Working Paper Series 799
(ISSN 2788-0443)

The EU ETS is unprepared for 2040 and beyond

Silvester van Koten

CERGE-EI
Prague, July 2025

The EU ETS is unprepared for 2040 and beyond[1]

Silvester van Koten
Faculty of Social and Economic Studies, J. E. Purkyně University, Ústí nad Labem, Czech Republic
CERGE-EI, a joint workplace of Charles University and the Economics Institute of the Czech Academy of Sciences, Prague, Czech Republic
Faculty of Economics, Prague University of Economics, Prague, Czech Republic
Email address: slvstr@gmail.com, silvester.vankoten@cerge-ei.cz, silvester.vankoten@ujep.cz

Abstract
The central instruments of a cap-and-trade program are its abatement schedule and a system of guardrails designed to prevent permit prices from becoming excessively high or low. I argue that these instruments are currently poorly aligned in the EU's cap-and-trade flagship climate policy, the EU ETS. I argue that the abatement schedule risks being overly ambitious and that the ETS' existing guardrails, the Market Stability Reserve (MSR), do not offer sufficient protection against extreme prices. This misalignment may result in substantial economic costs and could ultimately undermine public support for the ETS. This paper recommends consideration of more effective guardrails, such as the well-established the price collar as implemented in California's cap-and-trade program.

Keywords: EU Emissions Trading System (EU ETS), Market Stability Reserve (MSR), net zero, abatement path, price collar

Highlights
- The new proposed EU ETS abatement path stops issuing new permits by 2040.
- The Market Stability Reserve (MSR) does not provide effective protection against an extreme permit price.
- There is a concrete risk of unprecedentedly high permit prices under the proposed policy.
- A price collar effectively protects against the risk of extreme permit prices.
- A price collar provides additional benefits.

1. Introduction

Cap-and-trade schemes are effective and efficient instruments for reducing carbon emissions. However, their success depends on a carefully calibrated decarbonization path, neither too fast, nor too slow. To prevent extreme outcomes, policy frameworks typically include guardrails that enable adjustments to the decarbonization trajectory when the carbon emission permit price rises too high or fall too low. I show that the decarbonization path and the guardrails are poorly aligned in the proposed policy (July 2025) for the European Union's cap-and-trade program, the EU Emissions Trading System (EU ETS), and that they will not provide effective protection against sharply elevated permit prices. The findings in this paper support the widespread concerns that currently (July 2025) prevail among most EU governments (Weise, Mathiesen, & Guillot, 2025).

The EU ETS is the EU's flagship policy for decarbonizing the economy (European Commission [EC], 2024a). Presently (July 2025), a crucial policy debate is being held to implement laws that effectively set 2040 as the terminal date for issuing new carbon permits within the EU ETS (EC, 2024a, Pahle, Quemin, Osorio, Günther, & Pietzcker, 2025). I refer to this proposed policy as the "accelerated" scenario, as opposed to the previous "linear" scenario, using the terminology of Chyong (CH) (2025). I argue that the proposed new abatement schedule risks being overly ambitious, so long as the ETS' existing guardrails, the Market Stability Reserve (MSR), do not offer adequate protection against extreme prices.

[1] I want to thank Josef Klement for his insightful comments on an earlier version of the paper.

In this paper, I first explain the theoretical relationships between abatement paths, marginal abatement costs, permit prices, and societal costs. I then address the likely economic effects of very high permit prices. Next, I discuss the proposed new abatement path and argue that it is unprecedented in its ambition, and presents a concrete risk of very high permit prices. I support this claim by presenting results from three recent energy system optimization models.

I then show that the present EU ETS guardrails, the MSR, do not sufficiently protect against extreme prices. I rely on existing literature to reiterate the well-documented fact that the MSR fails to mitigate anticipated shocks and instead amplifies them (Perino et al., 2022; Borghesi et al., 2023). I then show that the MSR cannot prevent relatively steep increases in the permit price and lacks a reliable mechanism to reduce elevated permit prices.

Together, an ambitious abatement path and ineffective guardrails create a dangerous combination. I discuss possible solutions, including reducing the abatement path and transforming the existing guardrails into a system with a price collar, a well-documented solution used in California. I also comment on alternative solutions, such as reintroducing international credits despite past poor experiences. I conclude with a discussion of the additional advantages of a price collar and the considerations needed to set appropriate floor and ceiling prices.

2. Price, Cost, and Economic Effects of an ETS

2.1 Abatement, MACC, and Permit Prices

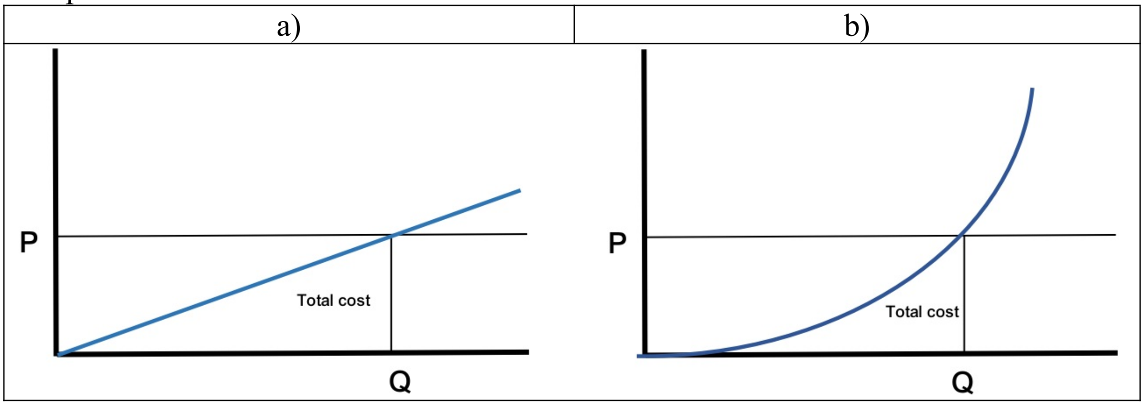
The central element of an ETS is its abatement schedule. Firms covered by the ETS must obtain and surrender a carbon permit for each ton of carbon dioxide equivalent (tCO2e) they emit, which in the EU ETS is known as an EU Allowance (EUA).[2] To implement the required abatement in the EU, the total number of permits in the ETS is reduced annually, and emissions in the covered sectors decline correspondingly over time. For individual firms, the most important factor in their decisions is the permit price, which results from competition over the shrinking pool of permits. The permit price effectively imposes a carbon cost on greenhouse gas emissions, incentivizing firms to either abate emissions or, by buying permits, to pay the carbon costs. Firms are thus incentivized to make only those reductions with marginal costs below the permit price, while more expensive reductions are avoided through permit purchases. This mechanism helps minimize total abatement costs.

The permit price rises as more abatement is required and abatement technology becomes more costly. Marginal abatement cost curves (MACCs) help illustrate this interaction, by explicitly showing the relationships between marginal costs and abatement. The volume of all possible emissions reductions is plotted on the x-axis, ranked from lowest to highest cost, and the abatement cost per tCO_2e appears on the y-axis. The ordering of the reductions is strictly cost-based, so abatement units from firms or consumers are typically dispersed along the curve, and adjacent units may thus originate from different actors.[3]

[2] A firm that fails to surrender a permit when required receives a penalty, in addition to the obligation to surrender the outstanding permits. In shipping or air transport, repeat offenders may be expelled and subject to an operating ban.

[3] For more details on MACCs, see Kesicki and Ekins(2012).

Graph 1



Source: Constructed by the author.

Graph 1 shows stylized MACCs. Graph 1a), on the left, shows a linear MACC, while Graph 1b), on the right, shows a convex MACC. When fewer permits are released to the market, the abatement required becomes greater (denoted as Q in Graph 1) and the permit price (P) rises. The convex MACC in Graph 1b) is generally considered more realistic, as initial abatements are relatively cheap, but costs rise more steeply with greater abatement. Thus, the greater the level of abatement and the steeper the MACC, the higher the permit price, and the higher the total abatement costs borne by firms.

Permit Scarcity and Demand Curtailment Lead to Higher Costs

The permit price typically reflects the cost of replacing carbon-emitting goods or services with more expensive zero-emission alternatives at the margin. However, if the required level of abatement becomes excessive, exceeding the capacity of available alternatives, additional abatement must come from reductions in supply. At this point, the permit price would no longer reflect the marginal cost of zero-emission alternatives; rather, it would function as a rationing mechanism. Its elevated level would then correspond to the price necessary to sufficiently curtail demand for carbon-intensive goods or services to meet the required abatement. Such a rationing-based carbon price would likely be extraordinarily high.[4]

The True Cost of an ETS

The amount of abatement and the shape of the MACC together determine not only the permit price, but also the total cost society must bear for that abatement. Higher amounts of abatement, and thus higher permit prices, result in greater societal costs. Importantly, the net societal cost of the ETS is *not* represented by the total revenue raised from permit sales. These revenues are merely transfers from firms (and, indirectly, from consumers via pass-through pricing) to the government and are therefore not a net economic cost.[5]

The true societal economic cost lies in the efforts undertaken by firms and consumers specifically to avoid bearing the direct or indirect costs of carbon permits. For firms, the cost may include forgone profits from scaling back emission-intensive activities, higher input costs from substituting cleaner fuels (e.g., gas vs. coal), and capital investments in efficiency improvements or low-carbon technologies. These costs are typically passed on fully to consumers (Dechezleprêtre, Nachtigall, & Venmans, 2023). Consequently, for consumers, costs rise through changes in their consumption patterns, when they shift away

[4] In the electricity sector, this logic is well documented in the phenomenon of "scarcity pricing": during supply shortages, electricity prices, normally between \$20/MWh and \$100/MWh, may spike to \$10,000/MWh or higher to reduce demand to the level of available supply.

