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Options for implementing limits for CDR integrated into the EU ETS 1

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Abstract: Options for implementing limits for CDR integrated into the EU ETS 1 1

To support the achievement of EU climate targets, the European Commission is expected to propose the integration of permanent carbon dioxide removals (CDR) into the EU Emissions Trading System 1 (EU ETS 1) in the context of the ETS revision starting in July 2026. Motivations include compensating for (hard-to-abate) residual emissions as well as flexibility and cost-effectiveness. While such integration could help scale permanent removals and provide flexibility for EU ETS 1 participants, it also raises concerns regarding mitigation deterrence, market uncertainty, sustainability impacts, and fiscal and distributional effects. This report examines how limits on permanent CDR credits used for compliance within the EU ETS 1 could be designed to address these risks. It identifies and describes how nine potential limit approaches could be implemented, falling within four categories: quantitative supply-side limits, quantitative demand-side limits, qualitative supply-side limits, and qualitative demand-side limits. We briefly assess these considering likely policy objectives, and find that the suitability of limit approaches depends on the policy objective as well as the model for integrating CDR into the EU ETS 1. The findings suggest that, where CDR is integrated via an intermediary, a combination of a maximum CDR integration limit with stringent CDR certificate eligibility rules performs particularly well against the criteria of quantity management and cost-effectiveness. Similarly, where CDR is integrated directly into the EU ETS 1 without an intermediary, our results suggest that individual entity limits combined with CDR certificate eligibility rules appear most suitable against these same criteria. Under both models, technology-specific quotas may help support a diverse CDR portfolio, important to manage risks and reduce long-term costs. “Favouring” approaches that give some emitters preferential access to CDR allowances pose some practical and cost-effectiveness challenges; this means that other policy tools that are not considered in this paper, such as targeted free allocation of allowances, may be preferable to achieve distributional objectives motivating such limit approaches. The report concludes that some form of quantitative limit is likely needed to safeguard EU ETS 1 functioning and avoid mitigation deterrence, while qualitative eligibility rules are essential for addressing sustainability concerns.

Kurzbeschreibung: Optionen für die Umsetzung von Obergrenzen für CDR, die in den EU-Emissionshandel 1 integriert sind

Zur Unterstützung der Erreichung der EU-Klimaziele wird erwartet, dass die Europäische Kommission die Integration dauerhafter Kohlendioxidentnahmen (Carbon Dioxide Removals, CDR) in den EU-Emissionshandel 1 (EU ETS 1) im Rahmen der Reform des EU-ETS 1 ab Juli 2026 vorschlagen wird. Zu den Beweggründen gehören der Ausgleich von (schwer vermeidbaren) Restemissionen sowie Flexibilität und Kosteneffizienz. Eine solche Integration könnte dazu beitragen, dauerhafte Entnahmen hochzuskalieren und den Teilnehmenden am EU-ETS 1 zusätzliche Flexibilität zu verschaffen. Gleichzeitig bestehen jedoch Bedenken hinsichtlich einer möglichen Hemmung bzw. Verdrängung von Emissionsminderungen (mitigation deterrence), Marktunsicherheiten, Nachhaltigkeitswirkungen sowie fiskalischer und verteilungspolitischer Effekte.

Der vorliegende Bericht untersucht, wie Begrenzungen für die Nutzung dauerhafter CDR-Gutschriften zur Erfüllung von Verpflichtungen im EU ETS 1 ausgestaltet werden könnten, um diesen Risiken zu begegnen. Hierzu identifiziert und beschreibt der Bericht neun mögliche Begrenzungsansätze, die vier Kategorien zugeordnet werden können: quantitative angebotsseitige Begrenzungen, quantitative nachfrageseitige Begrenzungen, qualitative angebotsseitige Begrenzungen und qualitative nachfrageseitige Begrenzungen. Diese Ansätze werden kurz im Hinblick auf wahrscheinliche politische Zielsetzungen bewertet.

Die Ergebnisse deuten darauf hin, dass bei einer Integration von CDR über einen Intermediär eine Kombination aus einer maximalen CDR-Integrationsgrenze und strengen Kriterien für die Zulässigkeit von CDR-Zertifikaten im Hinblick auf die Kriterien des Mengenmanagements und der Kosteneffizienz besonders gut abschneidet. Wenn CDR hingegen ohne Intermediär direkt in den EU ETS 1 integriert wird, deuten unsere Ergebnisse darauf hin, dass individuelle Obergrenzen für einzelne Marktteilnehmende in Kombination mit Regeln zur Zulässigkeit von CDR-Zertifikaten für dieselben Kriterien am besten geeignet erscheinen.

Unter beiden Modellen können technologiespezifische Quoten dazu beitragen, ein vielfältiges CDR-Portfolio zu unterstützen, was wichtig ist, um Risiken zu managen und langfristige Kosten zu senken. Ansätze, die bestimmte Emittenten „bevorzugen“ und ihnen einen prioritären Zugang zu CDR-Zertifikaten gewähren, werfen einige praktische Probleme und Herausforderungen bei der Kosteneffizienz auf; dies bedeutet, dass andere politische Instrumente, die in diesem Papier nicht berücksichtigt werden – wie die gezielte kostenlose Zuteilung von Zertifikaten – vorzuziehen sein könnten, um die Verteilungsziele zu erreichen, die solche Begrenzungsansätze motivieren.

Der Bericht kommt zu dem Schluss, dass eine gewisse Form von quantitativer Obergrenze wahrscheinlich erforderlich ist, um die Funktionsweise des EU ETS 1 zu sichern und eine Schwächung von Minderungsmaßnahmen zu vermeiden, während qualitative Kriterien für die Zulässigkeit unerlässlich sind, um Nachhaltigkeitsbedenken auszuräumen.

Table of contents

Table of contents 3
List of tables 5
List of abbreviations 5
Summary 6
Zusammenfassung 9
1 Introduction 12
2 Background 16
2.1 Models for CDR integration into the EU ETS 1 16
2.2 Factors affecting CDR integration in the EU ETS 1 18
3 Approaches to limit CDR integrated into the EU ETS 1 20
3.1 Quantitative supply-side limit: System-wide limits 21
3.2 Quantitative demand-side limit: Individual limits 22
3.3 Qualitative supply-side limit: CDR eligibility rules 22
3.4 Qualitative demand-side limit: “Favouring” approaches 23
4 Implementation of CDR limit approaches in the EU ETS 1 26
4.1 Implementation differences by CDR integration model 26
4.1.1 Quantitative supply-side limits: System wide limits 26
4.1.2 Quantitative demand-side limits: Individual limits 26
4.1.3 Qualitative supply-side limit: CDR eligibility rules 27
4.1.4 Qualitative demand-side limit: “Favouring” approaches 27
4.2 Possible combinations of limits 27
4.3 Static versus dynamic limit setting 28
5 Comparison of CDR limit approaches 29
5.1 Assessment framework 29
5.2 Assessment of integrated CDR limit approaches 29
5.2.1 Assessment of CDR limit approaches assuming CDR integration via an intermediary 30
5.2.2 Assessment of CDR limit approaches assuming CDR integration via direct integration 32
6 Conclusions and recommendations 34
6.1 Key conclusions 34
6.2 Useful combinations of limit approaches 34

6.3 Study limits, open questions and areas for further consideration 35
7 List of references 37

List of tables

Table 1 Limit approaches: categorisation of approaches to CDR integrated into the EU ETS 1 21
Table 2 Framework for assessing approaches to limit CDR integration (own compilation) 29
Table 3 Analysis of approaches to limit CDR integration into the EU ETS 1 via an intermediary (own compilation) 30
Table 4 Analysis of approaches to limit CDR integration into the EU ETS 1 via direct integration (own compilation) 33

List of abbreviations

Abbreviation	Explanation
BioCCS	Biogenic emissions capture with carbon storage
CCfD	Carbon Contract for Difference
CCS	Carbon Capture and Storage
CDR	Carbon Dioxide Removal
CO_2	Carbon Dioxide
CRCF	Carbon Removal and Carbon Farming
DACCS	Direct Air Carbon Capture and Storage
ESABCC	European Scientific Advisory Board on Climate Change
EU ETS	EU Emissions Trading System
EUA	European Union Allowance
GHG	Greenhouse gas
ICAP	International Carbon Action Partnership
IPCC	Intergovernmental Panel on Climate Change
MSR	Market Stability Reserve
Mt	Megatonne
UBA	German Environment Agency

Summary

Context and objective

To boost permanent carbon dioxide removals (CDR) and support the achievement of EU climate targets, the EU Commission is expected to propose integrating permanent CDR into the EU Emissions Trading System 1 (EU ETS 1). The recent EU Climate Law amendment considers motivations including compensating for residual emissions as well as flexibility and cost-effectiveness. While this follows the recommendation of the European Scientific Advisory Board on Climate Change and others, integrating permanent CDR into the EU ETS 1 raises important concerns, including risks of emissions reduction deterrence, market uncertainty linked to permanent CDR supply and costs, potential sustainability impacts, as well as fiscal and distributional impacts, among others.

In light of these concerns, this report identifies approaches for implementing limits on the quantity of permanent CDR credits used for compliance within the EU ETS 1, and assesses their strengths and weaknesses. We develop an assessment framework to evaluate CDR limit approaches considering likely policy objectives, and make recommendations as well as identifying open questions for further research. Our identification and assessment of permanent CDR limit approaches considers two likely integration models for CDR into the EU ETS 1.

Models for integrating CDR into the EU ETS 1

The feasibility and attractiveness of different CDR limit approaches depend on how permanent CDR is integrated into the EU ETS 1. We limit focus to two CDR integration models:

- **CDR integration via an intermediary:** Under this model, a public intermediary links the EU ETS 1 and the permanent CDR market. The intermediary purchases CDR and releases them into the EU ETS 1 for compliance use, e.g. via auctions. Depending on its design, it could also help manage quality standards, liability, and market stability. The intermediary has many CDR limit approaches available to it.
- **Direct integration without intermediary:** EU ETS 1 emitters purchase CDR directly from CDR suppliers and use the purchased units for compliance. The regulator can establish CDR limits by establishing rules to define eligible CDR, among other approaches.

In addition to the EU ETS 1 integration model, a key but uncertain design issue is the scale of permanent CDR integration – with implications for the attractiveness of different CDR limit approaches. Expected scale is uncertain, due to 1) uncertain CDR supply and cost, given current limited deployment and with wide predicted ranges reported in literature; 2) undetermined demand for CDR within the EU ETS 1 (particularly the volume of hard-to-abate residual emissions of EU ETS 1 sectors), which will depend on EU ETS 1 integration design decisions (including both scale of integration and potential accompanying policies e.g. carbon contracts for difference), as well as the size of the EU ETS 1 and stringency of its cap, among other aspects.

