



Enhancing the Voluntary Carbon Market: Gaps and Solutions

Winnie Mak

Executive Summary

The voluntary carbon market (VCM) supports scaling novel carbon capture and removal technologies and channels capital to carbon reduction projects. To fulfill its role, however, the VCM faces significant challenges, including concerns about the integrity of voluntary carbon credits (VCCs), a lack of standardization and transparency in transactions, accusations of greenwashing, and the high risk and costs associated with VCM investment.

Current policies and market practices have yet to overcome these barriers and drive sufficient investment for VCMs to function optimally. Fragmentation of standards, opaque over-the-counter transactions, inadequate carbon pricing to support carbon removal, and the lack of risk management tools are among the key issues facing VCMs.

The VCM is one among many tools for climate finance, but the scale of the climate challenge requires maximizing the potential of every tool available. This report explores actionable solutions to enhance the VCM as an effective tool to support climate policy objectives. It analyzes current policy and market efforts and suggests improvements for policymakers, VCC investors, and service providers. Potential solutions include the following:

- Implementing regulations to ensure comprehensive disclosure regarding VCM transactions, including price-sensitive information, and leveraging registries and blockchain technology to enhance price transparency in bilateral deals, enabling better-informed investment decision making.
- Harmonizing VCC integrity standards across international and domestic VCMs; aligning risk assessment methodologies with regard to the treatment of extra credits used in buffers and provisioning in case of

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loss of permanence of the carbon reduction capacity of a given project. More consistency in standards and risk-adjustment methodologies is needed to mitigate market fragmentation.

- Promoting a unified carbon price to integrate carbon compliance markets (CCMs, which govern allocation of emissions allowances for covered emitters) with VCMs. Establishing a regulated domestic VCM alongside existing CCMs can allow the market mechanism to reduce price gaps between the cost of allowances (in CCMs) and offsets (in VCMs). With effective integration, this approach can also encourage carbon removals.
- Supporting the role of the VCM as a mitigation contribution toward a just transition to accelerate the development of outcome-based climate finance instruments.

1. Introduction

The carbon market serves as a mechanism to ensure global adherence to carbon budgets by assigning a value to emissions (Archer 2023). There are two main types of carbon market: compliance carbon markets (CCMs) and voluntary carbon markets (VCMs). CCMs disincentivize carbon emissions by assigning a price to carbon and setting emissions thresholds and allowances for covered emitters through a cap-and-trade mechanism (see Yang and Preece 2024). In contrast, VCMs enable entities to purchase carbon credits to offset their emissions. VCMs appraise the market value of the underlying benefit and incentivize carbon removals, reductions, and other sustainable activities.

VCMs provide a platform for entities or individuals seeking accountability for their carbon footprint to channel capital toward supporting transitions, particularly for development of novel carbon removal technologies (Budinis and Lo Re 2023) and sustainable initiatives in developing markets (Climate Champions 2022).

Currently, companies in certain countries and regions, such as Australia, California, China, and Singapore, are permitted to use voluntary carbon credits (VCCs) to partially offset their emission obligations under CCMs or carbon tax systems. The airline industry's Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) requires participants to offset emissions that exceed predetermined baselines through the purchase of eligible carbon

credits.¹ In addition, Stripe, Alphabet, Shopify, Meta, and McKinsey jointly founded Frontier, an advance market commitment program focused on carbon removal. Furthermore, 11 countries have signed bilateral agreements to purchase VCCs generated by sustainability initiatives from developing countries to achieve their nationally determined contributions (NDCs) by funding climate actions abroad as of 3 September 2024 (UN Environment Programme, Copenhagen Climate Centre 2024).

Financial institutions are participating in all stages of the VCM value chain (see **Exhibit 1**). Schrodgers (2022, p. 3) suggests that climate-focused investors seek to “reduce their portfolio emissions to a point where further reductions would place too much pressure on the investment integrity” (i.e., compromising financial goals or diversification), and beyond that point, offsetting is an appropriate tool. Morgan Stanley (2023) projects significant growth in the VCM, anticipating an increase of market size from around USD2 billion in 2022 to approximately USD100 billion in 2030 and around USD250 billion by 2050.

Nevertheless, the advancement of VCMs faces several obstacles, including mistrust in VCCs regarding their actual climate benefits, lack of standardization and transparency (two-thirds of VCM transactions are conducted privately), and claims that carbon offsets represent greenwashing, whereby companies may rely on questionable VCCs without adequate emission reduction efforts.

