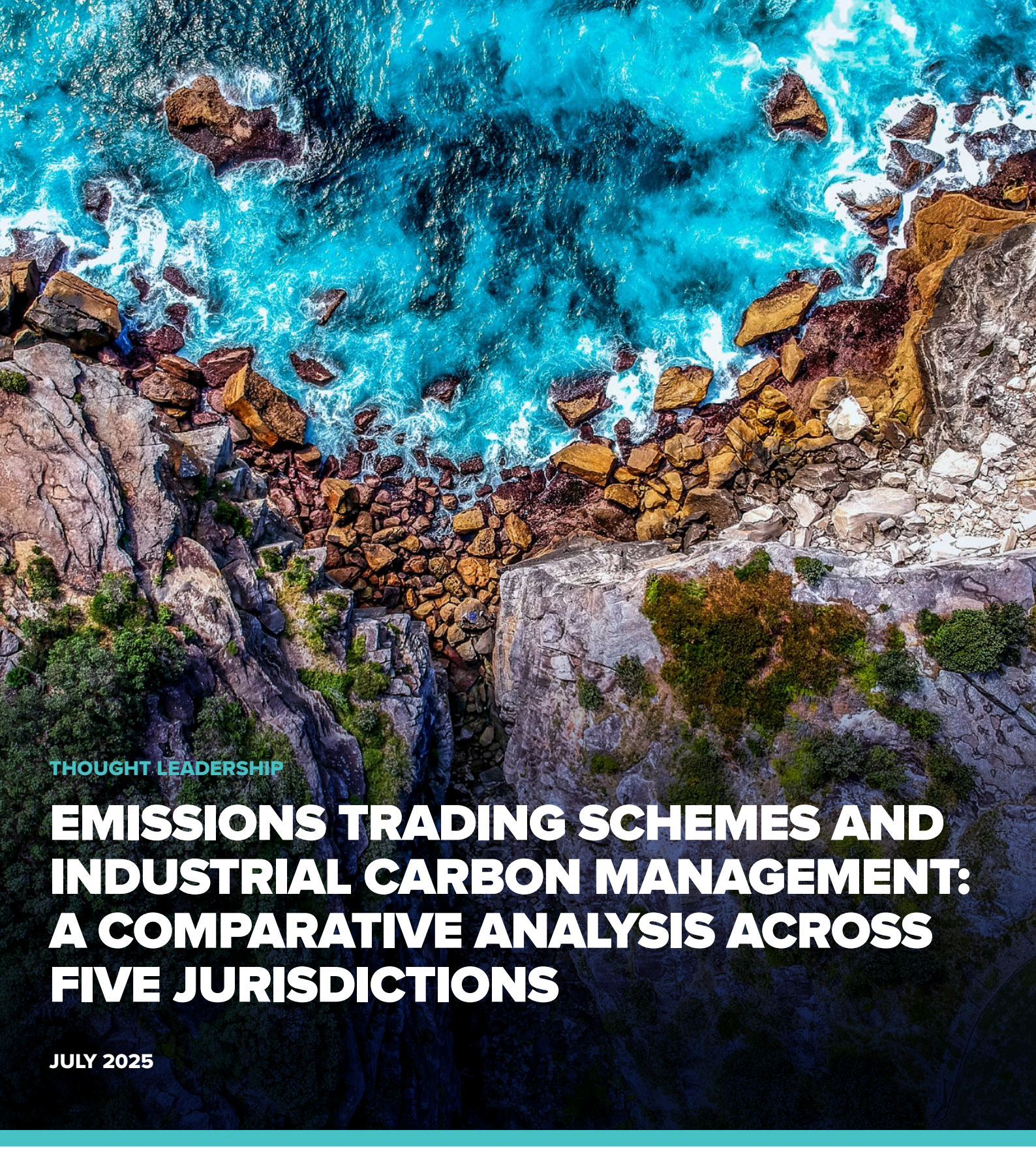

THOUGHT LEADERSHIP

EMISSIONS TRADING SCHEMES AND INDUSTRIAL CARBON MANAGEMENT: A COMPARATIVE ANALYSIS ACROSS FIVE JURISDICTIONS

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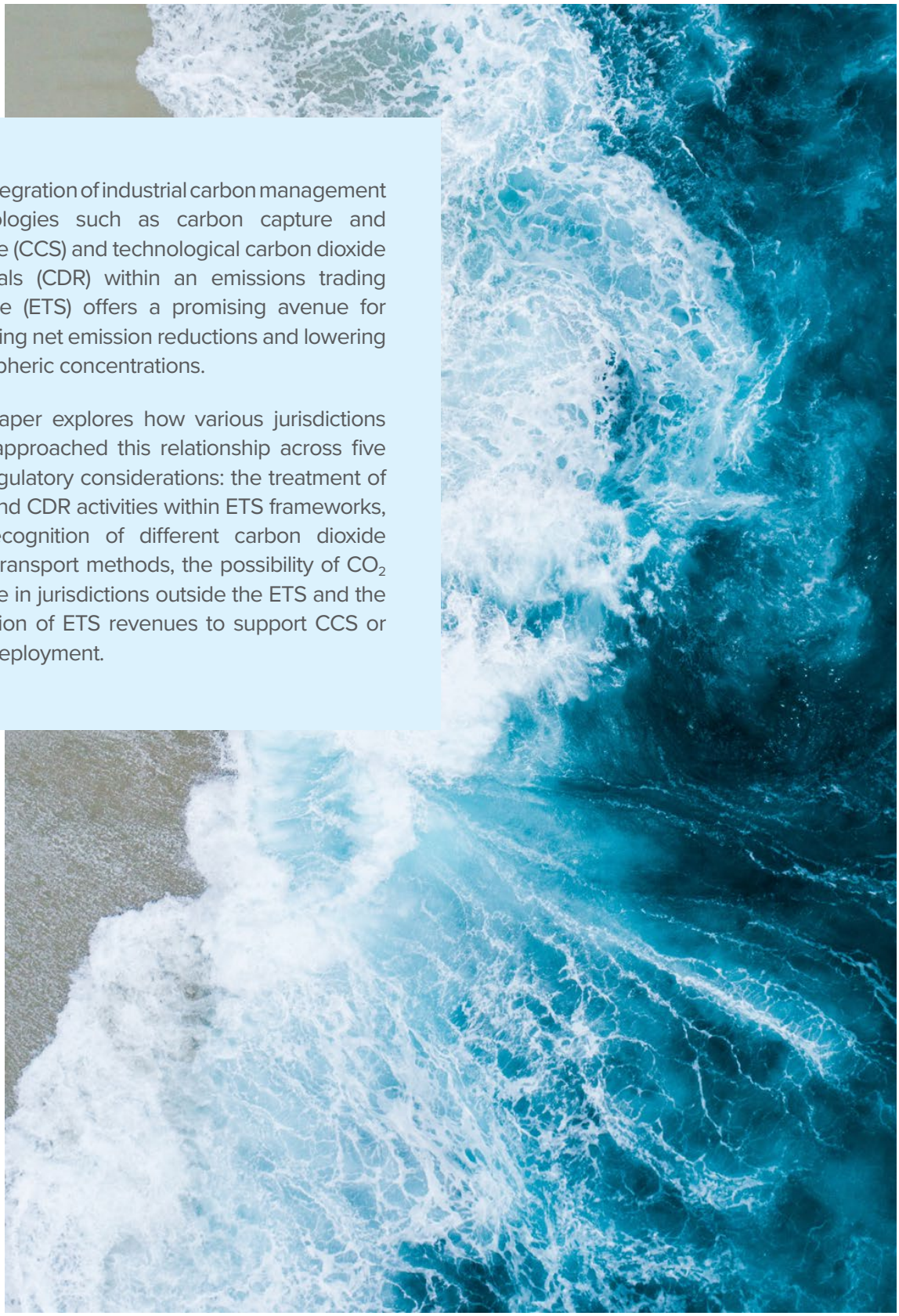
CONTENTS