Limit approaches considered in the report

The report identifies four categories of approaches for limiting CDR integrated into the EU ETS 1. These differ according to whether they operate on the supply side or the demand side, and whether they limit CDR quantitatively or qualitatively.

- **Quantitative supply-side limits** restrict how much CDR can enter the EU ETS 1 overall. We identify three approaches: a maximum CDR integration limit, technology-specific quotas, or EU ETS 1 cap adjustment.

- **Quantitative demand-side limits** restrict how much CDR individual EU ETS 1 emitters can use, either through individual entity limits or individual technology-specific quotas.
- **Qualitative supply-side limits** restrict which removals or suppliers are eligible to be integrated, either through CDR certificate eligibility rules (e.g., by setting stricter quality criteria) or supplier eligibility rules.
- **Qualitative demand-side limits** restrict which entities are allowed to use CDR. We identify two approaches: only favoured entities are permitted to use CDR for compliance or, under an intermediary model, participation in CDR allowance auctions is limited to selected sectors or emitters.

For each limit approach, we describe concretely how they could be implemented in the EU ETS 1 under the two CDR integration models. We also consider the relative advantages of dynamic limit setting over time as new information comes available, and the combination of limits.

Assessment of the limit approaches

To understand the relative strengths and weaknesses of different CDR limit approaches, the report assesses them against five criteria:

(i) effective quantity management,

(ii) effective quality management,

(iii) cost-effective climate action,

(iv) avoidance of practical implementation barriers, and

(v) effective distribution of costs.

Conclusions and recommendations

The assessment finds that different CDR limit approaches are better suited to different policy objectives - no single CDR limit approach performs best across all criteria. The performance of CDR limit approaches also differs slightly under the different EU ETS 1 integration models, with fewer approaches practically implementable under the direct integration without an intermediary model. Our assessment does not identify any consistent trade-offs between criteria, with the performance of approaches against criteria differing due to individual characteristics of the approaches.

The most appropriate limit approach depends on the policy objective and integration model. If the primary objective is to control the quantity of CDR entering the EU ETS 1 and reduce mitigation deterrence, quantitative limits are needed. If the primary objective are sustainability concerns, then qualitative eligibility rules are essential. While our assessment considers the relative performance of different approaches and does not explicitly consider the situation of no limits, the literature clearly concludes that some form of quantitative limits can improve EU ETS 1 functioning and CDR supply by increasing certainty for market actors.

If CDR is integrated via an intermediary, if effective quantity management and cost-effectiveness are policy priorities, then the strongest option is a maximum CDR integration limit combined with stringent CDR certificate eligibility rules. This would give the intermediary clear control over both quantity and quality, while preserving relatively efficient trading of CDR units once they enter the EU ETS 1.

If CDR is directly integrated into the EU ETS 1 without an intermediary, if effective quantity management and cost-effectiveness are policy priorities, then the most suitable option is individual entity limits combined with CDR certificate eligibility rules. In the context of direct integration without an intermediary, this combination is more practical than a system-wide supply limit, although it is somewhat less efficient because it restricts the allocation of CDR use across entities and therefore potential gains from trade.

Under both EU ETS 1 integration models, **combining the above limit approaches with technology-specific quotas offers benefits**. They can ensure demand for diverse CDR types, important for managing risk and delivering dynamic efficiency. Conversely, **approaches that favour particular sectors or entities pose efficiency downsides and practical challenges** that mean other policy tools that are not considered in this paper, such as targeted free allocation of allowances, may be preferable to achieve distributional objectives.

The results of this study should be interpreted as indicative, as they are based on simplifying assumptions regarding future EU ETS 1 design and CDR integration, and do not cover all relevant evaluation criteria. Additionally, any definitive policy recommendation depends on clearer prioritisation of the multiple political objectives associated with integrating CDR into the EU ETS 1.

Several avenues for further research are identified, including updating assessments once the EU ETS 1 integration model is defined, revising assessments under as CDR supply and demand becomes clearer, and considering alternative policy tools to meet objectives such as favouring particular entities or sectors.

Zusammenfassung

Kontext und Zielsetzung

Um dauerhafte Kohlendioxidentnahmen (Carbon Dioxide Removals, CDR) zu stärken und die Erreichung der EU-Klimaziele zu unterstützen, wird erwartet, dass die Europäische Kommission die Integration dauerhafter CDR in das EU-Emissionshandelssystem (EU ETS 1) vorschlagen wird. Die jüngste Änderung des Europäischen Klimagesetzes berücksichtigt dabei Beweggründe wie den Ausgleich von Restemissionen sowie Flexibilität und Kosteneffizienz. Auch wenn dies den Empfehlungen des Europäischen Wissenschaftlichen Beirats zum Klimawandel und anderer folgt, wirft die Integration dauerhafter CDR in das EU ETS 1 wichtige Fragen auf. Dazu gehören unter anderem Risiken einer Abschwächung von Emissionsminderungsanreizen, Marktunsicherheiten im Zusammenhang mit Angebot und Kosten dauerhafter CDR, mögliche Nachhaltigkeitswirkungen sowie fiskalische und verteilungspolitische Auswirkungen.

Vor diesem Hintergrund identifizieren wir im vorliegenden Bericht Ansätze zur Umsetzung von Begrenzungen der Menge dauerhafter CDR-Gutschriften, die zur Erfüllung von Verpflichtungen im EU ETS 1 genutzt werden können und analysieren und bewerten deren Stärken und Schwächen. Hierfür entwickeln wir einen Bewertungsrahmen, um Ansätze zur Begrenzung von CDR mit Blick auf wahrscheinliche politische Zielsetzungen zu bewerten, Empfehlungen abzuleiten und offene Fragen für weitere Forschung zu identifizieren. Die Analyse von Ansätzen zur Begrenzung dauerhafter CDR berücksichtigt zwei wahrscheinliche Modelle der Integration von CDR in das EU ETS 1.

Modelle zur Integration von CDR in das EU-ETS

Welche Begrenzungsansätze praktikabel und zielführend sind, hängt maßgeblich davon ab, wie dauerhafte CDR in das EU ETS 1 integriert werden. Der Bericht konzentriert sich auf zwei Integrationsmodelle:

- **CDR-Integration über eine zwischengeschaltete Stelle (d.h. „Intermediary“)**: In diesem Modell verbindet eine öffentliche zwischengeschaltete Stelle das EU-ETS mit dem Markt für dauerhafte CDR. Die zwischengeschaltete Stelle erwirbt CDR und macht diese zur Nutzung für die Erfüllung von Verpflichtungen im EU ETS 1 verfügbar, beispielsweise über Auktionen. Je nach Ausgestaltung könnte sie zudem zur Steuerung von Qualitätsstandards, Haftung und Marktstabilität beitragen. Der zwischengeschalteten Stelle steht dabei eine Vielzahl möglicher Begrenzungsansätze zur Verfügung.
- **Direkte Integration ohne zwischengeschaltete Stelle**: In diesem Modell erwerben Emittenten im EU ETS 1 CDR direkt von CDR-Anbietern und nutzen die erworbenen Einheiten zur Erfüllung ihrer Verpflichtungen. Die Regulierungsbehörde kann Begrenzungen für CDR unter anderem durch Regeln festlegen, mit denen zulässige CDR definiert werden.

Neben dem Integrationsmodell ist der Umfang der Integration dauerhafter CDR eine zentrale, aber unsichere Ausgestaltungsfrage – mit Auswirkungen auf die Wirkung verschiedener Begrenzungsansätze. Der erwartete Umfang ist aus mehreren Gründen unsicher: Erstens bestehen Unsicherheiten hinsichtlich Angebot und Kosten von CDR, da CDR derzeit nur in begrenztem Umfang eingesetzt werden und in der Literatur sehr breite Prognosespannen berichtet werden. Zweitens bestehen erhebliche Unsicherheiten hinsichtlich der Nachfrage nach CDR innerhalb des EU ETS 1. Diese wird maßgeblich von der konkreten Ausgestaltung der CDR-Integration beeinflusst, insbesondere vom Integrationsumfang und möglichen flankierenden Politikinstrumenten wie Carbon Contracts for Difference. Darüber hinaus spielen Faktoren wie die Größe des EU ETS 1 und das Ambitionsniveau seines Caps eine wichtige Rolle.

Im Bericht betrachtete Begrenzungsansätze

Der Bericht identifiziert vier Kategorien von Ansätzen zur Begrenzung der Menge an CDR, die in das EU ETS 1 integriert werden. Diese unterscheiden sich danach, ob sie auf der Angebots- oder Nachfrageseite ansetzen und ob sie CDR quantitativ oder qualitativ begrenzen.

- Quantitative angebotsseitige Begrenzungen beschränken die Gesamtmenge an CDR, die in das EU ETS 1 integriert werden kann. Wir identifizieren drei Ansätze: eine maximale CDR-Integrationsgrenze, technologiespezifische Quoten oder eine Anpassung des EU ETS 1-Caps.
- Quantitative nachfrageseitige Begrenzungen beschränken die Menge an CDR, die einzelne Emittenten im EU ETS 1 nutzen können. Dies kann entweder durch individuelle Begrenzungen für einzelne Marktteilnehmende oder durch individuelle technologiespezifische Quoten erfolgen.
- Qualitative angebotsseitige Begrenzungen legen fest, welche Entnahmen oder Anbieter für die Integration zulässig sind. Dies kann entweder über Zulässigkeitsregeln für CDR-Zertifikate, etwa durch strengere Qualitätsanforderungen, oder über Zulässigkeitsregeln für Anbieter erfolgen.
- Qualitative nachfrageseitige Begrenzungen beschränken, welche Marktteilnehmende CDR nutzen dürfen. Wir identifizieren zwei Ansätze: Entweder dürfen ausschließlich begünstigte Marktteilnehmende CDR zur Erfüllung ihrer Verpflichtungen nutzen, oder – im Modell mit zwischengeschalteter Stelle – die Teilnahme an Auktionen für CDR-Berechtigungen wird auf ausgewählte Sektoren oder Emittenten beschränkt.

Für jeden Begrenzungsansatz beschreibt der Bericht konkret, wie dieser unter den beiden CDR-Integrationsmodellen im EU ETS 1 umgesetzt werden könnte. Darüber hinaus betrachten wir die relativen Vorteile einer dynamischen Festlegung von Begrenzungen im Zeitverlauf, wenn neue Informationen verfügbar werden, sowie die Kombination verschiedener Begrenzungsansätze.

Bewertung der Begrenzungsansätze

Um die relativen Stärken und Schwächen der verschiedenen Ansätze zur Begrenzung von CDR zu verstehen, bewertet der Bericht diese anhand von fünf Kriterien:

a) wirksame Mengensteuerung,

b) wirksame Qualitätssteuerung,

c) kosteneffizienter Klimaschutz,

d) Vermeidung praktischer Umsetzungshemmnisse und

e) wirksame Verteilung von Kosten.

