Shifting concerns for the EU ETS: Are carbon prices becoming too high?

Reyer Gerlagh[*], Roweno J.R.K. Heijmans[†], Knut Einar Rosendahl[‡]

September 27, 2021

Abstract

Carbon prices in the EU ETS have risen from around 5 euro per ton of CO2 in 2017 to above 60 euro in 2021. One probable explanation is the cancellation mechanism implemented along with the Market Stability Reserve (MSR) of the EU ETS in 2018. We identify realistic conditions under which the MSR results in truly massive cancellation of emissions allowances, pointing to the steepness of the emissions pathway over time as essential. A flattening of the emissions pathway implies huge reduction in cumulative emissions, suggesting much higher ETS prices. The concerns about too low and 'ineffective' carbon prices may turn into concerns for too high prices. The results have important ramifications for planned revisions of the EU ETS.

[*]Department of Economics, Tilburg University, the Netherlands. Email: r.gerlagh@uvt.nl.

[†]Department of Economics, Swedish University of Agricultural Sciences, Uppsala, Sweden. Email: r.j.r.k.heijmans@uvt.nl.

[‡]School of Economics and Business of the Norwegian University of Life Sciences, Norway. Email: knut.einar.rosendahl@nmbu.no.

1 Main text

The European Union's Emission Trading System (EU ETS) is the flagship EU climate policy, covering around half of the EU's CO_2 emissions (Bayer and Aklin, 2020). The EU ETS has had a tumultuous past with volatile and mostly low prices, especially after the 2008 financial crisis. In the years 2012-2017, the price hovered consistently below €10 per ton of CO_2, falling short of even the most conservative estimates for the social cost of carbon (Pindyck, 2019). Then prices started rising – a trend that gained momentum despite the COVID-19 pandemic and led to record-breaking prices throughout 2021. What happened?

There probably are two main explanations. One is the EU's more ambitious emissions reduction target for 2030, strengthened from 40% to 55% (vis-a-vis 1990). The other is a key reform of the EU ETS in 2018, when a cancellation mechanism was incorporated into the Market Stability Reserve (MSR). This reform implies that cumulative emissions over time are no longer dictated by predetermined EU ETS supply schemes but depend on ETS market dynamics. The EU ETS thus changed from a system with an exogenous cumulative cap on emissions to one with an endogenous cap (Perino, 2018; Rosendahl, 2019; Gerlagh et al., 2020b).

The MSR is essentially a vault, taking in allowances as long as the surplus in the market at the end of a year ("total number of allowances in circulation" – TNAC) is greater than 833 million allowances – the supply of new allowances (via auctioning) is reduced by the same amount. When the MSR holds more allowances than a given threshold, the excess is *permanently* canceled, thus reducing the supply of allowances and thereby the cumulative emissions cap. This regulatory change is expected to cause massive cancellation of allowances in years to come, implying large reductions in emissions (Perino and Willner, 2017; Kollenberg and Taschini, 2019; Bruninx et al., 2020; Gerlagh et al., 2020a; Osorio et al., 2021).

Although several papers build models to simulate the cancellation mechanism, there is no overarching picture of what drives the extent of cumulative cancellation in the EU ETS. Here we discuss a critical yet often neglected driver: the steepness of the emissions pathway over time. We summarize this dynamic in the simplest way possible by addressing a very basic question: will emissions decline more or less gradually over time?

With an exogenous cumulative cap (without a cancellation mechanism), the time-structure of emissions does not affect cumulative emissions. A flattening of the emissions pathway involves lower current emissions combined with a corresponding increase of future emissions. Graphically speaking, the two emission pathways E1 and E2 in Figure 1 exhibit the same area under their curves.