Acronyms

ACCU	Australian carbon credit unit
BECCS	Bioenergy with carbon capture and storage
CARB	California Air Resources Board
CCS	Carbon capture and storage
CCSA	Carbon Capture and Storage Association
CCUS	Carbon capture, utilisation and storage
CDR	Carbon dioxide removal
CER	Clean Energy Regulator
CERF	Climate Emergency Response Fund
CO_2	Carbon dioxide
CRISP	Carbon Removal Innovation Support Program
DAC	Direct air capture
DACCS	Direct air carbon capture and storage
EEA	European Economic Area
EHR	Enhanced hydrocarbon recovery
ETS	Emissions trading scheme
EU	European Union
GGR	Greenhouse gas removal
GGRF	Greenhouse Gas Reduction Fund
GHG	Greenhouse gas
LCFS	Low Carbon Fuel Standard
MRV	Monitoring, reporting and verification
NPT	Non-pipeline transport
NZ	New Zealand
NZU	New Zealand emission unit
SB	Senate bill
SGM	Safeguard Mechanism
SMC	Safeguard Mechanism Credit
UK	United Kingdom

1.0 OVERVIEW



The integration of industrial carbon management technologies such as carbon capture and storage (CCS) and technological carbon dioxide removals (CDR) within an emissions trading scheme (ETS) offers a promising avenue for achieving net emission reductions and lowering atmospheric concentrations.

This paper explores how various jurisdictions have approached this relationship across five key regulatory considerations: the treatment of CCS and CDR activities within ETS frameworks, the recognition of different carbon dioxide (CO_2) transport methods, the possibility of CO_2 storage in jurisdictions outside the ETS and the allocation of ETS revenues to support CCS or CDR deployment.

2.0 INTRODUCTION

An ETS is a market-based mechanism designed to reduce greenhouse gas (GHG) emissions, such as CO_2, thereby helping to lower their atmospheric concentrations over time. It can operate at regional (e.g., the European Union's ETS), national (e.g., the United Kingdom's ETS, New Zealand's ETS or the Australian Carbon Credit Unit Scheme) or local levels (e.g., California's cap-and-trade program). Entities participating in such a market, either on a mandatory or voluntary basis, typically include power and heat generation plants, hard-to-abate industries, or, more recently in some ETSs, the maritime and domestic aviation sectors.

There are two main approaches to emissions trading: cap-and-trade and baseline-and-credit. In a cap-and-trade system, the regulatory authority caps the overall emissions allowed and allocates allowances to participants, based on their permitted pollution levels. Each allowance represents the right to emit one tonne of CO_2 equivalent. If participants need more allowances than allocated, they must purchase additional ones from those that have successfully reduced their emissions. In some ETSs, participants can also buy offset credits from companies that are not participating in the ETS and have generated such credits by avoiding or removing emissions. In a baseline-and-credit system, the regulatory authority establishes emissions baselines for participating entities. Those emitting below their baseline earn credits, which can be sold to entities exceeding their limits. In both approaches, the regulatory authority can gradually tighten emissions limits over time by reducing the number of allowances or the pre-defined baselines to drive decarbonisation efforts further.

By providing a financial incentive for CO_2 emission reductions, ETSs can support the development of industrial carbon management technologies, such as CCS or CDR. Despite this potential, only a few jurisdictions currently have established regulations explicitly integrating such technologies, mainly CCS, within their ETS frameworks (International Energy Agency, 2023). Approaches to CCS integration vary globally, ranging from none or minimal interaction with CCS to direct and indirect mechanisms that facilitate its integration (La Hoz Theuer et al., 2023). However, as CCS deployment expands globally (Global CCS Institute, 2024b), jurisdictions are adapting their ETS frameworks to support emerging commercial opportunities within the carbon management value chain.

This paper aims to provide a comparative analysis of the ETS in five key jurisdictions, namely the European Union (EU), the United Kingdom (UK), California, Australia, and New Zealand (NZ). Beyond examining their differences in design, it will focus on how the selected ETS frameworks address regulatory challenges associated with industrial carbon management technologies, including:

- The treatment of CCS activities,
- The treatment of CDR activities,
- The consideration of all CO_2 transport methods,
- The possibility of storing CO_2 in jurisdictions outside the ETS coverage,
- The allocation of ETS revenues to support CCS or CDR deployment.

By analysing these ETS frameworks, this paper seeks to identify best practices to support large-scale industrial carbon management to drive decarbonisation in line with climate targets.

> **"BY PROVIDING A FINANCIAL INCENTIVE FOR CO_2 EMISSION REDUCTIONS, ETSs CAN SUPPORT THE DEVELOPMENT OF INDUSTRIAL CARBON MANAGEMENT TECHNOLOGIES"**

3.0 OVERVIEW OF SELECTED ETSs

The jurisdictions selected for this comparative analysis – the EU, the UK, California, Australia and NZ – are characterised by well-established ETS frameworks, each with its own distinct design features, as demonstrated in Table 1. This section provides an overview of the ETSs in these five jurisdictions, highlighting their key characteristics and recent developments.

3.1. EU ETS

The EU ETS, the world's first large-scale carbon market launched in 2005, applies to the European Economic Area (EEA). Participation in the system, referred to as 'ETS 1', is mandatory for sectors listed in Annex I of the revised EU ETS Directive[1]. These include carbon-intensive industries, power and heat generation, aviation and, more recently, shipping.

As a cap-and-trade system, the EU ETS sets a limit on total emissions from covered sectors, which is reduced over time to encourage decarbonisation. Companies receive free allowances or purchase them at auctions or on a secondary market. EU ETS participants that emit less than their allocated allowances can sell their surplus or save them for future compliance years, while participants exceeding their limits must purchase additional allowances or reduce their emissions to comply with the system.

With the European Green Deal and the Fit-for-55 package, the EU ETS emissions cap is now being reduced at a faster pace in order to meet the EU's target of cutting net emissions by at least 55% by 2030 compared to 1990 levels (European Commission, 2019, 2021). Under current rules, this cap is expected to reach zero by 2039, effectively ending EU ETS allowance auctions and restricting the use of previously issued quotas.

The Clean Industrial Deal, released in February 2025, confirmed that the European Commission would revise the EU ETS Directive in 2026 (European Commission, 2025b). Following this, a public consultation is taking place from April to July 2025, covering key topics such as the expansion of maritime emissions, the inclusion of CDR technologies and the integration of municipal waste incineration installations (European Commission, 2025d). In parallel, starting in 2027, a new, separate ETS for road transport and building fuels, referred to as 'ETS 2', is set to be introduced. However, this paper primarily focuses on the existing ETS ('ETS 1').