This report aims to explore actionable solutions for stakeholders to improve and optimize the VCM as a viable tool to support climate action in developing countries, finance novel technologies, and complement compliance schemes. Collaborative efforts between policymakers and market participants are crucial, and this report examines and evaluates the recent solutions and new initiatives by government bodies and market participants. It also identifies policy gaps and makes recommendations to improve market functioning.

Exhibit 1. Links Between VCMs, Financial Institutions, and Corporations

Supply of Credits		Demand for Credits
Origination	Trade and Advisory	Use
Banks, investment funds, and corporations invest in, develop, and operate carbon projects.	Banks and brokers act as intermediaries for institutional and individual clients. Trading venues, such as exchanges and OTC markets, offer solutions for spot and future transfer of ownership.	Asset managers and banks use VCMs for offsetting portfolio emissions. Carbon tax-liable entities use VCMs to meet mandatory obligations. Companies with net-zero commitments make VCC-backed carbon-neutral or negative claims.

Source: Wessel and de Boer (2023); modified by author.

¹CORSIA requires members to buy CORSIA-eligible emission units from the VCM to offset emissions that cannot be reduced using technological and operational improvements and CORSIA-eligible fuels (International Civil Aviation Organization 2024). Participation is voluntary from 2021 to 2026 and becomes mandatory in 2027.

Chapter 2 of this report explains the life cycle of VCCs, and Chapter 3 outlines obstacles in the VCM. Chapters 4 and 5 evaluate new regulations and standards by intergovernmental and governmental bodies as well as new initiatives by market participants. Chapter 6 explores potential solutions for addressing the identified gaps.

Corporations, including financial institutions, participate in VCMs with different roles at different stages for different purposes, illustrated in the next chapter. In this report, VCM investing is defined as any offering and trading activity along the VCM value chain with the goal of generating positive environmental impacts and/or financial returns, with or without additional co-benefits.

2. The VCC Life Cycle

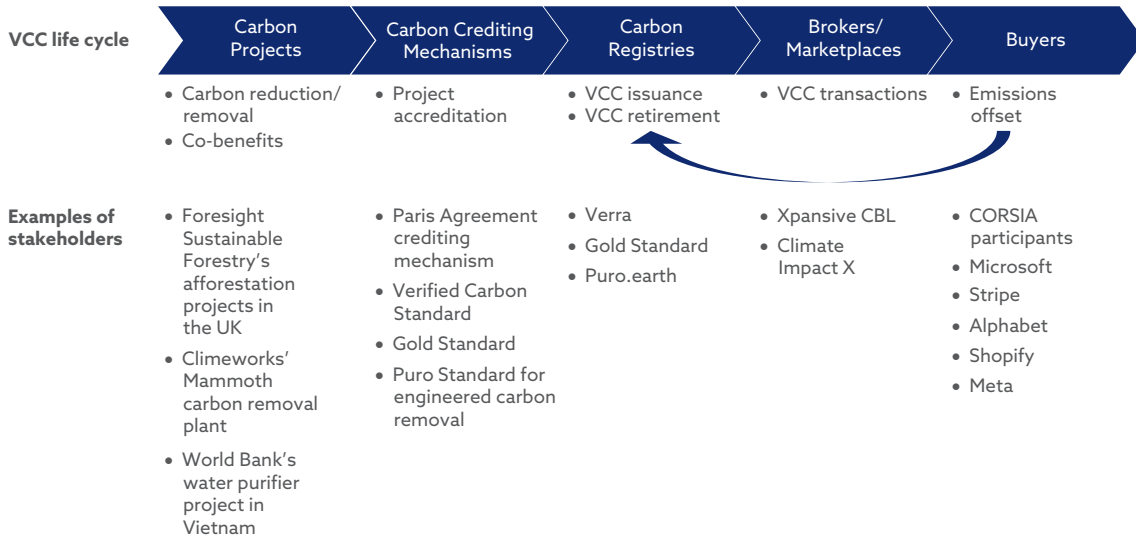
VCCs vary widely. According to Ecosystem Marketplace (Bennett 2022), there are 170 different types of credit-generating projects. These projects generally fall into two categories: carbon reduction and carbon removal. Carbon-reduction projects, which make up around 90% of VCC supply, include REDD+ (Reducing Emissions from Deforestation and Forest Degradation in Developing Countries),² renewable energy, and improvements in resource and energy efficiency. On the other hand, carbon removal projects encompass nature-based solutions, such as reforestation and wetland management, and technological interventions, such as direct air capture (DAC), carbon capture and storage (CCS), and bioenergy with carbon capture and storage (BECCS). Many carbon projects also deliver co-benefits, including enhanced biodiversity, job creation, and benefit sharing with local communities (ICVCM 2024b; Potts 2023).