Things work very differently when the cumulative cap on emissions is endogenous due to the cancellation mechanism. As a flattening of the emissions pathway involves lower initial emissions, this leads to a larger surplus of allowances in early years, by construction causing an increased inflow of allowances into the MSR and thus more cancellation over time; the cumulative supply of allowances, and hence emissions, consequently drop. This is illustrated in Figure 1. Both E1 and E3 are emissions pathways consistent with the updated MSR rules as recently proposed by the Commission (2021b) (E2 is not and only serves as illustration of exogenous cap). We notice that E3 is not only flatter than E1 (like E2) – it is also substantially lower. Emissions must start much lower – otherwise there will be a shortage in the ETS market in later years because of the cancellation mechanism. In other words, the area under the E3 curve is much smaller than the area under the E1 curve; the difference is caused by the MSR reacting strongly to a flattening of the emissions pathway. While it is not surprising that the areas differ, the size of the effect is remarkable.

To disentangle the effects summarized in Figure 1, one may compare Figures 2 and 3. These figures present the number of allowances (i) banked (TNAC), (ii) entering the MSR, (iii) released from the MSR, and (iv) canceled in a given year when the emissions pathway declines by 4.5% and 3.0% (of 2021 emissions) annually, respectively. The two figures look distinctively different. As mentioned, the surplus of allowances (banking) is substantially larger in the 3.0% scenario. This is intuitive: if emissions are to decline less rapidly over time, more allowances need to be saved for future usage. An immediate implication is that the inflow of allowances into the MSR is greater, and therefore so is allowance cancellation. The total number of allowances canceled in the 3.0% scenario is hence substantially larger than in the 4.5% scenario.

To investigate this further, we calculate the cumulative emissions consistent with the EU ETS and updated MSR rules for various slopes of the emissions pathway. Figure 4 shows cumulative emissions and initial emissions (in 2021) for each of these paths. If emissions, and thus demand for allowances, are set to decrease by 4.5% annually (i.e., 4.5% of the 2021 level), cumulative emissions add up to 16 GtCO2. If emissions are set to decrease more slowly, i.e., by 3.5% of the 2021 level annually, emissions must start at a much lower level in 2021, and cumulative emissions drop to 9 GtCO2. Cumulative

