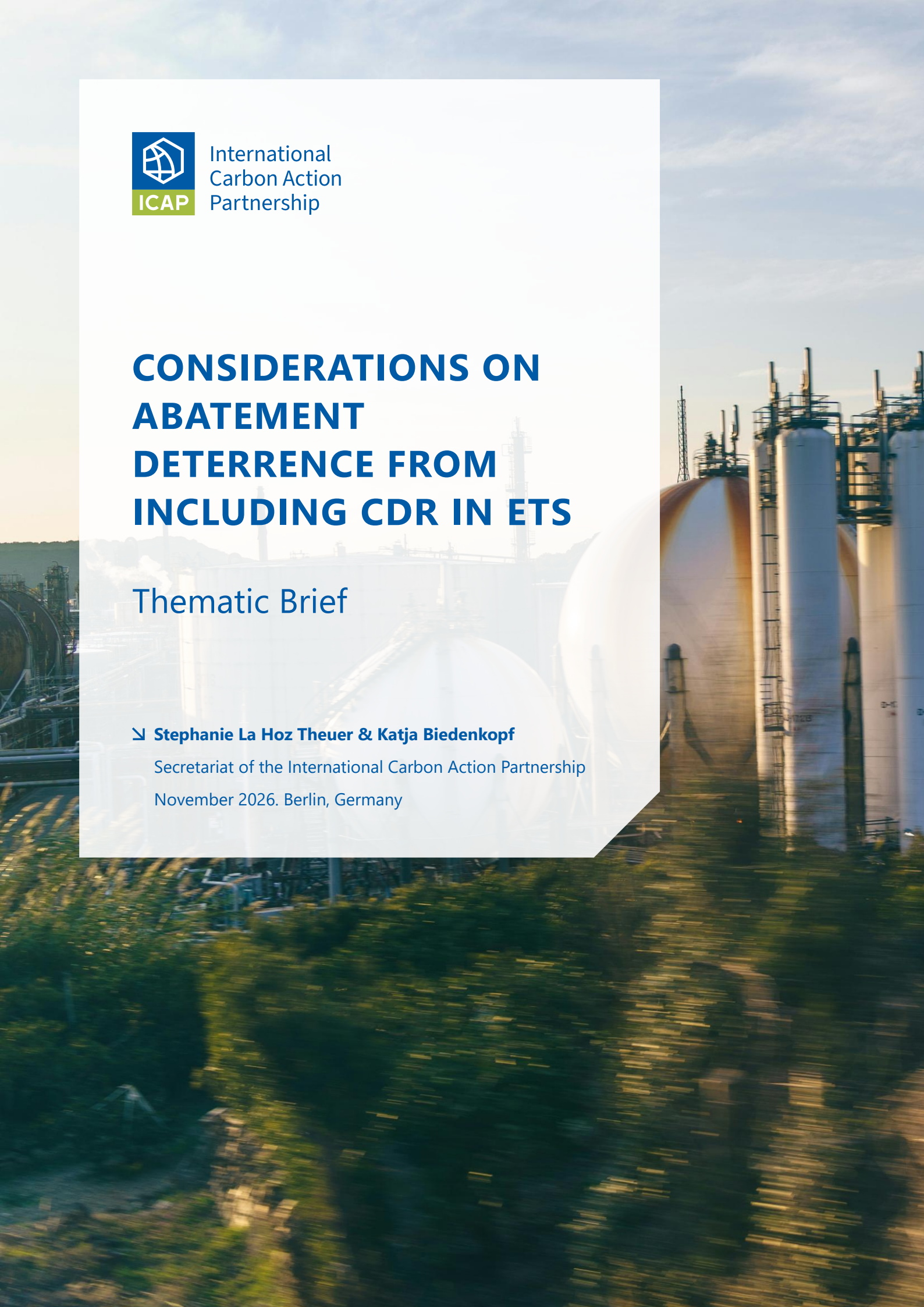

International Carbon Action Partnership

CONSIDERATIONS ON ABATEMENT DETERRENCE FROM INCLUDING CDR IN ETS

Thematic Brief

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EXECUTIVE SUMMARY

Integrating carbon dioxide removal (CDR) into emissions trading systems (ETSs) can lower compliance costs and help scale CDR, but it risks **abatement deterrence: reduced or delayed abatement resulting from the introduction or consideration of CDR in an ETS**. Abatement deterrence is not inherently problematic. **Where CDR delivers climate outcomes and broader societal benefits comparable to emission reductions, abatement deterrence may be acceptable or even desirable**, e.g., where abatement would otherwise entail prohibitive costs or substantial negative welfare impacts.

However, abatement deterrence can also be problematic. The European Scientific Advisory Board on Climate Change (ESABCC, 2025) identifies six concerns about delaying abatement action in favor of CDR: (1) Reliance on unproven CDR technologies; (2) Delayed near-term abatement; (3) Rebound effects; (4) Reversal risks; (5) Depletion of CDR potential; (6) Greater negative spillovers. While the ESABCC framework provides a comprehensive account of the risks, it was not designed with CDR-ETS interactions specifically in mind. This note explores how abatement deterrence takes place in the ETS context, distinguishing where effects occur (within or outside the ETS) and when (short or long term).

Abatement deterrence in the ETS context

Within the ETS, in the short term. Regulated entities may surrender removal units[1] instead of abating. This replacement is not inherently a problem and may be desirable, provided removals are equivalent to abatement and that outside-ETS effects are managed. However, low-cost removals – already cost-competitive in some ETSs, notably from land use – can depress allowance prices and dampen abatement incentives. This may help contain compliance costs, but can also lead to higher-carbon lock-in, shift mitigation effort across sectors, and deplete CDR potential. A fundamental question is whether removals can be made truly equivalent to abatement, especially at scale and with significant time lags.

