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Mitigating Through the Market: The EU's Emissions Trading System

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Abstract: The European Union (EU) Emissions Trading System (ETS) is an example of market-based environmental governance. While it has delivered measurable emission reductions in covered sectors, especially after major post-2013 reforms, its fairness, legitimacy, and transformative capacity remain contested. Therefore, this paper asks to what extent the EU ETS has contributed to emission reductions in the EU and what limitations emerge when it is assessed from a social-ecological economics (SEE) perspective. Using a qualitative, literature-based approach, it combines empirical studies on environmental and economic impacts of the ETS with a comparative theoretical framework that contrasts neoclassical environmental economics with SEE. The analysis shows that, on neoclassical terms, the ETS qualifies as a relatively efficient and adaptive carbon market, achieving targeted abatements at limited aggregate costs. However, when evaluated against broader criteria of ecological adequacy, distributional justice, governance and power, transformation potential and precaution, the system’s market-centred architecture commodifies atmospheric capacity, leaves the scale of socio-economic metabolism and growth dependence largely untouched, and only partially addresses inequalities through ex post correction. In doing so, the paper bridges mainstream carbon pricing debates with SEE, arguing that emissions trading can support mitigation but must be subordinated to more far-reaching strategies of regulation, sufficiency, and socio-ecological provisioning if the EU is to align climate policy with planetary boundaries and social justice.

Keywords: Emissions Trading, neoclassic, socio-ecological economics, European Union.

JEL codes: F55, Q52, Q56, Q57

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1. Introduction

During the 2012 Eurozone crisis, European Central Bank (ECB) President Mario Draghi uttered a phrase that reshaped monetary policy: "Within our mandate, the ECB is ready to do *whatever it takes* to preserve the euro. And believe me, it will be enough" (ECB, 2012). This commitment transformed the ECB from a conservative guardian into a bold lender of last resort. From a social-ecological economics (SEE) perspective, the escalating climate crisis demands a parallel "whatever it takes" shift in ambition and institutional design in European climate governance.

The European Union (EU) Emissions Trading System (ETS), introduced in 2005, constitutes the cornerstone of EU climate policy. By establishing a cap on emissions and allowing allowances to be traded, it seeks to reduce greenhouse gas emissions cost-effectively. More recently, the Fit for 55 package has further strengthened the system by tightening the cap, expanding its sectoral coverage, and implementing ETS2 as an additional emissions trading system for buildings and road transport. These reforms underline the continued political commitment to emissions trading as a central instrument of European climate policy. At the same time, they have intensified debates about the effectiveness, fairness, and political legitimacy of carbon markets.

Mainstream environmental economics evaluates emissions trading primarily in terms of efficiency and effectiveness: does the system achieve emission reductions at least cost, and does it provide credible incentives for innovation? From this perspective, rising carbon prices and declining emissions in covered sectors are often interpreted as indicators of success. However, the climate crisis extends beyond a problem of inefficient pricing. It reflects structural tensions between economic growth, resource use, and planetary boundaries. SEE conceptualises the economy as embedded within biophysical systems and emphasises ecological limits, distributional justice, governance structures, and long-term resilience.

This paper argues that evaluating the EU ETS solely through efficiency criteria yields an incomplete assessment. While the system has contributed to measurable emission reductions, its market-centred architecture raises broader structural and normative questions. The central research question, therefore, asks: *To what extent has the EU Emissions Trading System contributed to emission reductions in the European Union, and* *what limitations emerge when it is assessed from a socio-ecological economics perspective?*

Methodologically, the study adopts a qualitative, literature-based, and analytically oriented approach. It draws on a structured review of peer-reviewed journal articles, policy reports, and official EU documents on the environmental and economic impacts of the EU ETS, including emission trajectories, carbon leakage, competitiveness effects, and policy interactions. These empirical findings are systematically interpreted through a theoretical framework derived from SEE, which specifies evaluative criteria such as ecological adequacy, distributional justice, governance and power, transformation potential, and precaution. The review is selective rather than exhaustive and focuses on studies published since the introduction of the ETS, with particular attention to the period after major Phase III and Phase IV reforms.

This dual design allows the EU ETS to serve both as a policy instrument to be evaluated empirically and as a case through which competing paradigms of environmental governance can be critically examined. The tension between efficiency-oriented carbon pricing and the broader normative and structural demands of SEE is the analytical thread that runs throughout the paper.

The paper proceeds as follows. Chapter 2 develops the theoretical framework and specifies the evaluative criteria. Chapter 3 describes the evolution of the EU ETS and its institutional reforms from Phase I to Phase IV. Chapter 4 assesses the system against mainstream benchmarks for effectiveness and efficiency. Chapter 5 re-evaluates the ETS through the lens of SEE, examining its governance structure, distributive dynamics, and normative implications, and then applying the five criteria in a systematic assessment. Chapter 6 then summarises the main findings and discusses their broader political and institutional implications for European climate governance.

If the climate crisis demands a “whatever it takes” transformation comparable in ambition to Draghi’s intervention during the Eurozone crisis, then the adequacy of market-centred climate policy must be critically examined. The EU ETS provides a case for assessing the potential of carbon pricing as a vehicle for socio-ecological transformation, or for the necessity of deeper institutional shifts.

2. Social-Ecological Economics vs. Neoclassical Environmental Economics

Underlying assumptions about the relationship between the economy, society, and nature shape environmental governance. To assess the EU Emissions Trading System, it is necessary to clarify the theoretical perspectives that underpin different understandings of policy success. This chapter introduces the SEE framework, which serves as the paper's primary analytical lens. As this perspective emerged largely as a critique of the dominant paradigm in environmental economics, the chapter first outlines the core assumptions of neoclassical environmental economics before presenting the SEE approach and its broader evaluative criteria. The concluding section contrasts the two perspectives and derives implications for the subsequent assessment of the EU ETS.

2.1. Neoclassical Environmental Economics

Neoclassical environmental economics is rooted in the broader framework of welfare economics. It is based on a set of methodological and ontological assumptions about how economic systems function. According to this framework, the economy is conceptualised as a self-regulating system of markets in which rational, utility-maximising individuals interact under conditions of scarcity. Methodological individualism serves as the analytical foundation. Social outcomes are understood as the aggregate result of individual choices, and economic analysis proceeds through marginal reasoning and equilibrium models. Within this framework, efficiency is the central normative benchmark. Pareto optimality, in particular, refers to a state in which no individual can be made better off without making at least one other individual worse off (Varian, 2014). This provides the normative basis for evaluating economic arrangements and policy interventions in Welfare economics. Deviations from Pareto-efficient outcomes signal allocative distortions that justify corrective measures.

Within this paradigm, environmental problems are primarily interpreted as instances of market failure. According to Baumol and Oates (1988), externalities arise when the actions of one economic agent directly affect the utility or production possibilities of others without being mediated through market prices. Negative externalities, such as pollution, imply that private decision-makers do not bear the full social costs of their activities. This idea is based on Pigou’s earlier analysis of differences between private and social costs. Pigou (1920) suggested that unpriced external effects lead to excessive levels of harmful activities. From this perspective, environmental degradation is not a structural feature of economic systems, but rather the result of missing or distorted price signals. When pollution is not properly priced, firms and consumers face incentives that diverge from the socially optimal allocation of resources.

The core policy implication follows directly from this diagnosis: environmental policy should adjust market signals to align private decision-making with social costs. The classical instrument is the Pigouvian tax. It is set equal to the marginal social damage caused by pollution (ibid.). By internalising external costs, this tax restores the conditions for a Pareto-efficient allocation. In other words, polluters are encouraged to reduce emissions until their marginal abatement costs equal the tax rate. This ensures that total abatement is achieved at the lowest possible cost.