3.2. UK ETS

The UK ETS was established in January 2021 following the UK's departure from the EU ETS. Although it now operates independently, its structure closely mirrors its predecessor in many respects.

The system covers activities listed in Schedules 1 and 2 of the Greenhouse Gas emission Trading Scheme Order 2020, which includes carbon-intensive industries, power and heat generation, as well as domestic aviation. Future changes include expanding coverage to domestic maritime emissions from 2026 and incorporating energy-from-waste and waste incineration from 2028 (UK Department for Energy Security & Net Zero, 2023a). Additionally, ongoing policy discussions explore the inclusion of greenhouse gas removal (GGR) technologies in the UK ETS as a means to drive emission reductions further (UK Department for Energy Security and Net Zero, 2024).

Like the EU ETS, the UK ETS operates on a cap-and-trade basis, with a progressively decreasing emissions cap to align with the UK's net-zero by 2050 target.

[1] Directive (EU) 2023/959 of the European Parliament and of the Council of 10 May 2023 Amending Directive 2003/87/EC Establishing a System for Greenhouse Gas Emission Allowance Trading within the Union and Decision (EU) 2015/1814 Concerning the Establishment and Operation of a Market Stability Reserve for the Union Greenhouse Gas Emission Trading System (Text with EEA Relevance), 2023

3.3. California cap-and-trade program

California's cap-and-trade program, launched in 2013, is one of the most comprehensive ETSs in North America. It establishes a state-wide emissions cap, covering approximately 80% of California's total GHG emissions across the transport, building, industrial and power sectors. Allowances are distributed through a combination of auctions and free allocations to regulated industries. Each year, the cap is progressively lowered to reduce the number of available allowances and drive decarbonisation.

A distinct feature of California's cap-and-trade program is its experience as the first system to establish a formal linkage with another ETS. Since January 2014, it has been linked with Québec's cap-and-trade system, allowing for the joint trading of allowances between the two jurisdictions. Discussions have also begun on expanding this linkage to include Washington State's cap-and-invest programme (Washington State's Department of Ecology, 2024).

California's ETS undergoes periodic reviews to assess its effectiveness and implement necessary updates. The next scoping plan update is scheduled for 2027.

3.4. ACCU Scheme

The Australian Carbon Credit Unit (ACCU) scheme operates as a baseline-and-credit system, distinguishing it from the other ETS frameworks discussed in this paper. Launched in 2016, the scheme includes both voluntary and mandatory components.

Under the voluntary component of the ACCU Scheme, registered companies can generate ACCUs by undertaking activities that reduce or avoid emissions in line with legislated ACCU methods, provided their projects are registered with the Clean Energy Regulator (CER). These include, for instance, reforestation and afforestation, savanna fire management, energy efficiency improvements or waste reduction activities. For each tonne of CO_2-equivalent emissions that these projects store or avoid, they earn one ACCU. These credit units are then purchased by the CER at a fixed contract price, providing an additional income for companies. Alternatively, registered companies can sell these credits on the secondary market to entities participating under the Safeguard Mechanism (SGM) or other industry players who wish to offset their emissions.

The SGM applies to Australia's 219 biggest emitters (Australian Department of Climate Change, 2024a). Emissions baselines have been established for Safeguard Facilities in 2023, requiring them to remain within their allocated limits. Under the SGM, facilities emitting more than 100 kilotonnes of CO_2 equivalent annually must reduce their emissions according to pre-defined baselines, which progressively tighten over time to align with Australia's climate targets.

Baselines decline by 4.9% per annum between 2023 and 2030 and in predictable 5-year blocks thereafter, until 2050. Facilities emitting less than their baseline automatically generate Safeguard Mechanism Credits (SMCs), which can be saved for future compliance periods or sold to other Safeguard Facilities exceeding their limit. Conversely, Safeguard Facilities that exceed their baseline emissions must offset the surplus using banked SMCs, purchase ACCUs or acquire SMCs from other facilities emitting below their baselines.

3.5. NZ ETS

Established in 2008, the NZ ETS is widely considered one of the most comprehensive ETSs globally due to the wide and diverse range of sectors it covers. These sectors include forestry, maritime, waste, domestic aviation, transport, buildings, industry, power and agriculture. With the exception of agriculture, all covered sectors must surrender New Zealand Units (NZUs) to account for their emissions. In this respect, the NZ ETS operates as a cap-and-trade system, similar to the EU ETS, the UK ETS, and California's cap-and-trade system, where the total number of units is capped, and participants must buy or trade allowances to comply with their emission targets.

A notable feature of the NZ ETS is the ability for the forestry sector to earn NZUs through afforestation and reforestation activities, where landowners earn one NZU for each tonne of carbon sequestered. These NZUs can then be sold on the carbon market, creating an economic incentive for landowners to invest in carbon sequestration. On the flip side, landowners are also liable for purchasing and surrendering NZUs if they engage in deforestation, reflecting the emissions released when trees are removed from the land.

Table 1 - Comparison of the design of selected ETSs

	EU ETS	UK ETS	CALIFORNIA CAP-AND-TRADE PROGRAM	ACCU SCHEME	NZ ETS
Regulatory authority	European Commission and competent authorities in EU Member States	UK ETS Authority	California Air Resources Board (CARB)	CER	Ministry for the Environment and Environmental Protection Authority
Start of operation	2005	2021	2013	2016	2008
Geographical scope	European Union, Iceland, Liechtenstein and Norway	United Kingdom	California, United States	Australia	New Zealand
Link with other systems	Switzerland since 2020	Not applicable	Québec since January 2014	Not applicable	Not applicable
Type of approach	Cap and trade	Cap and trade	Cap and trade	Baseline and credit	Cap and trade
Covered emissions	Around 40% of EU's GHG emissions (European Commission, 2024b)	Around 25% of UK's GHG emissions (UK Government et al., 2024a)	Around 80% of California's GHG emissions (California Air Resources Board, 2024a)	Not applicable for ACCU Scheme; around 60% of Australia's GHG emissions under the SGM[2] (Parliament of Australia, 2024)	Over 50% of New Zealand's GHG emissions (New Zealand Ministry for the Environment, 2022)
Covered sectors	Industry, power, maritime, domestic aviation and waste[3] (ETS 1)	Industry, power, domestic aviation (including from the UK to the EEA and Switzerland)	Transport, buildings, industry and power	Electricity generation, mining, oil and gas extraction, manufacturing and waste	Forestry, maritime, waste, domestic aviation, transport, buildings, industry, power and agriculture[4]
Number of ETS participants	Over 11,000 (European Commission, 2024b)	Around 1,000 (UK Government et al., 2024a)	Around 350 (California Air Resources Board, 2024b)	633 facilities as of January 2024 (Australian National Audit Office, 2024).	4,796 (New Zealand Environmental Protection Authority, 2025)
Future reviews	EU ETS review confirmed for 2026, which could include the following: • Potential full inclusion of municipal waste incineration in 2028 • Potential inclusion of carbon dioxide removals	• Inclusion of domestic maritime from 2026 • Inclusion of energy from waste and waste incineration from 2028 • Potential inclusion of carbon dioxide removals upon further consultation	Next review of scoping plan scheduled for 2027[5]	• Review of safeguard mechanism baselines in 2026-2027 • Review of various policy settings (treatment of international units, suitability of arrangements for emissions-intensive and trade-exposed activities, etc.) in 2026-2027	Potential inclusion of CCS

[2] According to the National Greenhouse Gas Inventory Quarterly Update: June 2023, total emissions for the 2022–23 financial year were 465.2 million tonnes of CO_2-e (Mt CO_2-e). In the 2022-23 year, covered emissions from safeguard facilities were 138.7 Mt CO_2-e, while emissions from grid-connected generators were 137.2 Mt CO_2 e.