Within the ETS, in the long term. Firms may defer abatement investments in anticipation of future cost-effective CDR, which is problematic if that CDR fails to materialize (concern 1). In principle, an ETS cap is self-correcting: if CDR fails to deliver, ETS prices rise and induce abatement. However, this safeguard breaks down if two conditions coincide: ETS regulated entities underinvest in abatement based on overly optimistic CDR expectations; and policymakers soften the cap when allowance prices rise. A similar risk arises if the cap is loosened in anticipation of CDR that does not materialize. In both cases, emissions are higher in the interim, increasing the risk of irreversible climate damage (concern 2).

Outside the ETS, in the short term. The main risk is rebound (concern 3), e.g., where biomass-based removals increase emissions in uncapped sectors along the CDR value chain (such as through land-use change and biomass transport), and where energy-intensive removals such as DACCS increase the use of emissions-intensive energy. These effects arise as soon as CDR is deployed at scale, but their emissions-related severity diminishes if ETS coverage expands to bring the relevant sectors under the cap. A residual risk nonetheless remains for sectors that are not brought under a cap, as well as for imported biomass where deforestation emissions are uncapped.

[1] Note that removals may be issued as offset credits or as allowances. We use 'removal units' here to encompass both options.

Similarly, negative spillovers (concern 6) are also a risk here, as are reversals (concern 4), especially if remediation for reversals happens outside the ETS.

Outside the ETS, in the long term. The expectation of future CDR may lead actors beyond the ETS to adopt less ambitious targets or policies than they would otherwise have set – mitigation forgone, or 'moral hazard', which we treat as part of concern 1. Other effects also outside the ETS and relevant to GHG emissions and removals include: the depletion of CDR potential, making it harder to achieve net negative targets in the second half of the century (concern 5); the risk of reversals if not compensated through the ETS (concern 4); and negative spillovers (concern 6).

Design responses

Design responses inside the ETS include: **managing expectations** (credible trajectories, gross-emission guardrails, borrowing limits; transparency on CDR developments); **relationship with the cap** (gross cap integration, maintain cap stringency); **defining equivalence** explicitly; setting **CDR limits**; using **sequencing**, using an **intermediary body**, defining **permanence and reversal provisions**, using **lifecycle MRV**, **expanding the scope** of the ETS; and defining robust **eligibility criteria**.

Outside the ETS, two important design dimensions are highlighted: **separating abatement and removal targets** and providing **dedicated CDR support.** These help address abatement deterrence across different channels and time horizons, as follows:

	Short term	Long term
Within the ETS	Determine equivalence of abatement and removals; avoid excessive price suppression due to low-cost removals; restrict interperiod borrowing; ensure all externalities are priced in; CDR limits to prevent excessive high-carbon lock-in; maintain cap stringency; channel removals through an intermediary body; limit the use of CDR to hard-to-abate sectors; address reversals within the ETS.	Reduce uncertainty (separate targets; credible trajectories, limits, sequencing) so firms do not rationally delay capital-intensive abatement; facilitate transparency on CDR developments; guardrail gross emissions and hold cap firm also during price hikes.
Outside the ETS	Address rebound via lifecycle MRV, ETS scope expansion, and companion policies; enact robust policies for permanence and reversals; reduce overall risks through stringent eligibility criteria and safeguards.	Manage scarce CDR potential over time (separate abatement/removal targets; credible net-negative pathway; robust policy for reversals) and avoid mitigation forgone in the wider policy mix; reduce overall risks through stringent eligibility criteria and safeguards.

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INTRODUCTION

Several jurisdictions are actively debating whether and how to integrate carbon dioxide removal (CDR)[2] into their emissions trading systems (ETSs). The United Kingdom, the European Union, and Brazil are among those considering concrete steps in this direction, while a few other systems (e.g. in California, China, and New Zealand, among others) already interact with CDR (La Hoz Theuer, Doda et al (2025); La Hoz Theuer & Wenzel (2025)).

Integrating CDR into an ETS can offer important advantages. Inside the ETS, it can provide compliance flexibility and help reduce compliance costs – which can be particularly impactful for residual and hard-to-abate emissions.[3] Outside the ETS, CDR integration can create incentives for CDR technologies to scale, complementing dedicated support policies. But integration also introduces risks, such as those stemming from challenges in quantification and reversal events. Including CDR in an ETS may also reduce or delay abatement – the risk of undesirable abatement deterrence.

Abatement deterrence is a key concern in current debates on CDR-ETS integration, yet it remains underexplored in the emissions trading literature. This note aims to help fill that gap. It maps the existing knowledge on abatement deterrence onto the ETS context, proposes an analytical framework that distinguishes between different channels and time horizons through which deterrence may operate, and sets out ETS design options to address undesirable abatement deterrence while retaining the key benefits of CDR-ETS integration.

The note is structured as follows. Section 2 conceptualizes abatement deterrence, tracing its origins in the broader mitigation deterrence literature, drawing on a systematic account of its risks, and developing an analytical framework that integrates recent ETS-specific analysis. Section 3 examines how regulated entities make decisions under uncertainty – a necessary foundation for understanding the long-term channel of abatement deterrence. Section 4 sets out ETS design options to prevent undesirable abatement deterrence.

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[2] CDR is understood to mean "anthropogenic activities removing carbon dioxide (CO2) from the atmosphere and durably storing it in geological, terrestrial, or ocean reservoirs, or in products. It includes existing and potential anthropogenic enhancement of biological or geochemical CO2 sinks and direct air carbon dioxide capture and storage (DACCS) but excludes natural CO2 uptake not directly caused by human activities." (IPCC 2023)

[3] There are no established definitions for 'residual' and 'hard-to-abate' emissions. In this note, 'residual emissions' is taken to mean any emissions that reach the atmosphere after the net-zero point (Schenuit et al. 2023; Smith et al. 2024); and "hard-to-abate" emissions to mean those whose abatement feasibility is limited because of technological, economic, social or political considerations (Edelenbosch et al. 2022; Lund et al. 2023; Schenuit et al. 2023; Smith et al. 2024).