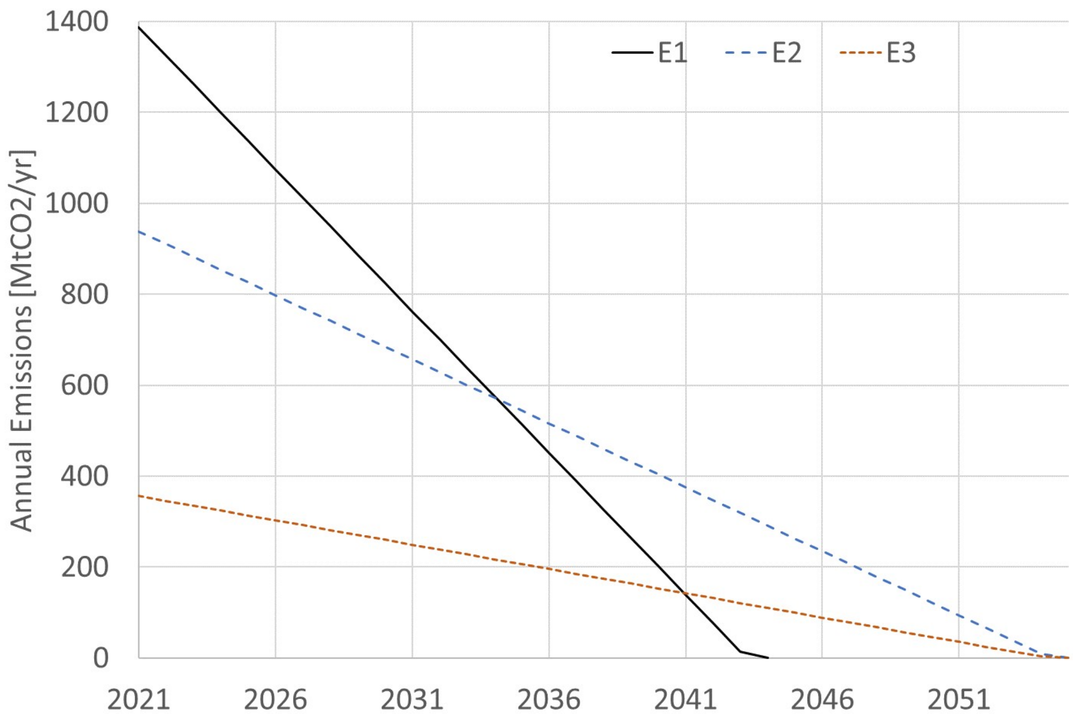

Figure 1: Linearly decreasing emission pathways. Scenario E1: Emissions decline by 4.5% of 2021 emissions annually and supply follows MSR rules. Scenario E2: Emissions decline by 3.0% of 2021 emissions annually and cumulative emissions as in E1. Scenario E3: Emissions decline by 3.0% of 2021 emissions annually and supply follows MSR rules. The area between E2 and E3 measures the reduction in cumulative emissions due to the change in the slope of the emissions pathway. E1 and E3 are consistent with MSR rules and also part of Fig. 2; E2 serves as an illustration.

emissions are reduced by almost one half in response to a seemingly moderate change of the slope of the emissions pathway.

We emphasize that our results follow mechanically from the rules of the MSR and do not involve any economic assumptions on the EU ETS market (such as price-sensitivity of demand). The MSR is a purely quantity-based protocol for backloading and canceling allowances (one potential exemption being Article 29a of the EU ETS Directive, see below). The time-structure of emissions, together with the rules of the MSR, are all we need to fully determine the outcomes depicted in Figure 4. Indeed, the only two assumptions entertained in the analysis are, first, that emissions decline linearly over time, and second, that firms are not allowed to hold allowances beyond 2070 (the