Carbon project developers are mostly private companies, ranging from individual project developers to firms that manage portfolios of multiple projects. Regardless of their size, all developers must demonstrate that the emission reductions or removals generated by their projects would not have occurred without the financial support from the sale of VCCs, referred to as additionality (Verra 2024).

To issue VCCs under a specific crediting program, a project designed to reduce or eliminate emissions must undergo validation and verification by an independent auditor. After passing these stages, the project can apply for approval from the relevant crediting program. Once approved, the certified project is registered in the corresponding registry, and the VCCs it generates are serialized. Buyers can purchase these VCCs either directly from the project or through brokers and trading platforms. To claim the credit, often referred to as offsetting, the buyer must “retire” the respective credits in the registry, which permanently removes them from circulation. **Exhibit 2** depicts the life cycle of VCCs, alongside examples of stakeholders involved at each stage.

²REDD+ is a framework adopted in 2013 at the 19th Conference of Parties (COP19) in Warsaw. REDD stands for “reducing emissions from deforestation and forest degradation in developing countries,” and the + indicates sustainable management of forests and the conservation and enhancement of forest carbon stocks (see UNFCCC [United Nations Framework Convention on Climate Change] 2024).

Exhibit 2. VCC Life Cycle and Examples of Stakeholders



3. The Challenges of the VCM

This chapter covers concerns about poor integrity of the supply of carbon credit-generating projects, transactions, and use of VCCs. These issues heighten the risk and cost of VCM investment and can deter VCM development.

3.1. Mistrust in the Quality of VCCs

Mistrust in the quality of VCCs stems from various concerns, including overestimated impact, lack or low levels of additionality, potential abuse of human rights, double counting, lack of permanence, and leakage.

Historically, forestry projects have been significant contributors to the VCM, but they have faced persistent scrutiny. A joint investigation conducted by SourceMaterial (a collaborative investigative journalism organization), the *Guardian*, and the German weekly *Die Zeit* (SourceMaterial 2023) revealed concerning findings for REDD+ projects certified by Verra, the world's largest independent registry. The investigation found that credits from a significant portion of these projects showed no climate benefit, with some projects overclaiming by substantial margins. For instance, only 6% of the credits generated by examined projects were deemed genuine emission reductions. Additionally, analysis suggests that baseline scenarios of forest loss were overstated by approximately 400%, raising doubts about the validity of the associated VCCs in preventing deforestation (Greenfield 2023).

Forestry carbon credits are "essentially predicting whether someone will chop down a tree and selling that prediction," according to Professor Andreas

Kontoleon from the University of Cambridge Department of Land Economy (Lewsey 2023). Following that analogy, such predictions could be

- inflated, when the probability of a tree being chopped down is intentionally inflated,
- outdated, when predictions are based on historical trends that are no longer relevant (for example, if market preferences shift toward reclaimed wood, the probability of a tree being chopped down might decrease), or
- deceptive, when a tree is located in the most remote or inaccessible part of the forest where conservation efforts are likely to succeed regardless, implying the tree might not have been at risk in the first place (i.e., lack of additionality).

Such inaccuracies lead to an overestimation of climate mitigation impacts and raise doubts about the additionality of VCCs in addressing deforestation and climate change.

Beyond environmental concerns, some REDD+ projects have been linked to allegations of human rights abuses. For instance, local communities affected by project developments have reported instances of home demolitions and loss of access to livelihood needs. Legal cases, such as one filed by Indigenous authorities in Colombia against a REDD+ project, highlight the importance of safeguarding fundamental rights in carbon credit projects, potentially setting legal precedents with broader implications (Stankova 2024).

Double counting, wherein the same emission reduction is claimed/issued through the VCM by multiple entities (ICVCM 2024c), is another concern. One example is an emission reduction claimed once by a VCC buyer for its carbon neutrality claim and again by the selling country of the respective carbon project against its NDCs. Another example is a situation in which a clean cookstove project that aims to prevent people from cutting trees for firewood and a forest protection project that aims to reduce deforestation in the same area are both issued credits for the same carbon benefit.

