carbon Capture and Storage
CDM	Clean Development Mechanism
CDR	Carbon Dioxide Removal
CER	Certified Emission Reduction
DACCS	Direct Air Carbon Capture and Storage
EU ETS	EU Emissions Trading System
GDIP	Green Deal Industrial Plan
GHG	Green House Gas
IRA	US Inflation Reduction Act
MSR	Market Stability Reserve
R&D	Research and Development
STEP	Strategic Technologies for Europe Platform
VDL Commission	von der Leyen Commission

About Mistra Carbon Exit

Mistra Carbon Exit is a research programme that identifies and analyzes the technical, economic and political opportunities and challenges for Sweden to reach the target of net zero greenhouse gas emissions by 2045. We will identify pathways and policies for how Sweden and Swedish companies can become frontrunners in transforming society and industries, providing low carbon products and services while at the same time dressing market risks. This will make Sweden an important international example for other countries to follow.

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