Schlussfolgerungen und Empfehlungen

Die Bewertung zeigt, dass verschiedene Ansätze zur Begrenzung von CDR für unterschiedliche politische Zielsetzungen besser geeignet sind. Kein einzelner Begrenzungsansatz schneidet über alle Kriterien hinweg am besten ab. Die Leistungsfähigkeit der Ansätze unterscheidet sich zudem leicht zwischen den verschiedenen Integrationsmodellen. Im Modell der direkten Integration ohne zwischengeschaltete Stelle sind weniger Ansätze praktisch umsetzbar. Unsere Bewertung zeigt keine durchgängigen Zielkonflikte zwischen den Kriterien. Unterschiede in der Bewertung ergeben sich vielmehr aus den spezifischen Eigenschaften der einzelnen Ansätze.

Welcher Begrenzungsansatz am besten geeignet ist, hängt sowohl von den verfolgten politischen Zielen als auch vom gewählten Integrationsmodell ab. Besteht das vorrangige Ziel darin, die Menge der in das EU ETS 1 gelangenden CDR zu steuern und eine Abschwächung von Emissionsminderungsanreizen zu vermeiden, sind quantitative Begrenzungen erforderlich. Stehen Nachhaltigkeitsbedenken im Vordergrund, sind qualitative Zulässigkeitsregeln unerlässlich. Während unsere Bewertung die relative Leistungsfähigkeit verschiedener Ansätze betrachtet und die Situation ohne Begrenzungen nicht ausdrücklich untersucht, kommt die Literatur eindeutig zu dem Schluss, dass eine Form quantitativer Begrenzung die Funktionsfähigkeit des EU ETS 1 und das Angebot an CDR verbessern kann, indem sie die Planungssicherheit für Marktteilnehmende erhöht.

Erfolgt die Integration von CDR über eine zwischengeschaltete Stelle und stehen Mengensteuerung sowie Kosteneffizienz im Vordergrund, erscheint eine maximale CDR-Integrationsgrenze in Kombination mit strengen Zulässigkeitsregeln für CDR-Zertifikate als die geeignetste Option. Diese Kombination würde der zwischengeschalteten Stelle eine klare Steuerung von Menge und Qualität ermöglichen und gleichzeitig einen vergleichsweise effizienten Handel mit CDR-Einheiten innerhalb des EU ETS 1 gewährleisten.

Erfolgt die Integration von CDR hingegen direkt und ohne zwischengeschaltete Stelle und stehen Mengensteuerung sowie Kosteneffizienz im Vordergrund, erscheinen individuelle Begrenzungen für einzelne Marktteilnehmende in Kombination mit Zulässigkeitsregeln für CDR-Zertifikate am geeignetsten. Im Kontext der direkten Integration ohne zwischengeschaltete Stelle ist diese Kombination praktikabler als eine systemweite angebotsseitige Begrenzung. Sie ist jedoch etwas weniger effizient, da sie die Verteilung der CDR-Nutzung zwischen Marktteilnehmenden einschränkt und damit potenzielle Handelsgewinne begrenzt.

Unter beiden Integrationsmodellen bietet die Kombination der genannten Begrenzungsansätze mit technologiespezifischen Quoten Vorteile. Diese können die Nachfrage nach unterschiedlichen CDR-Typen sicherstellen, was für das Risikomanagement und die dynamische Effizienz von Bedeutung ist. Umgekehrt sind Ansätze, die bestimmte Sektoren oder Marktteilnehmende begünstigen, mit Effizienznachteilen und praktischen Herausforderungen verbunden. Dies bedeutet, dass andere, in diesem Bericht nicht untersuchte Politikinstrumente – etwa eine gezielte kostenlose Zuteilung von Berechtigungen – möglicherweise besser geeignet sind, um verteilungspolitische Ziele zu erreichen.

Die Ergebnisse dieser Studie sollten als indikativ (bzw. richtungsweisend) interpretiert werden, da sie auf vereinfachenden Annahmen bezüglich der künftigen Gestaltung des EU ETS 1 und der CDR-Integration basieren und nicht alle relevanten Bewertungskriterien beinhalten. Darüber hinaus hängt jede endgültige politische Empfehlung von einer klareren Priorisierung der vielfältigen politischen Ziele ab, die mit der Integration von CDR in das EU ETS 1 verbunden sind.

Abschließend identifiziert der Bericht mehrere Ansatzpunkte für weitere Forschung. Dazu gehören eine Aktualisierung der Bewertung, sobald das Integrationsmodell für das EU ETS 1 feststeht, eine Überarbeitung der Bewertung, wenn Angebot und Nachfrage von CDR klarer abschätzbar sind, sowie die Betrachtung alternativer Politikinstrumente zur Erreichung von Zielen wie der gezielten Begünstigung bestimmter Marktteilnehmende oder Sektoren.

1 Introduction

There is scientific consensus that negative emissions (carbon dioxide removal, CDR) are required to achieve net zero and then net negative emissions, counterbalancing and then exceeding (hard-to-abate) residual emissions (IPCC, 2022)**.** To limit the rise in global temperature to well below 2 °C or even below 1.5 °C above pre-industrial levels, drastic and immediate reductions in greenhouse gas (GHG) emissions are essential but likely insufficient. All emissions reduction pathways that restrict warming to below 2 °C assume that CO_2 will be removed from the atmosphere through conventional nature-based solutions, and almost all of these assume that CO_2 will be removed through technical solutions; Smith *et al.* (2024, p.144) assessed 540 scenarios compatible with limiting warming to 2 °C and found that at least 95% of these include permanent CDR approaches. However, there are concerns around the feasibility and scale of permanent CDR deployment[1]. Not only are there economic and technical challenges, but there are also a number of potential risks associated with the use of CDR. Relying too heavily on future removals (that might not materialise) could for example delay immediate emission reductions today and lead to overshooting climate targets in the future. Therefore, CDR should be treated as a complement rather than a substitute for emissions reduction efforts (Grant et al., 2021).

The EU Commission is expected to publish a proposal on the integration of permanent CDR into the EU Emissions Trading System (EU ETS 1) as part of its scheduled review of the EU ETS 1 and Market Stability Reserve (MSR), due in July 2026.[2] Specifically, the recent European Climate Law amendment setting an EU-wide intermediary climate target for 2040, establishes three removals-related expectations for the EU Commission's review, whose legislative proposals should appropriately reflect (Art. 5)[3]:

- "(b) the role of domestic permanent removals under … the EU ETS 1 to compensate for residual hard-to-abate emissions;
- (c) enhanced flexibility within and across sectors and instruments, to support the achievement of targets in a simple and cost-effective way;
- (d) the realistic contribution of carbon removals to the overall emission reduction effort…"

These potentially contradictory requirements illustrate the still uncertain and conflicted role foreseen for carbon removals within the EU ETS 1 and as a tool to achieve EU climate objectives more generally.

The European Scientific Advisory Board on Climate Change (ESABCC, 2025) and others have recommended the gradual integration of permanent CDR into the EU ETS 1 over time. In their most recent report, the ESABCC indicates that incorporating carbon removals into a cap-and-trade system could take multiple forms but effectively would allow emitters under the EU ETS 1 to use removals for compliance, to counterbalance their emissions obligations (pp. 210-213). This could allow EU ETS 1 emitters to use removals to offset their own residual emissions within the established market cap and could promote the implementation of carbon removal strategies in a fiscally sustainable and cost-effective manner (p. 23). They suggest setting minimum and maximum targets for the contribution of removals towards net emissions

[1] This concerns predominantly permanent CDR deployment rather than nature-based CDR, where approaches are already widespread. We focus on permanent CDR throughout this report.

[2] In accordance with Article 30 of the EU ETS Directive - 2003/87 - EN - EUR-Lex

[3] Regulation (EU) 2026/667

goals, which could provide flexibility to pursue cost-effectiveness while helping to safeguard against mitigation deterrence (p.18).

Aside from the objectives of offsetting residual emissions and promoting demand and (private) funding for CDR (McDonald et al., 2025), the discussions have also identified other possible objectives for integrating CDR in the EU ETS 1. These include, for example: enabling the EU ETS 1 to become a tool that can incentivise and contribute to net negative emissions (Rickels et al., 2021); managing potential issues of market functioning (e.g., lack of liquidity) as the EU approaches its 'endgame' towards 2040 (Pahle et al., 2025); and lowering costs of meeting EU climate targets by supporting identification of an efficient mix of emissions reductions and carbon removals (Sultani et al., 2024).

However, besides pursuing the above objectives, integrating permanent CDR into the EU ETS 1 also raises several concerns that could justify limiting the quantity of permanent CDR that is integrated. Concerns raised regarding CDR integration include:

- **Mitigation deterrence risk[4]:** Integrating CDR into the EU ETS 1 introduces a significant modification to climate policy that could affect its ability to effectively reduce emissions from the sectors currently covered by the cap. This could arise due to direct mitigation deterrence, where EU ETS 1 emitters return removal-backed allowances, instead of reducing their own emissions (or instead of purchasing EU ETS 1 allowances from other emitters that incentivise emissions reductions within the current EU ETS 1 scope) (ESABCC, 2025).[5] Moral hazard also poses a risk, where the promise of future availability of CDR units within the EU ETS 1 delays or disincentivises emissions reductions, even ahead of their integration (McLaren, 2020).
- **EU ETS 1 functioning**: While integrated CDR could improve market functioning (e.g. by providing additional volume of allowances) in the EU ETS 1 as the cap approaches zero, it could also negatively affect functioning through uncertainty over, for example, the timing, quantity, and expected prices of CDR units—influencing market liquidity, price volatility, and the behaviour of market participants.
- **Negative externalities**: Permanent CDR can generate negative externalities for nature and society, for example through unsustainable biomass use, land competition linked to BECCS or biochar implementation (Deprez et al., 2024), excess energy and water use linked to DACCS, among other impacts (ESABCC, 2025).
- **CRCF quality concerns**: Expert reviews of the adopted EU Carbon Removals and Carbon Farming Regulation (CRCF)[6] methodologies have raised concerns about unresolved issues, particularly regarding sustainability safeguards (e.g., insufficient accounting of biomass use), quantification (e.g., risk of overestimating removals), additionality, permanence, liability, and technology-specific risks for DACCS, BECCS and biochar. If such concerns are not adequately addressed, CRCF-certified removals could enter the EU ETS 1 and potentially compromise environmental integrity. The integration could also exacerbate risks of non-equivalence and mitigation deterrence (Carbon Market Watch, 2025; Schneider et al., 2025; Siemons et al., 2025).

[4] The specific relationship between limits and mitigation deterrence remains a research question.