[5] However, these transfers may contribute to social costs by imposing costs on consumers and firms, while the government (temporarily) holds excess revenues that must later be redistributed. There is also a risk that governments may not spend these funds efficiently, but rather will dissipate parts of them. A portion of the transfers is usually earmarked for renewable energy projects, and some of these have been documented as being excessively costly in the past (Marcantonini & Ellerman, 2016; Marcantonini & Valero, 2017).

from goods whose prices have increased due to the pass-through of permit or abatement costs.

Of course, these efforts by firms and consumers, though they incur societal costs, are precisely the target effects of the ETS, as they lead to the intended emissions reductions. This is the core mechanism of the ETS. The resulting societal costs are unavoidable and, provided that the abatement targets have been set appropriately, represent a worthwhile sacrifice in return for the abatement achieved. Graph 1 shows total abatement costs as the area under the MACC up to the level of abatement induced by the permit price. The graph illustrates that higher abatements and steeper MACCs result in higher permit prices and total abatement costs.[6]

Uncertainty Regarding the MACC's Shape

The future costs of ETS thus depends on requested future abatements and the shape of the MACC. However, the future shape of the MACC is generally not known and must be estimated. Progress in abatement technology may effectively flatten the future MACC. For example, innovation can improve the efficiency and lower the cost of carbon-neutral power generation (e.g., nuclear, hydro, wind, and solar), power storage (e.g., batteries and green hydrogen), energy-saving technologies (e.g., insulation, efficient lighting and heating), and emissions removal technologies (e.g., carbon capture and storage [CCS], bioenergy with carbon capture and storage [BECCS], and direct air carbon capture and storage [DACCS]). A future featuring large-scale deployment of inexpensive abatement solutions would allow deep abatement without necessarily incurring high price levels.

Making predictions about the future MACC therefore involves assumptions about both the pace of technological progress and the scale of deployment of abatement solutions. More (less) optimistic assumptions imply a flatter (steeper) MACC and, for a given level of abatement, lower (higher) estimates of societal abatement costs and permit prices.

Setting the Right Abatement Target

The future abatement target is a decision variable, and, given the shape of the MACC, determines the societal cost and the permit price. Higher abatement means higher expected costs. For policy to be effective and welfare-improving, it is thus essential to determine the correct abatement path, requiring the correct trajectory for annual reductions in available permits. Targeting too few (many) permits along this path leads to inefficiently high (low) societal costs and an excessively high (low) permit price. Choosing the optimal level of abatement is inherently difficult, given uncertainty about the future shape of the MACC.

2.2 Excessively High Permit Prices Inflict Economic Harm

The danger of extreme permit prices, in particular excessively high ones, with high compliance costs, has been acknowledged in most constituencies that have introduced cap-and-trade mechanisms. Three approaches have been initially used in various regions, including the EU and California (EC, 2021; Kynett, 2024), to prevent high permit prices: (i) setting an overgenerous annual release of permits; (ii) allowing the use of cheap international credits instead of permits; and (iii) introducing companion policies, such as renewable energy support schemes, which reduce permit demand and thereby lower their market price. The EU has employed all three strategies, although it discontinued the use of international credit schemes in 2021 due to serious concerns about their effectiveness (EC, 2021).

The Early Experiences: Low Carbon Prices

These approaches resulted in persistently low carbon prices (typically below €30/tCO_2e) in carbon cap-and-trade markets (Burtraw, Palmer & Kahn, 2010; Burtraw & Keyes, 2018). As a result, there is virtually no empirical literature examining the effects of very high

[6] In Graph 1a), the area forms a triangle, and thus the total abatement cost equals ½ × abatement × permit price. This is generally regarded as an upper-bound estimate, because the area and thus the costs tend to be lower under a convex MACC such as in Graph 1b).

carbon prices. Perhaps unsurprisingly, cap-and-trade markets with low sustained price levels have generally been found to have little or no impact on economic growth or employment (see, for example, Metcalf & Stock, 2020, 2023; Dechezleprêtre, Nachtigall, & Venmans, 2023).

A Very High Carbon Price Would Deteriorate the Economy

However, a very high ETS permit price, for example, into the range of €400 to €4,000 per tCO_2e, would substantially raise production costs for the electricity sector and energy-intensive industries, including fertilizers, ammonia, cement, and chemicals. Many firms could be expected to cease production and reduce the supply of critical intermediate and final goods, a process already underway at permit prices presently in the relatively low range of €70 to €80.[7] Other industries might continue production, but would face rising costs, whether due to more expensive permit purchases, investments in cleaner technologies, or higher input prices. These cost increases are typically passed on in full to consumers. Industrial goods and energy prices would increase significantly. As a rule of thumb, the variable cost of one MWh of electricity produced with coal (or gas) rises by approximately 1.0 (or 0.5) times the permit price. As higher prices suppress both supply and demand, GDP growth would likely decrease. In addition, higher energy prices would propagate through the economy, raising inflation.

Moreover, as higher energy and product prices are visible to the public and disproportionately affect lower-income households, they can trigger a backlash against climate policies. Such a backlash can already be observed even with today's relatively modest carbon price of around €70 to €80 (€70/tCO_2 as of June 2025); it is referred to as "greenlash". With a very high permit price, the right-wing populist parties calling for lower climate ambitions or even the disbandment of the ETS (Kulin, Johansson Sevä, Dunlap, 2021) may gain further influence.

Effects of the 2022 Energy Price Crisis

The economic and social costs of a scenario with an extremely high permit price can be illustrated by the energy price crisis triggered by Russia's suspension of gas deliveries to the EU in 2022, which caused sharp increases in natural gas and electricity prices and led to an increase in inflation. The literature documents major effects of this energy crisis: for firms, reduced profitability and heightened risk of default (Ferriani & Gazzani, 2023); greater inequality, as low-income households experienced larger reductions in income and consumption (Bobasu, Dobrew, & Repelea, 2025); negative impacts on food prices, environmental quality, and public health (Alexander et al., 2023); and a possible decline in GDP (Yagi & Managi, 2023).

3. Abatement Path: How Fast is Too Fast?

3.1 The Accelerated Scenario

Presently (summer 2025), new legislation is set to impose a much steeper ETS reduction path, which will effectively end permit issuance in 2040. This "accelerated" scenario involves a fast and deep reduction, thereby increasing the risk of markedly higher permit prices and abatement costs by 2040 and 2050.

In 2013, the annual number of permits was set at 2.084 $MtCO_2e$ (2,084.301856 $MtCO_2e$) and has since been gradually reduced (EC, 2020). At the end of 2024, the cap had declined

---

[7] For example, in the Netherlands, parliamentary questions (Ministerie van Economische Zaken en Klimaat, 2025) show that a substantial share of the projected Dutch emission reduction in 2025,1.5$MtCO_2e$, results from halted production at firms including the SABIC naphtha cracker, OCI subsidiary BioMCN, the Gunvor refinery, and from the planned closure of LyondellBasell's LYB/Covestro plant at the Maasvlakte. Most of the total reduction in the energy-intensive industry
between 2021 -2024, 6.6 Mton CO_2e, also results from production cuts.

by 29% since 2013 (from 2.084 $MtCO_2e$ to 1,476 $MtCO_2e$).[8] Over the same period (2013-2024), ETS-covered emissions declined even more sharply, by 40% (from 1656 $MtCO_2e$ to 1000$MtCO_2e$) (European Environment Agency, 2025).[9] This stronger reduction has resulted from companion policies, such as mandates, subsidies, and the banking of permits, as well as their withdrawal (and partial cancellation) through the MSR. The new plan seeks to reduce the cap to zero by 2040, a further 71% reduction relative to 2013, which will eliminate the remaining 60% of covered emissions from the 2013 level within only15 years.[10]

At present (June 2025), permit prices, and thus marginal abatement costs for ETS-covered sectors, are around €70/tCO_2e (Trading Economics, 2025). As marginal abatement cost curves (MACC) are convex, achieving a 60% emissions reduction over a relatively short 15-year horizon risks driving prices considerably higher.[11] Indeed, under the planned cap reduction, industrial sectors, including cement, steel, chemicals, and electricity generation in particular, will be required to fully decarbonize or to develop large-scale negative emissions capabilities, a proposition that appears improbable under current technological and economic constraints.[12]

3.3 Energy System Optimization Models: Divergent Carbon Cost Projections

Energy system optimization models can help to shape expectations of possible cost and price outcomes. These models calculate patterns of energy production that minimize costs given constraints including capacity, reliability and stability conditions of the networks (for electricity, gas, CO2, and hydrogen). Naturally, the outcomes are strongly dependent on the assumptions regarding these constraints and the objective of the models. Presently, three models address the new EU decarbonization plans: Chyong (CH) (2025), European Commission (EC) (2024b), and Pahle, Quemin, Osorio, Günther, & Pietzcker (PA) (2025). All models consider both the accelerated ("S3" in EC and "Reform" in PA) and the linear scenarios ("S1" in EC and "Reference" in PA).[13] As the models were developed for

---

[8] Author's calculations based on the reduction schedule reported in EC(2024a) and the 2013 cap level reported in EC (2020). Relative to the base year of 2005, ETS covered emissions have been reduced by 51% (from 2059$MtCO_2e$ to 1000$MtCO_2e$).

[9] For 2023, total emissions (including those not covered by the ETS) show a considerably less sharp decline, at 19% since 2013 (from 3,307$MtCO_2e$ to 2,675 $MtCO_2e$) (Eurostat, n.d.). (At the time of writing, the 2024 data were still not available).