[3] As of 1 January 2024, municipal waste incineration installations above a specified threshold are required to monitor and report their emissions under the EU ETS. However, they are not yet required to surrender allowances. By July 2026, the Commission is expected to assess and report on its feasibility starting in 2028.

[4] The agriculture sector reports its emissions through the NZ ETS but does not need to surrender NZUs to the Government.

[5] The scoping plan was last reviewed in 2022 and is updated every five years.

4.0 COMPARATIVE ANALYSIS

4.1 Different ETS treatments of CCS activities

Integrating CCS into emissions trading schemes offers several economic and legal benefits. First, as previously noted, companies can reduce their ETS compliance obligation or earn tradable carbon credits by capturing CO_2 and storing it permanently. Permanent storage refers here to the long-term sequestration of CO_2 in geological formations, such as depleted oil and gas fields or saline aquifers, in order to effectively isolate CO_2 from the atmosphere. This approach contrasts with methods like enhanced hydrocarbon recovery (EHR) where CO_2 is injected into oil and gas reservoirs to increase production. Through EHR, CO_2 is utilised to extract more fossil fuels. Second, the inclusion of CCS in ETS frameworks often relies on robust monitoring, reporting and verification (MRV) rules, which helps to enhance the environmental integrity of CCS activities by ensuring accurate accounting of emissions reductions. Jurisdictions have adopted various approaches to integrating CCS into their ETS frameworks, reflecting differing regulatory priorities, economic considerations, and local contexts, as demonstrated by Figure 1.

Given their shared origins, the EU ETS and the UK ETS present notable similarities in their treatment of CCS. Both schemes allow ETS participants to subtract from their reported emissions the CO_2 that has been captured, transported and permanently stored in geological storage sites, provided these sites are permitted in accordance with the relevant CCS regulatory frameworks[6]. This mechanism enables participants in the EU ETS or UK ETS to reduce their compliance obligations through CCS, thereby improving the financial attractiveness of CCS projects. Additionally, both ETS frameworks cover the entire CCS value chain, including CO_2 capture, transport, and storage. Operators of such facilities are held responsible for their operational and potential leakage emissions. Like any other ETS participants, they must surrender the appropriate amount of EU ETS or UK ETS allowances for any emissions linked to CCS activities.

Australia has adopted a distinct approach to CCS through its ACCU Scheme. This scheme allows a wide range of GHG sequestration activities to earn ACCUs, issued for each tonne of CO_2 avoided. In September 2021, after CCS was identified as one of Australia's priority low emission technologies, the government introduced a new methodology determination for CCS (Australian Department of Climate Change, 2021; Australian Department of Industry, 2020). Since then, projects that satisfy eligibility criteria under this method can earn ACCUs for the CO_2 that is captured and injected for permanent underground storage, provided they are not located on site of a Safeguard Facility[7]. These credits can be purchased by the government or private buyers, including Safeguard Facilities. Changes to the SGM in 2023 made CCS operations that reduce covered emissions on site at a Safeguard Facility ineligible to generate ACCUs. With emissions baselines under the SGM declining by 4.9% per year until 2030, CCS may be the only viable solution to meet these increasingly stringent targets, aside from reducing production with associated carbon leakage risks.

New Zealand is currently considering amendments to its ETS framework to better support CCS deployment and has explored a 'third way'. In July 2024, the government launched a public consultation seeking input on the potential expansion of CCS inclusion beyond the geothermal sector[8], currently the only sector under the NZ ETS where emission reductions from CCS are recognised[9] (New Zealand Ministry of Business, 2024). While the consultation presented various options for incorporating additional forms of CCS in the NZ ETS, the government's proposed

[6] The EU CCS Directive in the EEA and the Energy Act 2008 and accompanying regulations in the UK.

[7] Under Australia's Safeguard Mechanism, a Safeguard Facility is an industrial facility that emits more than 100,000 tonnes of carbon dioxide equivalent per year.

[8] Geothermal activities using CCS may apply for a unique emissions factor under the NZ ETS.

[9] The Climate Change Response Act includes provisions for the "storage of carbon dioxide after capture" as a removal activity, although the lack of a comprehensive regulatory framework has hindered its implementation.

THE NEW ZEALAND GOVERNMENT CONFIRMED THAT CCS WILL BE FULLY RECOGNISED WITHIN THE NZ ETS

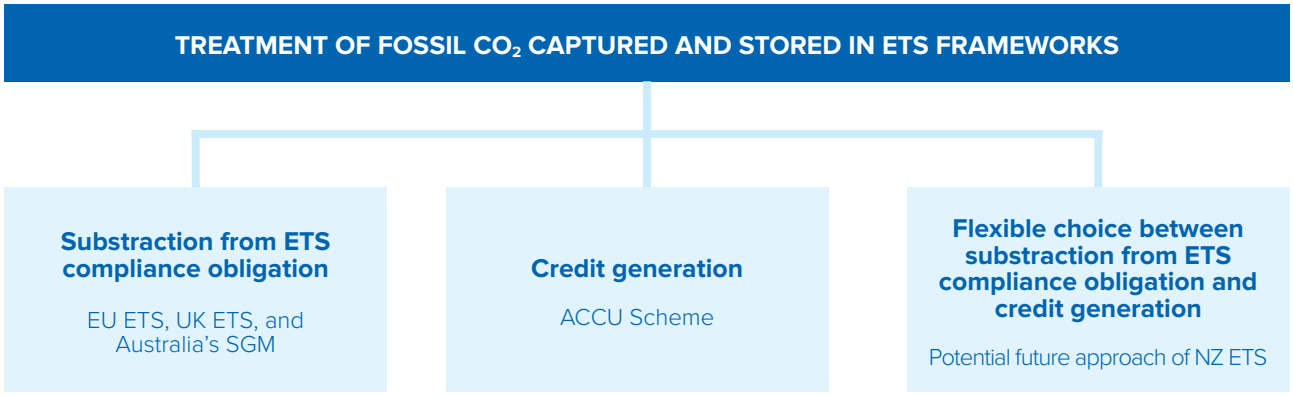
approach would provide (non-geothermal) ETS participants engaged in CCS activities with two possibilities:

- Participants would be allowed to subtract the emissions captured and stored through CCS from their reported emissions when estimating their ETS liability, which would mirror the treatment of CCS currently applied to the geothermal sector.
- Additionally, businesses deploying CCS could earn NZUs for CO_2 captured and stored, similar to the approach adopted by the NZ ETS in the forestry sector.