[5] The extent of direct emissions reduction deterrence depends on how the integration of CDR is designed, as well as on relative marginal costs (i.e. it requires that CDR-backed units available at lower prices than EUAs).

[6] Carbon Removals and Carbon Farming Regulation - EU - 2024/3012 - EN - EUR-Lex

- **Non-equivalence**: Given permanent CDR's early stage of development, there is a lack of evidence on its effectiveness and concern as to whether permanent CDR has equivalent effects on atmospheric GHGs as a tonne of emissions reductions. Since carbon dioxide can linger in the atmosphere for over 1,000 years, carbon removals will only be comparable to emission reductions if they can prevent CO_2 from re-entering the atmosphere for an equivalent duration (Meyer-Ohlendorf, 2023). These concerns arise for a number of reasons, including uncertainty regarding monitoring, reporting, and verification approaches (and the possibility that the removed emissions are re-released into the atmosphere), which are often private and non-transparent (Burke & Schenuit, 2024), or have been criticised as likely to generate low-quality units, as in the case of the draft EU CRCF certification methodologies (Schneider et al., 2025). It is also important to have sufficient liability and preventive measures in place to ensure that any future carbon leakage is sufficiently compensated.
- **Limited CDR supply**: Due to various constraints on scaling up permanent CDR in the future and the potential need to offset residual emissions in non-ETS sectors (e.g. agriculture), the regulator could use limits to ensure that this supply entering the EU ETS 1 is rationed, distributed and spread out over time. For example, Caldecott and Johnstone (2024) introduced the concept of a finite carbon removal budget which could motivate such concerns.
- **Fiscal costs and social inequality**: EU ETS 1 participant purchases of CDR-backed allowances may reduce demand for EUAs, decreasing auction revenue and therefore funds available for supporting the green transition. Should ownership of CDR technologies sit primarily in private hands, CDR integration would also be expected to increase income inequality (Andreoni et al., 2024).

This report identifies and assesses potential approaches for limiting the quantity and quality of domestic permanent CDR entering the EU ETS 1 (what we refer to as "integrated CDR") and explores how these approaches could be implemented under different models of CDR integration. The report proceeds as follows: In chapter 2, because quantitative limits depend on market structure, we provide a brief, high-level overview of models for CDR integration into the EU ETS 1 and discuss key factors that influence the future supply and demand of integrated CDR, including CDR availability, costs, and the scale of hard-to-abate emissions. In chapter 3, we characterise different "limit approaches" to constrain integrated CDR, considering quantitative and qualitative limit approaches, including both supply and demand side limits. In addition to existing limit approaches to managing the integration of CDR (drawing on experience with the integration of offsets), such as proportional quantitative limits at either the system or individual level, we also consider the feasibility of approaches that "favour" particular EU ETS 1 sectors or emitters by providing exclusive access to use of removal credits for these groups (and therefore also providing them with greater flexibility).[7] In chapter 4, we examine how different limit approaches could be implemented in practice, for both of the most relevant EU ETS 1 integration models (integration through an intermediary or direct integration without an intermediary). We also consider possible combinations of limits as well as static versus dynamic limit-setting. In chapter 5 we develop an assessment framework to identify relative strengths and weaknesses of the limit approaches. Criteria for assessing the different limit approaches include their ability to effectively manage the quantity and quality of removals, cost-effectiveness, avoidance of practical barriers, and effective distribution of costs.

[7] While such approaches may be motivated by additional objectives such as a desire to aid specific hard-to-abate-industries or EU ETS emitters, for instance those with a larger share of residual emissions, they can pose significant challenges and drawbacks (see chapter 5).

Chapter 6 concludes, making recommendations for limit approach combinations under the EU ETS 1 integration models considered, and identifying open questions and future research needs.

2 Background

2.1 Models for CDR integration into the EU ETS 1

The types of limit approaches that can be implemented and their relative strengths and weaknesses depend on how CDR is integrated into the EU ETS 1. Following Verbist, Sultani and Pahle (2025), we differentiate between two main "stages" for the design of CDR integration. The first concerns the timing and scale of CDR integration, including whether volumes are determined in advance or adjusted dynamically in response to market conditions, CDR availability, or climate policy objectives. These considerations are outside the scope of our study.

The second refers to the design of the system that will be used to achieve the objectives within the expected timeframe. Different ways of integrating CDR into the EU ETS 1 (CDR integration models) have been developed and discussed in recent years (for examples, see La Hoz Theuer *et al.*, 2021; Meyer-Ohlendorf, 2023; Department for Energy Security and Net Zero, 2024). A review of the literature reveals the complexity of the decisions that would have to be made when integrating CDR into the EU ETS 1. This includes the degree of integration, that is, whether the integration is direct (i.e. an EU ETS 1 emitter buys directly from a CDR supplier), indirect (i.e. mediated by an intermediary), or separate (i.e. there is no link between CDR and the EU ETS 1 cap); the existence of an intermediary and its mandate and design; the cap design, for example, whether to have a net cap or a gross cap (see Box 1 for a discussion on the cap options); closely related, the additionality of the CDR certificates, for example, whether they are included in addition to current allowances or whether they replace them; the degree of fungibility of CDR certificates; the level of differentiation of CDR certificates (e.g., based on technology or origin); and the timing of the integration.

To provide a simple and clear frame for identifying and evaluating potential CDR limit approaches, this study considers two conceptual integration models, an “intermediary” model and a “direct integration model,” building on ESABCC (2025) and La Hoz Theuer et al. (2021):

1. **Indirect integration (via intermediary):** The government acts as an intermediary, linking the EU ETS 1 to the removals market and vice versa. They could achieve this by funding removals and allowing EU ETS 1 emitters to use removals for compliance use, i.e. to counterbalance their emissions. The mandate of the intermediary could be broader, e.g. including developing a strategic carbon removal certificate reserve (Rickels et al., 2024), managing the supply and demand of units in the system, or managing liability and other compliance issues, among others (McDonald et al., 2025). The ‘government’ role could be fulfilled by a number of institutions, including the EU Commission or its implementing agencies, or a purpose-built institution such as a ‘carbon central bank’ (Rickels et al., 2022), among others. Depending on the type of institution that assumes the functions and its mandate, the independence of the intermediary will be affected (Rickels et al., 2024). Another related option would be integration through a predefined rule-system akin to the MSR, where removals only enter the EU ETS 1 once certain thresholds related to market functioning are reached. This is the recommendation of Verbist et al (2025).
2. **Direct integration (without an intermediary):** EU ETS 1 emitters are directly connected to CDR providers, from whom they purchase certified CDR units for compliance use. In this study, we assume that this would not be uncontrolled, but rather the regulator would set some quantitative and qualitative limits on transactions, in order to limit the volume or types of removals that are permitted for compliance within the EU ETS 1. The CDR could be made available to EU ETS 1 emitters in the form of fungible

allowances (where a regulator would translate CDR into EU ETS 1 allowances) or they could be in the form of an approved credit, such as a CRCF certificate.

Other models discussed in the literature but not considered further in this report include the "integrated markets without constraints" model and a deductions model. Such models were considered not viable by the ESABCC (2025) due to high risks. Under the former, CDR providers are fully integrated within the scope of the EU ETS 1, with the regulator issuing allowances to removals providers in return for their generation of certified removals, which they can sell to EU ETS 1 emitters for compliance. This model mirrors the inclusion of the forestry sector in New Zealand's ETS (Carver et al., 2022). An alternative model is a "deductions" model, a form of direct integration where existing EU ETS 1 emitters could themselves generate removals for compliance to counterbalance their emissions.[8] In the EU ETS 1 and permanent CDR context, such a deductions model could be feasible in the case where a bioenergy plant adds a carbon capture and storage (CCS) unit, for example.

A related but somewhat independent question is the *form* of CDR integration, i.e. whether fungible allowances are created, external certificates are permitted for compliance, or another form of CDR unit can be used for compliance. The key difference between certificates and allowances is who carries out the certification: certificates (or credits, such as those arising from the EU CRCF) are certified by an external institution, while allowances would be created by the EU ETS 1 regulator based on their own 'certification' of CDR.[9] Alternative integration forms are also imaginable, for example, under the *Indirect integration (via intermediary)* model, the government could allow emitters to pay a set fee per tonne of removals, reducing their emissions obligation by an amount equivalent to the tonnes of removals they "purchase", without creating allowances or permitting certificates.[10] To simplify, in the remainder of the report we focus only on forms of integration involving allowances or certificates.

Box 1: Options for defining ETS caps when integrating CDR

The way that ETS caps are defined with CDR integration also affects CDR limit approaches. ETS caps with CDR can be defined in a number of ways (see e.g., the UK Department for Energy Security and Net Zero (2024) or La Hoz Theuer, Ortiz Rivera and Biedenkopf, 2025).

A gross cap defines the total number of allowances in the ETS, covering both emissions allowances and CDR allowances. CDR integration into a gross cap could be done without changing the level of the gross cap (i.e. by reducing emissions allowances for every additional CDR allowance integrated – one-in-one-out), which would result in fewer net emissions relative to the same gross cap without removals; or by increasing the gross cap (i.e. keeping the number of emissions allowances unchanged and adding CDR allowances on top), resulting in the same net emissions relative to the same gross cap without removals. When setting a gross cap, some experts have proposed setting both lower and upper limits on the volumes of CDR to be integrated, to reduce risk of market failures and mitigation deterrence in the face of significant CDR and ETS market uncertainties (ESABCC, 2025; Verbist et al., 2025).

A net cap defines the total number of emissions allowances within the ETS, i.e. excluding CDR from the definition of the cap. CDR integration into an ETS with a net cap could be implemented such that the net cap is lowered (relative to the cap without CDR), with CDR allowances integrated in

[8] In a different context, Bognar et al. (2023) consider the implications of such a deductions model in the case the case of integrating LULUCF into an ETS on agricultural emissions

[9] Note, the regulator could also choose to create allowances based upon externally certified certificates.

[10] The implications for setting limits would be similar to the permitting of certificates.

parallel, such that the combined total of the net cap (i.e. emissions allowances) and CDR achieves the overall net emissions target without affecting the number of total allowances within the ETS.

We discuss in section 3.1 (approach C) the different options for introducing limits on integrated CDR by adjusting the cap.

2.2 Factors affecting CDR integration in the EU ETS 1

Aside from the integration model, other factors can substantially influence the future supply and demand of integrated CDR in the EU ETS 1. These factors, in turn, will affect the relevance and relative value of different CDR limit approaches. Key factors to consider include the development of CDR capacities, the development of CDR costs, and the volume of hard-to-abate emissions.