[10] Relative to the base year of 2013, the issuance of annual permits was reduced by 1.74% per year from 2013 to 2020, and by 2.2% per year from 2021 to 2023, saw an extra reduction of 4.32% (90$MtCO_2e$) in 2024, and will be reduced by 4.3% per year from 2024 to 2027. An additional reduction of 1.30% (27$MtCO_2e$) is scheduled for 2026, followed by a 4.4% reduction per year from 2028 onward until issuance reaches zero in 2040. A residual number of permits will remain available for the maritime and aviation sectors, amounting to 17 $MtCO_2e$, which will decline to zero by 2044 (Pahle et al., 2025, p. 14). Another often mentioned base year is 2005, when the ETS started. During 2005-2008 (the 1st phase), permit issuance was set to cover all emissions. During 2009-2012 (the 2nd phase), issuance was 6% lower than during the 2005-2008 period.

[11] When the permit price is very high, the carbon border adjustment mechanism (CBAM) may limit the inflow of industrial goods that have not been taxed for carbon emissions. However, CBAM does not mitigate the resulting domestic price increases within the EU caused by an elevated permit price.

[12] Even decarbonizing only the electricity supply sector, often considered the easiest to decarbonize, by 2040 will be a major challenge. For example, the Czech Republic's grid operator, ČEPS (2024), warns of potential capacity inadequacy by 2040. The projected capacity relies on the completion of 2 GW of conventional nuclear and 0.3 GW of small modular nuclear reactors (SMRs) by 2040 (p. 30), which are expected to supply nearly 20% of the total supply of electricity (p. 7). However, construction of a conventional nuclear plant is scheduled to start in 2029 (Úřad vlády České republiky, 2025), raising concerns about potential delays beyond 2040, particularly given that the most recent nuclear plant commissioned in the EU took 18 years to complete. More concerningly, ČEPS (2024) assumes continued substantial reliance on natural gas (16% of total generation) and, in one scenario, coal (1.3%), which implies the need for large-scale deployment of carbon removal technologies, such as CCS and negative emissions technologies. In addition, the required strong growth of intermittent renewables within the Czech Republic, a fourfold increase in solar production and a nine-fold in wind production, introduces substantial new risks. The Czech Republic, a long-time net electricity exporter (8.5% of domestic generation in 2023), is expected to rely on net imports in 2040, amounting to 8.5% or 16% of demand, depending on the scenario (ČEPS, 2024).

[13] EC also presents the "S2" and "LIFE" scenarios, which are not discussed here for reasons of brevity.

different purposes, comparisons between them should be interpreted with caution. I therefore focus primarily on the broad insights that can be reasonably drawn.

The main scenarios and their outcomes are shown in Table 1. EC and CH present their scenario as a reduction of all net emissions (including those not covered by the ETS) to 90% in 2040 and 100% in 2050 of the base year 1990. However, all three scenarios imply that annual permit issuance will be zero or close to zero in 2040. Costs and prices are, as in the original articles, in Eur2023/tCO2 (CH, p.18; PA, p.4, EC, part 2, p.43). Percentages for CH and EC are calculated relative to the base number of emissions in 1990, 4,753 MtCO_2e.[14] The percentages for PA are calculated relative to the emissions cap in 2013.[15]

Table 1

	Scenario Name	2040		2030	2040	2050
		Reduction relative to 1990	*resulting emissions MtCO_2e*	**EU MAC**		
Chyong (C)	Accelerated	90%	*583*	€134	€17,246	€2499
	Linear	76%	*1,407*	€134	€420	€1,944
				ETS permit price		
European Commission (EC)	Accelerated ("S3")	92%	*360*	-	*€240*	*€470*
	Linear ("S1")	78%	*1050*	-	*€160*	*€470*
		Reduction ETS relative to 2013**	*resulting ETS CAP MtCO_2e*	**ETS permit price**		
Pahle (P)	Accelerated ("Reform")	99%	*30*	€185	€305	€455
	Linear ("Reference")	63%	*772*	€49	€81	€133

Source: Constructed by the author based on C, EC, P and own calculations.

* as a percentage of emissions 1990

** as a percentage of ETS CAP 2013 (2,084.3 MtCO_2e)

CH,[16] building on Chyong, Pollitt, Reiner and Li (2024), models 2040 emission reductions at 90% for the accelerated scenario, and 76% for the linear scenario. For 2030 and 2050, the reductions are the same for both scenarios: 55% and 76%, respectively. For the accelerated scenario, CH projects marginal (average) abatement costs per tCO_2e of

[14] Striving for full consistency with the data reported in EC, I deduce the 1990 baseline emissions as 4,753 MtCO_2e, based on values reported in EC. For each reduction target reported both as an absolute value and a percentage, I calculate the implied 1990 baseline emissions. For example, a reported reduction of 93% is contained in a percentage range of [92.5%-93.5%], and a reported remaining emission of 353 MtCO_2e is contained in a range of [352.5-353.5]. Thus the 1990 baseline must be between 4,700 (=352.5/(1-0.925)) and 5,438 (=353.5/(1-0.935)). I then take the maximum (minimum) of all lower (upper) bound estimates, yielding a baseline of 4,700 (4806), as derived from the LIFE (S3) scenario, where a reduction of 93% (92%) results in remaining emission of 353 (360) MtCO_2e. The average of these two bounds, 4,700 MtCO_2e and 4,806 MtCO_2e, gives the final estimate of 4,753 MtCO_2e. For convenience, I present the full calculation in the online Appendix. Chyong, Pollitt, Reiner and Li (2024, p.10) report encountering similar inconsistencies in outcomes and percentages using other European Commission data, possibly due to the absence of reported base numbers or rounding. Baseline emissions, whether referring to 1990 totals or 2005 ETS caps, are often not straightforward, as they may or may not include corrections for changes in EU membership (UK, new member states), new sectors, indirect CO_2 or non-CO_2 GHG. For example, PA (p.9) reports total 1990 emissions as 5,408 MtCO_2e, while the European Environment Agency (EEA) (2025) data viewer reports 4,635 MtCO_2e, which are both different from the number I inferred from EC. This discrepancy does not substantially affect the results. However, studies should be encouraged to report baseline values explicitly, as this greatly facilitates transparency and understanding.

[15] PA does not report its outcomes as percentages. I calculate them using the annual permit quantity of 2,084 MtCO_2e in 2013 (EC, 2020) as the base number.

[16] Chyong (2025) uses data and parameter values from earlier EU impact assessments, specifically the MIX scenario from the 2021 analysis for *The European Green Deal* (https://energy.ec.europa.eu/data-and-analysis/energy-modelling/policy-scenarios-delivering-european-green-deal_en) and from *A Clean Planet for All* (https://climate.ec.europa.eu/system/files/2019-08/long-term_analysis_in_depth_analysis_figures_20190722_en.pdf).

€17,246 (€2,499) in 2040 and €2,499 (€872) in 2050.[17] For the less stringent linear scenario, CH projects €420 (€65) in 2040, and €1,944 (€271) in 2050.[18] The reported costs are exceedingly high, particularly for the accelerated scenario, with levels that are unlikely to be economically or politically feasible.

The EC impact assessment, accompanying the new EU plans (EC, 2024b, Part 3, pp. 4, 151), models emission reductions in 2040 of 92% for the accelerated ("S3") scenario and 78% for the linear ("S1") scenario. For 2030 and 2050, the reductions are identical for both scenarios: 55% and 101%, respectively. Unlike CH and PA, this model does not derive costs or prices endogenously; instead, permit price levels are assumed and used as exogenous inputs. For 2040, the assumed permit prices per tCO_2e are €240 for the accelerated (S3) scenario and €160 for the linear (S1) scenario. For 2050, the assumed permit price is €470/tCO_2e for both scenarios (Part 2, p. 43). The model projects that the economic cost of adopting the accelerated scenario instead of the linear one would be relatively modest, around 1.4% of GDP.

PA directly models the number of available permits in the ETS, incorporating the dynamics of the MSR, and evaluates both the accelerated ("reform") and the linear ("reference") scenario. In the accelerated scenario, PA projects ETS prices per tCO_2e of €185 in 2030, €305 in 2040 and €455 in 2050. In the linear scenario, PA estimates €49 in 2030, €81 in 2040 and €133 in 2050.

While the models use slightly different measures and baseline numbers, the differences are relatively modest, and their results should be broadly in agreement, generally not differing by more than a factor of two. Indeed, for the accelerated scenario in 2050, the models are in strong agreement, reporting moderately elevated marginal costs or prices of €426, €470, and €455 for CH, EC, and PA, respectively. For 2040, EC and PA are broadly in agreement, reporting estimates of €240 and €305, respectively. In contrast, under the less stringent linear scenario, PA reports lower prices than the marginal costs reported by EC for both 2040 (€81 for PA vs. €160 for EC) and 2050 (€133 for PA vs. €470 for EC).

CH's model, however, stands apart, reporting exceedingly high marginal costs in the accelerated scenario: €17,246 in 2040 and €2,499 in 2050. While part of these high estimates may be explained by the CH's exclusion of companion policies such as subsidies,[19] this is unlikely to reduce the discrepancy significantly. An important factor may be that CH uses a stricter upper limit for novel technologies such as CCS and hydrogen than EC. CH's projections suggest that rapid decarbonization in the accelerated scenario requires very costly adaptation measures and possibly demand rationing. Even in the less stringent linear scenario, estimated abatement cost rises sharply to €1,944 in 2050. Such costs appear difficult to justify economically or politically. Taken together, for the accelerated scenario in 2040 and 2050, the model expresses at best a high degree of uncertainty, and at worst a risk of extreme price spikes.[20]

---

[17] The model excludes companion policies such as renewable subsidies (CH, p.2). In such a setting, abatement costs would likely be higher, as subsidies displace cheaper abatement with costlier alternatives, while permit prices would be lower, because subsidies reduce permit demand.
[18] Chyong (2025) also calculates outcomes using input 257 for 2040 and 445 for 2050 (and 68 for 230). These result in decarbonization rates of 70% in 2040 and 86% in 250).
[19] Abatement subsidies to firms covered by the ETS tend to raise total abatement costs and lower permit prices by shifting abatement from low-cost non-subsidised units to higher-cost subsidised units without reducing total emissions.
[20] The divergence between model projections warrants a detailed comparison of the modelling approaches and assumptions underlying the results, but such an analysis is beyond the scope of this paper.