1 CONCEPTUALIZING ABATEMENT DETERRENCE IN ETSS

Abatement deterrence is a term recently coined in the specific context of integrating CDR into emissions trading.[4] In this context, it generally refers to **the prospect of reduced or delayed abatement resulting from the introduction or consideration of CDR in an ETS.**

Abatement deterrence can generally occur in two ways: through the offsetting of emissions with removals within a given time period; and through delay to or deterrence of abatement in anticipation of removals becoming available at scale and with affordable costs in the future (ESABCC, 2025).

Importantly, abatement deterrence is not inherently problematic (Markusson et al., 2018). Including CDR in ETSs can deter abatement inside the ETS, but spur investment in CDR. As long as CDR can deliver climate outcomes and broader societal benefits comparable to those from emission reductions, abatement deterrence (through the offsetting or substitution of emissions with CDR) may be acceptable or even desirable, particularly where abatement would otherwise entail prohibitive costs or substantial negative welfare impacts (ESABCC, 2025).

However, abatement deterrence can also be problematic. While policy objectives that focus narrowly on the achievement of temperature goals might readily accept substitution by carbon removals, broader considerations emphasizing climate justice, biodiversity, and technological uncertainties may view this substitution less favorably (Carton et al. 2021, Moioli et al. 2025). The European Scientific Advisory Board on Climate Change (ESABCC, 2025) identifies six concerns about delaying abatement action in favor of CDR:

1. **Reliance on unproven CDR technologies.** Large-scale deployment of permanent CDR depends on technologies that are not yet at the necessary stage of development and are comparatively costly. If these technologies fail to materialize as anticipated, emissions cannot be retroactively reduced, leading to higher atmospheric GHG concentrations and elevated climate risks (Carton et al., 2023; McLaren, 2020; Markusson et al., 2018).
2. **Delayed near-term abatement.** Even if future permanent CDR performs as expected, delaying near-term abatement increases atmospheric GHG concentrations in the interim, raising the risk of triggering climate tipping points and causing irreversible damage (Schleussner et al., 2024). This asymmetry in the effect of emissions and removals increases with volume (Zickfeld et al 2021). Effects could also be felt in terms of lower technological spillovers: if developed countries lower abatement investments, other countries may suffer from reduced technological spillovers (Moioli et al., 2025).

[4] The term abatement deterrence is derived from mitigation deterrence, a concept some authors also apply to CDR in ETSs. Markusson et al. (2018) define mitigation deterrence as "the prospect of reduced or delayed mitigation resulting from the introduction or consideration of another climate intervention." In the context of this note, that intervention is CDR. However, in the context of CDR, the term mitigation deterrence can be misleading because CDR itself constitutes a form of mitigation (Honegger et al., 2021). What is reduced or delayed due to investment in CDR is *abatement*, not mitigation per se. For this reason, 'abatement deterrence' more accurately captures the dynamic that may occur when CDR is integrated into an ETS – namely, that regulated entities defer action or investment in abatement that they would otherwise undertake.

3. **Rebound effects.** CDR may yield fewer climate benefits than anticipated due to rebound effects, including increased emissions along the CDR value chain, spillover effects such as indirect land-use change, and the lock-in of fossil fuel infrastructure (McLaren, 2020).
4. **Reversal risks.** Future reversals of removals undermine their climate benefit unless compensated by new removals. This may be infeasible or raise concerns about intergenerational fairness (Markusson et al., 2018). The risk is particularly acute if the costs of continuous monitoring and compensating potential reversals are not fully reflected in CDR prices, making them appear cheaper than they truly are (Prado and Mac Dowell, 2023, Moioli et al 2025).
5. **Depletion of CDR potential.** Using CDR to substitute for reductions in activities that have viable abatement alternatives could deplete the limited CDR potential needed to achieve net-negative emissions in the second half of the century (Schleussner et al., 2024).
6. **Greater negative spillovers.** Compared with emission reductions, CDR is likely to yield fewer positive externalities and may carry higher risks of negative externalities (Carton et al., 2023; Markusson et al., 2018; McLaren, 2020).

While the ESABCC framework provides a comprehensive account of the risks, it was not designed with CDR-ETS interactions specifically in mind. Two analytical distinctions help locate these risks more precisely and identify appropriate design responses in the context of ETS policy. A first dimension is whether the effect happens within or outside the ETS. This dimension, highlighted by Sultani et al. (2026), distinguishes between abatement deterrence within and outside the ETS as a result of CDR inclusion in the ETS. A second analytical dimension concerns the time horizon over which abatement deterrence operates.[5] Note that the analysis below focuses on effects related directly or indirectly to GHG emissions and removals.

Within the ETS, short term. Within-ETS abatement deterrence arises when regulated entities replace abatement in the ETS with CDR – for example, where an ETS-covered entity that faces obligations in a given year chooses to surrender a removal unit rather than abating to fulfil its compliance obligation. As highlighted above, *this replacement is in itself not a problem and may be desirable, provided that removals are equivalent to abatement and that outside-ETS effects are managed*. The inclusion of low-cost removals (which are often also non-permanent) could, however, lower ETS prices and dampen abatement incentives inside the ETS – which may on the one hand be desirable (e.g. to reduce compliance costs and improve political acceptability of the system) – but may on the other hand also lead to higher-carbon lock-in and increased outside-ETS effects from CDR use (see next paragraph). This is relevant in particular for mitigation burden sharing across sectors as well as for the depletion of CDR potential. In the short term, this risk is most immediate where removals (notably from land-use, such as from afforestation, reforestation, and biochar projects) are already cost-competitive in some ETSs today. A fundamental question, in this case, is also whether removals can be made truly equivalent to abatement – especially on a large scale and with significant time lags. Within-ETS abatement deterrence can also happen in the short term if ETS revenues are redirected from supporting abatement in ETS-covered sectors to supporting CDR.