- **Future CDR availability:** While optimistic scenarios show rapid upscaling of permanent CDR, these are uncertain and begin from a very low base—permanent CDR generation in the EU in 2025 was just 0.01 Mt (less than 0.2% of the EU Commission's 2030 aspirational goal set in the Sustainable Carbon Cycles Communication[11] of 5 Mt), and the majority of these were delivered from biochar (81%) and mineralisation (11%)—neither of which are currently foreseen for EU ETS 1 integration in the short to medium term ((Velten et al., 2025). In a future scenario where CDR fails to develop in significant volumes (for example, to levels required to offset residual emissions), there would be less need for CDR limit approaches.
- **Future CDR costs:** CDR would only be advantageous to EU ETS 1 emitters if they were allowed to purchase and use CDR for compliance and CDR were available at costs below the future EUA price. However, current and projected CDR costs are significantly higher than current and medium-term scenarios for EU ETS 1 prices. Witteveen *et al.* (2025) find that DACCS and BioCCS costs range from €462-1256 and €172-314 today, respectively, in comparison to current EU ETS 1 prices of €76.[12] They project DACCS and BioCCS costs to decrease to €201-402 and €163-228 respectively by 2035. These costs are higher than EU ETS 1 price expectations modelled by Enerdata (2023), who project EU ETS 1 prices to rise gradually from around €70 in 2030, to around €85 in 2035, to around €130 by 2040 before steeply rising in the 2040s to over €500 in 2044. Accordingly, without government intervention to lower CDR prices or supply them at lower prices, access to CDR is only likely to be an advantage to emitters in later time periods (e.g. post-2040) and under relatively ambitious scenarios of CDR development. Still, it is worth noting that the affordability of CDR for emitters could be improved through public support schemes, e.g. in the form of carbon contracts for difference (CCfDs). Another dimension to consider is that since CDR cost estimates differ substantially across removal types, there is a risk that CDR integration would only favour the lower-cost option (e.g., only BioCCS is favoured instead of DACCS).
- **Volume of hard-to-abate residual emissions:** The relevance and scale of integrated CDR, and the limits set on their use, depend on the demand for CDR from EU ETS 1 emitters, which in turn depends on their ongoing "hard-to-abate" residual emissions. The definition of hard-to-abate emissions is contested. La Hoz Theuer et al. (2025) define these as (i) technologically infeasible or uneconomical to abate emissions (ii) with social or political considerations. A narrow definition of hard-to-abate would restrict residual emissions to

[11] EUR-Lex - 52021DC0800 - EN - EUR-Lex

[12] Price on 22nd of May 2026 (Trading Economics, 2026)

those that are technically unavoidable even in the long term (e.g. process emissions in cement or lime after full deployment of best-available technologies, including CCS). A broader definition could include emissions that are technically abatable but only at very high cost, or emissions that are unlikely to be eliminated within relevant timeframes. Generally, the broader the definition of hard-to-abate, the greater the volume of acceptable residual emissions and, correspondingly, the greater the volumes of CDR that will be needed should these "hard-to-abate" emissions be permitted to continue and CDR were to be used to compensate these emissions. The definition of hard-to-abate emissions can also be dynamically adjusted over time, upwards or downwards, depending on observed abatement costs, and potentially also depending on how steeply permanent CDR technologies decrease in costs. Verbist, Sultani and Pahle (2025) provide a literature review of modelled hard-to-abate emissions in the EU, ranging from roughly 700-1100 MtCO2 by 2040 across all sectors, estimated by the European Commission (2024) in its 2040 target Impact Assessment. Verbist, Sultani and Pahle (2025) report **EU Commission estimates of approximately 180-420 MtCO2 of residual emissions[13] existing in EU ETS 1 1-covered sectors in 2040.**

For the subsequent analysis, we assume that CDR exists in substantial quantities, removals costs are competitive with marginal emissions reduction costs in the EU ETS 1 sectors, and that there is demand for CDR; see section 6.3 for how these issues could be addressed in future research.

[13] The Commission does not explicitly define what these residual emissions are, but it states that removals are required to compensate emissions that cannot be abated due to extremely high abatement costs or technical unfeasibility (residual emissions) (European Commission, 2024, p.39).

3 Approaches to limit CDR integrated into the EU ETS 1

In this section, we identify concrete approaches to manage CDR entering the EU ETS 1 ("integrated CDR"), should integration of permanent CDR occur. Following chapter 2.1, we limit our focus to two conceptual models for CDR integration into the EU ETS 1: via intermediary or direct integration (without an intermediary). We draw on literature related to managing the integration of offsets into emissions trading systems (La Hoz Theuer et al., 2023; Partnership for Market Readiness & International Carbon Action Partnership, 2021b), extending this into the context of integrating CDR into the EU ETS 1.

As illustrated in Table 1, **we identify four groups of approaches for limiting integrated CDR, which differ on two axes**:

- **Supply vs. demand limit:** In the case of supply limits, rules or requirements limit the volume, type, or source of CDR permitted to enter the EU ETS 1. In the case of demand limits, rules or requirements limit the volume of CDR that EU ETS 1 emitters are permitted to use for compliance within the EU ETS 1.
- **Quantitative vs. qualitative limit**: Quantitative limits directly limit integrated CDR, e.g. in the form of a maximum quantity. Alternatively, the quantity of integrated CDR can be limited by setting qualitative requirements or rules that limit the eligibility of supplied CDR or the eligibility of EU ETS 1 emitters permitted to use CDR units for compliance in the EU ETS 1.

Below, we describe the limit approaches in more detail. For approaches that are commonly applied to manage the quantity of credits entering an ETS, we describe how they could be implemented in this context of integrating permanent CDR. For those options that represent more novel approaches (e.g. C, H, I), we describe their concrete implementation in more detail. In the discussion in this chapter, we focus primarily on the "how" – i.e. how could this limit be practically implemented; we limit discussion on the "why," i.e. what limits should be set, on what basis, and how such limits should be decided upon.

As indicated in section 2, EU ETS 1 integration design elements enable or limit the implementation of limit approaches. Unless otherwise stated, we assume the following:

- **Allowances vs certificates**: CDR can be integrated into an EU ETS 1 either by converting it into (some form of) EU ETS 1 allowances, or by allowing EU ETS 1 emitters to use external certificates for compliance. We assume that CDR is converted into an allowance, and identify where this is an impactful assumption.
- **Cap design**: While the EU ETS 1 cap setting approach (see Box 1) affects the relative strengths and weaknesses of limit options, it does not affect the practical implementation of the CDR integration limits; therefore, we do not consider alternative cap designs in this chapter.
- **EU ETS 1 integration model**: Practically implementing CDR integration limits will happen differently under different CDR integration models i.e. with or without an intermediary; we explore these differences in section 5.

Table 1 Limit approaches: categorisation of approaches to limit CDR integrated into the EU ETS 1

	Supply-side (system-wide level)	Demand-side (individual emitter or activity level)
Quantitative	**Quantitative supply-side limits (how much CDR can enter the EU ETS 1)** A: **Maximum CDR integration limit:** ETS-wide maximum volume limit on CDR integrated into EU ETS 1. B: **Technology-specific quotas:** max./min. % of CDR entering EU ETS 1 obliged to be a specific technology, e.g. DACCS. C: **ETS cap adjustment:** tightening or loosening EU ETS 1 cap to affect CDR demand.	**Quantitative demand-side limits (how much CDR is allowed to be used by each EU ETS 1 emitter)** D: **Individual entity limits:** proportional or absolute limit on amount of CDR an obligated emitter can use for EU ETS 1 compliance. E: **Individual technology-specific quota:** max/min% of CDR used for EU ETS 1 compliance obliged to be a specific technology, e.g. DACCS.
Qualitative	**Qualitative supply-side limits (which CDR types/qualities and suppliers are allowed and for what purpose)** F: **CDR certificate eligibility rules:** only permit specific "types" of CDR to enter EU ETS 1 (e.g., methodology, quality). G: **CDR-supplier eligibility rules:** only permit specific suppliers to generate CDR allowances or certificates for EU ETS 1 compliance.	**Qualitative demand-side limits (which installations/activities are allowed to use CDR)** H: **Favoured entities permitted to use CDR**: Selected EU ETS 1 emitters permitted to use CDR allowances/certificates to fulfil their compliance obligations (% or absolute limits could apply). I: **Limit participation in CDR allowance auctions** to favoured entities.

3.1 Quantitative supply-side limit: System-wide limits

A. Maximum CDR integration limit

A gross limit on the maximum amount of CDR to be integrated into the EU ETS 1 over a particular time period.

B. Technology-specific quota

In addition to or as an alternative to a *maximum CDR integration limit*, a technology-specific quota could set an obligation that a maximum or minimum percentage of CDR generated by a particular technology, e.g. at least 10% of CDR entering the EU ETS 1 must be from DACCS. In addition to limiting the amount of specific types of CDR, the technology-specific quota could require a minimum amount of expensive CDR types, which would increase the average price of CDR entering the EU ETS 1 and therefore reduce the total quantity of CDR.

C. ETS cap adjustment

The EU ETS 1 cap could be adjusted to indirectly limit integrated CDR by affecting the amount of demand for CDR. The mechanism depends on the form of EU ETS 1 cap. If CDR allowances enter the EU ETS 1 as part of a gross cap (i.e. a cap on the total number of allowances, i.e. emissions

allowances plus CDR allowances), then a tightening of the gross cap would decrease the number of allowances in the EU ETS 1, including CDR allowances, thereby decreasing integrated CDR by an uncertain amount (depending on relative marginal costs of emissions reductions and CDR). Under a net cap (i.e. a cap on the number of emissions allowances in the EU ETS 1), a tightening of the net cap would increase demand for CDR, increasing total CDR integrated (and vice versa – assuming no additional limit approaches apply); the exact impact on CDR integrated would be uncertain, depending on marginal abatement costs of emissions reductions and removals.[14]

3.2 Quantitative demand-side limit: Individual limits

D. Individual entry limit

Quantitative limits can be set, such that EU ETS 1 emitters can only use a maximum amount of CDR allowances or certificates for compliance. Limits can be set in proportional terms (i.e. as a %), for example relative to the entity's compliance obligation or verified emissions.[15] Alternatively, this could be set relative to the proportion of the initial allocation (an approach limiting entity offset use in the China Hubei pilot ETS), a percentage of emissions reductions achieved (e.g. as in the Saitama ETS), or as a proportion relative to the gap between free allocation and verified emissions (e.g. as in the China Shenzhen pilot) (La Hoz Theuer et al., 2023). Individual entity limits could also be set for individual emitters or sectors based upon an assessment of expected residual emissions.[16] It would also be feasible to set an absolute limit (e.g. fixed maximum tonnes of CDR per installation), though this would pose downsides. In particular, it would advantage actors with smaller compliance obligations over others if the absolute limit were equal for all entities. Moreover, such an approach could generate more market uncertainty than a percentage limit for both CDR suppliers and the ETS market due to their static and non-adaptive nature.