Building on this logic, neoclassical environmental economics also supports quantity-based instruments, such as tradable emission permits. While Pigou emphasised corrective taxation, later developments, such as Coase's analysis of external harms (1960), highlighted that the allocation and exchange of clearly defined emission rights can achieve similar efficiency outcomes under appropriate institutional conditions. By capping total emissions and allowing permits to be traded, regulators can leave price formation to the market while ensuring that a predetermined environmental target is met. As Tietenberg and Lewis (2012) emphasise, such market-based instruments are designed to achieve environmental objectives at minimum aggregate cost, since firms with lower abatement costs will reduce emissions more and sell permits to firms facing higher costs.

Within this framework, policy success is defined in terms of efficiency criteria. First, environmental targets, such as a given level of emission reduction, should be met at the lowest possible cost (static efficiency). Second, instruments should provide continuous incentives for technological innovation and cost-reducing improvements in abatement (dynamic efficiency) (Tietenberg & Lewis, 2012). Market-based instruments are valued not only for minimising compliance costs but also for stimulating innovation through price-based incentives. In this view, environmental protection is achieved by aligning individual economic behaviour with socially optimal outcomes through properly designed market signals. These efficiency-based criteria serve as the benchmark against which environmental policies such as the EU Emissions Trading System can be assessed in subsequent chapters.

2.2. Social-Ecological Economics: A Paradigm Shift

While neoclassical environmental economics conceptualises environmental degradation as primarily an issue of inefficient allocation, SEE is based on fundamentally different ontological premises. Since the analytical framework adopted in this paper influences the criteria used to evaluate the EU Emissions Trading System, it is crucial to clarify these underlying assumptions. SEE represents a paradigm shift in understanding the relationship between the economy, society, and nature. Rather than treating environmental problems as marginal distortions within an otherwise self-regulating system, it situates economic processes within broader social and ecological structures.

Importantly, there is no single, universally agreed-upon definition of SEE. Rather, it is understood as a plural and evolving body of thought united by shared ontological commitments. In academic literature, closely related approaches are often described as ecological economics, political ecology, or linked to degrowth and post-growth debates. For the purposes of this paper, these strands are treated collectively under the term social-ecological economics, insofar as they share a common rejection of the reduction of economics to market allocation and a common emphasis on embeddedness, material limits, and questions of power and justice (Røpke, 2005; Spash, 2020).

At the core of this perspective lies a shift in ontology. Rather than being conceived as an autonomous sphere governed by equilibrium-seeking markets, the economy is viewed as a subsystem of society, which is embedded within the biosphere. Economic processes depend on the flow of energy and materials, as well as the absorptive capacity of ecosystems. Therefore, production and consumption are ecologically conditioned. As SEE scholars emphasise, economic systems are open systems that depend on continuous material and energy throughput and are constrained by ecological structures and limits (Spash & Guisan, 2021). From this standpoint, environmental degradation cannot be reduced to missing price signals, instead it reflects the scale and structure of socio-economic metabolism.

This ontological reframing implies a different understanding of what economics studies. Rather than defining it as the science of allocating scarce resources under conditions of unlimited wants, SEE conceptualises economics as the study of social provisioning. Social provisioning refers to the institutional and collective arrangements through which societies organise the satisfaction of human needs. Markets are just one possible institutional mechanism. The focus shifts from individual utility maximisation to the reproduction of societies within ecological constraints and under conditions of care and justice (Spash & Guisan, 2021). Questions of who decides, whose needs are prioritised, and how benefits and burdens are distributed become integral to economic analysis rather than external, normative add-ons.

A further defining element of this approach is its emphasis on ecological limits. Building on ecological economics and thermodynamic insights, SEE scholars stress that economic activity transforms low-entropy energy and materials into waste, and that this process is subject to irreversible physical constraints. The scale of economic activity relative to ecological carrying capacity, therefore, becomes a central analytical concern (Spash, 2020). In contrast to neoclassical environmental economics, which prioritises allocative efficiency, SEE foregrounds the question of scale, so whether the overall magnitude and form of economic activity is compatible with the long-term reproduction of ecological systems.

This perspective incorporates a structural critique of growth-oriented capitalism. Economic growth is not regarded as a neutral indicator of welfare improvement, but as embedded in institutional arrangements and power relations that systematically expand material throughput. Authors such as Brand and Wissen (2017) highlight how contemporary patterns of production and consumption are stabilised through what they describe as an "imperial mode of living," in which ecological costs are spatially and socially externalised. Thus, growth-dependent accumulation dynamics are linked to global inequalities and environmental degradation. Although SEE encompasses differing views on the desirability and feasibility of post-growth transitions, there is a shared understanding that indefinite material expansion within a finite biosphere is incompatible with ecological sustainability.

The analytical implications of this framework are substantial. Rather than treating environmental problems as isolated market imperfections, this framework views them as manifestations of deeper structural contradictions between capital accumulation, social reproduction, and ecological limits. Accordingly, economic policy instruments cannot be sufficiently assessed in terms of their efficiency properties.

Instead, building upon the literature of social-ecological and ecological economics (e.g., Røpke, 2005; Spash, 2020; Brand & Wissen, 2017), SEE proposes a broader evaluative framework for environmental governance. First, ecological adequacy concerns whether an instrument contributes to maintaining economic activity within ecological boundaries. Second, distributional justice addresses how costs and benefits are allocated across social groups and regions. Third, governance and power refer to the institutional arrangements through which decisions are made and whose interests shape policy design. Fourth, transformation potential examines whether policies reinforce existing growth-oriented structures or enable structural change toward more sustainable modes of provisioning. Finally, under conditions of ecological uncertainty and potential irreversible damage, precaution and long-term resilience gain importance.

Combined, these dimensions redefine what constitutes policy success. Instead of focusing primarily on allocative efficiency or marginal cost minimisation, SEE evaluates economic instruments in relation to ecological boundaries, distributional justice, institutional power structures, and their capacity to enable structural transformation. This broader evaluative framework establishes the foundation for comparing theoretical perspectives and their implications for assessing market-based climate policy.

2.3. Theoretical Contrasts and Implications for the Assessment

The preceding sections outlined two distinct theoretical paradigms based on different ontological assumptions about the relationship between the economy, society, and nature. These differences are not merely methodological, but they entail fundamentally divergent understandings of environmental problems, appropriate governance mechanisms, and the criteria by which policy instruments like the EU ETS should be evaluated.

Neoclassical environmental economics conceptualises environmental degradation as primarily a problem of inefficient allocation resulting from market failure. Within this framework, environmental policy is successful when it restores allocative efficiency. Emission reductions are evaluated in relation to predefined targets, and cost-effectiveness is the primary benchmark. The core evaluative criteria are static efficiency (least-cost abatement) and dynamic efficiency (incentives for technological innovation). By contrast, SEE challenges these premises and instead interprets environmental degradation as a manifestation of structural tensions between capital accumulation, social reproduction, and ecological limits. From this perspective, markets are not neutral coordination devices, but rather, they are historically specific institutions that are embedded in power relations and growth-oriented dynamics. Therefore, governance through price signals is not merely a technical instrument, but a particular mode of organising ecological constraints within capitalist economies.

This ontological divergence translates into distinct normative benchmarks. Neoclassical environmental economics prioritizes efficiency, whereas SEE emphasizes a broader set of criteria: ecological adequacy (compatibility with biophysical limits), distributional justice (fair allocation of costs and benefits across social groups and regions), governance and power (those who design and control institutions), transformation potential (the capacity to enable structural change beyond marginal adjustments), and precaution and long-term resilience under ecological uncertainty. Efficiency is not rejected outright, but it is decentered. It becomes one of many considerations, rather than the most important benchmark.