Within the ETS, long term. Within-ETS deterrence can also happen as a result of an anticipatory choice, notably where entities forgo investments in future abatement in the hope of cost-effective CDR in the future. For example, while permanent CDR technologies such as BECCS and DACCS are not yet cost-competitive in ETSs, firms making capital-intensive investment decisions today must nevertheless form expectations about future CDR costs and availability. They may defer abatement

[5] While we differentiate this by short term vs long term, this dimension could also be understood as "at realisation" vs "in expectation", respectively.

investments accordingly, even before any CDR unit has entered the market. Similarly, regulated entities could choose to invest in CDR to help drive deployment of removals rather than invest in abatement technology on their own site. Such choices can be problematic in particular if the expected CDR fails to materialize at anticipated costs and/or scale (ESABCC concern 1). In principle, a stable ETS cap provides a structural safeguard against this, as a failure for CDR to deliver in the context of an upheld cap would drive up carbon prices, inducing abatement in the system. Under this logic, within-ETS abatement deterrence is largely self-correcting. However, this safeguard breaks down when two conditions are met simultaneously: a market failure condition, in which regulated entities under-invest in abatement based on overly optimistic CDR expectations (e.g. due to information asymmetries about future CDR costs); and a policy failure condition, in which policymakers soften the cap (e.g. when allowance prices rise beyond politically acceptable levels - Sultani et al., 2026). When both conditions materialize together, the ETS's environmental integrity is compromised. If regulated entities systematically defer abatement based on optimistic CDR expectations that prove wrong, the resulting carbon price spike creates political pressure to soften the cap precisely when it needs to hold firm, increasing atmospheric GHG concentrations in the interim and thereby raising the risk of triggering irreversible climate tipping points (ESABCC concern 2).[6] A similar dynamic can occur through cap-setting effects – if the ETS cap is loosened in the expectation of CDR in the future, but the CDR does not materialize and the cap is not tightened back in response, then the atmosphere will see higher emissions than if the cap loosening had not taken place.

Outside the ETS, short term. Outside-ETS abatement deterrence arises through several mechanisms. Sultani et al (2026) highlight in particular rebound effects (ESABCC concern 3). Rebound effects can happen for example where biomass-based removals increase emissions in uncapped sectors along the CDR value chain, such as through land-use change in agriculture and forestry and through the transportation of biomass.[7, 8] Similarly, they can occur with competition for energy for energy-intensive technological removals such as DACCS, if such competition leads to higher use of emissions-intensive energy sources. These rebound effects are primarily a short-term concern, arising as soon as CDR is deployed at scale. Their emissions-related severity diminishes if ETS coverage expands to bring the relevant sectors under the cap. A residual risk nonetheless remains for sectors that are not brought under a cap, as well as for imported biomass if deforestation emissions are uncapped in the country of origin. Reversals (ESABCC concern 4) are also a risk here, especially if remediation for reversals happens outside the ETS in an uncapped (or less strictly capped) environment.

Outside the ETS, long term. Mitigation forgone (also referred to as 'moral hazard', see e.g. Carton et al (2023)) relates to a situation where the expectation of future CDR leads actors beyond the ETS to adopt less ambitious abatement targets or policies than they would otherwise have set (which we see as part of ESABCC concern 1). This is primarily a long-term risk: it operates through the gradual erosion of policy ambition over time as CDR expectations become embedded in national climate strategies and sectoral policies. Other long-term effects also outside the ETS and relevant to GHG emissions and removals include: (a) the depletion of CDR potential (e.g. CO2 storage sites and other sinks), which can limit the possibility of addressing residual emissions

[6] While such an effect may also take place regarding anticipated abatement technologies, Sultani et al (2026) argue that the effect is more pronounced in the case of CDR due to information asymmetries on the development of CDR technologies.

[7] As will be seen below, this effect can be addressed if lifecycle emissions are deducted from the CDR calculation, such that the removal units issued represent the net outcome. This is already the case in most crediting programs, although the treatment of different sources varies across programs. This is an area of active ICAP research.

[8] Beyond the effect on emissions, an increased use of biomass can lead to socially inefficient use of land, if externalities and other policy priorities are not appropriately internalized or otherwise regulated. While this is not discussed here as an effect on GHG emissions, it is nonetheless a crucial area of society-wide concern. See e.g. Braun et al (2025).

outside the ETS and make it harder to achieve net negative targets in the second half of the century (ESABCC concern 5) – this is a long-term risk that accumulates as replaced or deferred abatement progressively exhausts the CDR potential needed beyond net-zero; (b) the risk of reversals if not compensated through the ETS (ESABCC concern 4) – a risk that spans both time horizons, as reversals can occur at any point during the lifetime of a temporary removal; and (c) negative spillovers (ESABCC concern 6) – which, like reversals, span both time horizons, as many arise at deployment while others accumulate over time.

Table 1 maps the ESABCC concerns onto this two-dimensional framework, illustrating how each concern relates to a specific channel and time horizon, and pointing toward the design responses set out in section 4.

Table 1 - ESABCC concerns across the two dimensions of analysis

ESABCC concern	**Channel**	**Time horizon**
(1) Reliance on unproven CDR technologies	Within and outside-ETS	Long-term
(2) Delayed near-term abatement	Within-ETS	Long-term
(3) Rebound effects	Outside-ETS	Short-term
(4) Reversal risks	Within and outside-ETS	Short and long-term
(5) Depletion of CDR potential	Outside-ETS	Long-term
(6) Greater negative spillovers	Outside-ETS	Short and long-term

2 REGULATED ENTITIES' DECISION MAKING UNDER UNCERTAINTY

Understanding how abatement deterrence operates through the long-term, within-ETS channel requires understanding how regulated entities make investment decisions under uncertainty. The potential integration of permanent CDR technologies – not yet cost-competitive but anticipated by some firms to become so – shifts the decision context: whether to invest now in abatement or to wait for future CDR options that could render such investments unnecessary or defer their need.