E. Individual technology-specific quota

In addition to or as an alternative to a D. *Individual entity limit*, an individual technology-specific quota could require that EU ETS 1 emitters return a maximum or minimum percentage of the allowed CDR volume from a particular technology, e.g. at least 10% of their CDR allowances must be sourced from DACCS. In addition to limiting the amounts of specific types of CDR, this could be used to require expensive CDR types, which would increase the average price of CDR purchased by EU ETS 1 emitters and therefore reduce the total volume of CDR.

3.3 Qualitative supply-side limit: CDR eligibility rules

F. CDR certificate eligibility rules

CDR certificate eligibility rules represent a qualitative supply-side instrument which indirectly influences the volume of CDR that can enter the EUETS. Eligibility rules are typically designed to

[14] The tightening of a net cap would lead to lower net emissions; the tightening of a gross cap would have uncertain impacts on net emissions (as it could result in more emissions reductions or less removals).

[15] As in the Korean and Californian ETSs (La Hoz Theuer et al., 2023).

[16] We discuss other "favouring" approaches in section 4.1.4.

ensure that removals meet minimum quality standards[17] (e.g. the CRCF) but stringent criteria can have the additional effect of reducing the number of removal activities that qualify, as well as entail high costs for demonstrating eligibility, both of which limit supply.

G. CDR supplier eligibility rules

Limits could also be set such that only specific types of suppliers are permitted to generate CDR for compliance, e.g. generation of CDR could be limited to emitters already covered by the EU ETS 1 (which could in principle generate CDR via BioCCS). Such an approach could be used to limit quantity but could also be deployed to manage sustainability impacts, e.g. by limiting DACCS supply to regions with high renewable energy generation.

3.4 Qualitative demand-side limit: "Favouring" approaches

A qualitative, demand-side approach could potentially also be used to limit the amount of CDR integrated into an ETS, where only selected sectors or emitters would be permitted to use CDR units for compliance, effectively limiting the total volume of CDR used for compliance in the EU ETS 1. We refer to this as a "favouring" approach, as only those sectors or emitters who are selected by the regulator would have access to CDR. In this case, the limited CDR-backed certificates or allowances would be "booked" for particular actors. To our knowledge, this "favouring" approach has not been widely implemented (see Box 2 for an overview of relevant, related approaches), so we introduce these limit approaches in more detail.

Such a "favouring" approach could have multiple motivations, with the policy objectives having implications for implementation. As in the previous limits, a key motivation would be to limit the number of CDR units entering the EU ETS 1, with multiple potential reasons for this identified in section 1. There is also the potential to use access to CDR credits as an incentive tool, e.g. access could be awarded to those actors who have already implemented significant emissions reductions or can demonstrate they have developed climate neutrality plans or that they will in the near future implement decarbonisation strategies. Favouring approaches could also be motivated on similar grounds to free allocation, including a desire to manage the distribution of costs (e.g. for those with high residual emissions), provide transitional support, or reduce carbon leakage or competitiveness risks.[18] The motivation for a favouring approach would not affect how it was implemented, simply the grounds on which "favoured" entities would be identified. A favouring approach assumes that the favoured sector or entity would receive benefits from having access to the CDR allowances.

The decision of which EU ETS 1 sectors or emitters would receive "favourable" access to CDR would ultimately be a political decision. In the context of CDR, considerations regarding which are the "hard-to-abate" sectors with "unavoidable" or residual emissions would be expected, though these can be politically and technically challenging to define (Schenuit et al., 2023). An option could be to limit access to those who have demonstrated recent, additional effort to decarbonise, e.g. those who have completed a Climate Neutral Plan, though this may

[17] These restrictions could focus on and/or be justified by many different criteria, e.g. they could be criteria focused on ensuring equivalence with EU ETS emissions (e.g. the CRCF criteria of additionality, permanence, quantification), or could aim to manage or avoid externalities, e.g. with sustainability criteria that would exclude BioCCS unless it can demonstrate sustainable biomass sourcing.

[18] Carbon leakage is currently addressed through the allocation of free allowances for industry sectors—and these will be replaced by the incoming Carbon Border Adjustment Mechanism, which is phased in from 2026-2034.

involve significant administrative overhead.[19] Regulators would also need to consider whether "favouring" certain sectors or entities is the best way to achieve objectives, or whether other approaches (e.g. free allocation of allowances) would be preferable.

H. Favoured entities permitted to use CDR

A limit could be set on which EU ETS 1 emitters could use CDR allowances or certificates for compliance. "Favoured" entities would receive special dispensation to return CDR allowances (or certificates)[20] to counterbalance their (residual) emissions and comply with their EU ETS 1 obligations. Only those who have this dispensation would be motivated to purchase CDR allowances or certificates, as for other actors they would have no compliance value. This favoured entity approach could be further specified, such that different favoured entities were permitted to use different amounts of CDR for compliance, building on the quantitative demand side limit approaches D and E discussed in section 3.2.

I. Limit participation in CDR auctions to favoured entities

Should EU ETS 1 integration be through an intermediary, the regulator would have an additional option for implementing this approach by limiting participation in auctions of CDR allowances to "favoured" sectors and entities.[21] As explored in section 5.2, this would pose significant practical challenges and be ineffective at limiting CDR quantity, as favoured buyers would be able to on-sell allowances or reduce their demand for other allowances.

Box 2: Further examples of "favouring" approaches

While we did not identify examples of existing qualitative, demand-side approaches to limit the volume of CDR (or offsets) integrated into the EU ETS, some related examples of "favouring" approaches" could be instructive:

1) **Differentiated individual emitter limits on offsets**: Experiences with using differentiated emitter limits is relatively limited, with only one example reported by La Hoz Theuer et al. (2023). They identify that in the Saitama ETS, factories are permitted to return a higher share of offset credits than offices, expressed as a differentiated quantitative limit.[22] Another example is during the third phase of the EU ETS from 2013 to 2020, where differentiated treatment was provided for stationary installations and aviation, where stationary installations were able to return higher amounts of offsets than aviation (European Commission, 2013). These differentiated limits were implemented through a quantitative demand-side limit: aviation could return up to 1.5% of its verified emissions in the form of offsets, while stationary installations could return up to 11% of earlier free allocations. The Regulation states that incorporation of international credits is in order to increase cost-effectiveness but does not justify the differentiation.

[19] See DEHSt - Climate neutrality plans

[20] This could be implemented either by allowing favoured entities to use certificates for compliance (e.g. CRCF certificates) or by differentiating CDR and regular EU ETS units and only allowing favoured entities to use CDR allowances. Such a two "currency" system within the EU ETS is comparable to the use of Aviation certificates (EUAAs) in the past.

[21] This would exclude intermediaries (e.g. banks), who play an important role purchasing allowances on behalf of EU ETS emitters.

[22] Factories are permitted to return up to 50% of their reduction obligations in the form of external credits; offices 33%.

2) **Free allocation of ETS allowances** is commonly used to manage the distribution of costs arising from an ETS (Partnership for Market Readiness & International Carbon Action Partnership, 2021a) and offers a model for thinking through how favouring approaches could perform in practice. Free allocation can be used to address many policy objectives but is primarily justified by carbon leakage protection. Decisions over the distribution of allowances are contentious and subject to high political pressure (*Ibid.)*.

4 Implementation of CDR limit approaches in the EU ETS 1

In order to be used, the limits approaches identified above would need to be implemented in the EU ETS 1. Their implementation – whether it is possible and how it would practically be done – mainly depends on the model of CDR integration, that is, whether CDR is integrated via an intermediary or directly integrated without an intermediary. Below, we specify concretely how each CDR limit approach could be implemented to limit CDR flowing into the EU ETS 1.

4.1 Implementation differences by CDR integration model

4.1.1 Quantitative supply-side limits: System wide limits

A. Maximum CDR integration limit: It would be straight forward to implement a maximum CDR integration limit should CDR be integrated via an **intermediary**, as the intermediary could simply limit the maximum number of certificates they purchase or release (e.g. via auctioning or allocation) into the EU ETS 1. For direct integration of CDR **without an intermediary**, this would be more challenging and/or inefficient. The regulator could limit the number of CDR-backed allowances permitted to be created,[23] but practically this would be challenging to implement. If a simple first-in-first-served rule applied, there would be significant uncertainty for CDR suppliers, who would be uncertain if their specific unit of CDR would be permitted to enter the EU ETS 1, even if it was low cost.[24] Any more sophisticated models than first-in-first-served (e.g. reverse auctions) would seem to result in the regulator effectively becoming an intermediary.

B. **Technology-specific quota:** An **intermediary** could simply implement this by either purchasing or releasing into the EU ETS 1 a set proportion of particular types of CDR. For integration **without an intermediary,** this would not be practical to implement, as there would be no way to guarantee that the quotas were met by voluntary suppliers; an equivalent limit could instead be set on the demand side (see limit type *E*).

C. **ETS cap adjustment**: Adjusting the EU ETS 1 cap would be achieved by the EU ETS 1 regulator; implementation would be the same whether through **intermediary** or **without intermediary.**

4.1.2 Quantitative demand-side limits: Individual limits

D. Individual entity limit: Implementation would be the same through both **intermediary** and direct integration **without intermediary** models: the regulator would enforce limits when doing the annual EU ETS 1 compliance check to ensure that emitters have sufficient allowances to cover emissions, where they would also ensure that each emitter only uses a permitted proportion or amount of CDR allowances.

[23] This limit approach could not be implemented without an intermediary if EU ETS emitters were permitted to use certificates for compliance (i.e. no conversion to a form of EU ETS allowance is necessary for this limit to be implemented in the case of direct integration).

[24] The UK government has proposed using such a supply limit within a direct integration model, but have not specified how this will be practically implemented (UK Government et al., 2025). The first-in-first-served approach generates additional uncertainty for suppliers, as if the limit is reached there is no ability to sell CDR units, even if there CDR is preferable (e.g. cheaper, better sustainability outcomes); this differs from an intermediary approach, where the supplier has some options to supply CDR (such as lowering prices).

E. Individual technology-specific quota: Like *D. Individual entity limit*, this would be implemented in the same way for both **intermediary** and direct integration **without intermediary** models, by the regulator enforcing quotas when doing the compliance check.

4.1.3 Qualitative supply-side limit: CDR eligibility rules

F. CDR certificate eligibility rules: An **intermediary** could set their own specific, stringent quality (or other) standards and only purchase or release into the EU ETS 1 CDR that meet that standard. Examples of eligibility rules could include e.g. expected permanence of over 1000 years, or more stringent biomass sourcing requirements. To implement in the case of direct integration **without intermediary**, the regulator could also set stringent eligibility criteria for the creation of CDR allowances. For both intermediary and without intermediary models, flexibility may be somewhat limited (politically) by the presumptive quality standard established by the CRCF; going beyond this may be politically challenging.