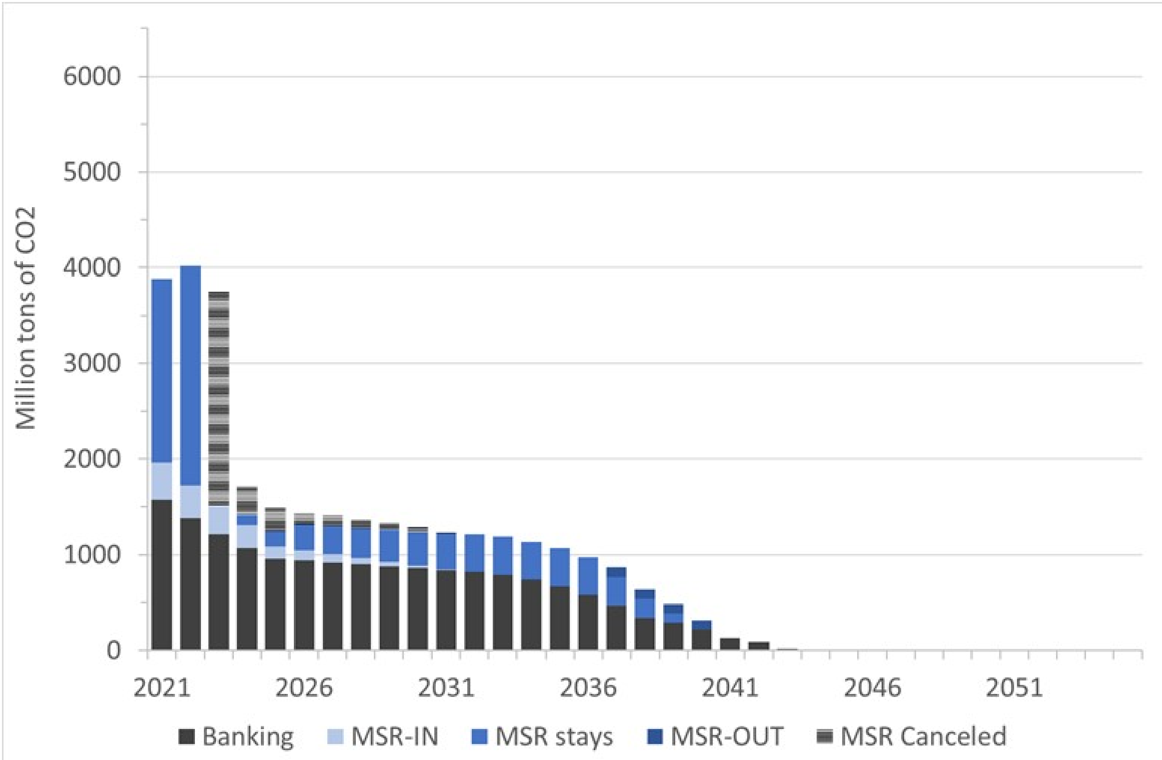

Figure 2: Stock of allowances (i) banked (TNAC), (ii) entering the MSR, (iii) released from the MSR, and (iv) canceled in a given year when the emissions pathway declines by 4.5% (of 2021 emissions) annually.

supply of allowances drops to zero after 2040). Neither of these are important drivers of our results. We discuss the role played by a linear demand reduction below. As to the market ending at the latest in 2070, we observe that *if* the EU ETS were to continue after 2070 (so allowances issued before 2041 can be used after 2070), cumulative emissions would be even lower than shown in Figure 4.

The intuition for the magnitude of the effect in Figure 4 is as follows. If emissions decline less rapidly over time, they must start at a lower level. Lower emissions in early years imply a larger initial surplus, so more allowances are stored in the MSR. Of those, a substantial fraction gets canceled. The cumulative supply of allowances therefore decreases and emissions adjust downwards, including in the early years. But this means we have to repeat our argument, with a larger initial surplus and more cancellation again and again. The cancellation feedback loop spirals on and on, stabilizing only after a massive amount of allowances got canceled. Our argument thus predicts that if