Permanence (or durability), referring to how long the emissions removed or avoided will be kept out of the atmosphere, is another concern because forestry projects are exposed to the risk of reversal (carbon removed being released back to the atmosphere) through fire, insect damage, and severe weather. Very often, a buffer pool will be used as a safeguard or insurance-like mechanism, in which a portion of VCCs generated is set aside and can be canceled from the pool if a reversal takes place. Insufficient buffer pools to cover non-permanence risk are a concern, however. Leakage—the phenomenon whereby emission reductions in one area lead to emission increases outside the project boundary—is another significant issue, particularly for nature conservation projects.

Additionally, carbon projects are accredited by different carbon crediting mechanisms. Each crediting mechanism establishes its own methodologies,

which outline the criteria and processes for measurement, reporting, and verification (MRV) of the emission reductions or removals achieved by a project. The integrity of VCCs depends on the accuracy, appropriateness, and robustness of these methodologies. Potential conflicts of interest pose a concern, including those arising from crediting programs profiting from VCC issuance on a fee per credit basis (SourceMaterial 2023) and those between MRV auditors and project developers (Taskforce on Scaling Voluntary Carbon Markets 2021).

3.2. Lack of Standardization and Transparency

Market integrity issues stem from the lack of standardization and transparency of VCCs, which hinders price discovery. VCCs are not uniform, and the crediting methodologies are not standardized. In addition, two-thirds of VCC transactions are conducted over the counter (OTC) or mediated by third parties through bespoke bilateral agreements, which lack transparency in contract details and pricing structure (Favasuli and Sebastian 2021; Refinitiv 2023). This lack of standardization and transparency impedes the VCMs from establishing a functional carbon price reflective of market dynamics and available information.

Furthermore, a Carbon Market Watch (2023a) report highlights that 90% of intermediaries do not disclose their fees transparently, with the remaining 10% reporting an average 15.5% fee. This opacity hampers the accurate assessment of how much funds allocated for climate mitigation through VCC purchases effectively contribute to the cause. It thus prevents the optimal allocation of resources and the efficient functioning of the carbon market.

3.3. Criticism of Carbon Offsets as Greenwashing

Criticism of carbon offsets as greenwashing persists. This skepticism, coupled with concerns about the quality of VCCs, amplifies worries about greenwashing practices. For instance, between 2022 and 2024, greenwashing cases were filed against seven companies, including Delta Airlines and KLM Royal Dutch Airlines, alleging false or misleading claims through their use of carbon offsets, based on Sabin Center for Climate Change Law's (2024) climate change litigation databases.

To combat greenwashing, the EU Empowering Consumers Directive entered into force in March 2024. The rule bans climate claims on goods and services based on offsetting. Company-level claims are still allowed, but more granular disclosure of VCC usage is required under the European Sustainability Reporting Standards (Carbon Gap 2023). Pending passage by the European Parliament, the Green Claims Directive further requires companies to use offsets only for residual emissions (European Parliament 2024). France and the United Kingdom have also passed regulations and published guidance relating to carbon offsetting and claims of carbon neutrality in advertising.

Outside Europe, the US Federal Trade Commission is looking to update its guidance on carbon offsets and other climate-related claims in the

“Green Guides.” Other standards and rules primarily focus on disclosure, such as IFRS S2 (IFRS Foundation 2023) and rules adopted by the US Securities and Exchange Commission (2024). Different rules and regulations on carbon offsets in different jurisdictions could create greenwashing loopholes, as well as challenges for multinational corporations that need to neutralize residual emissions to achieve net zero.

Offsetting is contentious when used as a substitute for genuine emission reduction efforts. According to the Science Based Targets initiative (SBTi), VCCs cannot count toward companies’ net-zero science-based targets. Beyond the emission reduction targets, however, companies should neutralize residual emissions (less than 10% of baseline emissions) through permanent removal and storage of carbon from the atmosphere. Companies can also consider taking action to mitigate emissions beyond their value chains, such as purchasing high-quality VCCs (SBTi 2024a).

Nowadays, greenwashing concerns overshadow the role of offsetting as a necessary element of net-zero objectives, disconnecting the VCM from genuine sustainability efforts.

3.4. High Risk and High Costs

For users with long-term carbon-neutral or carbon-negative plans that incorporate offsetting as part of the strategy, such as Microsoft, and such project investors as Climate Asset Management (a joint venture formed by HSBC Asset Management and Pollination Group) and Campbell Global (acquired by J.P. Morgan Asset Management), success depends on the delivery of genuine and measurable reduction and/or removal of emissions, along with co-benefits if applicable, at a reasonable cost.