To prevent double counting, participants subtracting emissions captured and stored by CCS from their ETS liability would not be eligible to receive NZUs for the same captured and stored emissions. These options are mutually exclusive, aiming to provide NZ ETS participants engaged in CCS activities with flexibility while maintaining the integrity of the ETS framework. Building on the outcomes of the consultation, the New Zealand government announced key decisions in February 2025 regarding the development of its CCS regulatory framework, with legislation expected to be introduced later in 2025 (New Zealand Government, 2025). As part of this announcement, the government confirmed that CCS will be fully recognised within the NZ ETS; however the specific mechanism for incentivising CCS within the scheme has yet to be confirmed.

Finally, California's cap-and-trade program currently does not explicitly recognise CO_2 reductions achieved through CCS. However, such reductions may be credited under the Low Carbon Fuel Standard (LCFS), a separate regulatory mechanism that applies exclusively to the transportation sector. The LCFS establishes lifecycle carbon intensity targets for all transportation fuels sold in the state of California, aiming to support decarbonisation and diversification goals. In 2018, the LCFS was revised to include a CCS protocol that enables CCS projects that reduce emissions associated with the production of transport fuels sold in California, as well as projects that directly capture CO_2 from the air, to generate LCFS credits (Low Carbon Fuel Standard, 2020). However, while CCS has been confined to the transportation sector, the passage of Senate Bill (SB) 905 in September 2022 mandated CARB, in collaboration with other state agencies, to create a program for accelerating the deployment of carbon management technologies in the state of California (Senate Bill No. 905, 2022). In particular, according to SB 905, by 2025, CARB must establish regulations governing the construction and operation of CCS projects. Once these regulations are in place, California's cap-and-trade program may inform the integration of CCS as an emission reduction technology across multiple sectors within its compliance framework.

Figure 1 - Various CCS integration approaches in selected ETS frameworks



4.2 Different ETS treatments of CDR activities

Jurisdictions worldwide are increasingly exploring the possibility to include CDR activities in their ETS frameworks. CDR encompasses a variety of solutions, from natured-based solutions like forestry to technology-based ones such as direct air carbon capture and storage (DACCS) and bioenergy with CCS (BECCS). Integrating CDR into ETS frameworks can boost market liquidity by providing additional allowances or credits, especially as emissions caps tighten. Additionally, CDR integration could help lower the costs associated with carbon removal. However, this could also present risks, including the potential impacts on the prices of ETS allowances.

Despite growing interest, real-world examples of CDR integration into ETSs remain limited. Among the frameworks reviewed, the ACCU Scheme and the NZ ETS stand out for their unique recognition of forestry-based CDR initiatives. In Australia, projects under the plantation forestry method can earn ACCUs by planting or maintaining forestry (Australian Clean Energy Regulator, 2024b). These credits can then be purchased by the Australian government or private entities, including Safeguard Facilities. However, the ACCU Scheme explicitly excludes direct air capture (DAC) technologies under the CCS method (Carbon Credits (Carbon Farming Initiative) Act 2011, 2020).

Similarly, New Zealand recognises forestry activities under the Climate Change Response Act 2002, enabling landowners to earn NZUs for emissions removals (Climate Change Response Act 2002, 2024). Under the NZ ETS, landowners are also required to surrender NZUs when they clear forests to offset the resulting emissions. Building on this approach, the government is working on a future carbon removals strategy to build a more diverse portfolio of CDR activities beyond forestry and, as part of this initiative, will consider new legislation to enable additional removal activities to be recognised within the ETS (New Zealand Ministry for the Environment, 2023).

The UK has also expressed its interest in integrating CDR into its ETS. In June 2023, as part of its review of the UK ETS, the UK ETS Authority indicated that it sees its compliance market as an appropriate long-term market for GGRs while committing to further consultation on the matter (UK Government et al., 2023). Following this, in May 2024, the Authority launched a call for evidence to gather feedback on the potential integration of GGRs into its ETS, addressing issues such as market design and eligibility criteria (UK Government et al., 2024b). The proposed approach mirrors the NZ ETS's approach for forestry: GGR operators that meet specific requirements would be eligible to earn allowances for removing and storing CO_2. These allowances would be delivered ex-post, once the verification process has been completed. The operators of GGR facilities would then be allowed to sell their allowances on the UK ETS market, allowing other UK ETS participants to purchase them to meet their own compliance obligations. The Authority intends to maintain the gross cap of UK ETS allowance for the initial integration of GGRs.

In contrast, the EU has taken a more cautious stance by excluding most CDR initiatives from its ETS, while also signalling a willingness to explore further integration. For biogenic CO_2 emissions, participants may or may not need to surrender EU ETS allowances based on the type of biomass used (zero-rated or non-sustainable) and the fuel mix (pure biomass or a blend with fossil fuels). Notably, installations that

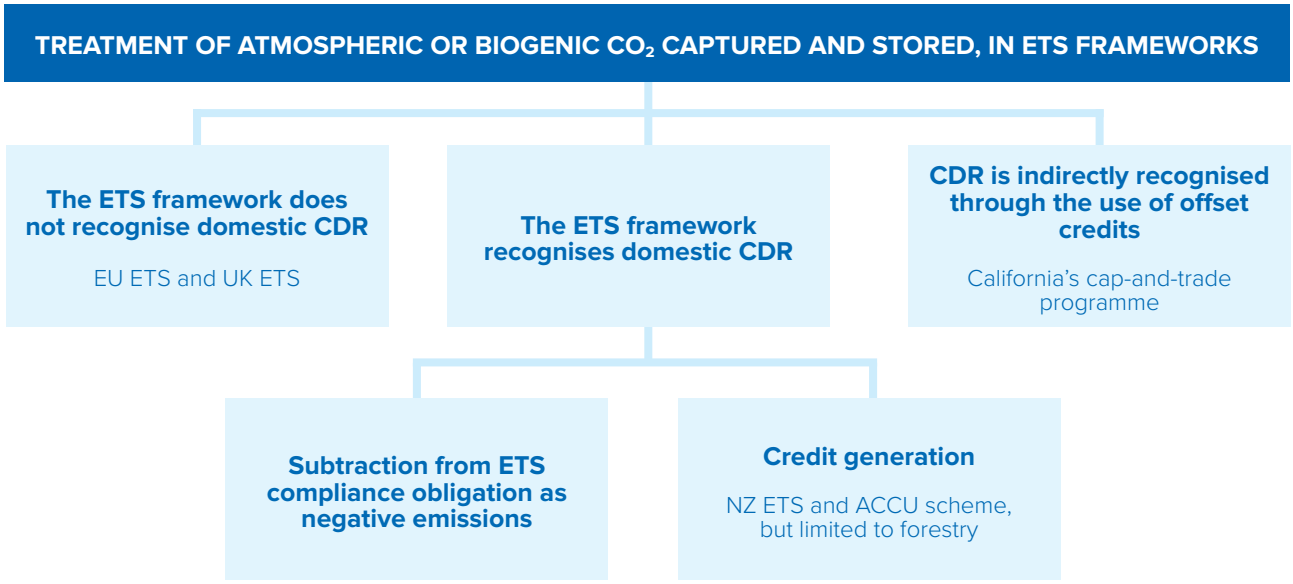
consume 100% zero-rated biomass are exempt from surrendering EU ETS allowances. However, the EU ETS currently does not permit the generation of new allowances (as seen in the NZ ETS case with forestry) or the accounting for negative emissions. Furthermore, DACCS facilities remain outside the EU ETS scope. BECCS and DACCS projects can instead generate credits for voluntary carbon markets in accordance with the recently-adopted EU Regulation regarding permanent carbon removals, carbon farming and carbon storage in products[10]. More recently, the European Commission initiated discussions on the potential integration of domestic CDR into the EU compliance carbon market as part of the future review of the EU ETS. This consultation, running from April to July 2025, seeks inputs on the following aspects (European Commission, 2025a):

- How the EU ETS could account for negative emissions resulting from GHGs that are removed from the atmosphere and permanently stored,
- How negative emissions could be covered by 'emissions trading' or other policies,
- What measures are necessary to ensure that CDRs do not merely offset required emissions reductions.