When applied to an instrument such as the EU ETS, these differences translate into distinct evaluative implications. From a neoclassical perspective, the EU ETS is evaluated based on its ability to deliver emission reductions in a flexible and cost-effective manner. The instrument can be regarded as successful if emissions decline in line with the cap, compliance costs are minimised, and the carbon price provides stable innovation incentives. On the other hand, a SEE perspective raises additional questions that cannot be captured by efficiency metrics alone. For example, does the cap reflect ecological adequacy in relation to planetary boundaries? How are costs distributed among sectors, social groups, and regions? What power relations are institutionalised through the allocation of tradable emission rights? Does reliance on market coordination reinforce growth-dependent accumulation dynamics, or does it facilitate structural transformation toward more sustainable forms of social provisioning?

Crucially, these perspectives do not merely emphasise various aspects of the same phenomenon; they may lead to different overall judgments. For example, an emissions trading system can be cost-effective yet ecologically insufficient. It can reduce emissions within regulated sectors while simultaneously stabilising existing socioeconomic structures. Therefore, what counts as “success” depends on the theoretical lens through which the instrument is viewed.

For this reason, the following analysis proceeds in three steps. Chapter 3 outlines the design and evolution of the EU ETS. Chapter 4 then examines the system through the lens of the dominant evaluative framework of environmental economics, focusing on emission reductions, carbon leakage, competitiveness, and policy interactions. Then, Chapter 5 reevaluates the EU ETS through the broader lens of SEE and addresses questions of governance form, commodification, justice, and transformation potential.

By structuring the analysis in this way, the paper's aim is not simply to present two perspectives side by side, but rather to use their contrast to illustrate the broader implications of market-based climate governance. Thus, the EU ETS serves as both a policy instrument to be assessed empirically and a case through which competing paradigms of environmental governance can be critically examined.

3. The EU ETS: Design and Evolution

The EU ETS stands as the world's flagship carbon market, covering approximately 40 % of EU greenhouse gas (GHG) emissions from power, industry, and aviation since its 2005 launch (European Commission, 2026). Emerging from failed 1990s EU-wide carbon tax attempts, it leveraged qualified majority voting for cap-and-trade rather than fiscal unanimity, using National Allocation Plans (NAPs) to balance Kyoto goals with subsidiarity (Sato et al., 2022; Vogler, 2023). This chapter traces the evolution of its politically contingent design, from a fragile pilot to the Fit for 55 ambitions, through its origins, institutional phases, and recent reforms.

3.1. Historical emergence of emissions trading in EU climate governance

The historical emergence of emissions trading in EU climate governance cannot be understood merely as a technocratic shift toward more cost-effective instruments. Still, it must be situated within the institutional power structures, political coalitions, and ontological choices that shaped early climate policy. Seen through the SEE lens, this origin story reveals how the EU institutionalised a particular form of market-based governance. A form that prioritised the reproduction of existing accumulation structures over confrontation with ecological limits and distributional conflicts.

In the early 1990s, the European Commission (EC) proposed an EU-wide carbon tax to internalise emerging climate commitments, reflecting a Pigouvian logic of price correction for environmental externalities (Sato et al., 2020). Key Member States blocked this due to fiscal sovereignty concerns, as taxation required Council unanimity, whereas environmental measures such as emissions trading advanced via qualified majority voting (Sato et al., 2020). This asymmetry, combined with the United States' insistence on flexibility mechanisms during the 1997 Kyoto protocol negotiations, redirected attention toward cap-and-trade as a politically viable alternative (Rea, 2019; Vogler, 2023).

From 1998, Commission policy entrepreneurs reframed emissions trading as both a demonstration of EU climate leadership and a mechanism compatible with the principles of subsidiarity (Vogler, 2023; Sato et al., 2022). An unlikely coalition of pro-market environmental non-governmental organisations (ENGOs), financial actors, and industry representatives, such as BP (formerly British Petroleum), urged the proposal. They favoured trading over taxation for its flexibility and initial free allocations that bypassed direct fiscal transfers (Sato et al., 2022; Rea, 2019). Devolving allocation decisions to national governments through NAPs further defused objections to subsidiarity. The Emissions Trading Directive was adopted in October 2003, with trading starting in 2005 to align with the Kyoto Protocol (Böning et al., 2003; Vogler, 2023).

This trajectory exemplifies SEE's governance concerns. While neoclassical environmental economics might celebrate the shift from taxation to tradable permits as a gain in static efficiency (achieving abatement at lower cost), the SEE perspective reveals deeper concerns. Emissions trading did not emerge as a neutral corrective to market failure, but as a politically expedient compromise that subordinated ecological goals to the reproduction of carbon-intensive industries (Spash, 2010). The scheme commodified atmospheric capacity as a fictitious commodity, extending neoliberal logic into nature's limits and subjecting protection to price perversities (ibid.). Rea (2019, p. 56) characterised this as "protection via commodification", referring to Polanyi's double movement distorted by power imbalances favouring emitters over advocates. Grandfathering, the free allocation of emission allowances based on firms' historical pollution levels, generated rents that strengthened industry lobbying, foreshadowing challenges to respect for planetary boundaries (Sato et al., 2022). The EU ETS's origin thus raises immediate questions of ecological adequacy, distributional justice, and transformation potential, which are analysed through the lens of institutional evolution.

3.2. Institutional design and policy phases (I-III)

Having traced the EU ETS's politically contingent emergence as "protection via commodification" (Rea, 2019, p. 56), this section dissects its institutional design across Phases I-III. Initial compromises evolved through crisis into stringency. As Table 1 shows, each phase tests the efficiency promises of market logic against power and resource limits, setting the stakes for leakage and interactions.

Phase I: Pilot Fragility

Launched to coincide with Kyoto's first period, Phase I "covered […] CO_2 emissions from power generators and energy-intensive industries", with nearly all allowances allocated for free via NAPs based on historical emissions (European Commission, 2026, Development of EU ETS [2005-2020]). In the absence of reliable data, caps resulted in a 280 million surplus of allowances, leading prices to collapse near zero by 2007, as Phase I allowances could not be banked forward (ibid.; Sato et al., 2022; Dechezleprêtre et al., 2023). On neoclassical criteria, this phase failed. Over-allocation excluded static efficiency, while zero prices eliminated dynamic incentives for innovation beyond low-cost fuel-switching (Sato et al., 2022). On the other hand, it has been argued that, through surplus sales and consumer pass-through costs, emitters' political power has been solidified without adequate ecological gains (Spash, 2010; Rea, 2019).

Phase II: Kyoto Alignment

Phase II then aligned with Kyoto targets through a 6.5 % lower EU-wide cap, limited banking of allowances, and other Measures (European Commission, 2026; Sato et al., 2022). Free allocation declined modestly. Yet the 2008 financial crisis, combined with the expansion of renewables, created an 800 million allowance surplus. Prices halved post-Copenhagen, yielding only 10-15% reductions attributable to the ETS, despite an 11% total emissions decline in 2008-2009 (Dechezleprêtre et al., 2023; Böning et al., 2023). This phase offered partial progress in effectiveness through a lower cap, yet persistent surpluses signalled weak dynamic efficiency amid external shocks.

Phase III: Pivotal Centralisation

Phase III replaced NAPs with a single EU-wide cap. In this phase, additional sectors and gases were included, and harmonised benchmarking and auctioning were made the default (rising to above 40% of allowances). The 2018 Market Stability Reserve (MSR) addresses surpluses by automatically adjusting supply, stabilising prices above €25 per tonne by 2019. Firms face hard annual limits. Verified emissions exceeding allowances trigger fines and double-surrender obligations, thereby enforcing compliance without unlimited hoarding (European Commission 2026). Auction revenues simultaneously reached €32 billion, funding climate projects, while delivering around 2.5% annual emission cuts post-reform (European Commission, 2026; Sato et al., 2022; Böning et al., 2023). Yet market framing retained power imbalances (Sato et al., 2022; Böning et al., 2023; Spash, 2010).