The uncertain integrity of VCC supply, however, translates into high project risk, methodology risk, and performance risk of investing in the VCM. Insufficient standardization and transparency of VCC transactions translate into high market and liquidity risk and add complexity to VCM investments, resulting in higher associated costs (financial capital, human capital, and time spent on due diligence) and impacting potential returns. Additionally, the absence of clear regulatory frameworks in certain jurisdictions heightens regulatory risk, and the criticism of carbon offsets as greenwashing leads to reputation risk (see **Exhibit 3**).

The combination of high risk and elevated costs can discourage market participation and limit the pool of available capital for funding carbon reduction and removal initiatives. Enhancing the viability of VCM investment requires coordinated efforts from governmental bodies (to de-risk VCM investment and encourage demand) and from market participants (to reduce market frictions).

Exhibit 3. Analysis of Impact, Return, and Risk Factors in VCM Investing

Characteristic		Description
Impact		Genuine and measurable reduction/removal of emissions and co-benefits
Return		Financial gains, effectiveness of resource allocation (including financial and human capital and time) in achieving the desired impacts
Risks	Integrity of supply	Project risk (additionality, double counting, permanence, leakage, abuse of human rights), methodology risk (impact outcomes are contingent upon the accuracy and appropriateness of methodologies, which differ across crediting mechanisms and are subject to ongoing evolution), performance risk (financial and nonfinancial outcomes)
	Integrity of transactions	Market risk, liquidity risk, regulatory risk, reputation risk (greenwashing accusation), performance risk (financial and nonfinancial outcomes)
	Integrity of use	Regulatory risk, reputation risk (greenwashing accusation)

4. Analysis of Policy Efforts

Various intergovernmental, governmental, and industry organizations have crafted standards, regulations, and guidance to tackle the challenges stated in Chapter 3 in an effort to steer VCM development in the right direction. **Exhibit 4** provides a non-exhaustive overview of key regulatory and standard setting initiatives.

Standards and guidance published by such industry organizations as the Integrity Council for the Voluntary Carbon Market (ICVCM, for VCC supply), International Carbon Reduction and Offset Alliance (ICROA, for VCM service providers), SBTi, and Voluntary Carbon Market Integrity initiative (VCMI, for VCC usage) address the challenges of the VCM by establishing or recommending general market standards. This chapter focuses on the regulations and policy initiatives by intergovernmental and governmental bodies, which go beyond standard setting to enable the VCM to fulfill its roles in financing climate actions. These roles include:

- A tool to unlock financial support for developing countries: The VCM serves as a market-based mechanism to channel capital to strengthen or maintain developing countries' carbon sequestration capacity. According to the United Nations Framework Convention on Climate Change (UNFCCC), Article 6 of the Paris Agreement (A6) "enables international cooperation to tackle climate change and unlock financial support for developing countries."³

³See the UNFCCC's Paris Agreement Crediting Mechanism webpage: <https://unfccc.int/process-and-meetings/the-paris-agreement/article-64-mechanism#:~:text=It%20enables%20international%20cooperation%20to,countries%20meet%20their%20climate%20targets.>

Exhibit 4. Standards and Regulations Regarding the VCM

Challenges	Standards and Regulations Addressing VCM Challenges	
	Overarching	Specific
Mistrust in quality of VCCs	Article 6 of the Paris Agreement (for international transfer), jurisdictional carbon credit schemes	Core Carbon Principles by the Integrity Council for the Voluntary Carbon Market (ICVCM), the Energy Transition Accelerator crediting standard, the EU carbon removal certification framework
Lack of standardization and transparency of the VCM		Good Practices by the International Organization of Securities Commissions, the Code of Best Practices from the International Carbon Reduction and Offset Alliance (ICROA), proposed guidance by the US Commodity Futures Trading Commission
Criticism of offsetting as greenwashing		Criteria for science-based target setting from the SBTi, the Claims Code from the VCM Integrity Initiative (VCMI), the EU Empowering Consumers Directive, the US Federal Trade Commission's "Green Guides," climate-related disclosures required by the European Sustainability Reporting Standards, the US SEC, and IFRS S2

- A market-based mechanism that supports genuine decarbonization and the upscaling of carbon dioxide removal (CDR): In the EU, the Industrial Carbon Management Strategy recognizes the importance of CDR to tackle emissions in hard-to-abate sectors, and making outcomes from CDR a "tradable commodity" is part of the strategy (European Commission 2024). Additionally, Japan uses and Australia intends to use a public exchange to promote market transparency and minimize market frictions.
- A complement to compliance carbon market schemes: In 2023, China and India—together representing 31% of the world's total emissions (Friedrich, Ge, Pickens, and Vigna 2023)—rebooted their carbon pricing mechanisms, using the VCM as a complement to the CCM as part of their net-zero strategies. Closer integration of VCMs with CCMs could lead to more unified carbon pricing.