3.4 Strong Assumptions in the EC's Impact Assessment

Table 2a: Crucial projections underlying the EC(2024b) impact assessment for the Accelerated Scenario. (followed by the corresponding part of the table)

	CCS	Negative emissions			Green hydrogen	
	(MtCO2)	DACCS (MtCO2)	BECCS (MtCO2)	LULUCF ($MtCO_2e$)	hydrolyzer cap. (GW)	production (Mtoe)
Observed						
2024	1	0	0	**236 (2022)	0.39	0.027 (2023)
Projection						
2040	243	42	33	215-374	302	93
2050	247	53	56	206-396	536	175

Source: See notes under Table 2b.

Table 2b: Crucial projections underlying the EC(2024b) impact assessment for the Accelerated Scenario. (second part of the table)

	Fossil plants			Renewables		
	cap. (GW)	production (TWh)	cap. factor (%)	capacity (GW)	production (TWh)	share of el. production
Observed						
2024	330	*600	21%	579	1151	47%
Projection						
2040	156	177	13%	2298	4540	83%-90%
2050	142	232	19%	3027	6074	87%-93%

Source: Constructed by the author based on EC and own calculations.
The table gives annual numbers in the unit shown in the heading. The year is the one indicated in the left column, unless indicated differently in the cell.
* +/-10 as this number could only be retrieved from a graph in EC (2025, p.18)
** European Environment Agency. (2024)

The Assumptions

The EC projections rely on large-scale deployment of carbon-neutral and carbon-negative technologies, including the well-established land use, land-use change, and forestry (LULUCF) sector. EC (2024b, part 3, p.4) carefully considers the uncertainties surrounding LULUCF by projecting a range of potential carbon absorption levels and has incorporated these into its carbon reduction targets. The EC projects carbon absorption in the range of 215-374 $MtCO_2$/year for 2040 and 206-396 $MtCO_2$/year for 2050. If absorption is at the lower end of these ranges, the target reduction in carbon emissions will be 90% instead of 92% in 2040, and 98% instead of 101% in 2050. The European Environment Agency (EEA, 2024) reports that in 2022, LULUCF was 236 MtCO2/year, following a decreasing trend. It had averaged 315 $MtCO_2e$/year in 1990-2021 and is projected, absent additional policy measures, to fall to 206 $MtCO_2e$ in 2022-2050, the lower bound of the EC's projected range.

Unfortunately, EC (2024b, part 3) has not applied the same level of caution to the uncertainties surrounding the large-scale deployment of novel technologies that are crucial to its projections, despite acknowledging that these are "not yet commercially available at large scale" (p. 4). These technologies include carbon capture and storage (CCS), bioenergy with carbon capture and storage (BECCS), direct air carbon capture and storage (DACCS), and renewable hydrogen. The model also relies on a multiple-fold increase in renewables, but does not address the well-documented issues that may hinder such rapid expansion. In Table 2a and 2b, I present the key assumptions from the EC impact assessment (EC 2024b), and examine each in turn.[21]

[21] EC(2024b) provides the precise numerical values in its accompanying Excel file, "policy_targets_2040_IA_Annex_8_graphs".

The EC (2024b, part 3) projects a large-scale deployment of CCS: 243 Mt CO_2/year in 2040 and 247 Mt CO_2/year in 2050 (p. 22). CCS requires the capture of CO2, its transport, and long-term storage in suitable geographic locations. The model also relies heavily on CCS being combined with BECCS and DACCS, which together are assumed to generate negative emissions of 74 Mt CO_2/year in 2040 and 115 Mt CO_2/year in 2050 (p. 10). In contrast, in 2024, only 1 Mt CO_2/year was captured in the EU (Reid, 2024), and no negative emissions were generated using BECCS and DACCS.

The EC (2024b, part 3) projects a large-scale deployment of green hydrogen, which can serve as a storage medium for electricity and as fuel for hard-to-decarbonize sectors. Green hydrogen can be produced by electrolyzers powered by renewable electricity. The EC is counting on installed green hydrogen electrolyzer capacity to reach 302 GW by 2040 and 536 GW in 2050 (p. 35). The corresponding green hydrogen output is projected to reach 93 Mtoe in 2040 and 175 Mtoe in 2050 (p. 42). In contrast, in 2024, only 0.39GW was installed in the EU and production in 2023 was only 0.027 Mtoe (European Hydrogen Observatory. (2025).

The EC is counting on renewables, the main source of carbon-free electricity, to increase their share of electricity generation to between 83% and 90% by 2040, and between 87% and 93% by 2050 (p. 37). Installed renewable capacity is projected to reach 2,298 GW in 2040 and 3,027 GW in 2050 (p. 35), generating 4,540 TWh in 2040 and 6,074 TWh in 2050 (p. 32).[22] However, in 2024, the share of renewables in electricity generation in the EU was considerably smaller, at 47% (EC, 2025, p. 6), with an installed capacity of 579 GW (p. 20) and electricity generation from renewables amounting to 1,151 TWh (p. 18).

The Assumptions are Very Optimistic

Today's figures highlight the risk that not all elements relied upon by the EC (2024b), summarized in Table 2 above, will be realized in time. The tiny volume captured via CCS in the EU, just 1 MtCO_2/year, contrasts sharply with the projected 243 MtCO_2/year in 2040. Likewise, the zero values for DACCS and BECCS highlight the early-stage nature of the technologies and contrast with the quantity of 75 MtCO_2/year they are expected to produce in 2040.

Similarly, the installed green hydrogen electrolyzer capacity of 0.39 GW in 2024 contrasts with the 302 GW projected by 2040. Moreover, it shows that the project is behind schedule, as the EU projected 6 GW would be installed by 2024 (European Hydrogen Observatory, 2023). In addition, hydrogen production remains expensive, and its conversion losses range from 40% (feedstock use in industry) to 68% (electricity storage) (Ajanovic, Sayer, & Haas, 2024).

Renewable electricity production must also increase nearly fourfold within just16 years. While such a scale-up may be possible, it faces substantial economic, regulatory, and practical challenges, including grid integration, intermittency, and permitting. Intermittency is a major problem connected to the increasing frequency of negative electricity prices, which deteriorates the economic viability of renewables. The positive correlation between intermittent renewables across large regions reduces the potential to balance their variability through cross-border electricity trade, thus increasing risk. None of these challenges is substantially addressed in EC (2024b), except for two brief mentions of grid integration on pages 33 and 163.

What if the Assumptions are Not Realized?

The main argument developed in this paper is that the projections of EC (2024b) for the accelerated scenario involve considerable uncertainty. If one or more of the projections fail to materialize, decarbonization will become substantially more difficult and costly than

[22] In parallel, the model projects fossil-based power plant capacity will decline from 330GW in 2024 to 156GW in 2040 and 142GW in 2050. Their electricity output is projected to decline from 600GW in 2024 to 177GW in 2040 and 232 in 2050, implying a decline in the capacity factor from 21% in 2024 to 13% in 2040 and 19% in 2050.

projected. CH's model suggests that, in such a case, the carbon abatement cost, and thus the permit price, may rise sharply to induce the use of expensive abatement options, possibly including demand curtailment. Such an extreme price increase would likely be economically and politically unfeasible, and underscores the necessity for effective measures to hedge against this risk. A relevant question is whether the ETS's system of guardrails will provide the necessary protection.

4. Guardrails: The Defective MSR

The EU has taken partial measures in response to the challenge of an unfavorable trajectory of permit prices. Initially, however, its policy focus was on persistently low permit prices (European Commission [EC], n.d.). In the early years of the ETS, annual permit issuance was only modestly reduced - by just 6% between 2005 and 2012. Simultaneously, the economic recession substantially reduced demand for permits, further depressing their price, which averaged around €10 during this period. In an effort to raise the permit price, the EU first attempted "backloading": temporary reductions in permit issuance by postponing their auctioning. The EU then created the Market Stability Reserve (MSR), introduced in 2015, revised in 2018, and implemented in its present form in 2023 (Perino, Willner, Quemin, & Pahle, 2022; Willner & Perino, 2022; Borghesi, Pahle, Perino, Quemin, & Willner, 2023; EU, 2003; 2023).

The MSR is a market-balancing instrument that withdraws and holds permits from the market when a surplus is identified, thereby supporting the permit price (EU, 2015). The MSR also cancels permits when their volume exceeds a threshold (currently set at 400 million), thereby permanently reducing the overall supply of permits. Conversely, when the total number of permits (allowances) in circulation (TNAC) in the market is deemed too low, the MSR may release a limited quantity of permits back into the market.

However, the MSR in its present form (European Union, 2003, 2023) does not provide effective protection against either excessively low or high prices. Firstly, as Perino et al. (2022) and Borghesi et al. (2023) note, the MSR's reliance on the TNAC, a quantity-based indicator, as a scarcity signal can exacerbate price instability in the face of anticipated shocks. It withdraws (or releases) permits when firms bank (or debank) in anticipation of a rising (or falling) permit price, thereby reinforcing the expected price movement. Thus, if market participants anticipate a rising permit price, the MSR will amplify that increase.