TABLE 1: ETS Phases Overview

	Phase I	**Phase II**	**Phase III**
Years	2005-2007	2008-2012	2013-2020
Purpose	Learning by doing to prepare for Phase II	Coincided with the Kyoto commitment period	Major reform for EU-wide stringency
Coverage	CO_2 from power generators and energy-intensive industries	3 new countries, nitrous oxide emissions, and the aviation sector were added	More sectors and gases are included, and a single EU-wide cap
Cap and Allocation	~100% free allowances via NAPs	Reduction in allowances and free allocation to ~90 %, adding international credits	Auctioning as default with harmonised allocation rules
Banking rules for EUAs	No banking to Phase II – unused expired	Limited banking allowed	Unlimited banking
Compliance Penalty	€40 per tonne	€100 per tonne	€100 per tonne
Outcomes	Infrastructure to monitor, report, and verify emissions	Verified data enabled cap adjustment	Shift to EU-wide cap and innovation funding via New Entrants Reserve
Challenges	Surplus from data gaps	Surplus of allowances and credits created carbon price pressure	Persistent surplus led to MSR (2018); low prices until reforms
Source: European Commission, 2026, authors' depiction			

Taken together, the first three stages forged a resilient yet imperfect instrument. From Phase I's windfall-generating over-allocation, Phase II's crisis-buffered offsets, to Phase III's MSR-stabilised auctions yielding 2.5 % annual cuts. Phase IV inherits this development amid Fit for 55 and ETS2 expansions, confronting new challenges in scaling ambition. The following section unpacks the mechanics and implications of these reforms, tracing whether they resolve embedded contradictions or strengthen them as they move toward 2030 neutrality.

3.3. Phase IV and recent reforms

Building on the institutional maturation of Phases I-III, Phase IV (2021-2030) marks the EU ETS's newest evolution, embedding ambition under the 2021 Fit for 55 packages amid the European Green Deal (European Commission, 2026; Wettestad, 2023). This phase transforms the ETS from a sector-specific abatement tool into a broader mechanism for economy-wide decarbonization, directly addressing prior surpluses, leakage risks, and exclusions through tighter supply, revenue mobilisation, and parallel schemes such as ETS2 (Böning et al., 2023). Yet, as neoclassical efficiency meets SEE realities, these reforms test whether market governance can deliver ecological outcomes at scale without amplifying distributional tensions.

At the core of Phase IV, Fit for 55 revises the ETS Directive to align with the EU's 55% net GHG reduction target by 2030 (1990 baseline), nearly doubling the annual linear abatement factor from 2.2% to 4.3% to hasten the tightening of caps (European Commission, 2026). This rebasing counters Phase III's lingering surpluses via a one-off intake of 117 million allowances into the strengthened MSR, which now accelerates cancellations post-2023 if prices exceed €35 per ton CO_2. This builds on post-2013 tightening that already drove 2.5% annual cuts in regulated sectors (Böning et al., 2023; European Commission, 2026). Seamlessly, the phase-out of free allocations, starting 2026 for Carbon Border Adjustment Mechanism (CBAM)-covered goods (cement, steel, fertilisers) and completing by 2034, shifts from grandfathering's rents to full auctioning, generating revenues for Innovation and Modernisation Funds to seed low-carbon technologies (Dechezleprêtre et al., 2023). Böning et al. (2023) validate this trajectory: rising prices enhance dynamic efficiency, thereby evolving the ETS into an industrial policy instrument targeting 61% industrial reductions by 2030.

Parallel innovations broaden the scope. ETS2 will launch in 2028 as a distinct cap on fuel for buildings and road transport. Initially, about 75 million tons of CO_2, scaling to 43% reductions by 2030, and channelling nearly €225 billion in revenue to the Social Climate

Fund for equitable transitions, explicitly countering regressivity on low-income households (European Commission, 2026; Wettestad, 2023). ETS2 thus brings carbon pricing directly to citizens through fuel costs, yet market governance limits their involvement to indirect revenue benefits rather than participatory decision-making (ibid.). Unlike the original ETS's point-source focus, ETS2 targets suppliers, resolving prior exclusions of ¾ of EU emissions and embedding consumption-side pricing for diffuse sources (Klimko & Hasprová, 2025, p. 14). Maritime expansion via ETS2 further aligns shipping with funding for low carbon amid rising prices (European Commission 2026). The International Energy Agency (2020) underscores how such extensions boost predictability, harmonising incentives toward 2050 neutrality.

Complementing these, CBAM (full enforcement 2026) imposes ETS-equivalent charges on embedded emissions in imports, neutralising leakage for trade-exposed sectors and evolving allocation from national rent-seeking to EU benchmarks (Sato et al., 2022; Böning et al., 2023). Collectively, Phase IV signals a paradigm shift: from reactive surplus management to proactive policy, with auctions fueling green innovation. As Green Deal pillars, Fit for 55 and ETS2 hold significance for future EU climate policy. They will scale the ETS to economy-wide coverage, driving 55 % emissions cuts by 2030 and paving industrial pathways to 2050 climate neutrality.

This tightening, however, embeds trade-offs. Steeper prices risk driving the outsourcing of non-CBAM goods and disrupting global value chains, while ETS2's fuel levies strain political viability amid energy crises and regressive impacts (Wettestad, 2023). Klimko and Hasprová (2025) affirm cumulative 42.8 % drops (2005-2022) from design evolution, yet position Fit for 55 as a crucible: Can it scale ambition without fracturing coalitions or entrenching inequities? These repetitive refinements aimed to drive effective emissions reductions, curb carbon leakage and competitiveness losses, and align with broader EU climate policies. However, literature reveals a more nuanced reality.

4. Empirical effectiveness: Environmental and Economic Impacts

Assessing the empirical effectiveness of the EU ETS is not straightforward. Evaluations typically centre on three dimensions: emission reductions in covered sectors, carbon leakage and competitiveness effects, and the system's interaction with broader EU climate and energy policies. Together, these criteria aim to determine whether the ETS achieves its core goal of cost-effective GHG abatement while avoiding significant economic side-effects.

The central difficulty is attribution. Emissions in ETS-regulated sectors have shifted alongside a range of overlapping factors, including economic cycles, energy prices, technological change, and parallel regulatory measures, making it hard to isolate what the trading system itself has actually caused. Empirical studies, therefore, tend to use econometric and counterfactual methods to disentangle ETS effects from broader structural trends (Dechezleprêtre et al., 2023; IEA, 2020), though methodological uncertainty remains a recurring theme in the literature. The three sections that follow review the evidence on each dimension in turn, laying the groundwork for the socio-ecological critique in Chapter 5.

4.1. Emission reduction

The EU ETS was designed, above all, to reduce GHG emissions from covered sectors. Evaluating whether it has actually done so is harder than it sounds. Emission trends across ETS sectors have been shaped by economic downturns, shifting energy prices, and parallel policy initiatives, which means that observed declines cannot simply be read off as proof of the system working. The key methodological question is always the counterfactual: what would have happened without the ETS?

The early phases of the ETS produced only modest and often contested emission reductions. Phase I (2005–2007) was widely seen as a learning period beset by over-allocation and unreliable baseline data, both of which undermined the carbon price signal before it could meaningfully change firm behaviour. Estimates suggest that any reductions during this period were small, a matter of a few percentage points, and largely driven by external factors rather than by the ETS itself (Sato et al., 2022; Ellerman & Buchner, 2008, as cited in Klimko & Hasprová, 2025). Phase II (2008–2012) is even harder to evaluate, given that it coincided almost entirely with the global financial crisis and the sharp industrial contraction that followed. Econometric studies generally conclude that only a small portion of the emission declines observed in those years can be traced back to carbon pricing policy (Dechezleprêtre et al., 2023; Sato et al., 2022).