G. CDR supplier eligibility rules: This could be implemented using the approaches indicated in *F. CDR certificate eligibility rules.* In the case of **the intermediary** model, this would manifest as the intermediary only purchasing from specific suppliers (effectively implemented by setting a narrow standard, identifying the specific suppliers or supplier characteristics that are permitted for intermediary purchase and/or released into the EU ETS 1). These same challenges would apply in the case of direct integration **without intermediary**, though an additional limited implementation option would be to limit CDR allowance generation to existing EU ETS 1 emitters by only recognising CDR when carrying out ETS compliance check, meaning only existing EU ETS 1 entities would be able to have CDR recognised.

4.1.4 Qualitative demand-side limit: "Favouring" approaches

H. Favoured entities permitted to use CDR: Implementation would be the same under both **intermediary** and direct integration **without intermediary** models: At the compliance check stage, the regulator would only allow favoured entities to use CDR for compliance.

I. Limit participation in CDR auctions to favoured entities: If this were implemented via an **intermediary,** they would be able to limit participation in CDR-allowance auctions to "favoured" sectors and entities. This would pose some challenges, as explored in section 5.2.1. This approach would not be implementable if EU ETS 1 integration occurred via direct integration **without intermediary**, as there would be by definition no intermediary hosting auctions.

4.2 Possible combinations of limits

Some limits could be combined, while others would result in duplication and confusion**.** The combination of different approaches can be used to address multiple policy objectives, such that they are addressed simultaneously but in a targeted manner. For example, stringent CDR certificate eligibility rules (a qualitative supply-side limit) could be utilised to manage quality concerns alongside quantitative limits, whether they be system-wide limits or individual entity limits. Some combinations would not be advisable due to potential duplication and confusion. For example, it would seem simpler and equally effective to use just one of *A. Max CDR integration limit* and *D. Individual entity limit*, as both aim to directly limit the quantity of CDR, only at different entry points—A. at the point where CDR enters the EU ETS 1; D. at the point of compliance. For our assessment in chapter 5, we assess approaches individually; in section 6.3, we develop potential useful combinations.

4.3 Static versus dynamic limit setting

Limit rules could be fixed or be dynamic, for example responding to market indicators or otherwise revised over time. For example, the volume of CDR integration permitted could be tied to EU ETS 1 allowance availability thresholds, following the example of the MSR. For example, approach *A. Max CDR integration limit* could be implemented such that a maximum limit was fixed in advance, or alternatively, rules could be agreed such that the maximum limit changes in a predictable way over time, e.g. if EU ETS 1 price exceeds a certain level, then additional CDR allowances would be released for auction. Static approaches and dynamic approaches have different strengths and weaknesses, creating different risks or uncertainties (or safeguards) for different actors: fixed approaches increase certainty for market actors, supporting long-term investments (for both CDR supply and EU ETS 1 demand); conversely, dynamic approaches can adapt to reduce costs that arise when CDR innovation and/or EU ETS 1 price paths diverge from expectations: Verbist et al (2025) propose a "CDR quantity corridor" approach that sets maximum and minimum CDR integration limits with pre-defined adaptive rules. The form of EU ETS 1 integration would also be important to consider, with the intermediary model potentially offering greater ongoing flexibility for revising rules dynamically, if the intermediary role was implemented in the form of an institution with significant decision-making power. For our assessment of CDR limit approaches in chapter 4, we assume approaches are static (i.e. set in advance and remain fixed, irrespective of market developments).

5 Comparison of CDR limit approaches

The above-described approaches for limiting CDR integrated into the EU ETS 1 pose different strengths and weaknesses. In this section we introduce a set of assessment criteria and assess the limit approaches introduced in chapter 3. Our assessment considers the different approaches for integrating CDR in isolation, to enable a meaningful comparison. We discuss potential combinations and links to models for CDR integration in the conclusions in chapter 6.

5.1 Assessment framework

In this section, we present the key criteria we use to comparing limit approaches. They build on the motivations for limiting the quantity of CDR integrated into the EU ETS 1, as set out in chapter 1. Those motivations partially overlap and, in some cases, even conflict, reflecting the differing perspectives of the actors who raise them. Rather than translating these directly into assessment criteria, the framework evaluates the strengths and weaknesses of different approaches using the criteria outlined in Table 2.

Table 2 Framework for assessing approaches to limit CDR integration (own compilation)

Criteria (objectives)	Explanation
Effective quantity management	Ability to effectively manage the quantity of removals (with certainty, and predictability). This impacts emissions reduction deterrence and market predictability, and thereby the efficient functioning of the EU ETS 1.
Effective quality management	Ability to effectively manage quality of removals (e.g., avoid negative externalities such as excess biomass use, non-permanence, non-equivalence)
Cost-effective climate action	Supports the EU ETS 1 in achieving a net emission reduction objective at lowest cost by incentivising lowest cost mix of emissions reductions and removals25
Avoidance of practical barriers for implementation	Avoids major barriers to implementation, such as those arising from complexity, administrative and participant transaction costs, and potential political difficulties
Cost distribution management	Ability to manage distribution of cost across different EU ETS 1 emitters or sectors, i.e. the ability to favour particular industries or actors, such as those with higher emissions reduction costs

5.2 Assessment of integrated CDR limit approaches

The assessment is summarised in Table 3 and Table 4, with justifications for assessments detailed below. Assessments are relative, that is, they compare the different approaches in relation to each criterion. It is important to note that different criteria will have different importance (weight), depending on the concerns and motivations of the regulator and that these might change over time.

[25] This criterion considers the relative efficiency losses of different limit approaches. In the context of putting limits on integrating permanent CDR into the EU ETS, efficiency would be achieved when the limited carbon removals allowances or certificates are returned by those with the highest marginal abatement costs, meaning that those with lower marginal abatement costs reduce their emissions. If CDR is available at marginal costs below EU ETS market price, then – assuming CDR is equivalent to emissions reductions - any limit will increase the cost of achieving environmental targets relative to no limits.

We evaluate limit approaches separately considering two potential contexts: in section 5.2.1 we first assess limit approaches assuming CDR integration into the EU ETS 1 via an intermediary; and in section 5.2.2 we identify differences if we assume CDR integration occurs via direct integration without intermediary.

5.2.1 Assessment of CDR limit approaches assuming CDR integration via an intermediary

Table 3 Analysis of approaches to limit CDR integration into the EU ETS 1 via an intermediary (own compilation)

Type		Limit approach	Effective quantity manage-ment	Effective quality manage-ment	Cost-effective mitigation	Avoid practical barriers	Cost distribution management
Quantitative	Supply	A. Max CDR integration limit	H	L	M	H	L
		B. Technology-specific quota	L	M	L / M	H	L
		C. ETS cap adjustment	L / M	L	H	H	L
	Demand	D. Individual entity limit	H	L	L	H	L / M / H
		E. Individual technology-specific quota	L	M	L / M	H	L
Qualitative	Supply	F. CDR certificate eligibility rules	L	H	M	M	L
		G. CDR supplier eligibility rules	L	H	M	M	L
	Demand	H. Favoured entities permitted to use CDR	M	L	L	M	H
		I. Limit participation in CDR auctions	M	L	L	M	H

Note: H indicates high (green), M indicates medium (yellow), L indicates low (red).

Effective quantity management: *A. Max CDR integration limit* and *D. Individual entity limit* score highest, as they directly set transparent limits on the volume of CDR entering/used in the EU ETS 1. The transparency of these limits also supports EU ETS 1 functioning, as participants will be able to see current and future CDR limits and plan and invest accordingly. "Favouring" approaches (*H. Favoured entities* and *I. Limit participation in CDR auctions*) are less transparent and less certain, with the total volume of allowances depending on the criteria for acquiring "favoured" status, and uncertainty regarding favoured entities' demand for CDR.[26] Other

[26] A fundamental problem with *I. Limit participation in CDR auctions* arises due to the ability of "favoured" sectors and entities to trade allowances and certificates, which would mean that this "favoured" approach would be theoretically assumed to approximate the quantitative supply-side limit outcome, thus failing to justify the increased complexity posed by the limiting of CDR auction participation to favoured entities approach. To explain this logic, imagine that a "favoured" emitter could purchase CDR at prices below the EU ETS market price. Even if they did not need their full allotment - e.g., if they met their compliance obligations by counterbalancing their own emissions before CDR allowances (or their allotment of allowances) was exhausted - they would be incentivised to purchase all available CDR allowances and sell these into the EU ETS (a regulator could apply additional restrictions, e.g. excluding the trade of removals certificates or allowances; however, this would not fully address the issue, as "favoured" emitters

approaches only indirectly limit the volume of CDR entering the EU ETS 1, with higher uncertainty about the limited quantities, which can negatively affect EU ETS 1 market operation.

In the case of *C. ETS Cap* Adjustment, the assessment depends on the form of the EU ETS 1 cap (see box 1). If it is a gross cap (i.e. a limit on total allowances in the EU ETS 1, including both CDR and emissions allowances), then the limit's effectiveness at reducing CDR depends on the relative marginal abatement costs of CDR and emissions reductions: if CDR has the highest marginal abatement costs, then a reduction in the gross cap will reduce CDR in the EU ETS 1, whereas if emissions reduction has the highest marginal abatement costs, then a gross cap reduction will not affect CDR. Conversely, the reduction of a net cap (where the cap establishes the number of emissions allowances, not considering CDR-backed allowances) would likely increase the amount of CDR, which would become relatively more affordable compared to the more limited emissions reduction allowances.

Effective quality management: *F. CDR certificate eligibility rules* offer the most direct and effective management of quality, given its specific focus on setting quality criteria to permit or exclude different types or sources of CDR; *G. CDR supplier eligibility rules* can also effectively manage quality, if well-specified. Technology specific quotas, whether set at the intermediary level (i.e. *B. Technology specific quota*) or individual entity (*E. Individual technology specific quota*), can be used to favour particular removal types (e.g., those with high permanence) and therefore influence quality, though with slightly less specificity than limits *F.* and *G.* The other limit approaches target CDR in general or focus on who can use supply, i.e. demand rather than supply, so offer no control over the quality of CDR.[27]

Cost-effective mitigation: *C. ETS cap adjustment* scores highest on efficiency grounds, as it places no restrictions on the trading of emissions reductions and removals (apart from the sum total), enabling the market to find the most cost-effective mix. *A. Max CDR integration limit* scores relatively highly: while it limits the relative amount of CDR and emissions reductions (potentially standing in the way of an efficient mix), they pose no limits on trading of CDR allowances and therefore would theoretically achieve efficient distribution of limited CDR allowances once they have entered the EU ETS 1. Similarly, *F. CDR eligibility rule* and *G. CDR supplier eligibility rules* limit the amount of CDR entering the EU ETS 1, but do not limit trading of the CDR that is integrated into the EU ETS 1. The technology-specific quota approaches (*B.* and *E.)* would limit the CDR entering the EU ETS 1, limiting the system's ability to reach the cost-effective mix of emissions reductions and removals; however, this could in some cases be justified on dynamic efficiency grounds, if e.g. there were requirements for purchase of currently expensive CDR to support its long-term technology development. Other limit approaches limit the amount of CDR individual entities would be able to use for compliance, even if some

could purchase CDR allowances and sell off other allowances they hold). Theoretically, we would expect that in such a case, all CDR allowances would be purchased by "favoured" emitters, and would be sold into the EU ETS, with the final distribution of allowances equal to the *A. Maximum CDR integration limit* case (assuming no transaction costs), with no additional limit on CDR entering the EU ETS but with windfall profits for the favoured sectors/emitters.