Secondly, the MSR currently lacks a specific mechanism to reduce an excessively high permit price, as it does not react directly to the permit price itself, but only to the TNAC, and, as noted above, imperfectly so.

Thirdly, I find that the MSR cannot effectively counter gradual but substantial price increases (European Union, 2003, 2023). To counter steep price increases, Article 29a mandates the release of 75 million permits if the average permit price over the most recent six calendar months exceeds 2.4 times the average of the prior 24 months. A similar provision was introduced for ETS2 under Article 30h, requiring the release of 50 million permits, but with *stricter* (sic) thresholds: the average price over the prior three calendar months is compared to that of the prior six months.

I find that, despite these safeguards, the provisions still permit substantial price increases, potentially resulting in an excessively high permit price. Under the MSR, the ETS (ETS2) permit price can consistently rise by up to 6.64% (17%) per month without triggering permit releases. A steady monthly increase of 6.64% causes the price to rise from 100 to 438 (average: 230) over the two-year reference period; during the subsequent six months, the price increases from 467 to 645 (average: 552). The resulting ratio of the average price in the latter period (552) to that of the reference period (230) is 2.398, just below the ETS threshold of 2.4. Similarly, a steady monthly increase of 17% causes the price to rise from 100 to 219 (average:153) over the six-month reference period; during the subsequent three months, the price increases from 256 to 351 (average: 302). The resulting ratio of average prices, 302 to 153, is 1.974, just below the ETS2 threshold of 2.0. (See the Appendix for full-period overviews up to five years.)

At such steady monthly rates, no intervention would be triggered even as the ETS (ETS2) price doubles (increases more than fivefold) over one year and rises by a factor of 40 (10,000) over five years, respectively. Moreover, as noted in the first point, the MSR amplifies expected price movements rather than mitigating them (Perino et al., 2022; Borghesi et al., 2023). Furthermore, the volume of additional permits issued by the MSR is fixed at 75 million permits, a quantity that may be either insufficient or excessive, depending on the market conditions. After such issuance, no further releases are allowed under the ETS (ETS2) for 12 (6) months, regardless of how the price evolves. In the case of ETS2, additional permits may be issued, but only following a committee decision (EU, 2003).

In conclusion, the ETS's system of guardrails does not provide sufficient protection against extreme permit prices, particularly excessively high ones. This poses a major risk, especially as the new accelerated abatement plans for the ETS are very ambitious and carry a substantial risk of excessively high permit prices.

5. Possible Solutions

5.1 Abatement Path Adjustments

The most straightforward possible solution is for the EU to adopt a less aggressive abatement path. Such a path would reduce the risk of extreme permit prices. Indeed, in CH's model, lower marginal abatement cost paths are consistent only with lower abatement levels.[23] However, a new, explicit formal plan with a less ambitious abatement path would likely entail political costs, as it could arguably be in conflict with Article 4.3 of the Paris Agreement (United Nations, 2015). In addition, a less aggressive abatement path does not address the risk of excessively low permit prices, which may occur if new technologies scale faster and more cheaply than presently projected.

5.2 Guardrail Adjustments

Use a Price Collar to Prevent Extreme Outcomes

A politically more realistic solution is to adjust the guardrails to make them more effective in protecting against extreme prices. As noted above, the MSR is presently not effective because it lacks a price-based component (Perino et al., 2022, p.1; Borghesi et al., 2023, p.147). A possible implementation of a price-based component is a price collar, which sets firm ceiling and floor price paths (Pizer, 2002)[24]. Price collars are well-established in the literature and have been in use in their present form in California since 2021. The California price collar has a price floor of $24.04[25] and a ceiling of $65.00, which both rise annually at 5% plus inflation (California Air Resources Board [CARB], 2024). There are several ways to enforce the price limits (for example, see Burtraw et al, 2020). The EU price ceiling could be enforced through its permit auctions by offering additional permits at the ceiling price if all winning bids reach or exceed that threshold. The price floor could be enforced by using a reserve price for permits sold. These adjustments would thus prevent extreme prices, especially the extremely high price levels as observed in Chyong's (2025) model.

Of course, if future developments more closely reflect Chyong's (2025) projections than those of the EC (2024b), the price collar system would be activated to release additional permits, thereby automatically lowering the level of abatement ambition.

---

[23] CH also models three non-extreme marginal abatement cost paths for 2030-2040-2050: low (68-91-114), medium (68-193-318), and high (68-257-445). These cost paths achieve abatement levels (relative to 1990 levels) ranging from 61% to 70% in 2040 and from 68% to 86% in 2050.

[24] The first general discussion of the optimal choice between price-based and quantity-based instruments for carbon emissions regulation was presented by Weitzman (1974).

[25] The price floor was initially set at $10/t$CO_2$e in 2012 (California Air Resources Board, 2018).

Chyong's (2025, p. 3) outcomes suggest that a price ceiling of €445 would likely result in an abatement level of 86% by 2050, which falls short of the official EU targets. However, in the absence of a price collar, Chyong's (2025) suggests that, when abatement exceeds 86%, marginal abatement costs could reach excessive levels that would be economically and politically infeasible, and would likely prompt ad hoc political interventions to reduce prices to more moderate levels. The price collar thus allows policymakers to address such trade-offs in advance, rather than relying on reactive policy responses.

Moreover, if the abatement ambition is automatically reduced because the permit price reaches very high levels, this reduction reflects a limited capability to abate and may therefore be consistent with Article 4.3 of the Paris Agreement (United Nations, 2015). Indeed, if future developments more closely resemble those projected by the EC (2024b), the permit price will remain below €470 in 2050. Provided that €470 is still below the price ceiling, the collar would not be triggered to release additional permits, and thus the 100% abatement level projected by EC (2024b) would not be compromised.

Setting the Right Permit Price: a Complex Task

An important consideration is which guiding principles should be used to choose the ceiling and floor price. Theoretically, the answer is straightforward. If the objective is to achieve a global welfare-optimal outcome[26], then marginal abatement costs should equal the marginal global damage caused by carbon emissions. This can best be achieved by setting the carbon price equal to the marginal global damage caused by carbon emissions.[27] A lower price would result in insufficient abatement, resulting in damages from global warming that could have been avoided relatively inexpensively. A higher price would result in excessive abatement, leading to disproportionate societal costs relative to the climate benefits.

Practically, the answer is not straightforward, as the academic literature does not provide a single definitive estimate for marginal global damage, also referred to as the social cost of carbon (SCC). Instead, the literature shows increasingly divergent estimates, stemming from differing methodologies, assumptions, and discount rates, which substantially influence projections of long-term damages and, consequently, the SCC. For example, Tol (2024, p. 10), conducts a meta-analysis of existing studies and applies a 1% discount rate, and reports an estimated SCC range per ton of carbon (tCO_2e) from –$355[28] to +$587, with a weighted average of $59 in 2010$.[29] Moore et al. (2024) review 1,823 widely varying SCC estimates from 147 studies and, after truncating the upper and lower 0.1% of values, report an average per tCO_2e of $132 and a median of $39 in 2020$.[30] Accordingly, determining a reasonable range for the SCC - and thus for the permit price - ultimately requires a combination of scientific analysis and normative policy judgment.[31]

5.3 Alternative Solutions

International Credits Help Emitters, But Not the Climate

---

[26] Countries may also pursue national climate welfare objectives that diverge from the global optimum. For example, a country's income level, its anticipated exposure to the costs and benefits of global warming, or the presence of competing pressing domestic challenges may influence how it perceives the social cost of carbon. Also, countries may be unwilling to contribute to a global public good such as climate stability. Note that the fact that climate stability is a global public good also implies that the EU cannot claim that climate stability can be achieved solely by doing accomplishing its share of abatement. This outcome can only be fully realized if all other countries also accomplish the required abatement.

[27] Firms will abate emissions until their marginal abatement cost equals the permit price and aligns with the marginal global damage of carbon emissions.

[28] Some estimates thus imply that global warming may increase overall welfare.

[29] All values are expressed in 2010 U.S. dollars ($) per tonne of carbon, unless reported differently, for emissions in 2015. With a CPI inflation calculator (e,g, www.usinflationcalculator.com), prices can be projected to 2020$ by multiplying by approximately 1.2.

[30] All values are expressed in 2020 U.S. dollars per tonne of carbon, without specifying the year of emissions.

[31] There appears to be a broad consensus that certain price levels are clearly implausible. A carbon price per tCO_2e of €10 is widely considered too low, while a price of €1,000 is regarded as excessively high, not least due to its political infeasibility.

Alternative solutions would be variants of the above two main options discussed above. One such solution would be to allow abatement within the EU to be replaced by abatement outside the EU through the use of international credits, such as those under the Clean Development Mechanism (CDM). Although the CDM was phased out in the EU due to concerns over its effectiveness, especially the questionable additionality of many projects, it is now being reconsidered in light of fears over extreme permit prices. It would provide, as Politico puts it, a "loophole" (Weise, Mathiesen, & Guillot, 2025).[32] This would be unfortunate, as the academic literature broadly confirms the ineffectiveness of such offsets. For example, regarding offsets in the CDM, Calel, Colmer, Dechezleprêtre, and Glachant (2025) estimate that 52% were not additional, while Chen, Ryan, and Xu (2025) estimate that CDM offsets in China may have increased emissions rather than reduced them.

Piecemeal Reforms of the MRS May Be Inadequate

Another alternative solution would be to adjust the MSR to trigger at smaller permit price increases or to release more permits when activated. This would provide some relief, but the response would still involve releasing a fixed number of permits. More importantly, it would not resolve the problem of its destabilizing effect in response to anticipated shocks. As Perino et al. (2022, p.1) and Borghesi et al. (2023, p.147) note, without a price-based adjustment mechanism, the MSR's main shortcomings will persist. However, introducing price-based elements would effectively create soft or hard price floors and ceilings, which function similarly to a price collar.