The picture changes considerably from Phase III (2013–2020) onward. The shift to a single EU-wide cap, higher rates of auctioning, and the introduction of the MSR all helped stabilise and raise allowance prices, strengthening the incentive to abate. Dechezleprêtre et al. (2023), drawing on installation-level panel data, estimate that regulated firms cut emissions by around 10% relative to comparable non-ETS firms, and without measurable damage to their economic performance. Cross-country analyses point in the same direction, finding that emission reductions in covered sectors outpaced those in non-covered sectors after 2013, consistent with a more credible and effective price signal (Böning et al., 2023; Klimko & Hasprová, 2025).

In aggregate terms, emissions from stationary installations under the EU ETS fell by roughly 40–45% between 2005 and the early 2020s (Dechezleprêtre et al., 2023). That is a substantial decline, but the literature is consistent on one point: carbon pricing alone cannot account for all of it. The coal-to-gas fuel switch and the rapid build-out of renewable electricity across Europe were significant independent drivers, interacting with the ETS in ways that complicate clean attribution (IEA, 2020; Vogler, 2023). The system's effectiveness, in short, cannot be read in isolation from the energy transition happening around it.

A useful distinction in this literature is between short- and long-term abatement channels. In the near term, firms tend to respond to carbon costs through operational changes such as fuel switching, efficiency gains, and output adjustments in the most emissions-intensive processes. Longer-term responses require actual capital investment in low-carbon technologies, and that only happens when firms trust that the carbon price will stay high enough to justify it. Post-Phase III, credibility appears to have improved. Institutional reforms reduced the allowance surplus and signalled that the system would not be allowed to collapse under its own excess supply, and some studies read more recent investment patterns as evidence that firms began pricing in a sustained carbon constraint rather than just reacting to current prices (Dechezleprêtre et al., 2023; Böning et al., 2023).

Taken together, the evidence on emission reductions is genuinely mixed. The ETS struggled to deliver in its early years, undermined by design flaws and bad timing, but Phase III reforms produced measurable results at the firm and sectoral level. Attribution, however, remains contested throughout. Because emission trends reflect carbon pricing, structural energy transitions, and overlapping policy interventions simultaneously, separating the ETS contribution is never clean. That ambiguity is not just a technical inconvenience; it matters for how we evaluate the system overall, and it feeds directly into the socio-ecological critiques explored in Chapter 5.

One alternative way to assess abatement is through allowance price dynamics rather than emission outcomes alone. Within a neoclassical framework, the carbon price functions as a signal of scarcity: when prices are low and stable at near-zero, as they were through much of the late 2000s, that indicates an oversupplied market with little real pressure on firms to reduce. Conversely, the sustained price recovery following the introduction of the Market Stability Reserve suggested a genuine tightening of the cap (IEA, 2020; Vogler, 2023). Studies linking price levels to fuel choices in the power sector find that higher carbon costs did make coal-fired generation comparatively more expensive, reinforcing the shift toward gas and renewables. Price-based analysis of this kind adds an important layer to installation-level studies, showing how individual firm responses aggregate into broader market outcomes.

4.2. Carbon leakage and competitiveness

Beyond emission reductions, carbon leakage represents a persistent concern in ETS evaluations. The basic worry is that stringent carbon pricing pushes firms to shift production toward less regulated markets, displacing emissions geographically rather than eliminating them. Were this to occur at any significant scale, the climate benefits of the ETS would be partially offset while regulated European producers absorb a competitive disadvantage. Anticipating this risk, policymakers built protective measures into the system from early on, most consequentially through the extensive use of free allowance allocation for industries deemed vulnerable to international competition.

Measuring leakage empirically is notoriously difficult. Researchers typically track trade flows, foreign direct investment patterns, and production levels in emissions-intensive sectors, each of which captures a slightly different dimension of competitive pressure. The basic question is whether imports of carbon-intensive goods rise as domestic output falls, or whether firms redirect investment toward lower-regulation environments. The EU ETS literature generally finds limited evidence of systematic leakage on these measures, though global demand fluctuations and energy price differentials make it hard to isolate any ETS-specific effect (Sato et al., 2022; Böning et al., 2023). Leakage, in short, is easier to theorise than to observe.

The theoretical concern is straightforward: carbon pricing raises production costs for emissions-intensive and trade-exposed (EITE) sectors, which could erode their competitiveness relative to rivals operating in less regulated markets (IEA, 2020). This logic was taken seriously in the ETS's early design phases, where generous free allocation based on historical emissions, a practice known as grandfathering, was used to cushion the industry from full exposure to the carbon price (Sato et al., 2022). The political logic was straightforward: keep industry on board by softening the financial impact. But grandfathering came with a significant economic cost: it weakened the price signal and, particularly in the power sector, generated substantial windfall profits as utilities passed through the opportunity cost of allowances to consumers even though they received those allowances for free (Sato et al., 2022; Rea, 2019).

When it comes to observed outcomes, the evidence is broadly reassuring, at least from a conventional economic perspective. Firm-level econometric work finds no statistically significant drop in employment, output, or investment among ETS-regulated firms compared to similar non-regulated firms (Dechezleprêtre et al., 2023), suggesting that the competitive damage has been more modest than many initially expected. Sectoral studies reach similar conclusions. There is little evidence of systematic production shifts from the EU to less-regulated regions that can be attributed to the ETS specifically (Böning et al., 2023). Global demand conditions, energy costs, and technological trajectories appear to matter considerably more for location decisions than carbon pricing.

The absence of large-scale leakage should not, however, be taken as straightforward evidence that the ETS has resolved the competitiveness problem. A more plausible reading is that free allocation functioned as a pre-emptive shield. By insulating trade-exposed firms from the full carbon price, it reduced their incentive to relocate, but it also means we cannot know how much leakage would have occurred under a more stringent regime (Sato et al., 2022). The policy intervention and the absence of leakage are not independent observations. There is also a distributional dimension here. Sectors receiving more protection through free allocation tended to show weaker abatement responses, precisely because their exposure to the price signal was blunted (Dechezleprêtre et al., 2023). Protection came at the cost of incentive.

Whether firms can pass their carbon costs through to consumers is a related but distinct issue. The extent to which they can depends largely on market structure and trade exposure. Electricity producers, operating in regulated or semi-captive markets, have generally been able to incorporate carbon costs into prices; firms in globally traded manufacturing sectors have much less room to do so, which is where genuine competitiveness pressure tends to concentrate (Sato et al., 2022). This heterogeneity helps explain why the leakage debate has always been most intense around a relatively narrow set of energy-intensive, trade-exposed industries, even though the ETS covers a far wider range of emitters. Competitiveness impacts, in other words, are unevenly distributed rather than economy-wide.

Phase IV reforms represent an attempt to resolve this long-standing tension. The gradual phase-out of free allocation, combined with the CBAM, shifts the logic from cushioning domestic industry against carbon costs to imposing equivalent costs on imports (Böning et al., 2023; Vogler, 2023). In principle, this should allow the carbon price to operate more freely without triggering competitive disadvantage. In practice, CBAM's effectiveness remains uncertain. Its sectoral coverage is limited, its administrative complexity is considerable, and its trade implications are still being contested both empirically and politically.

On balance, the evidence does not support the conclusion that the EU ETS has produced systematic leakage or severe competitiveness losses. But the design choices made to prevent those outcomes, particularly the scale of free allocation, have themselves shaped what the data show, and have come at an actual cost to abatement incentives. This is a tension the system has never fully resolved, and it is one that critics from a socio-ecological perspective find particularly telling, as discussed in Chapter 5.