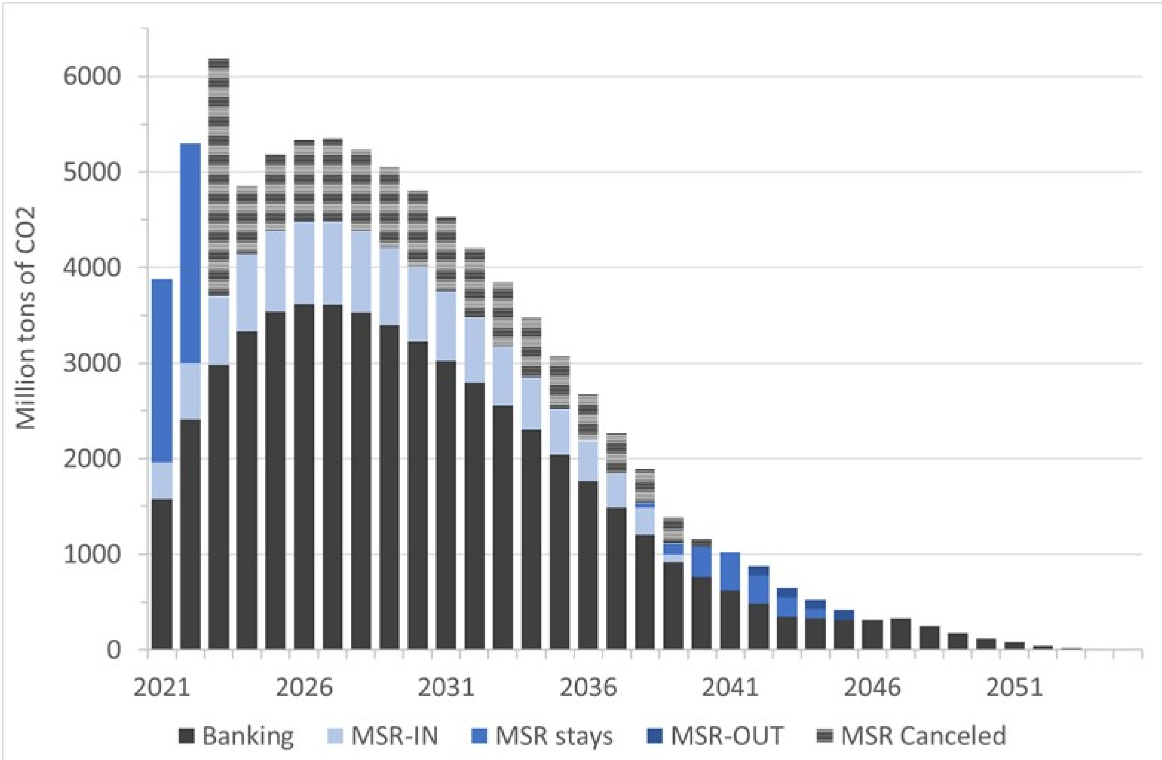

Figure 3: Stock of allowances (i) banked (TNAC), (ii) entering the MSR, (iii) released from the MSR, and (iv) canceled in a given year when the emissions pathway declines by 3.0% (of 2021 emissions) annually.

or when the market expects a flattening of the emissions pathway, we should expect to see a markedly upward shift in the ETS price due to the substantial reduction in cumulative supply of allowances. Observe that the logic or intuition behind our results is general and does not rely on linear emissions pathways; linearity was assumed only to simplify the story.

What do we know about the time-structure of emissions? In general, it depends on a number of factors, such as technological change and the development of (marginal) abatement costs over time (Bruninx et al., 2020). Some observations suggest, however, that the emissions pathway has become flatter over time than previously believed (Flachsland et al., 2020). From a polluting firm's perspective, an emission allowance is a non-renewable resource that is perfectly substitutable over time. For this reason, the allowance price should follow Hotelling's rule and rise with the interest rate (Hotelling, 1931), at least approximately. The interest rate has fallen consistently over the last