6. Discussion

6.1 Summary

I show that the present ETS system, combined with its ambitious new abatement path as in the EC(2024b) and its price guardrails in the form of the MSR, carries a substantial risk of leading to excessively high permit prices and, as a result, excessively high marginal abatement costs and societal economic costs. The reason is, firstly, that the new abatement path requires unprecedented deep decarbonization and depends on many factors playing out optimally, including the development and scaling-up of new technologies, even though present data indicate that some key technologies (CCS, BECCS, DACCS, and green hydrogen) are behind schedule. This concern is supported by at least one recent Energy System Optimization Model: Chyong (2025), which projects marginal abatement costs exceeding the extraordinary level of €17.000 in 2040. Secondly, the present guardrails, the MSR, are not effective in preventing excessive price increases.

Possible solutions include adjusting the abatement path to be less ambitious, or introducing a price-based element to the MSR in the form of a price collar. Both measures would reduce the risk of extreme prices.

6.2 Further Advantages of a Price Collar

Price collars have a number of additional advantages. Firstly, the price collar is a possible implementation of the price-based element advocated by Perino et al. (2022, p.1) and Borghesi et al. (2023, p.147). By limiting the impact of permit scarcity or surplus, the price collar mitigates the MSR's problem of amplifying expected price movements following anticipated shocks.

Secondly, a price floor would prevent excessively low prices and establish a harmonized EU-wide minimum permit price. This could address concerns in some member states. For example, the Netherlands currently uses a tax that effectively sets a minimum price for ETS sectors. The tax applies only when the ETS price falls below the threshold, with the tax rate equal to the difference between the two. A binding EU-wide minimum

[32] For example, Weise, Mathiesen, and Guillot (2025) quote François Gemenne as saying that "the EU is trying a bit pathetically to achieve its objectives using a loophole ...".

price could reduce the need for such national measures and set a harmonized standard across the EU.

Thirdly, price collars would transform the ETS into a hybrid construct, making it more closely resemble a carbon tax, thereby improving cost-efficiency and moving it closer to a welfare-optimal outcome. In the context of climate policy, setting a carbon price through a tax is widely regarded as more efficient than setting the carbon quantity through an ETS (Weitzman, 1974; 2019, Pizer, 2002).[33] Further adjustments could enhance system efficiency, such as auctioning additional permits at predefined price points below the ceiling. This would create a more price-responsive supply of permits and improve efficiency (Burtraw, 2020).[34]

Fourthly, coordination with the ETS of other countries could be achieved by harmonizing price floors and ceilings, effectively creating virtual linkages between systems worldwide. Coordination with the carbon taxes of other countries could also be pursued to some extent by narrowing the differences between ETS price floors, ceilings, and the tax rate of other countries rates.

CRediT authorship contribution statement

Silvester van Koten: Conceptualization, Analysis, Validation, Writing.

Acknowledgements

This work was supported by a grant from the Strategy AV21 Sustainable Energy. The paper was further inspired by the project 'Localizing Economic Education for V4 Countries and Beyond'. The project is co-financed by the governments of Czechia, Hungary, Poland and Slovakia through Visegrad Grants from the International Visegrad Fund. The mission of the fund is to advance ideas for sustainable regional cooperation in Central Europe.

Declaration of generative AI and AI-assisted technologies in the writing process.

Statement: During the preparation of this work the author(s) used Chat-GTP to assist with grammar correction and formulation suggestions. After using this service, the author reviewed and edited the content as needed and takes full responsibility for the content of the published article.

Declaration of competing interest

The authors declares that he has no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

---

[33] The reason is that the marginal benefits of abatement increase only slowly, while marginal abatement costs rise more steeply. Weitzman (2019) explains this as: "...the flow of CO2 emissions throughout a realistic regulatory period is but a tiny fraction of the total stock of atmospheric CO2 ... and therefore the corresponding marginal flow benefits of CO2 abatement within, say, a five- or ten-year regulatory period, are very flat, implying that prices have a strong comparative advantage over quantities."

[34] While a carbon tax may be the most efficient and effective, it may not be advantageous to switch to a carbon tax, as the ETS has a number of political advantages, being generally less unpopular both for the general population and for firms. People generally do not recognize the tax-like burden of the permit prices ("the fiscal illusion" (Oates, 1988), while firms, which usually receive free permits in the first years of an ETS, usually see their profit increase as they pass on the opportunity costs of the permits. Moreover, the ETS is more firmly embedded in the society and economy than a tax, as the trading institutions build around it create a constituency of people who support the continued existence of the ETS.

7. References

Alexander, P., Arneth, A., Henry, R., Maire, J., Rabin, S., & Rounsevell, M. D. (2023). High energy and fertilizer prices are more damaging than food export curtailment from Ukraine and Russia for food prices, health and the environment. Nature food, 4(1), 84-95.

Ajanovic, A., Sayer, M., & Haas, R. (2024). On the future relevance of green hydrogen in Europe. Applied Energy, 358, 122586.

Bobasu, A., Dobrew, M., & Repelea, A. (2025). Energy price shocks, monetary policy and inequality. European Economic Review, 175, 104986.

Borghesi, S., Pahle, M., Perino, G., Quemin, S., & Willner, M. (2023). The market stability reserve in the EU emissions trading system: A critical review. Annual Review of Resource Economics, 15, 131–152. https://doi.org/10.1146/annurev-resource-111820-030145

Burtraw, D., Palmer, K., & Kahn, D. (2010). A symmetric safety valve. *Energy Policy*, *38*(9), 4921-4932.

Burtraw, D., & Keyes, A. (2018). Recognizing gravity as a strong force in atmosphere emissions markets. Agricultural and Resource Economics Review, 47(2), 201–219. https://doi.org/10.1017/age.2018.20

Burtraw, D., Holt, C., Palmer, K., & Shobe, W. (2020). Quantities with prices: price-responsive allowance supply in environmental markets. Resources for the Future Working Paper, 20-17.

California Air Resources Board. (2018). *Staff report: Initial statement of reasons—Proposed amendments to the California cap on greenhouse gas emissions and market-based compliance mechanisms regulation: AB 398: Evaluation of allowance budgets 2021 through 2030* (Appendix D). https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2018/capandtrade18/ct18398.pdf

California Air Resources Board. (2024, April 9). Regulation for the California cap on greenhouse gas emissions and market-based compliance mechanisms: 2024 amendments, standardized regulatory impact assessment (SRIA). https://ww2.arb.ca.gov/resources/documents/cap-and-trade-program-sria

ČEPS. (2024). Hodnocení zdrojové přiměřenosti ES ČR do roku 2040 (MAF CZ 2023). https://www.ceps.cz/cs/zdrojova-primerenost

Calel, R., Colmer, J., Dechezleprêtre, A., & Glachant, M. (2025). Do carbon offsets offset carbon?. *American Economic Journal: Applied Economics*, *17*(1), 1-40.

Chen, Q., Ryan, N., & Xu, D. (2025). *Firm Selection and Growth in Carbon Offset Markets: Evidence from the Clean Development Mechanism* (No. w33636). National Bureau of Economic Research.

Chyong, K. (2025). Decarbonisation in Europe: Modelling economic feasibility and the glidepath for gas. Oxford Institute for Energy Studies. https://www.oxfordenergy.org/publications/decarbonisation-in-europe-modelling-economic-feasibility-and-the-glidepath-for-gas/

Chyong, C. K., Pollitt, M., Reiner, D., & Li, C. (2024). Modelling flexibility requirements in deep decarbonisation scenarios: The role of conventional flexibility and sector coupling options in the European 2050 energy system. Energy Strategy Reviews, 52, 101322.

Dechezleprêtre, A., Nachtigall, D., & Venmans, F. (2023). The joint impact of the European Union emissions trading system on carbon emissions and economic performance. Journal of Environmental Economics and Management, 118, 102758. https://doi.org/10.1016/j.jeem.2022.102758

European Environment Agency. (2024, October 31). *Greenhouse gas emissions from land use, land use change and forestry in Europe*. Retrieved June 18, 2025, from https://www.eea.europa.eu/en/analysis/indicators/greenhouse-gas-emissions-from-land

European Environment Agency (EEA). (2025, May 18). *EU Emissions Trading System (ETS) data viewer* [Dashboard]. https://www.eea.europa.eu/en/analysis/maps-and-charts/emissions-trading-viewer-1-dashboards

European Commission (EC). (n.d.). Market stability reserve. EU Emissions Trading System (EU ETS). Retrieved June 24, 2025, from https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/market-stability-reserve_en

European Commission (EC). (2020, November 16). *Commission Decision (EU) 2020/1722 of 16 November 2020 on the Union-wide quantity of allowances to be issued under the EU Emissions Trading System for 2021* (Document C(2020)7704). *Official Journal of the European Union*, L 386, 26–28. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32020D1722

European Commission, (EC). (2021, May 25). *Updated information on exchange and international credits' use in the EU ETS*. European Commission. Retrieved June 18, 2025, from https://climate.ec.europa.eu/news-your-voice/news/updated-information-exchange-and-international-credits-use-eu-ets-2021-05-25_en

European Commission (EC). (2024a). Report from the Commission to the European Parliament and the Council on the functioning of the European carbon market in 2023 (COM(2024) 538 final). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52024DC0538

European Commission (EC). (2024b). Commission staff working document: Impact assessment report. Accompanying the Document 52024SC0064(SWD(2024) 64 final. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52024SC0063