[27] While less relevant for our context of integrating permanent CDR into the EU ETS, a favouring approach could potentially be used to manage non-equivalence. For example, in the context of an agricultural ETS, it could be feasible to only allow emitters with similar types of emissions (e.g. LULUCF emissions) to use afforestation-backed CDR for compliance. This would not explicitly target the quality of removals but could address the second element of the criterion, ensuring equivalence.

participants have higher marginal abatement costs than others; by definition, this reduces efficiency.

Avoid practical implementation barriers: In the context of CDR integration via intermediary, all limit approaches pose few practical implementation barriers, with two exceptions. Favouring approaches (*H. Favoured entities permitted to use CDR* and *I. Limit participation in CDR auctions)* will involve political challenges in terms of defining who qualifies as "favoured".[28] It will also be politically challenging to introduce additional quality standards on top of the agreed CRCF certificate standards, affecting the ability to introduce qualitative supply-side limits (*F: CDR certificate eligibility rules* or *G: CDR-supplier eligibility rules*). Otherwise, whether all limit approaches pose practical challenges is difficult to generalise but rather would depend on the specific way they were implemented.

Cost distribution management: The favouring approaches, *H. Favoured entities* and *I. Limit participation in CDR Auctions* specifically differentiate between different users of CDR and therefore are the only options that score highly on this criterion. *D. Individual entity limits* could also be designed to differentiate between different individuals or sectors; if this is the basis for their quantitative limit setting, they can also manage cost distribution. As all other limit approaches restrict users of CDR equally, they can only manage cost distribution in combination with these favouring approaches.

5.2.2 Assessment of CDR limit approaches assuming CDR integration via direct integration

The assessment of limit approaches in the context of CDR integration into the EU ETS 1 via direct integration rather than intermediary generates very similar results to section 5.2.1's assessment in the context of integration via an intermediary. In Table 4 we identify where differences in assessments occur (in bold black outlined cells). Two limit approaches are not implementable in the case of direct integration, *B. Technology-specific quota* (see section 4.1.1) and *I. Limit participation in CDR auctions* (see section 4.1.4). The only other difference in the two assessments is that in the case of direct integration, *A. Max CDR integration limit* scores poorly on the criterion, "avoid practical implementation barriers", due to the challenges of distributing rights among CDR suppliers, as outlined in section 4.1.1.

[28] Additionally, it would presumably also exclude intermediaries (e.g. banks), who play an important role purchasing allowances on behalf of EU ETS emitters.

Table 4 Analysis of approaches to limit CDR integration into the EU ETS 1 via direct integration (own compilation)

Type		Limit approach	Effective quantity manage-ment	Effective quality manage-ment	Cost-effective mitigation	Avoid practical barriers	Cost distribution manage-ment
Quantitative	Supply	**A. Max CDR integration limit**	H	L	M	H	L
		B. Technology-specific quota	NP	NP	NP	NP	NP
		C. ETS cap adjustment	L / M	L	H	H	L
	Demand	**D. Individual entity limit**	H	L	L	H	L / M / H
		E. Individual technology-specific quota	L	M	L / M	H	L
Qualitative	Supply	**F. CDR certificate eligibility rules**	L	H	M	M	L
		G. CDR supplier eligibility rules	L	H	M	M	L
	Demand	**H. Favoured entities permitted to use CDR**	M	L	L	M	H
		I. Limit participation in CDR auctions	NP	NP	NP	NP	NP

Notes: H indicates high (green), M indicates medium (yellow), L indicates low (red), NP indicates not possible (grey). Cells with bold border indicate differences from Table 3, i.e. differences in the assessment of CDR limits in the case of direct integration without an intermediary compared to an EU ETS 1 integration via an intermediary.

6 Conclusions and recommendations

6.1 Key conclusions

This report has investigated different approaches – and their relative strengths and weaknesses – that can be used to limit CDR integrated into the EU ETS 1.

Different approaches are better suited to address different objectives, and accordingly, **different limiting approaches should be selected depending on the underlying motivation for limiting CDR integration into the EU ETS 1.** A clear example is posed by the *F. CDR eligibility rules*. This approach is well suited for addressing quality concerns, including managing non-equivalence risks and negative externalities. However, it is less suited than other approaches to effectively and transparently manage the quantity of CDR, due to the potentially uncertain impact of strict CDR eligibility rules on the supply of CDR. Where limiting the quantity of CDR is the key policy objective – for example to manage emissions reduction deterrence or maintain current EU ETS 1 scope and function – then system-wide or individual emission limits would be preferable approaches.

Different limit approaches will be appropriate at different stages of CDR integration into the EU ETS 1. Limits would be appropriate in the early stages of CDR integration into the EU ETS 1. They reduce uncertainty for EU ETS 1 participants. They also enable learning to occur, without posing significant risks to market operations. They will also be important in later stages, as the volumes of EU ETS 1 allowances becomes more limited and CDR supply potential grows. Limits can always be adapted over time, as market experience and regulator knowledge increase. The stringency of limits should also reflect their impact on the growth of the CDR industry, which is important for achieving long-term climate targets.

6.2 Useful combinations of limit approaches

Based on our assessment of limit approaches, here we identify potential combinations of limit approaches that might be helpful for achieving one or more policy objectives, such as effective quantity management and cost-efficiency. Note, however, that these combinations may not be suitable in practice—for instance, if the regulator seeks to maximize other objectives (such as cost distribution).

CDR integration via intermediary: If effective quantity management and cost-effectiveness are the primary motivations, then *A. Max CDR integration limit* seems most appropriate in combination with *F. CDR certificate eligibility rules*. This combination gives the intermediary control over the quantity of CDR entering the EU ETS 1 as well as the quality of the CDR. It is also straightforward to implement: the use of *A. Max CDR integration* delivers more cost-effective mitigation relative to the alternative approach *D. Individual entity limit.* In combination, *B. Technology-specific quota* could be used to ensure demand for diverse CDR types, which could be important for risk management and dynamic efficiency reasons, as it would support development of a diverse portfolio of CDR technologies and suppliers (McDonald et al., 2025). Should regulators be motivated to limit CDR integration in order to favour particular sectors or entities, favouring approaches could be considered. However, they pose efficiency downsides and practical challenges that may justify achieving favouring objectives via other, more direct and tested approaches to achieve the same objectives, such as targeted free allocation of allowances.

CDR integration via direct integration without intermediary: If effective quantity management and cost-effectiveness are the primary motivations, then *D. Individual entity limits* seem most appropriate, in combination with *F. CDR certificate eligibility rules*. *D. Individual entity limits* can effectively manage quantity and avoids practical barriers. This favours it over *A. Max CDR integration limit* in the case of direct integration without intermediary, as in this case a max CDR integration limit creates significant risk for CDR suppliers, as it is unclear how the right to sell CDR would be distributed amongst suppliers. This could be used in combination with *E. Individual technology-specific quota* to ensure demand for diverse CDR types; individual technology type requirements can also affect quantity demanded by affecting average price.

The EU Climate Law provides multiple potentially conflicting objectives for the EU legislative proposals regarding CDR integration into the EU ETS 1. These include limiting CDR integration to compensate for residual hard-to-abate emissions (Art. 5 (b)) as well as enhancing flexibility to boost cost-effectiveness (Art. 5(c)). It is not yet clear which motivations for CDR integration (and its limitation) will dominate. Should flexibility and cost-effectiveness objectives predominate, then limits delivering effective quantity management and cost-effectiveness should be favoured. Whether these approaches also limit the CDR's integration into the EU ETS 1 to compensate for residual hard-to-abate emissions depends on the definition of residual hard-to-abate emissions. If defined as those emissions with the highest abatement costs, then these limit approaches can achieve this objective if the quantity limit is set equivalent to total EU ETS 1 residual emissions: via relatively unencumbered EU ETS 1 trading, these allowances would be expected to be purchased by the residual emitters. However, if residual hard-to-abate emissions are defined differently (e.g. based on a qualitative assessment), then favouring approaches may be justified, despite the practical and cost-effectiveness challenges identified.

6.3 Study limits, open questions and areas for further consideration

The results and conclusions of this study should be viewed as indicative due to several limitations. These include that we have not necessarily taken into account all relevant criteria required to evaluate the options. Moreover, the results are based on strong assumptions, for example regarding the model of CDR integration and the future design of the EU ETS 1, which may differ from what has been assumed in this study. In addition, any final recommendation is only possible once the political priorities for the integration of CDR into the EU ETS 1 are known, which at present are multiple, as outlined at the beginning of the study.

A number of **open questions and areas for further research remain**:

- **Updating limit assessments in the context of new or more detailed EU ETS 1 integration models**: This study has set out potential limit approaches and assessed them separately and under assumptions regarding EU ETS 1 integration model and EU ETS 1 cap approach, as well as EU ETS 1 and CDR market development. As ETS integration model discussions progress and become more concrete, it will be important to revise this assessment to ensure it reflects the specific context. Further, the relative attractiveness of different EUETS integration models should be considered, including in terms of their ability to effectively limit CDR entering the EU ETS 1; our study suggests that on solely these grounds an intermediary model offers more options and some advantages for implementing CDR limits, though the specifics of integration design and governance would need to be considered.

- **Understanding supply and demand of CDR:** Our assessment has only in a limited manner considered likely demand and supply scenarios for CDR in the EU ETS 1; consideration of how different scenarios would affect the need for and performance of CDR limit approaches would be a useful extension.
- **Considering alternative policy approaches to meet objectives:** We focus on the practical implementation of limits rather than justifications for these. In particular, related to the favouring approaches, it would be instructive to consider which sectors or entities should be favoured, and on what grounds – and to what extent these objectives could be better met by other policy instruments.
- **Considering justifications for and quantity of CDR integration:** A final and crucial question regards on what grounds and at what level the quantity of CDR integrated into the EU ETS 1 should be limited; while we identified potential motivations in the introduction, assessing and weighing up these relative concerns – and their implications – would be required.

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