4.3. Interaction with other EU climate and energy policies

The EU ETS has never operated in a vacuum. It sits within a broader framework of EU climate and energy policy that includes renewable energy targets, energy efficiency directives, and sector-specific regulations, all of which affect the same emissions that the ETS is meant to govern. Understanding how the system actually performs, therefore, requires looking at how it interacts with these other instruments, and whether the overall combination is coherent.

The EU has long combined emissions trading with renewable energy support schemes, efficiency obligations, and technology-specific standards, a multi-instrument approach that reflects the political and economic complexity of decarbonisation. From a purely economic standpoint, this creates a genuine tension. Parallel policies can address market failures that a carbon price alone cannot fix, such as innovation spillovers or infrastructure underinvestment (IEA, 2020). However, when additional regulations reduce emissions in ETS-covered sectors, they also reduce demand for allowances, which depresses the carbon price, potentially without generating any additional cuts at the level of the aggregate cap.

Renewable energy expansion has been the most significant source of these interactions. The rapid scaling of wind and solar across EU member states substantially reduced fossil fuel consumption in the power sector, bringing down ETS-sector emissions, but as a consequence of renewable policy, not of carbon pricing per se. This lowered allowance demand and put downward pressure on prices, particularly during the years of surplus that preceded the Market Stability Reserve (Vogler, 2023). Several studies conclude that renewable policies were responsible for a considerable share of the emission reductions credited to ETS sectors during the 2010s (Böning et al., 2023; IEA, 2020), a finding that complicates any straightforward narrative of ETS success.

This raises a genuine question about the division of labour between price-based and technology-specific instruments. The ETS sets an aggregate constraint and lets the market find the cheapest abatement path, while renewable support schemes and efficiency standards push particular technologies and sectors regardless of price. Whether this combination is redundant or complementary is actively debated in the literature, but the dominant view in the EU context is that technology-specific policies were necessary to drive structural energy transitions that a carbon price alone, at politically sustainable levels, could not have delivered (Vogler, 2023). The implication is that ETS outcomes cannot be evaluated as if the system were operating in isolation; they are jointly produced by carbon pricing and targeted technological policy.

Energy efficiency policies generate similar dynamics. Industrial efficiency improvements and demand-side reductions lower emissions without any involvement from the carbon price mechanism, but under a fixed cap, this does not automatically translate into additional EU-wide abatement. Instead, surplus allowances accumulate and flow to other emitters, a structural dynamic known as the "waterbed effect" (IEA, 2020). The net result is that individually beneficial policies may have limited aggregate impact without corresponding adjustments to the cap itself. The MSR addresses this partially by withdrawing excess allowances from circulation, though critics argue it is a fix designed around a structural problem rather than a solution to it.

Recent reforms under the European Green Deal and Fit for 55 have pushed toward greater coordination of these interactions, explicitly linking ETS tightening to renewable targets, efficiency obligations, and industrial policy (Vogler, 2023). This marks a meaningful shift in how the ETS is conceptualised: rather than a standalone market instrument expected to drive decarbonisation by itself, it is increasingly understood as a pricing backbone within a broader governance architecture. It sets cost signals and coordinates expectations across sectors, but relies on other instruments to address technology gaps, distributional concerns, and investment barriers (Vogler, 2023; IEA, 2020). The practical implication for empirical assessment is significant. If we want to understand what the ETS has achieved, we cannot look at the carbon price and emission trends in isolation. What we observe in ETS sectors is the joint product of carbon pricing, renewable policy, efficiency regulation, and structural energy system change. Separating those contributions cleanly is not possible, and acknowledging that honestly is, arguably, the most important conclusion this chapter can offer before turning to the deeper critiques that follow.

5. Social-ecological critique of carbon trading

The preceding chapters examined the EU Emissions Trading System primarily through the dominant evaluative framework of environmental economics, focusing on emission reductions, cost-effectiveness, and competitiveness effects. The following chapter reevaluates these findings through the broader lens of SEE.

The analysis proceeds in steps on different analytical levels. Section 5.1 begins with a structural analysis, examining the EU ETS as a governance system that converts ecological limits into tradable property rights and delegates coordination to price mechanisms. Section 5.2 narrows the focus to the distributive and political-economic dynamics generated by this arrangement, including patterns of externalisation, accumulation, and global asymmetry. Section 5.3 then turns to the normative implications of commodifying emission rights, addressing questions of responsibility, justice, and democratic legitimacy. Finally, Section 5.4 brings these dimensions together in a systematic re-evaluation of the EU ETS, drawing on the SEE criteria developed in Chapter 2.

5.1. EU ETS as governance by markets

Building on the SEE framework developed in Chapter 2, one key critique is the significant role assigned to the EU ETS in European climate policy. The EU employs various regulatory and supportive measures, such as renewable energy targets, efficiency standards, and industrial strategies. However, by designating the EU ETS as the "cornerstone" of its climate architecture, the Union has elevated carbon pricing to a central coordinating mechanism. This institutional choice shifts the focus of mitigation efforts from the direct political management of production and infrastructure to the calibration of a market mechanism intended to internalise ecological limits through price signals.

This form of governance reflects the neoclassical logic outlined earlier. Environmental degradation is framed as an externality that can be corrected by defining property rights and attaching a price to emissions. Once these allowances become tradable, firms are expected to incorporate the carbon price into their cost structures and adjust their production and investment decisions accordingly. As Spash (2010) argues, carbon trading operationalises a form of market environmentalism, translating ecological limits into economic incentives and coordinating them through exchange mechanisms. Ecological constraints are not imposed through political direction but are mediated through competitive markets.

At the core of this arrangement lies a process of commodification. The EU ETS defines European Union Allowances (EUAs), each representing the right to emit one ton of carbon dioxide. These allowances can be bought, sold, banked, and integrated into financial portfolios. In this way, part of the atmosphere's absorptive capacity is transformed into a standardised, tradable asset. From a SEE perspective, this move extends the commodification of nature. Ecological constraints are incorporated into capitalist exchange relations by converting them into property rights subject to circulation (Lohmann, 2006). Atmospheric capacity becomes a fictitious commodity, treated as an ordinary market good despite being embedded in complex ecological systems.

Importantly, commodification within the EU ETS does not imply state withdrawal. The carbon market is a politically constructed institution that requires monitoring, verification, enforcement, and periodic recalibration (Rea, 2019). In this sense, the ETS represents an attempt to re-embed environmental limits within market economies. Nevertheless, Rea (2019) himself questions the effectiveness of this re-embedding due to structural vulnerabilities of market-based coordination policy. As Spash (2010) notes, a key weakness of emissions trading compared to alternative instruments such as taxes or direct regulation lies in its sensitivity to design flaws. Excessive baselines, regulatory loopholes, and weak links in one sector can undermine the need for meaningful reductions elsewhere. The greater the scope and complexity of the scheme, the greater the potential for such weaknesses. Under market-based governance, ecological ambition becomes dependent on cap calibration and price stability, which narrows the policy focus to technical adjustments rather than structural intervention.

The political construction of the EU ETS reveals how governance by markets is shaped by power relations. Allocation rules, particularly the extensive use of free allocation in earlier phases, were the result of negotiations between member states, industry stakeholders, and EU institutions (Sato et al., 2021). These design choices structured the distribution of rents and influenced the strength of the price signal and the distribution of costs. In this context, markets are not neutral coordination devices, but rather institutional outcomes of political compromise that incorporate existing economic interests into the governance architecture.