To our knowledge, there is no study to date on how regulated entities make decisions under the prospective integration of permanent CDR into an ETS. However, several analyses examine other ETS features and reforms that changed regulated entities' expectations with regard to the future ETS development, such as the introduction of the Market Stability Reserve (MSR) in the EU ETS (see, e.g., Borghesi et al., 2023). These studies reach a consistent conclusion: uncertainty dampens abatement investment, pushing firms towards incremental, flexible measures such as fuel switching rather than capital-intensive options such as green hydrogen (Borghesi et al., 2023; Dolls et al, 2026; Pahle and Edenhofer, 2021; Venmans, 2016).

Capital-intensive assets – such as power plants or steel furnaces – earn returns over decades and have long asset lifetimes. Firms therefore care not only about expected cash flows, but also about the stability and credibility of the rules that govern and influence them. Decisions not to invest in carbon-intensive assets, or to invest in alternative, low-carbon ones, depend heavily on the certainty and policy longevity associated with carbon pricing policies (Dolls et al, 2026).

Many studies of decision-making by ETS-regulated entities (such as Tautorat et al, 2026 and Venmans, 2016) draw on real options theory, which posits that when investment is irreversible and future conditions are uncertain, the option value[9] of waiting increases. Greater volatility raises the threshold at which it becomes optimal to invest, often inducing delay (Dixit and Pindyck, 1994). As Venmans (2016) summarizes, investing today eliminates the option to invest later under more favorable conditions – for example, when technology costs are lower – or not to invest at all if future carbon prices turn out to be low.

Regulated entities make abatement investment decisions with a forward-looking lens. Because abatement measures are often capital-intensive, take time to implement, and yield returns over many years, firms must anticipate future carbon prices, technology costs, and ETS rules when deciding today. The predictability and credibility of the ETS trajectory therefore matter enormously (Pahle and Edenhofer, 2021). Credible long-term commitments to climate targets and to the integrity of an ETS have encouraged more farsighted behavior among regulated entities in the past (Sitarz et al., 2024). Price-containment and flexibility from the inclusion of CDR could also support ETS credibility (Best et al 2026). In short, signaling has been integral to ETS effectiveness: when ambition is paired with credible commitment, firms invest earlier and more decisively (and this applies to both abatement and removal); when uncertainty dominates – for example about the

[9] Option value describes the value associated with having the flexibility to choose from various alternatives in the future, rather than committing to a specific course of action now.

role and future evolution of CDR – firms rationally delay, awaiting clearer price trajectories, technology cost declines, and governance rules (Döbbeling-Hildebrandt et al., 2024; ESABCC, 2025).

Building on these insights into regulated entities' decision making and the distinction between short- and long-term impacts of uncertain technological and policy developments, the next section links the abatement deterrence concerns identified by the ESABCC to emissions trading systems and then sets out ETS design options proposed in the literature to prevent undesirable abatement deterrence. The discussion is organized around the six concerns identified by the ESABCC mentioned in section 2.

3 AVOIDING UNDESIRABLE ABATEMENT DETERRENCE

Policymakers must strike a balance between harnessing the economic efficiency benefits of integrating CDR into ETSs and addressing the risk of undesirable abatement deterrence. As per the understanding of abatement deterrence from section 2, the design challenge differs depending on the channel and time horizon through which deterrence operates. This section expands upon the analysis by Burke & Gambhir (2022) and outlines concrete policy options for addressing abatement deterrence in the ETS context.[10]

3.1 Mapping solutions

The six ESABCC concerns identified in section 2 have distinct implications for ETS design, falling along the two dimensions of the analytical framework. This section maps potential, ETS-relevant solutions to each of the six ESABCC concerns. Section 4.2 then provides more details on each of the strategies.

(1) Reliance on unproven CDR technologies. This is primarily an anticipatory (long term) effect both within and outside the ETS, and calls for a careful management of both gross and net emissions over time, e.g. through:

- Separate abatement and removal targets, also determining the circumstances under which a removal is equivalent to abatement. ETS trajectories should then remain consistent with jurisdictional targets. An intermediary body can also support with this;
- Transparent rules for CDR inclusion – sequencing provisions, with robust eligibility criteria[11] and credible quantity limits – create near-term certainty within the ETS while preserving a credible long-term vision;
- Facilitating information and transparency on CDR developments and price expectations, thereby helping ETS actors make better-informed decisions;
- Maintaining cap stringency, e.g. by using removal units to replace conventional allowances rather than in addition to them, and by avoiding loosening the ETS cap in the expectation of future CDR without establishing reliable safeguard mechanisms should CDR not materialize as expected.

(2) Delayed near-term abatement. In the ETS context this happens primarily if regulated entities delay abatement in the hope of future CDR, but where CDR fails to materialize and the cap is softened rather than holding firm – in this case, GHG emissions could increase compared to a situation where no CDR was allowed in. This reinforces the case for:

[10] For an analysis of options to address abatement deterrence in the wider climate policy mix, see Höglund et al. 2023.

[11] Stakeholders sometimes argue for eligibility criteria as a means to address the 'reliance on unproven technologies' concern. We note that even if systems were to focus only on the "mature" CDR technologies (notably, those related to forestry), there could still be a failure to deliver – for example, some forests may turn from sinks to sources in the next decades.