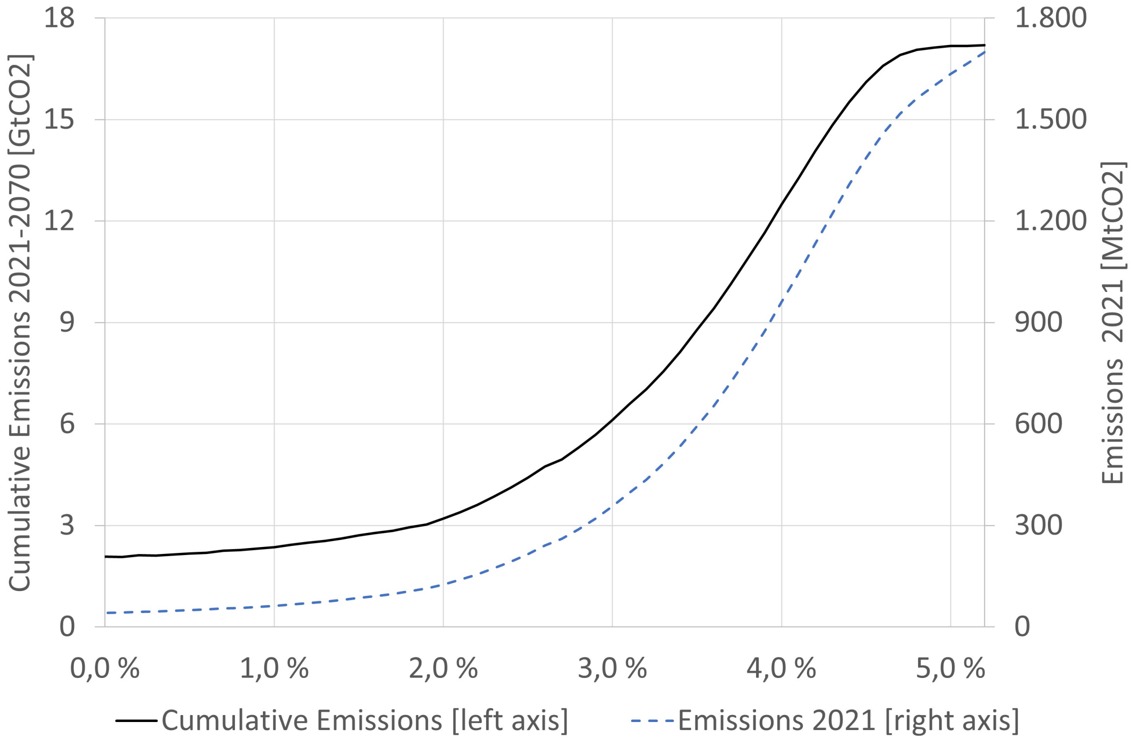

Figure 4: Time structure of emissions (horizontal axis) versus size of (cumulative) emissions (vertical axes). The horizontal axis shows the annual linear reduction rate (as a percentage of simulated emissions in 2021). The left vertical axis shows cumulative emissions over the years 2021-70. The right vertical axis shows simulated emissions in 2021.

years, implying a near-constant allowance price over time. The latter implication is borne out by the data: EU ETS prices for future allowances are close to current spot prices. All else equal, a flatter price path will tend to make the emission path decline less steeply. Combined with our findings above, the MSR thus supports a price path that reaches a fairly constant yet very high level, suffocating emissions. Due to this very low level of emissions and the implied substantial surplus of allowances in early years, a large majority of allowances will be canceled by the MSR, self-enforcing the extreme price level. This effect does not rely on the precise linear shape of the emissions pathway. The only thing that matters is that the emissions pathway is flat relative to the path of supply leading to a surplus of allowances in early years. After a decade of worrying about low allowance prices, the EU may soon find itself otherwise occupied, struggling with a carbon price that spirals out of control.

Our results thus reinforce calls for an MSR revision that incorporates price triggers. A price-triggered MSR was recently proposed in the EU's *Fit for 55* legislation package as market stability mechanism for a second, completely independent EU emissions trading system to cover buildings and road transportation. That said, a simple price ceiling or floor (Abrell and Rausch, 2017) is not so easily constructed in the EU ETS, largely because of the MSR. For instance, Article 29a of the EU ETS Directive stipulates that when over six consecutive months prices are more than three times higher compared to the average over the previous two years, 100 MtCO2 of allowances are moved back from the MSR to the market. Our calculations suggest almost all of these allowances are returned back to the MSR at later stages, implying negligible effect on cancellations and cumulative emissions.

References

Abrell, J. and Rausch, S. (2017). Combining price and quantity controls under partitioned environmental regulation. *Journal of Public Economics*, 145:226–242.

Bayer, P. and Aklin, M. (2020). The european union emissions trading system reduced co2 emissions despite low prices. *Proceedings of the National Academy of Sciences*, 117(16):8804–8812.

Bruninx, K., Ovaere, M., and Delarue, E. (2020). The long-term impact of the Market Stability Reserve on the EU Emission Trading System. *Energy Economics*, 89:104746.

Commission, E. (2021a). Communication from the commission. publication of the total number of allowances in circulation in 2020 for the purposes of the market stability reserve under the eu emissions trading system established by directive 2003/87/ec. Technical report, https://ec.europa.eu/clima/sites/clima/files/ets/reform/docs/c˙2021˙3266˙en.pdf.

Commission, E. (2021b). Proposal for a directive of the european parliament and of the council amending directive 2003/87/ec establishing a system for greenhouse gas emission allowance trading within the union, decision (eu) 2015/1814 concerning the establishment and operation of a market stability reserve for the union greenhouse gas emission trading scheme and regulation (eu) 2015/757. com/2021/551 final. Technical report, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021PC0551.

Flachsland, C., Pahle, M., Burtraw, D., Edenhofer, O., Elkerbout, M., Fischer, C., Tietjen, O., and Zetterberg, L. (2020). How to avoid history repeating itself: the case for an eu emissions trading system (eu ets) price floor revisited. *Climate Policy*, 20(1):133–142.