Following this consultation, the European Commission is expected to present a report to the European Parliament and the Council on the matter by 31 July 2026, as mandated by the revised EU ETS Directive.

Finally, California's cap-and-trade program offers a different model for integrating certain CDR activities into an ETS. Rather than directly including CDR into the compliance market, CARB allows participants to use carbon offset credits to meet a portion of their ETS compliance obligations. From 2021 to 2025, entities may fulfil up to 4% of these requirements with offsets, increasing to 6% from 2026 to 2030 (Assembly Bill No. 398, 2017). Since 2021, at least half of these credits must come from projects that provide direct environmental benefits within the state of California. CARB issues offset credits only to qualifying projects that reduce or sequester GHGs under one of the six Board-approved offset protocols – livestock management, mine methane capture, ozone depleting substance reduction, rice cultivation, US forest conservation and urban forestry – thereby incorporating some forms of nature-based CDR (CARB, 2025). Additionally, in early 2023, California State Senator Josh Becker introduced the Carbon Dioxide Removal Market Development Act, referred to as SB 308[11], which sought to require emitters over 25,000 metric tons of GHGs annually to purchase carbon removal credits in addition to their cap-and-trade obligations (World Resources Institute, 2023). However, the bill stalled in the Assembly Appropriations Committee and died in August 2024, leaving the current recognition of CDR unchanged (California Legislative Information, 2024). Finally, DAC projects are eligible to receive credits under the LCFS. As their inclusion is currently limited to this program, further guidance is needed on whether they should be eligible under the broader cap-and-trade program.

Figure 2 - Various CDR integration approaches in selected ETS frameworks



[10] Regulation (EU) 2024/3012 of the European Parliament and of the Council of 27 November 2024 Establishing a Union Certification Framework for Permanent Carbon Removals, Carbon Farming and Carbon Storage in Products, 2024

[11] SB-308 Net zero greenhouse gas emissions goal: carbon dioxide removal: regulations, 2023

4.3 Considerations of all CO_2 transport methods

CO_2 non-pipeline transport (NPT) options, such as transport via ships, barges, trains or trucks, can play an important role in the development of CCS and CDR by complementing CO_2 pipelines. These alternatives can address local needs or serve as viable options where a pipeline is technically or commercially not feasible. By facilitating the movement of CO_2 across multiple regions and sectors, non-pipeline transport can contribute significantly to achieving decarbonisation targets.

It is therefore essential that ETSs enable all means of CO_2 transport. A key example is the CCS method under the ACCU Scheme which adopts a technology-neutral definition and monitoring methodology for calculating operational and fugitive emissions from CO_2 transportation. This approach ensures that different modes of transport are accounted for, offering flexibility for project developers in moving CO_2 to storage sites or off-takers. Similarly, the New Zealand government has referenced CO_2 transport in a technology-neutral way in its recent consultations, although a clear methodology under the NZ ETS and a regulatory framework for CCS technologies have yet to be developed.

Nonetheless, many ETS frameworks have historically limited CO_2 transport to pipelines. This was the case in the EU until the recent revision of the EU ETS Directive[12], which expanded the definition of CO_2 transport to encompass all modes of CO_2 transport, thereby reviewing the previous pipeline-only reference. In September 2024, the EU further amended its EU Monitoring and Reporting Regulation[13] to align with this broader definition: from January 2025, any operator of CO_2 transport facility must now monitor and report their operational and leaked emissions and surrender the equivalent amount of EU ETS allowances the following year.

The UK ETS framework does not yet accommodate non-pipeline CO_2 transport although, in July 2023, as part of its response to a consultation on the review of the UK ETS, the government committed to expanding the scheme's scope to include CO_2 NPT. A recent consultation by the UK ETS Authority indicated a preference for an approach where NPT land transport operators would not be directly regulated by the UK ETS (UK Government et al., 2024c). Instead, the ETS liability for CO_2 would remain with the stationary installation from which it originates until it reaches a regulated transport and storage facility or a final storage site. Ideally, CO_2 transport by ship would align with the inclusion of maritime emissions in the UK ETS, a topic addressed in a parallel public consultation. While the government has outlined the expansion of the UK ETS towards NPT and published its regulatory preferences, the necessary legislation to implement these amendments has yet to be introduced.

In California, SB 905, which mandates the creation of a Carbon Capture, Removal, Utilisation and Storage Programme by CARB, currently only addresses CO_2 transport via pipelines to or from CO_2 capture, removal or sequestration projects. Notably, the bill stipulates that pipeline transport will be permitted only once the federal Pipeline and Hazardous Materials Safety Administration completes its rulemaking.[14] However, California's existing CCS Protocol under the LCFS outlines a comprehensive methodology that includes provisions for transport by pipeline, ship, rail and trucks. This Protocol could serve as a solid foundation for SB 905, ensuring harmonisation across state programs.

4.4 Possibility of storing CO_2 in jurisdictions outside the ETS coverage

Allowing countries to store captured CO_2 in other jurisdictions can enable those with limited or no storage capacity to decarbonise through CCS. This approach would also enable CO_2 storage-rich nations to offer it as a service. Additionally, cross-border CO_2 storage can be a more cost-efficient alternative to domestic options. A recent study for the Carbon Capture and Storage Association (CCSA) found that granting EEA countries access to UK stores could reduce offshore CO_2 storage costs for European emitters by 20% (CCSA, 2024). Despite these environmental and economic benefits, cross-border CO_2 storage faces significant regulatory challenges, including the potential loss of economic benefits provided by CCS under the ETS, as discussed in Section 4.1.

[12] Commission Implementing Regulation (EU) 2024/2493 of 23 September 2024 Amending Implementing Regulation (EU) 2018/2066 as Regards Updating the Monitoring and Reporting of Greenhouse Gas Emissions Pursuant to Directive 2003/87/EC of the European Parliament and of the Council, 2024

[13] In the EEA and the UK.

[14] Policy-making process in the US through which executive and independent agencies of the federal government develop and issue rules to implement policies

One notable example is the ACCU Scheme, which mandates that all components of CCS project – capture, transport and storage – must take place entirely within Australia to qualify for credits (Australian Clean Energy Regulator, 2024a).