- Limiting gross emissions in regulated sectors, even where future CDR availability appears plausible. Abatement-specific targets can set clear expectations for the level of emission reductions required independently of CDR contributions, and public investments into decarbonization technologies (e.g. from ETS auction revenues) can support development and deployment of such technologies;

- Restrictions on interperiod borrowing, which can limit the degree to which regulated entities can defer compliance obligations to future periods;

- Maintaining cap stringency, as described above; and

- Channelling removal units through an intermediary body that controls their volume and timing of release, which can reduce the scope for regulated entities to defer abatement based on their own expectations of future CDR costs.

(3) Rebound effects take place primarily outside the scope of the ETS and highlight that CDR may deliver lower net climate benefits than anticipated. Like concern 1, this reinforces the case for:

- Establishing stringent eligibility criteria for removal units admitted for compliance, alongside additional safeguards (e.g. for the use of biomass);

- Limiting overall CDR volumes (potentially with limits specific to certain CDR technologies, e.g. to limit the volume of biomass-intensive technology) within the ETS, and maintaining robust gross emission trajectories; and

- Expanding the scope of the ETS so as to limit rebound through the ETS cap, and/or employing MRV methodologies that account for full lifecycle emissions on a net basis. Residual risks – particularly indirect effects difficult to attribute and behavioral responses outside the ETS – require companion policies and robust MRV standards.

(4) Reversal risks are relevant within and outside the ETS, and span short- and long-term effects. Managing these effects involves:

- Establishing stringent eligibility criteria for removal units admitted for compliance, including robust MRV requirements and clear permanence and reversal provisions to ensure that reversals are addressed and that reversal costs are fully reflected in CDR prices. This may include a requirement to address reversals within the ETS (by surrendering compliance units), so as to maintain the integrity of the cap.

- Establishing robust equivalence ratios (or conversion rates) based on the risk and carbon duration of different CDR methods – e.g. such that multiple removal units be necessary to offset one tonne of CO2e.

(5) Depletion of CDR potential is an outside ETS, long term risk. This involves understanding the role that CDR can and should play in different sectors over time, taking a limited CDR potential into account. Managing a limited CDR potential requires:

- Deliberate, integrated and long-term management of limited CDR resources over time, which in turn requires clear long-term climate trajectories with separate abatement and removal targets (including net negative targets for the second half of the century), and ETS design that remains consistent with these pathways.

- Inside the ETS, this could entail limiting who can benefit from CDR. Markusson, Brad & Schneider (2026), for example, suggest that 'easy-to-abate' sectors be required to pay a premium for CDR permits to ensure deep emissions reductions remain the focus in those sectors.

(6) Negative spillovers is an outside ETS risk, spanning both time horizons. They further underscore the importance of:

- Deliberate, integrated and long-term CDR management – see concern 5

- Companion policies outside the ETS (e.g. targeting biodiversity objectives), including dedicated CDR support instruments that ensure commercialization does not come at the cost of abatement ambition.

The solutions above can be mapped onto the two dimensions of analysis as displayed in Table 2.

Table 2 - Abatement deterrence solutions across the two dimensions of analysis

	Short term	Long term
Within the ETS	Determine equivalence of abatement and removals; avoid excessive price suppression due to low-cost removals; restrict interperiod borrowing; ensure all externalities are priced in; CDR limits to prevent excessive high-carbon lock-in; maintain cap stringency; channel removals through an intermediary body; limit the use of CDR to hard-to-abate sectors; address reversals within the ETS.	Reduce uncertainty (separate targets; credible trajectories, limits, sequencing) so firms do not rationally delay capital-intensive abatement; facilitate transparency on CDR developments; guardrail gross emissions and hold cap firm also during price hikes.
Outside the ETS	Address rebound via lifecycle MRV, ETS scope expansion, and companion policies; enact robust policies for permanence and reversals; reduce overall risks through stringent eligibility criteria and safeguards.	Manage scarce CDR potential over time (separate abatement/removal targets; credible net-negative pathway; robust policy for reversals); avoid mitigation forgone in the wider policy mix; reduce overall risks through stringent eligibility criteria and safeguards.

3.2 Addressing abatement deterrence challenges

As outlined in section 4.1, a range of strategies can be employed to address undesirable abatement deterrence when designing the inclusion of CDR in an ETS. These strategies can be grouped into (1) ETS design measures and (2) broader climate policy mix measures.

(1) ETS design measures

A credible long-term pathway for the ETS – particularly its potential contribution to delivering sufficient removals to reach net-negative emissions in the second half of the century – will enhance certainty for long-term investment decisions. Regulatory certainty on CDR inclusion in the ETS can be provided through several elements:

Managing expectations for the short and long term. Providing a credible policy pathway for the ETS within the broader climate policy mix – including the role of CDR – is essential to minimize the uncertainty that often leads regulated entities to defer abatement investment. In the immediate term, transparency on CDR developments and related price expectations can help regulators and regulated entities make informed decisions. Policy decisions would ideally be informed by realistic CDR supply potentials, rather than purely by hypothetically cost-effective modelling results. The short- and medium-term trajectories for both gross and net emissions from ETS-regulated entities must be transparent and aligned with the jurisdiction's climate goals. Clear limits on gross and net emissions serve as guardrails for the ETS's role in the policy mix. Restrictions on borrowing across compliance periods, especially across phases, can discourage the deferral of investment decisions by providing clarity on scarcity and guiding short-term choices. Where an intermediary body is used, pre-announced rules on its purchases and releases of units can further anchor expectations (see 'Intermediary body').

Relationship with the ETS cap. Two related but distinct aspects of the cap matter for abatement deterrence: its architecture, i.e. how removal units relate to the cap, and its stringency, i.e. the level and trajectory at which the cap is set.