Gerlagh, R., Heijmans, R., and Rosendahl, K. E. (2020a). COVID-19 tests the Market Stability Reserve. *Environmental and Resource Economics*.

Gerlagh, R., Heijmans, R. J., and Rosendahl, K. E. (2020b). An endogenous emissions cap produces a green paradox. *Economic Policy*.

Hotelling, H. (1931). The economics of exhaustible resources. *Journal of political Economy*, 39(2):137–175.

Kollenberg, S. and Taschini, L. (2019). Dynamic supply adjustment and banking under uncertainty in an emission trading scheme: the market stability reserve. *European Economic Review*.

Osorio, S., Tietjen, O., Pahle, M., Pietzcker, R. C., and Edenhofer, O. (2021). Reviewing the market stability reserve in light of more ambitious eu ets emission targets. *Energy Policy*, 158:112530.

Perino, G. (2018). New EU ETS phase 4 rules temporarily puncture waterbed. *Nature Climate Change*, 8(4):262.

Perino, G. and Willner, M. (2017). EU-ETS Phase IV: Allowance prices, design choices, and the Market Stability Reserve. *Climate Policy*, 17:936–946.

Pindyck, R. S. (2019). The social cost of carbon revisited. *Journal of Environmental Economics and Management*, 94:140–160.

Rosendahl, K. E. (2019). EU ETS and the waterbed effect. *Nature Climate Change*, 9(10):734–735.

2 Supplementary Information

The simulations begin in 2021. Annual issuance of allowances starts at 1572 Mt in 2021 and drops by 82 Mt per year, reaching zero in 2041.[1] Total number of allowances in circulation (TNAC), that is, banking of allowances in the market, at the end of 2020 is 1579 Mt, while the MSR contains 1925 Mt (REFs) (Commission, 2021a). The details of the MSR are as follows, which is based on the proposed adjustments to the EU ETS and the MSR by the Commission (2021b):[2][3]

- Whenever the TNAC at the end of a year is between 833 and 1096 Mt, the number of auctioned allowances the following year is reduced by the difference between the TNAC and 833 Mt. If the TNAC exceeds 1096 Mt, the number of auctioned allowances is reduced by 24% of the TNAC. These allowances are instead put into the MSR.
- Whenever the TNAC at the end of a year is below 400 Mt, the number of auctioned allowances the following year is increased by 100 Mt. These allowances are taken from the MSR.
- Whenever the size of the MSR at the end of a year exceeds 400 Mt, the excess allowances are permanently cancelled. Cancellation begins in 2023.

We consider only linear emission pathways in our simulations, except that emissions always drop to zero after 2070. Thus, all emission pathways considered are on the form $E_t = E_{2021}(1 - a(t\text{–}2021))$ for $t < (2021 + 1/a)$ AND $t \leq 2070$ and $E_t = 0$ otherwise. Since borrowing is not allowed in the EU ETS, we only consider emission pathways consistent with this restriction. Hence, initial emissions cannot be too high, and the highest value of a is therefore 0.052. For a given a between 0.000 and 0.052, we search for values of E_{2021} that gives $TNAC_{2070} = 0$ (thus cumulative emissions equal cumulative supply to the market). We have also performed simulations with the existing EU ETS and MSR rules, and the results are qualitatively the same. Those results are available with the authors.

[1] This excludes aviation allowances, which are currently not included in the MSR, and UK emissions as the UK dropped out of the EU ETS after 2020.

[2] For a description of the MSR and the current rules, see https://ec.europa.eu/clima/policies/ets/reform˙en

[3] Strictly speaking, there is a slight delay in the inflow into the MSR, as the size of the TNAC at the end of year t reduces auctions in the 12-month period from September year $t+1$ to August year $t+2$. This delay is not incorporated into our model, but would not change the results in a notable way.