This chapter evaluates whether policy efforts can serve their respective purposes.

4.1. Unlocking Financial Support for Developing Countries

A6 of the Paris Agreement enables countries to voluntarily collaborate to fulfill their NDCs, with two distinct provisions—Article 6.2 (A6.2) and Article 6.4 (A6.4). A6 does not have regulatory authority and relies on participating countries to implement and enforce policies and regulations domestically, but it lays the groundwork for enhancing the integrity of the VCM:

- A6.2 allows countries to exchange mitigation outcomes under bilateral agreements. It establishes an accounting framework for the transfer

of Internationally Transferred Mitigation Outcomes (ITMOs)⁴ after corresponding adjustments (that the selling country can no longer claim the impact toward its NDC) to prevent double counting. In November 2024, at COP29, participating countries reached agreement on authorizing the trade of carbon credits and how registries will operate.

- A6 engages selling countries in playing an active role, including integration of A6 into their measurement, reporting, and verification frameworks at the project, sectoral, and national levels to ensure additionality and permanence, as well as to avoid leakage and other negative environmental and social impacts.
- A6.4 provides for a centralized international carbon crediting mechanism overseen by a designated supervisory body. It replaced the Clean Development Mechanism (UNFCCC's carbon offset scheme under the 1997 Kyoto Protocol). COP29 approved the Paris Agreement Crediting Mechanism (PACM), the UN's new high-integrity carbon crediting mechanism. As a result, under A6.4, a company in one country will be able to reduce emissions in that country and have those reductions credited under PACM, enabling it to sell them to another company in another country. The buyer may use the credits for complying with its own emission reduction obligations or to help it meet net-zero targets.⁵
- A6.4 credit, if not registered as an ITMO, can be applied as a "mitigation contribution"—that is, providing funds or contributing to the climate change mitigation efforts in the domestic market. It explicitly includes three use cases: domestic carbon pricing schemes, domestic market-based measures, and outcome-based climate finance (see Section 5.3.1).
- To make sure the system delivers an overall mitigation in global emissions—that is, beyond a zero-sum game—2% of credits issued under A6.4 will be automatically canceled.

Despite its potential, A6.4 has yet to be fully operationalized. As of 3 September 2024, 90 bilateral agreements under A6.2 have been signed or are under negotiation between 56 countries, with 141 pilot projects recorded (UN Environment Programme, Copenhagen Climate Centre 2024). This level of activity reflects considerable interest for ITMOs. The corresponding adjustment mechanism has also reminded policymakers of the need to carefully manage their "carbon accounts," apart from their national accounts. Carbon credits are intangible assets, and selling carbon credits contributes to national accounts but at the same time carries an opportunity cost for selling countries in meeting their NDCs. Policymakers must weigh the implications for their carbon market development strategies. Several governments plan to issue sovereign carbon credits, essentially "nationalizing" carbon credits.

⁴ITMOs are defined as the outcome of eligible activities, including emissions reductions or removals and co-benefits, that is authorized for use toward NDCs.

⁵See <https://unfccc.int/process-and-meetings/the-paris-agreement/article-64-mechanism>.

Additionally, India published a list of only 13 renewable energy generation and storage and CDR activities for inclusion in the A6.2 mechanism (Ministry of Environment, Forest and Climate Change, Government of India 2023), thus preventing overselling that could impede the country's net-zero target. India has created a two-tier VCM system: the export market (ITMOs) for capital-intensive activities to attract foreign capital and the domestic market to channel domestic capital to other sustainable activities.

A6.2 offers participating countries flexibility in implementation and enforcement, but this decentralized approach has led to fragmentation, making comparisons challenging, as noted by the Asian Development Bank (2020), and potentially resulting in low ambition among participants (Campo 2023). In December 2023, the Switzerland-based KliK Foundation⁶ announced the completion of an ITMO deal with Energy Absolute Public, the project developer of the Bangkok E-Bus Program. However, Alliance Sud, the umbrella development organization created by six Swiss aid agencies, raised concerns about nontransparent or nonexistent additionality (Civillini 2024).