From this perspective, the transformative capacity of carbon pricing becomes contested. SEE research questions whether carbon markets are capable of driving deep structural change, suggesting that they tend toward system optimisation rather than systemic transformation (Tvinnereim & Mehling, 2018). Price-based instruments may encourage incremental efficiency improvements while leaving underlying production and consumption structures largely intact. Furthermore, some stakeholders have strategically promoted emissions trading as the primary climate policy to deflect or delay more stringent regulatory and renewable energy policies, a phenomenon Markard and Rosenbloom (2020) describe as the ETS acting as a "Trojan Horse." According to this interpretation, governance by markets not only coordinates mitigation but also stabilises existing interests and restricts alternative transformation pathways.

Taken together, the EU ETS can be understood as a paradigmatic case of governance by markets. It translates ecological limits into tradable rights, delegates coordination to price mechanisms, and embeds climate mitigation within existing market relations. Although it is politically constructed and periodically reformed, the system relies on commodification and market incentives as its primary steering devices. From a SEE perspective, this institutional architecture is analytically significant because it structures how ecological constraints are mediated, which actors are empowered through market participation, and how far-reaching socio-economic transformation is pursued or limited within the framework of capitalist market coordination.

5.2. Offsets, leakage, and "accumulation by decarbonization."

If 5.1's argument is that the EU ETS governs through markets rather than through direct political steering, a natural question follows: where does that mitigation effort end up? Socio-ecological economics (SEE) critiques push well beyond the competitiveness and leakage concerns addressed in Chapter 4 to examine the spatial and distributive consequences of this market architecture. Where mainstream evaluations ask whether emissions are being reduced cost-effectively, this perspective asks who bears the costs and where mitigation happens. The EU ETS has historically permitted regulated firms to use international offset credits, primarily through the Clean Development Mechanism (CDM), to meet their compliance obligations. In policy terms, this was presented as a way of achieving cheaper global abatement. Critics see it differently: as a mechanism that allows industrialised economies to externalise their decarbonization obligations onto the Global South (Spash, 2010; Rea, 2019).

The core problem with offsetting, from this perspective, is that it allows domestic production patterns to continue unchanged. Rather than forcing structural transformation within regulated economies, firms can pay for emission reductions to happen elsewhere and count them toward compliance. Spash (2010) captures this with the phrase "brave new world," describing carbon markets as spaces where environmental constraints are turned into tradable commodities rather than confronted. The effect is that high-emission activity in industrialised economies continues, while mitigation work is contracted out. Offsets are not, in this reading, a form of global climate action so much as a way of deferring domestic transformation indefinitely.

Beyond the question of incentives, SEE scholarship connects offsetting to broader patterns of uneven ecological exchange. The projects that generate tradable credits tend to be located in land-use, forestry, or energy sectors in developing regions, where land rights are often contested, and local communities have limited say over how projects are designed or implemented. Rea (2019) develops the concept of "accumulation by decarbonization" to describe this dynamic, arguing that mitigation becomes a new frontier for capital investment and resource control in the Global South rather than a genuine redistribution of ecological responsibility. Far from transforming the relationship between industrialised and developing economies, carbon markets may add a green layer to existing asymmetries.

The EU's phase-out of international offsets under later ETS reforms does not put these concerns to rest. SEE critiques follow the logic into newer instruments, particularly the CBAM. Mainstream policy discourse frames the CBAM as a tool to prevent leakage and level the playing field. However, from a critical perspective, the more important question is what it does to trade relations and development trajectories in the Global South. By extending carbon cost requirements to imports, the EU effectively exports its regulatory standards to countries that had no role in designing them and often lack the institutional capacity to comply (Vogler, 2023). This is a different mechanism from offsetting, but the underlying distributional concern is similar: the costs and constraints of decarbonization are being shaped in Brussels and felt elsewhere.

What unites these critiques is a fundamental reframing of leakage and flexibility mechanisms. In mainstream evaluation, they are problems to be managed or design flaws to be corrected. In the SEE reading, these are features of a global carbon governance architecture that systematically redistributes mitigation obligations from the North to the South and from regulated economies to unregulated ones. The neoclassical case for emissions trading rests on cost-effectiveness and aggregate efficiency. This perspective insists that those metrics obscure as much as they reveal, and that any honest assessment of the EU ETS must also ask who benefits from flexibility, who absorbs the burden of mitigation, and whether market mechanisms can deliver the kind of structural transformation that climate change demands. These are not only questions of political economy but of ethics and legitimacy, which is where the analysis turns next.

5.3. Ethics, behaviour and democratic policies

Sections 5.1 and 5.2 demonstrate that the EU ETS institutionalises climate mitigation by commodifying emission rights and coordinating through prices, while generating distributive dynamics shaped by political compromise and accumulation processes. The normative implications discussed here are not separate from these structural features, but they arise from them. If ecological limits are mediated through property rights and markets, and if mitigation burdens are distributed through price mechanisms, then the framing of responsibility, moral obligation, and political legitimacy is necessarily affected.

A first normative tension revolves around the moral implications of defining tradable emission rights. By establishing EUAs as transferable entitlements to emit a fixed quantity of GHGs, the EU ETS creates a limited "right to pollute" (Lohmann, 2006, p. 55). Espinosa-Flor (2022) argues that such property rights approaches risk conflating legal compliance with moral justification. Once allowances are purchased, continued emissions may appear permissible within the bounds of the market. This creates a structural tension between a market-allocated entitlement to emit and a prior duty to prevent avoidable harm. Thus, commodification reframes responsibility through ownership and exchange rather than through direct reference to ecological limits or harm prevention.

Another closely related problem is abstraction. Lohmann (2006) emphasises that carbon trading transforms atmospheric capacity into standardised, interchangeable units, divorced from the social and ecological contexts in which emissions occur. Within the EU ETS, emissions from fundamentally different activities are treated as equivalent once expressed in tons of CO_2. While this equivalence enables exchange, it simultaneously obscures the qualitative differences between necessary and avoidable emissions and between activities with different social purposes. By transforming diverse forms of pollution into interchangeable units, the system reduces moral judgments to quantitative commensurability. The ethical meaning of emissions becomes detached from their concrete social and ecological context.

This abstraction facilitates a broader tendency toward ethical reductionism. As Spash (2010) notes, serious climate change problems risk being overshadowed by technical debates over baseline design, allocation rules, and exchange mechanisms. Furthermore, assigning monetary value to the harms and losses caused by emissions introduces additional ethical challenges (Espinosa-Flor, 2022) as incommensurable values, such as intergenerational justice and ecological integrity, are converted into cost calculations. The central policy challenge then becomes setting the "correct" carbon price rather than addressing contested questions about the legitimacy of particular production systems or consumption patterns.

Another normative dimension involves the broader institutional effects of market-oriented climate governance. Spash (2010) notes that the growth of carbon and offset markets has created a robust financial infrastructure with a stake in maintaining trading activity. Transaction costs, financial speculation, and market intermediation have become sources of profit. This creates incentives that are aligned with market expansion rather than rapid emission decline. As markets extend internationally and incorporate offset mechanisms, there is an increased potential for manipulation and regulatory loopholes, and environmental and social considerations may become secondary to financial gain. At the individual level, emissions trading may crowd out voluntary climate action by signalling that responsibility has been discharged through market participation alone.

Distributional fairness further intensifies these moral concerns. Beyond the general problem of pricing harm, cap-and-trade systems raise questions about the fair allocation of permits and burdens. Connected to the findings of chapter 5.2, Espinosa-Flor (2022) emphasises that determining how the cap is distributed among countries, sectors, and firms inevitably involves making normative judgments about responsibility and entitlement. From a SEE perspective, one must ask whether historically carbon-intensive actors are granted continued emission rights in a way that entrenches existing inequalities rather than redressing them.