Cap architecture. How removal units relate to the cap affects which part of the system bears the risk of abatement deterrence. Two broad options exist (Verbist et al., 2025):

- *Net cap*: removal units are added on top of the cap – that is, it increases the pool of compliance units in the ETS. The cap (that is, the volume of conventional allowances) then fixes net emissions, and gross emissions are defined by cap plus the removal units surrendered.
- *Gross cap*: each removal unit entering the system leads to the cancellation of an allowance. The cap then fixes gross emissions, and net emissions fall as conventional allowances are replaced with removal units (Rickels et al., 2021).

In Verbist et al.'s (2025) modelling, gross cap designs reduce the risk of abatement deterrence as compared to net cap integration. This is because, under a gross cap, removal units replace allowances instead of adding to them, such that the total volume of allowable gross emissions stays fixed regardless of how cheap or plentiful removals become; regulated entities therefore cannot expect to emit more by relying on removals, and the abatement required within the ETS remains determined by the cap rather than by removal costs.

Cap stringency. Whichever architecture is chosen, the level and trajectory of the cap determine how much abatement is required within the ETS. A cap trajectory aligned with the jurisdiction's climate targets gives regulated entities a clear signal of the emission reductions expected of them. Where the cap is set at a higher level in anticipation of future removals, the environmental outcome of the ETS becomes contingent on those removals being delivered: if CDR falls short of expectations and the cap is not adjusted in response, cumulative emissions will be higher than under the original trajectory. Pairing such cap decisions with safeguards helps manage this risk –

for example providing for pre-defined review points at which the cap is recalibrated should CDR deployment differ from expectations.

Equivalence between abatement and removal. ETS policymakers must define whether, and under what conditions, a removal unit can be surrendered against an emission in the scope of the ETS. Answering this question requires deciding not only *whether* removals are equivalent to abatement, but *in what respect,* and *when*. The carbon market literature usually focuses on permanence (e.g. Burke & Schenuit, 2024), which the ETS is best equipped to price and enforce – since MRV, liability rules, and allowances are all denominated in tCO2e (see also 'Permanence and reversal provisions' further below). As discussed in section 2, however, whether a removal delivers benefits comparable to an emission reduction also depends on its co-benefits, its effects on biodiversity and land use, its distributional and justice implications, and the technological lock-in it may entail, among many others (Carton et al., 2021; Moioli et al., 2025). Moreover, the time dimension is also important: given the asymmetry in warming and cooling effects of emissions and removals respectively (Zickfeld et al. 2021), the equivalence between emissions and removals may falter where there is a significant time lag between emissions and removals. Thus, the scope of a fungibility test would ideally be set explicitly. Where an ETS confines the test to permanence, the dimensions left out should be secured through other policy instruments (outside of the ETS) that ensure that broader policy goals are met.

Limits to CDR use. Setting limits on the use of CDR in the ETS can help balance cost-effectiveness with the risk of abatement deterrence, albeit also limiting the support that ETSs can provide to CDR upscaling. These limits can be implemented on either the supply or demand side. The bullets below outline the key options; for a detailed analysis on limits to CDR use, see McDonald & Gardiner (2026).

- **Overall quantity**: To manage undesirable abatement deterrence, policymakers could set volume limits that increase gradually, with clear, pre-announced trajectories. Tight limits would be more effective at curbing abatement deterrence. Limits could be set per compliance cycle or trading period. Policymakers looking to maintain gross emission trajectories could also establish price or quantity triggers to suspend CDR eligibility if allowance prices fall below a certain floor, although this could introduce significant uncertainty for CDR suppliers.
- **Supply and demand-side limits**: Limits are crucial if ETS regulators wish to control gross ETS emissions (and not only net emissions). They can be implemented on the supply and the demand sides. Supply side limits restrict how many removal units can enter the ETS without controlling who can use the units and how many units one regulated entity can use. Demand-side limits restrict how many removal units each regulated entity is allowed to surrender. In all cases, the limit would need to be highly credible and enforceable to help prevent undesirable abatement deterrence.
    - *Supply side, intermediary body*. An intermediary body purchases removal units and controls how many enter the system and when (see 'Intermediary body' below). Transparent and clear rules on how many units are purchased and when they are released would create certainty for market players.
    - *Supply side, first come, first served*. An overall limit on removal units is consumed as units flow into the system – either at the point of entry or at surrender for compliance. This approach could discourage speculative over-reliance on CDR by making the scarcity explicit: once the limit is reached, no further units can enter the ETS. This, however, can be very difficult to implement if regulators want to enable fair access to the limit "space" for CDR suppliers and regulated entities.

- *Demand-side limits* establish clear rules on how many removal units individual regulated entities can use, and who can use them. This could for example be expressed as a maximum percentage of the regulated entity's compliance obligations, which could potentially increase over time. A demand-side limit could be linked to specific sectors with hard-to-abate emissions (as proposed by Markusson et al 2026), although such tailoring can be highly contentious as it would require an explicit definition of what constitutes 'hard-to-abate', beyond an implicit definition through marginal abatement and removal costs (for a description of different approaches to defining hard-to-abate emissions, see La Hoz Theuer, Ortiz Rivera et al, 2025).

Sequencing: A phased approach, starting with a limited number of removal units and increasing over time, allows for policy learning and the gradual integration of permanent CDR as they approach cost competitiveness. See Burke & Gambhir (2022) and Burke & Schenuit (2024) for conceptualizations, as well as Sultani et al. (2026) for a detailed sequencing proposal in the context of the EU ETS.