In 2023, Suriname intended to issue sovereign ITMOs at USD30/tonne of carbon dioxide equivalent (t CO₂e) (Spring 2023). Yet, despite the considerable interests for ITMOs, Suriname's plan has seen little progress. One possible reason for this disparity is that the decentralized nature of A6.2 means selling countries' implementation and enforcement might not align with the varied requirements of different buying countries. Another possible reason is that it could be difficult for buyers to mitigate the potential cross-border carbon leakage. In 2022, Gabon planned to sell sovereign forest credits, but evidence showed that Gabon's logging ban had led to increased logging in neighboring countries such as Cameroon (Rainforest Foundation UK 2023). In 2024, Suriname was developing a new mechanism that would require companies extracting oil and gas in the country to purchase ITMOs, according to the country's environment minister (Harris 2024).

Although it is premature to judge the effectiveness of A6, the slow progress of the A6.4 mechanism (prior to COP29) and the decentralized approach of the A6.2 mechanism have led to continued mistrust in the quality of ITMOs and could create stranded asset risk. Multinational corporate buyers and international financial institutions engaged in VCM activities are predominantly regulated, leading them to turn toward A6 as a foundation for VCM rules to mitigate potential regulatory and reputational risks (Refinitiv 2023). Microsoft, which has committed to achieving carbon negativity by 2030, advocates for clear definitions and interoperability of governmental, intergovernmental, and independent carbon crediting mechanisms because the lack of clarity could potentially strand billions of dollars (Microsoft 2023). For instance, Microsoft entered into a 10-year CDR credit purchase agreement with Heirloom in 2023, but it remains unclear when CDR can or needs to be converted to ITMOs and what CDR credits Microsoft can use for its carbon negativity claim.

⁶The KliK Foundation is mandated under the Swiss CO₂ Act to offset parts of the emissions generated by the use of motor fuels in Switzerland.

At COP28, the Energy Transition Accelerator (ETA)⁷ was officially launched. It aims to mobilize up to USD207 billion of transition finance by selling VCCs to be generated from the early retirement of coal-fired power plants and the transition to renewable energy in Chile, the Dominican Republic, Nigeria, and other developing countries. Through fixed-price advance purchase commitments for VCCs, the ETA initiative plans to create predictable finance streams to improve the bankability of early retirement projects (US Department of State 2022). To bolster these efforts, the ETA has collaborated with Winrock International, the operator of the American Carbon Registry, to devise a novel jurisdictional accrediting approach that integrates localized dynamics of electricity demand and supply (Bumpers, Donovan, Grady, and Zakir 2023; Yin 2023), thereby enhancing the robustness of the baseline setting. A jurisdictional approach also serves to mitigate leakage within the jurisdiction.

The upcoming ETA standard will likely be used as an indicator of high integrity for credits generated from projects such as those to be launched by the Transition Credits Coalition led by the Monetary Authority of Singapore, which plans to generate “Transition Credits” from early retirement of coal-fired power plants in Asia (see Section 5.3.2).

Based on the ETA’s core framework, the platform is exclusively accessible to companies committed to achieving net-zero emissions no later than 2050, with science-based interim targets. Potential approaches under consideration include using the ETA credits as mitigation contributions under A6.4, allowing buyers to offset electricity-related emissions or a limited portion of their Scope 3 emissions, and potentially requiring additional credits for offsetting (US Department of State 2022; for example, permitting buyers to offset up to 50% of their Scope 3 emissions, with each tonne of CO₂e offset requiring 1.5 ETA credits).

According to Carbon Disclosure Project (a global disclosure system for environmental impact management), Scope 3 emissions constitute an average of 75% of total emissions across all sectors (Hadziosmanovic, Rahimi, and Bhatia 2022; Carbon Disclosure Project 2023). In April 2024, SBTi announced a plan to revise its rules to allow offsetting of a bigger portion of Scope 3 emissions by environmental attribute certificates,⁸ but amid controversies, it later said it has kept the rules unchanged. In May 2024, the US government’s “Voluntary Carbon Markets Joint Policy Statement and Principles” urged standard setters to consider “incorporating approaches that allow companies to count credits toward a portion of their Scope 3 emissions” to incentivize the use of high-integrity VCCs (White House 2024, p. 10). Later, in July 2024, SBTi published a discussion paper to explore the issue in greater depth (SBTi 2024b).