European Commission (EC). (2025). *Quarterly report on European electricity markets: Market Observatory for Energy (Vol. 17, Issue 4, covering fourth quarter of 2024)*. Directorate General for Energy. https://energy.ec.europa.eu/document/download/139371bf-b50b-4fd4-afd1-761b782a0703_en?filename=Quarterly%20report%20Q4%202024%20Electricity.pdf

European Hydrogen Observatory. (2025). *The hydrogen landscape at a glance 2023*. Clean Hydrogen Joint Undertaking. Retrieved June 16, 2025, from https://observatory.clean-hydrogen.europa.eu/

European Hydrogen Observatory. (2023, September 11). *EU hydrogen strategy under the EU Green Deal*. Retrieved June 17, 2025, from https://observatory.clean-hydrogen.europa.eu/index.php/eu-policy/eu-hydrogen-strategy-under-eu-green-deal

European Union (EU). (2003). Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC (consolidated version 01.03.2024). Official Journal of the European Union. http://data.europa.eu/eli/dir/2003/87/2024-03-01

European Union (EU). (2015). Decision (EU) 2015/1814 of the European Parliament and of the Council of 6 October 2015 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and amending Directive 2003/87/EC. http://data.europa.eu/eli/dec/2015/1814/2024-01-01

European Union (EU). (2023). Directive (EU) 2023/959 of the European Parliament and of the Council of 10 May 2023 amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union and Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading system. Official Journal of the European Union, L 130, 134–202. http://data.europa.eu/eli/dir/2023/959/oj

Eurostat. (n.d.). *Air pollutant emissions by source sector (env_ac_ainah_r2)* [Data set]. European Commission. Retrieved June 24, 2025, from https://ec.europa.eu/eurostat/databrowser/bookmark/6d14afa5-ccd0-495c-a23e-2b3f235cd4cc?lang=en

Ferriani, F., & Gazzani, A. (2023). The impact of the war in Ukraine on energy prices: Consequences for firms' financial performance. International Economics, 174, 221-230.

Kesicki, F., & Ekins, P. (2012). Marginal abatement cost curves: A call for caution. *Climate Policy, 12*(2), 219–236. https://doi.org/10.1080/14693062.2011.582347

Kulin, J., Johansson Sevä, I., & Dunlap, R. E. (2021). Nationalist ideology, rightwing populism, and public views about climate change in Europe. Environmental politics, 30(7), 1111-1134.
Kynett, K. G. (2024, December 18). The California Cap-and-Trade Program: Overview and considerations for Congress (CRS Report No. R48314). Congressional Research Service. https://crsreports.congress.gov/product/pdf/R/R48314
Marcantonini, C., & Ellerman, A. D. (2016). The implicit carbon price of renewable energy incentives in Germany. *The Energy Journal, 37*(1), 54–90. https://doi.org/10.5547/01956574.37.1.cmar
Marcantonini, C., & Valero, V. (2017). Renewable energy and CO_2 abatement in Italy. *Energy Policy, 106*, 600–613. https://doi.org/10.1016/j.enpol.2016.12.029
Metcalf, G. E., & Stock, J. H. (2020, May). Measuring the macroeconomic impact of carbon taxes. In AEA papers and Proceedings (Vol. 110, pp. 101-106). 2014 Broadway, Suite 305, Nashville, TN 37203: American Economic Association.
Metcalf, G. E., & Stock, J. H. (2023). The macroeconomic impact of Europe's carbon taxes. American Economic Journal: Macroeconomics, 15(3), 265-286.
Ministerie van Economische Zaken en Klimaat. (2025, juni 2). Beantwoording Kamervragen over de CO2-heffing en het verduurzamen van de Nederlandse industrie (Ons kenmerk EZK_DGBI_VI / 98369784). Rijksoverheid. https://www.rijksoverheid.nl/documenten/kamerstukken/2025/06/02/beantwoording-kamervragen-over-de-co2-heffing-en-het-verduurzamen-van-de-nederlandse-industrie
Moore, F. C., Drupp, M. A., Rising, J., Dietz, S., Rudik, I., & Wagner, G. (2024). Synthesis of evidence yields high social cost of carbon due to structural model variation and uncertainties. Proceedings of the National Academy of Sciences, 121(52), e2410733121. https://doi.org/10.1073/pnas.2410733121
Pahle, M., Quemin, S., Osorio, S., Günther, C., & Pietzcker, R. (2025). The emerging endgame: The EU ETS on the road towards climate neutrality. Resource and Energy Economics, 81, 101476. https://doi.org/10.1016/j.reseneeco.2024.101476
Perino, G., Willner, M., Quemin, S., & Pahle, M. (2022). The European Union emissions trading system market stability reserve: Does it stabilize or destabilize the market? Review of Environmental Economics and Policy, 16(2), 338–345.
Pizer, W. A. (2002). Combining price and quantity controls to mitigate global climate change. Journal of Public Economics, 85(3), 409–434. https://doi.org/10.1016/S0047-2727(01)00118-9
Reid, A. (2024). Carbon capture and storage: Europe's climate gamble. Institute for Energy Economics and Financial Analysis (IEEFA). https://ieefa.org/resources/carbon-capture-and-storage-europes-climate-gamble.
Trading Economics. (2025, June 24). *EU carbon permits*. https://tradingeconomics.com/commodity/carbon
United Nations. (2015). *Paris Agreement*. https://unfccc.int/files/meetings/paris_nov_2015/application/pdf/paris_agreement_english_.pdf
Úřad vlády České republiky. (2025, June 4). *Smlouva mezi Elektrárnou Dukovany II a KHNP na výstavbu dvou nových jaderných bloků v Dukovanech podepsána*. Vlada.gov.cz. https://vlada.gov.cz/cz/media-centrum/aktualne/smlouva-mezi-elektrarnou-dukovany-ii-a-khnp-na-vystavbu-dvou-novych-jadernych-bloku-v-dukovanech-podepsana-220044/
Weise, Z., Mathiesen, K., & Guillot, L. (2025, June 12). *Why the EU is about to cripple its next climate target*. POLITICO. https://www.politico.eu/article/eu-cripple-next-climate-target-global-warming-2040-carbon-credits-emissions/
Weitzman, Martin L. 1974. Prices vs. quantities. Review of Economic Studies 41 (4): 477–91.
Willner, M., & Perino, G. (2022). An upgrade for the EU ETS: Making Art. 29a and 30h fit for effective price containment (Policy Brief). Center for Earth System Research and

Sustainability (CEN), University of Hamburg. https://www.cen.uni-hamburg.de/research/policy-briefs/bilder-docs/2200425-pcm-policy-brief-cen.pdf
Yagi, M., & Managi, S. (2023). The spillover effects of rising energy prices following 2022 Russian invasion of Ukraine. Economic Analysis and Policy, 77, 680-695.

8. Appendix

A High Rate of Constant Growth Does Not Trigger the MSR

The table below illustrates that a constant monthly growth rate of 6.64% does not trigger the MSR to release permits for the ETS. The table tracks the growth in carbon permit price under this rate. The column "Month 1" lists the initial value of the permit price for each entry in the reference period, while "Month 24" shows the value reached at the end of the 24-month reference period. The "Avg" column gives the average price over the 24 months.

The next three columns, "Month 25" through "Month 30", represent the monitored period of six months immediately following the reference period. Again, the "Avg" column shows the average price over this monitored period.

Finally, the "Ratio" column reports the ratio between the monitored-period average and the reference-period average. This ratio remains constant around 2.395, indicating that, under constant exponential growth at 6.64% per month, the average price in the monitored period is approximately 2.395 times higher than the average over the initial 24 months. Such growth does not trigger the present MSR for the ETS.

Table A1: MSR indicator for ETS with 16.64% monthly growth

Index	Month 1	Month 24	Avg	Month 25	Month 30	Avg	Ratio
1	100	438	230	467	645	552	2.398
2	106	467	246	498	688	589	2.399
3	113	498	262	532	733	628	2.399
4	121	532	279	567	782	670	2.398
5	129	567	298	605	834	714	2.398
6	137	605	318	645	889	762	2.397
7	147	645	339	688	948	812	2.396
8	156	688	362	733	1011	866	2.396
9	167	733	386	782	1079	924	2.396
10	178	782	411	834	1150	985	2.396
11	190	834	439	889	1227	1051	2.396
12	202	889	468	948	1308	1120	2.396
13	216	948	499	1011	1395	1195	2.396
14	230	1011	532	1079	1488	1274	2.396
15	245	1079	567	1150	1586	1359	2.396
16	262	1150	605	1227	1692	1449	2.396
17	279	1227	645	1308	1804	1546	2.396
18	298	1308	688	1395	1924	1648	2.395
19	318	1395	734	1488	2052	1758	2.395
20	339	1488	782	1586	2188	1874	2.395
21	361	1586	834	1692	2333	1999	2.395
22	385	1692	890	1804	2488	2132	2.395
23	411	1804	949	1924	2654	2273	2.395
24	438	1924	1012	2052	2830	2424	2.395
25	467	2052	1079	2188	3018	2585	2.395
26	498	2188	1151	2333	3218	2757	2.395
27	532	2333	1228	2488	3432	2940	2.395
28	567	2488	1309	2654	3660	3135	2.395
29	605	2654	1396	2830	3903	3344	2.395
30	645	2830	1489	3018	4162	3566	2.395
31	688	3018	1588	3218	4439	3802	2.395
32	733	3218	1693	3432	4733	4055	2.395
33	782	3432	1805	3660	5048	4324	2.395
34	834	3660	1925	3903	5383	4611	2.395
35	889	3903	2053	4162	5740	4918	2.395
36	948	4162	2190	4439	6121	5244	2.395
37	1011	4439	2335	4733	6528	5592	2.395
38	1079	4733	2490	5048	6961	5964	2.395
39	1150	5048	2656	5383	7424	6360	2.395
40	1227	5383	2832	5740	7917	6782	2.395
41	1308	5740	3020	6121	8442	7232	2.395