A similar restriction applies under the EU ETS, despite its broader geographical scope. The revised EU ETS Directive exempts participants from surrendering allowances when CO_2 is captured, transported and stored in a site permitted under the EU CCS Directive. However, Article 2 of the EU CCS directive states that only CO_2 storage sites located in EU Member States, and by extension EEA countries[15], can receive a storage permit. Consequently, from the perspective of the EU ETS, while cross-border transport of CO_2 is permitted, CO_2 storage must remain within the geographical boundaries of the EEA. If EEA emitters store CO_2 in a site outside the EEA, they must surrender EU ETS allowances. However, recognising this limitation, and certainly in response to pressure from some EU Member States, the European Commission has recently signalled a shift towards exploring CO_2 storage options outside the EEA. In its EU Industrial Carbon Management Strategy published in February 2024, it identified EU candidate countries[16], which are considering temporary carbon pricing systems linked with the EU ETS, as potential partners for cross-border CO_2 transport and storage cooperation (European Commission, 2024a). Second, the public consultation on the EU ETS review running from April to July 2025 also examines the potential for linking the EU ETS not just with EU candidate countries, but potentially with other carbon markets as well.

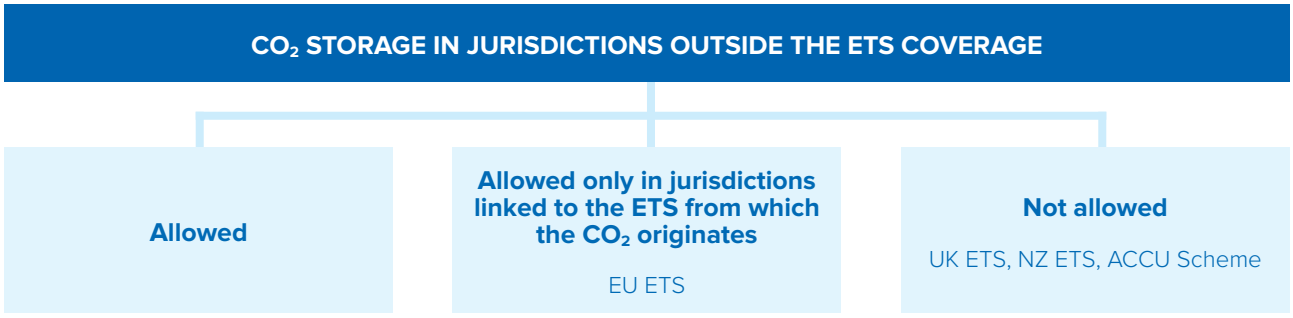
Most recently, in May 2025, the European Commission and the UK Government announced plans to establish a link between their carbon markets, opening a pathway for regulatory alignment on cross-border CO_2 transport and storage under their respective ETS frameworks (European Commission, 2025e).

The UK, likewise, currently restricts CO_2 storage to domestic locations under its current regulatory framework. Nevertheless, the government envisions to position itself as global leader in CCS (UK Department for Energy Security & Net Zero, 2023b). As part of this strategy, it expressed an ambition to use UK CO_2 stores to sequester emissions from regional partners. For this reason, in 2024, the UK Department for Energy Security and Net Zero conducted stakeholder consultations to assess the implications of cross-border transport and storage of CO_2 for the UK ETS (UK Department for Energy Security & Net Zero, 2024).

In New Zealand, the possibility of CO_2 storage outside the ETS is still being explored. The recent public consultation on treatment of CCS under the NZ ETS suggests that the government favours requiring CCS operators to remain ETS participants until they are no longer responsible for a CO_2 storage site. In the event of CO_2 leakage, operators would be required either to surrender NZUs or to store an equivalent amount of CO_2 without receiving additional NZUs. If implemented, this approach would likely restrict CO_2 storage to domestic sites unless a framework is established to recognise third-country CO_2 storage regimes as equivalent. Such provisions would be essential for ensuring compliance with New Zealand's future MRV requirements.

In California, it remains unclear whether the Carbon Capture, Removal, Utilisation and Storage Programme to be developed in accordance with SB 905 would restrict CO_2 storage within the state. Under the LCFS, CO_2 storage outside the state boundaries is permitted, provided it complies with the CCS Protocol, an approach California may choose to replicate under SB 905. Alternatively, California adopts a similar approach to the EU, it may allow CO_2 storage in Québec, due to its linkage with the Canadian province's cap-and-trade system, and potentially in Washington state if such a linkage agreement is finalised.

Figure 3 - Various approaches to storing CO_2 in jurisdictions outside the ETS coverage in selected frameworks



[15] The EU CCS Directive was incorporated in the EEA agreement in 2012.

[16] As of February 2025, the EU candidate countries include Albania, Bosnia and Herzegovina, Georgia, Moldova, Montenegro, North Macedonia, Serbia, Türkiye and Ukraine (European Commission, 2025c)

4.5 Allocation of ETS revenues to support CCS or CDR projects

Emission trading schemes may generate revenue through the sale of allowances or credits, which governments can reinvest into clean industrial technologies, such as CCS and CDR, to further drive emissions reductions. This can represent an interesting source of revenue as the value of ETS allowances or credits is likely to rise in the coming years as jurisdictions tighten their emissions caps to align with long-term climate goals. However, fluctuations in ETS allowance or credit prices, driven by factors like market dynamics, economic shifts or regulatory changes, can also lead to unpredictable funding streams, potentially limiting the ability of governments to provide stable and long-term financial support for decarbonisation projects.

The EU has adopted a direct reinvestment model, in which part of ETS auction revenues are channelled into dedicated funds; the Innovation Fund and the Modernisation Fund. The Innovation Fund finances various low-carbon innovations by providing direct grants for successful projects, including the construction and operation of CCS and CDR facilities. These projects typically compete within the same category, with projects delivering net carbon removals receiving an advantage during the selection process. The Innovation Fund has already backed numerous CCS projects capable of capturing approximatively 10 million tonnes of CO_2 per annum, with operations starting as early as 2027 (European Commission, 2024a). The Modernisation Fund, which assists 13 Member States in achieving their energy transition targets, primarily targets energy system improvements and efficiency measures. However, some countries have chosen to allocate part of the Modernisation Fund resources to support industrial carbon management projects. Romania, for example, has established a programme under the Modernisation Fund to facilitate the purchase and deployment of CO_2 capture, transport, storage and use facilities, as well as to upgrade facilities under the EU ETS to comply with Best Available Technique standards (Romanian Ministry of Investments and European Projects, 2024). That said, the public consultation on the future EU ETS review, initiated by the European Commission in April 2025, raised several questions regarding the use of ETS revenues, suggesting potential changes that could affect support for CCS and CDR projects. In particular, the consultation explores the possibility of repurposing Innovation Fund resources and portions of ETS revenues and revising the InvestEU mechanism to create an Industrial Decarbonisation Bank.