Intermediary body: An intermediary body – such as a public agency or central carbon bank – can act as a buffer between the CDR market and the ETS, purchasing removal units and controlling their release into the system. The degree of control can vary. At one end, the intermediary releases removal units as distinct compliance units that regulated entities can acquire and surrender. At the other, it follows a non-differentiated approach: removal units are auctioned alongside, and under the same rules as, regular allowances, so that regulated entities have minimal interaction with CDR and the intermediary is in full control of volumes and timing. Reserves can also be used to hold units for later release. An intermediary can help address abatement deterrence in several ways. First, because regulated entities do not procure removal units directly, their abatement decisions depend less on their own expectations of future CDR costs and availability; transparent, pre-announced rules on purchase volumes and release timing can further reduce uncertainty and thus the incentive to defer abatement investment to preserve option value. Second, by releasing units only under defined conditions – for example, when allowance prices exceed a pre-set threshold – the intermediary can prevent low-cost removals from suppressing allowance prices and weakening abatement incentives. Third, the intermediary can bridge the gap between CDR costs and allowance prices, supporting early deployment without exposing regulated entities to high removal costs. To realize these benefits, the intermediary should base its purchase volumes on realistic assessments of CDR supply and have access to a stable funding source.

Permanence and reversal provisions: Such provisions can involve several aspects, including MRV measures (such as the length of the monitoring period), liability measures (such as legal obligations in the case of a reversal), de-risking measures (such as insurance and market discount rates), durability measures (such as buffer pools) and fungibility measures (that is, trying to value CDR according to different levels of permanence, thereby arriving at equivalence ratios - see Watson & Bui (2026) for a description and analysis of several options) (Burke & Schenuit, 2023). Addressing reversals under the ETS (e.g., requiring the surrender of allowances in case of a reversal), helps ensure that reversals are also subject to a cap. Where temporary removals are used, this must be paired with discounting and robust liability, buffer, and monitoring mechanisms (Burke & Schenuit, 2023; Brander & Broekhoff, 2023; Watson & Bui, 2026)[12] – noting that existing such instruments may require significant reforms in order to achieve the necessary level of robustness.

[12] See also Venmans, Rickels and Groom (2026) for a proposal on using multiple temporary removal units to offset methane emissions.

Current buffer pools, for example, may be significantly undercapitalized – see e.g. Wu et al (2026) and Anderegg et al (2025).

ETS scope expansion: Can help address rebound effects, e.g. due to transport fuels and land-use. This is because the bigger the scope of the ETS, the smaller the space outside the ETS is – thus bringing more of the emissions under a cap.

Lifecycle MRV. Rebound effects (ESABCC concern 3) arise where a removal generates emissions along its value chain, such that its net climate benefit is smaller than the carbon it directly removes from the atmosphere. Where MRV methodologies account for these emissions on a full-lifecycle, net basis, the removal is credited only for the abatement it actually delivers, partly internalising rebound within the ETS by pricing the upstream emissions into the quantification. This, however, can lead to an issue of double penalty: where value-chain emissions already fall under the ETS and face a price, netting them off charges the CDR supplier twice. How best to address this issue is an area of active research.

Eligibility criteria: Clear standards for which CDR technologies qualify for ETS inclusion, based on criteria such as technological maturity, MRV, and permanence. Additional criteria could safeguard other environmental and social impacts. Eligibility criteria primarily serve to ensure the environmental integrity of removal units admitted for compliance – e.g. screening out technologies with high reversal risk or that cannot be quantified appropriately. The so-called like-for-like principle[13] is a prominent example, where only permanent geological removal would be considered sufficiently robust to offset fossil fuel emissions. Eligibility criteria also help exclude low-quality removal units, thus preventing a situation where cheap but unreliable removals flood the ETS, suppressing allowance prices and reducing abatement incentives in the system. A common assumption in current debates is that strict eligibility criteria (such as the requirement for permanent geological storage, exemplified by DACCS) imply high cost, and therefore preserve strong abatement incentives. While this holds under current cost conditions, it need not hold in the future: the eligibility criterion (permanence) and the cost of meeting it are two separate variables. Policymakers may therefore wish to test underlying assumptions by considering how a set of policies would perform if a DACCS technology emerged with removal costs of, for example, USD 1 per tonne. In that case, a technology that fully meets strict eligibility criteria could nonetheless become cheap enough to displace emissions reductions and weaken abatement incentives.

(2) Climate policy mix and companion policies

A robust, wider climate policy mix can and must further support the avoidance of abatement deterrence, including by reducing the costs of abatement. Höglund et al. (2023) provides a practical set of suggestions for how countries and other entities can manage the risk of undesirable abatement deterrence (see Figure 1 further below). Here, we highlight two in particular:

Separate abatement and CDR targets: Distinct targets for abatement and removals provide clarity on each pathway. They form the basis for setting CDR limits within the ETS and eliminate incentives to delay abatement investments in anticipation of cheaper CDR options. Separate targets also clarify the pathway beyond net-zero and for achieving net-negative emissions and addressing carbon budget overshoot. (See, e.g., Brad & Schneider 2023)

[13] For a discussion on the like-for-like principle, see Lebling & Lashof (2025).

CDR policy support: While an ETS can support CDR development and deployment once technologies become cost-competitive, support for commercializing CDR should primarily come from policy instruments outside the ETS. This approach helps mitigate the risk that failure of CDR technologies will make it impossible to retroactively reduce emissions.

Figure 1 - How to avoid carbon removal delaying emission reductions



Source: Höglund et al. (2023)

Table 3 below identifies ETS design elements that can help address each of the six abatement deterrence challenges.

Table 3 - Design elements across the six ESABCC concerns

	(1) Technology risk	(2) Near-term abatement deferral	(3) Rebound effects	(4) Reversal risks	(5) Depleting removal potential	(6) Negative spillovers
Within the ETS						
Managing expectations for the short and long term	x	x				
Relationship with the ETS cap	x	x				
Defining equivalence	x		x	x		x
CDR limits	x	x	x	x	x	x
Sequencing	x	x			x	
Intermediary body	x	x				
ETS scope expansion			x			
Permanence and reversal provisions				x		
Lifecycle MRV			x			
CDR eligibility criteria	x		x	x		
Outside the ETS						
Separate targets	x	x			x	x
CDR policy support	x		x			x

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