42	1395	6121	3220	6528	9003	7712	2.395
43	1488	6528	3434	6961	9601	8225	2.395
44	1586	6961	3662	7424	10238	8771	2.395
45	1692	7424	3906	7917	10918	9353	2.395
46	1804	7917	4165	8442	11643	9974	2.395
47	1924	8442	4442	9003	12416	10636	2.395
48	2052	9003	4737	9601	13241	11343	2.395
49	2188	9601	5051	10238	14120	12096	2.395
50	2333	10238	5386	10918	15058	12899	2.395
51	2488	10918	5744	11643	16057	13756	2.395
52	2654	11643	6126	12416	17124	14669	2.395
53	2830	12416	6532	13241	18261	15644	2.395
54	3018	13241	6966	14120	19473	16682	2.395
55	3218	14120	7429	15058	20766	17790	2.395
56	3432	15058	7922	16057	22145	18971	2.395
57	3660	16057	8448	17124	23616	20231	2.395
58	3903	17124	9009	18261	25184	21574	2.395
59	4162	18261	9607	19473	26856	23007	2.395
60	4439	19473	10245	20766	28639	24534	2.395

Technical parameters: Growth Factor = 1.0664, reference length = 24, monitored length = 6

Table A2 illustrates that a constant monthly growth rate of 17% does not trigger the MSR to release permits for the ETS2. The table tracks the growth in carbon permit prices under this rate. The column "Month 1" lists the initial value of the permit price for each entry in the reference period, while "Month 6" shows the value reached at the end of the 6-month reference period. The "Avg" column gives the average price over the 6 months.

The next three columns, "Month 7" through "Month 9", represent the monitored period of three months immediately following the reference period. Again, the "Avg" column shows the average price over this monitored period.

Finally, the "Ratio" column reports the ratio between the monitored-period average and the reference-period average. This ratio remains constant around 1.974, indicating that, under constant exponential growth at 17% per month, the average price in the monitored period is approximately 1.974 times higher than the average over the initial 6 months. Such growth does not trigger the present MSR for the ETS2.

Table A2: MSR indicator for ETS2 with 17% monthly growth

Index	Month 1	Month 6	Avg	Month 7	Month 9	Avg	Ratio
1	100	219	153	256	351	302	**1.974**
2	117	256	179	300	410	354	**1.974**
3	136	300	210	351	480	414	**1.973**
4	160	351	246	410	562	484	**1.971**
5	187	410	287	480	658	567	**1.973**
6	219	480	336	562	769	663	**1.973**
7	256	562	393	658	900	776	**1.973**
8	300	658	460	769	1053	907	**1.972**
9	351	769	538	900	1233	1062	**1.973**
10	410	900	630	1053	1442	1243	**1.973**
11	480	1053	737	1233	1687	1454	**1.973**
12	562	1233	862	1442	1974	1701	**1.972**
13	658	1442	1009	1687	2310	1990	**1.972**
14	769	1687	1181	1974	2703	2329	**1.973**
15	900	1974	1382	2310	3162	2725	**1.972**
16	1053	2310	1616	2703	3700	3188	**1.972**
17	1233	2703	1892	3162	4329	3730	**1.972**
18	1442	3162	2213	3700	5065	4365	**1.972**
19	1687	3700	2589	4329	5926	5107	**1.972**
20	1974	4329	3030	5065	6934	5975	**1.972**
21	2310	5065	3545	5926	8113	6991	**1.972**
22	2703	5926	4148	6934	9492	8180	**1.972**
23	3162	6934	4853	8113	11106	9570	**1.972**
24	3700	8113	5678	9492	12994	11197	**1.972**
25	4329	9492	6643	11106	15203	13101	**1.972**
26	5065	11106	7773	12994	17788	15328	**1.972**
27	5926	12994	9094	15203	20812	17934	**1.972**
28	6934	15203	10640	17788	24350	20983	**1.972**
29	8113	17788	12449	20812	28489	24550	**1.972**
30	9492	20812	14566	24350	33333	28724	**1.972**
31	11106	24350	17042	28489	38999	33607	**1.972**
32	12994	28489	19939	33333	45629	39320	**1.972**
33	15203	33333	23329	38999	53386	46005	**1.972**
34	17788	38999	27295	45629	62462	53826	**1.972**
35	20812	45629	31935	53386	73081	62976	**1.972**

36	24350	53386	37364	62462	85505	73683	**1.972**
37	28489	62462	43716	73081	100040	86209	**1.972**
38	33333	73081	51148	85505	117047	100864	**1.972**
39	38999	85505	59844	100040	136946	118011	**1.972**
40	45629	100040	70017	117047	160226	138073	**1.972**
41	53386	117047	81920	136946	187465	161546	**1.972**
42	62462	136946	95847	160226	219334	189008	**1.972**
43	73081	160226	112141	187465	256621	221140	**1.972**
44	85505	187465	131205	219334	300247	258734	**1.972**
45	100040	219334	153510	256621	351289	302719	**1.972**
46	117047	256621	179606	300247	411008	354181	**1.972**
47	136946	300247	210140	351289	480879	414392	**1.972**
48	160226	351289	245864	411008	562629	484839	**1.972**
49	187465	411008	287661	480879	658276	567261	**1.972**
50	219334	480879	336563	562629	770183	663696	**1.972**
51	256621	562629	393779	658276	901114	776524	**1.972**
52	300247	658276	460721	770183	1054303	908533	**1.972**
53	351289	770183	539044	901114	1233535	1062984	**1.972**
54	411008	901114	630682	1054303	1443236	1243691	**1.972**
55	480879	1054303	737897	1233535	1688586	1455119	**1.972**
56	562629	1233535	863340	1443236	1975646	1702489	**1.972**
57	658276	1443236	1010108	1688586	2311506	1991913	**1.972**
58	770183	1688586	1181826	1975646	2704462	2330538	**1.972**
59	901114	1975646	1382737	2311506	3164221	2726730	**1.972**
60	1054303	2311506	1617802	2704462	3702139	3190274	**1.972**

Technical parameters: Growth Factor = 1.17, reference length = 6, monitored length = 3

Deriving the Implied Estimate for 1990 EU-ETS Covered Emissions in EC (2024b)

For each reduction target reported both as an absolute value and a percentage, I calculate the implied 1990 baseline emissions. For example, a reported reduction of 93% is contained in a percentage range of [92.5%-93.5%], and a reported remaining emission of 353 $MtCO_2e$ is contained in a range of [352.5-353.5]. Thus the 1990 baseline must be between 4,700 (=352.5/(1-0.925)) and 5,438 (=353.5/(1-0.935)). I then take the maximum (minimum) of all lower (upper) bound estimates, yielding a baseline of 4,700 (4806), as derived from the LIFE (S3) scenario, where a reduction of 93% (92%) results in remaining emissions of 353 (360) $MtCO_2e$. The average of these two bounds, 4,700 $MtCO_2e$ and 4,806 $MtCO_2e$, yields the final estimate of 4,753 $MtCO_2e$. The table below shows the data in EC (2024b, part 3,p.4) used and the implied ranges.

Table A3: Reported Figures and Implied Range for 1990 Base Numbers

	Reduction for 2040	Resulting $MtCO_2e$	Implied 1990 emission	
			Midpoint	Range
Accelerated (S3)	92%	360	4500	4229-4793
S3 lower	90%	458	4580	4357-4827
S3 higher	94%	302	5033	4638-5501
Linear (S1)	78%	1050	4772	4664-4886
S1 higher	81%	893	4700	4576-4830
S2	88%	580	4833	4635-5048
S2 lower	86%	681	4864	4693-5049
S2 higher	89%	520	4727	4517-4958
LIFE	93%	353	4699	4699-5439
LIFE higher	94%	302	5033	4638-5501
Narrowest range			4753	4699-4793

Abstrakt

Ústředními nástroji programu cap-and-trade jsou harmonogram snižování emisí a systém ochranných opatření, jejichž cílem je zabránit tomu, aby ceny povolenek byly příliš vysoké nebo nízké. Argumentuji, že tyto nástroje nejsou v současné době v souladu s hlavní klimatickou politikou EU v oblasti obchodování s emisemi, EU ETS. Argumentuji, že harmonogram snižování emisí je příliš ambiciózní a že stávající ochranná opatření ETS, rezervy pro stabilitu trhu (MSR), neposkytují dostatečnou ochranu před extrémními cenami. Tento nesoulad může mít za následek značné ekonomické náklady a v konečném důsledku podkopat podporu veřejnosti pro ETS. Tento článek doporučuje zvážit účinnější ochranná opatření, jako je například osvědčený cenový limit, který je zaveden v programu cap-and-trade v Kalifornii.

Working Paper Series
ISSN 2788-0443

Individual researchers, as well as the on-line version of the CERGE-EI Working Papers (including their dissemination) were supported from institutional support RVO 67985998 from Economics Institute
of the CAS, v. v. i.

Specific research support and/or other grants the researchers/publications benefited from are acknowledged at the beginning of the Paper.

Published by
Charles University, Center for Economic Research and Graduate Education (CERGE)
and
Economics Institute of the CAS, v. v. i. (EI)
CERGE-EI, Politických vězňů 7, 111 21 Prague 1, tel.: +420 224 005 153, Czech Republic.
Phone: + 420 224 005 153
Email: office@cerge-ei.cz
Web: https://www.cerge-ei.cz/

Editor: Byeongju Jeong

The paper is available online at https://www.cerge-ei.cz/working-papers/.

ISBN 978-80-7343-606-3 (Univerzita Karlova, Centrum pro ekonomický výzkum a doktorské studium)