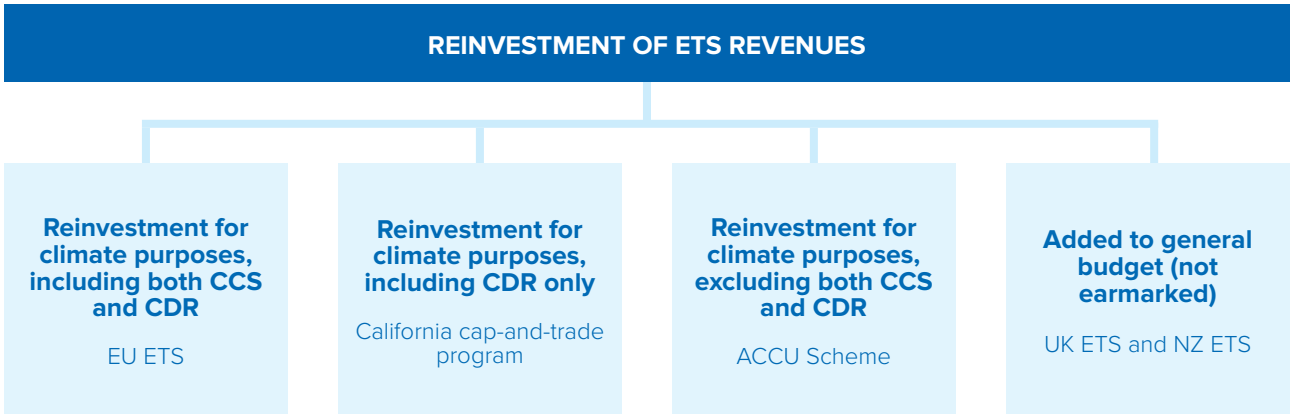
In California, revenues from the auction of allowances under the cap-and-trade program are also used to support social and climate initiatives at the state level. These revenues are deposited into the Greenhouse Gas Reduction Fund (GGRF), which finances various programs aimed at reducing GHG emissions, strengthening the economy, and improving public health and the environment, particularly in low-income communities. One such initiative is the Carbon Removal Innovation Support Program (CRISP), which focuses on advancing DAC technologies (California Energy Commission, 2024). In particular, CRISP will support pilot testing and demonstration of DAC, while promoting community engagement. However, it is important to note that there are currently no programs under the GGRF focusing exclusively on CCS projects.

In Australia, although the ETS operates under a baseline-and-credit model, the ACCU Scheme generates revenue for the government. As part of this scheme, the government purchases a substantial number of ACCUs from registered projects through carbon abatement contracts. The primary objective of these purchases is to encourage businesses and organisations to engage in emission reduction activities by providing them with an additional source of income. Another important goal is to provide certainty to SGM facilities regarding their maximum compliance costs. To achieve this, the government implemented a cost containment mechanism, allowing it to sell part of the purchased ACCUs to SGM facilities if the ACCU market price exceeds a specific threshold. The revenue generated from these sales is then allocated to the Powering the Regions Fund (PRF), which supports additional emission abatement projects and helps Australia to meet its climate targets (Australian Department of Climate Change, 2024b). However, to date, the funding streams opened under this initiative have not provided support for CCS.

In contrast to the EU, California and Australia, the UK provides a different model, in which ETS revenues are not explicitly allocated to climate projects, such as CCS or CDR, but are instead absorbed into the general budget. Although the UK government has demonstrated strong public support for CCS, as evidenced by its recent announcement of up to £21.7 billion in funding over 25 years for carbon capture, utilisation and storage (CCUS) and hydrogen development, this funding is not directly linked to revenues from the UK ETS (UK Government, 2024). However, an evaluation report on Phase 1 of the UK ETS highlighted concerns from industry stakeholders regarding the lack of transparency in the allocation of revenues generated by the UK ETS. Some operators suggested that the government should dedicate a portion of ETS revenues specifically to decarbonisation initiatives, similar to the EU's Innovation Fund model (UK ETS Authority, 2023).

Since 2024, New Zealand has adopted a similar approach to the UK one, following the government's decision to scrap the Climate Emergency Response Fund (CERF) to help fund tax cuts. This marked a significant policy change, as the CERF was originally established in 2021 to reinvest revenues from the NZ ETS into climate-related initiatives (New Zealand Treasury, 2024). Projects were eligible if they supported domestic or international emission reductions, adaptation projects, a te ao Maori approach to climate response, or aimed to address distributional impacts of climate change. As such, the CERF did not allocate direct fundings to CCS, although the fund backed forestry-based CDR initiatives in the forestry sector. Moving forward, revenues from the NZ ETS will no longer be dedicated to the CERF but will go toward the general government budget in the same way in the UK.

Figure 4 - Various approaches in the use of ETS revenues in selected ETS frameworks



5.0 SUMMARY OF ETS APPROACHES

REGULATORY CONSIDERATIONS	EU ETS	UK ETS	CALIFORNIA CAP-AND-TRADE PROGRAM	AUSTRALIAN CARBON CREDIT UNIT SCHEME	NEW ZEALAND ETS
ETS interaction with CCS applications	✓ Subtraction from ETS liability	✓ Subtraction from ETS liability	? Subtraction from ETS liability in the transport sector, CCS yet to be included for other sectors	✓ Credit generation (under the ACCU Scheme)	? Flexible approach under government consideration and likely expansion beyond geothermal sector
ETS interaction with CDR applications	? Ongoing discussion; report by July 2026	? Positive but subject to future legislation	? Some natured-based CDR considered; DAC included only under CCS Protocol developed for LCFS	? Limited to forestry, clear exclusion for DACCS	? Limited to forestry up to now, expansion under consideration
Consideration of all means of CO_2 transport	✓ Following recent changes effective as of January 2025	? Under consultation, pending future legislation	? Unclear; but covered under CCS Protocol developed for LCFS	✓ ACCU Scheme adopts a technology-neutral definition and methodology	? Regulatory provisions still to be developed
Storage in jurisdictions outside the ETS	? Currently not allowed, but interest from the European Commission	? Currently not allowed, but interest from the UK government	? Unclear; but covered under CCS Protocol developed for LCFS	✗ Not allowed under the ACCU Scheme	? Likely not to be allowed
Revenues from ETS supporting CCS or CDR technologies	✓ Example of EU Innovation Fund supporting both CCS and CDR initiatives	✗ ETS revenues reallocated to government general budget	✓ Example of CRISP supporting CDR initiatives, but not CCS	? Revenues reallocated to Powering the Regions Fund, with no possibility of support for CCS or CDR so far	✗ ETS revenues reallocated to government general budget

6.0 CONCLUSION

The integration of industrial carbon management technologies such as CCS and technological CDR within an ETS offers a promising avenue for achieving net emission reductions and lowering atmospheric concentrations. This paper explores how various jurisdictions have approached this relationship across five key regulatory considerations: the treatment of CCS and CDR activities within ETS frameworks, the recognition of different CO_2 transport methods, the possibility of CO_2 storage in jurisdictions outside the ETS and the allocation of ETS revenues to support CCS or CDR deployment. By analysing these factors, the paper highlights various policy design options, which can serve as a reference for policymakers considering similar integrations. Furthermore, it shows how some ETS frameworks are evolving to enhance the deployment of industrial carbon management techniques.

However, ETS frameworks alone remain insufficient to drive widespread adoption of CCS and CDR. Globally, only a limited number of facilities currently reduce ETS compliance obligations or generate credits through these technologies. In particular, successful projects have often relied on a combination of policy support mechanisms to improve economic viability and mitigate financial risks (International Energy Agency, 2023; Global CCS Institute, 2024). Combining ETS incentives with additional regulatory and financial support may offer a better avenue to scale up CCS and CDR deployment to meet climate targets.

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