Finally, emissions trading raises issues of democratic legitimacy. Page (2012) argues that evaluating cap-and-trade systems requires considering not only outcomes, but also procedural aspects such as accountability, transparency, and participation. The EU ETS operates through complex technical rules, market stabilisation mechanisms, and expert-driven recalibration processes. Decisions regarding cap trajectories, free allocation, and market interventions are made in specialised regulatory arenas that limit broader democratic deliberation. While such a technocratic design may enhance administrative precision, it also narrows the public space in which climate responsibilities are contested and collectively defined. If climate governance is increasingly framed as a matter of optimising market parameters, political disagreement risks being recast as a technical adjustment.

Viewed through the lenses of ethical framing, behavioural assumptions, and democratic legitimacy, the limitations of the EU ETS become pronounced. From an SEE perspective, these dimensions are not secondary concerns but central criteria for evaluating climate governance. Their insufficient integration within the current system underscores the tension between market-centred coordination and the normative demands of socio-ecological transformation.

5.4. Re-evaluating the EU ETS through the SEE lens

Building on the theoretical framework developed in Chapter 2, this chapter revisits the five evaluative criteria of ecological adequacy, distributional justice, governance and power, transformation potential, and precaution. Bringing together the findings from the previous chapters, this perspective enables a more comprehensive reassessment of the EU ETS beyond the efficiency-based evaluation presented in Chapter 4. It thus reveals a more ambivalent overall assessment of the system. From the perspective of *ecological adequacy*, the decisive question is whether the EU ETS aligns economic activity with biophysical limits. Empirically, emissions in covered sectors have declined significantly since 2005, particularly after the tightening of the cap and the introduction of the Market Stability Reserve (Dechezleprêtre et al., 2023; Böning et al., 2023). These reforms have strengthened price signals and reduced surplus allowances. However, attribution remains partial, as emission reductions have also been driven by renewable expansion, efficiency policies, and structural economic shifts (IEA, 2020; Vogler, 2023). More fundamentally, the ETS constrains emissions within selected sectors but does not address the overall scale of socio-economic metabolism or the growth-dependent dynamics of material throughput (Spash, 2010). From an SEE standpoint, this represents a structural limitation, as ecological adequacy is assessed in sectoral terms rather than in relation to planetary boundaries.

Regarding *distributional justice*, the EU ETS exhibits persistent asymmetries. Early phases were characterised by extensive free allocation and windfall profits, particularly in the power sector (Sato et al., 2022). While later reforms increased auctioning and created funds to support modernisation and innovation, these measures correct rather than fundamentally redesign the instrument's distributive logic. Internationally, the use of offsets and the externalisation of mitigation have been linked to patterns of uneven ecological exchange and "accumulation by decarbonization" (Rea, 2019). The introduction of CBAM modifies these dynamics but simultaneously extends EU regulatory power beyond its borders (Vogler, 2023). Domestically, the extension of carbon pricing to buildings and transport under ETS2 raises concerns about regressive impacts, even with compensatory mechanisms such as the Social Climate Fund (European Commission, 2026). What connects these different scales is a common structural feature: the allocation of emission rights follows market logic and competitiveness concerns rather than differentiated historical responsibility or social need. Justice, in this system, is not built into the mechanism but must be continuously imposed from outside it.

In terms of *governance and power*, the EU ETS institutionalises climate mitigation through market governance. Ecological limits are translated into tradable allowances, and abatement is allocated according to relative cost structures (Lohmann, 2006; Spash, 2010). The system's historical development demonstrates the influence of industry interests and competitiveness considerations on allocation rules and reform trajectories (Sato et al., 2022; Rea, 2019). Although the ETS has become more centralised and technically refined, decision-making remains embedded in expert-driven and highly technical processes (Page, 2012). Political contestation over the direction and pace of transformation is partially displaced into debates over cap calibration and price stability. From a SEE perspective, this governance architecture privileges market coordination over democratic steering and embeds existing power relations within the institutional design of climate policy.

The most decisive criterion concerns *transformation potential*. SEE asks whether a policy instrument enables structural change or merely optimises within existing economic frameworks (Brand & Wissen, 2017; Spash, 2020). The EU ETS can incentivise technological innovation and incremental decarbonization when carbon prices are sufficiently high and credible (Dechezleprêtre et al., 2023; Böning et al., 2023). However, price-based coordination tends toward system optimisation rather than systemic transformation (Tvinnereim & Mehling, 2018; Markard & Rosenbloom, 2020). What remains largely unaddressed is the structural reorganisation of production and consumption patterns, the reduction of aggregate resource throughput, and the political contestation of growth-dependent economic structures. Transformation is thus made conditional on market compatibility, thereby limiting the ETS's capacity to act as a driver of deep socio-economic transformation.

Finally, the criterion of *precaution* highlights the robustness of governance under uncertainty and the risk of irreversible damage. The early history of the EU ETS, marked by price collapses and surplus allowances, illustrates the vulnerability of market-based instruments to economic shocks and regulatory miscalibration (Spash, 2010; Sato et al., 2022). Although subsequent reforms, particularly the MSR, have enhanced stability (European Commission, 2026; IEA, 2020), the system remains dependent on price expectations and continuous regulatory adjustment. Under conditions of deep ecological uncertainty and potential tipping points, reliance on market signals raises questions about the precautionary adequacy of price-mediated governance (Spash, 2020). Environmental ambition must be repeatedly restored through technical correction rather than being structurally guaranteed.

Taken together, this re-evaluation suggests that the EU ETS performs convincingly within the efficiency-oriented logic of environmental economics yet remains structurally constrained when assessed against the broader criteria of SEE. Rather than representing isolated shortcomings, these tensions point to structural constraints inherent in market-centred climate governance.

6. Summary

This paper asks to what extent the EU ETS has contributed to emission reductions in the EU and which limitations emerge when it is assessed from a SEE perspective. Drawing on a qualitative, literature-based analysis, it combined neoclassical environmental economics with a social-ecological framework that evaluates climate policy along the dimensions of ecological adequacy, distributional justice, governance and power, transformation potential, and precaution.

From a mainstream economic viewpoint, the EU ETS can be regarded as a qualified success. Emissions in covered sectors have declined, particularly after Phase III and subsequent reforms tightened the cap, reduced allowance surpluses, and stabilised the carbon process. At the same time, empirical studies report only limited losses in competitiveness for regulated firms. The system has evolved into a more coherent carbon market that, in neoclassical terms, increasingly fulfils criteria of cost-effectiveness and dynamic efficiency by providing continuous price-based incentives for abatement and low-carbon innovation.

However, when assessed through the lens of SEE, the ETS displays structural limitations that are not merely technical design flaws but flow from its institutional logic of governance by markets. Ecological adequacy remains partial, as the instrument regulates carbon intensity in selected sectors without addressing the overall scale of socio-economic metabolism or the growth dependence of accumulation. Distributional justice is only weakly built into the system. It is mostly added later using ETS revenues. At the same time, decision-making focuses more on setting prices and maintaining market stability than on democratic choices about how transactions should occur. As a result, the transformative capacity of emissions trading appears structurally constrained: it tends to optimise within existing production and consumption structures instead of challenging those that drive ecological overshoot.

These findings imply that carbon markets can contribute to mitigation, but are insufficient as the central pillar of socio-ecological transformation. From a socio-ecological perspective, climate policy needs to subordinate emissions trading to a broader strategy of social provisioning that prioritises non-tradable ecological limits, sufficiency-oriented restructuring of energy and mobility systems, and redistribution of ecological space. This would involve combining or replacing market-based instruments with direct regulation of infrastructure and resource throughput, precautionary and more democratic forms of governance, and social policies that ensure fair transitions and protect reproduction and care work. The decisive question is therefore no longer whether the ETS "works" as a market, but under which institutional conditions climate policy can align with planetary boundaries and social justice, and to what extent this requires moving beyond market-centred governance towards more transformative forms of socio-ecological provisioning."

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