⁷The ETA is a partnership among the US Department of State, the Bezos Earth Fund, and the Rockefeller Foundation. Bank of America, Boston Consulting Group, Mastercard, McDonald’s, Morgan Stanley, PepsiCo, Salesforce, Standard Chartered Bank, and Schneider Electric have signed letters of interest with the ETA (US Department of State 2023; Hay 2024).

⁸Defined by SBTi as instruments used to quantify, verify, and track the environmental benefits associated with commodities, activities, or projects. Examples are emission reduction credits and energy attribute certificates.

If ETA credits are not allowed to offset a bigger portion of Scope 3 emissions, the ETA could find it more challenging to generate sufficient demand to achieve its ambitious funding goal.

4.2. Scaling Carbon Dioxide Removal

The UN Intergovernmental Panel on Climate Change (IPCC) defines carbon dioxide removal as human activities that remove CO₂ from the atmosphere and store it durably in geological, terrestrial, or oceanic reservoirs or in products.⁹ The IPCC has endorsed CDR as a key pathway to achieving net-zero emissions (Intergovernmental Panel on Climate Change 2022).

The Oxford Offsetting Principles stress the need for VCC users to shift toward CDR credits with durable storage (Axelsson, Wagner, Johnstone, Allen, Caldecott, Eyre, Fankhauser, et al. 2024). Based on “The State of Carbon Dioxide Removal” report (Smith, Geden, Gidden, Lamb, Nemet, Minx, Buck, et al. 2024), between 7 billion and 9 billion t CO₂ annual capacity is needed by 2050 globally, up from the current capacity of around 2 billion t CO₂.

Most CDR today counts on conventional methods (see **Exhibit 5**), which are mostly land based and occur through carbon farming activities.¹⁰ The extensive land requirements for these methods, however—together with trade-offs of ecosystem and sustainability co-benefits (e.g., biodiversity and the land–water–energy–food nexus)—will limit the potential of land-based CDR development. In addition, certain novel CDR methods (illustrated in Exhibit 5) are also far

Exhibit 5. CDR Methods and Durability of Storage

Permanence	Conventional CDR Methods	Novel CDR Methods
Decades to centuries	Afforestation/reforestation, improved forest management, soil carbon in croplands/grasslands, peatland/wetland restoration, durable harvested wood products	
Centuries to millennia		Biochar, biomass burial/sinking, ocean fertilization
Millennia or longer		Mineral products, enhanced rock weathering, bioenergy with carbon capture and storage, direct air capture and carbon storage, ocean alkalinity, direct ocean carbon capture and storage

Source: Smith et al. (2024).

⁹Note that carbon capture, utilization, and storage technologies applied to fossil CO₂ are not considered removal technologies in the IPCC framework.

¹⁰Carbon farming refers to practices to enhance carbon sequestration and storage in forests and soils, as well as reduce emissions from soils.

more durable. More investment in novel CDR technologies is therefore needed to achieve the goal of scaling CDR.

In the United States, under the Inflation Reduction Act, companies can claim tax credits of up to USD85/t CO₂e for carbon capture and storage and up to USD180/t CO₂e for direct air capture. At the time of writing, the United States is the top supplier and buyer of CDR credits generated from novel methods (tech-based or engineered CDR).

In the EU, the Carbon Removal Carbon Farming (CRCF) Regulation seeks to unlock new income opportunities for CDR development (including via VCM) while tackling greenwashing (European Commission 2022). CDR projects (including carbon removals, carbon farming, and carbon storage in products) need to meet "QU.A.L.ITY" criteria to be certified under the CRCF Regulation:

- "QU"antification: accurate measurement with unambiguous benefits
- "A"dditionality: beyond regulatory requirements and demonstrate financial additionality
- "L"ong-term storage: distinguishing permanent from temporary storage, with operators to be held accountable for reversal
- Sustainabil"ITY": contributing to sustainability objectives

The certified projects will take place in the EU, and the CRCF-certified credits generated therefrom can be used only for the EU's climate objectives and NDCs (i.e., no ITMOs; Council of the EU 2024). In April 2024, the European Parliament approved the provisional agreement on the CRCF, which is the world's first CDR certification framework. The EU will integrate the framework into its wider climate policy and will assess by 2026 whether and how the CRCF-certified credits could be covered by emissions trading (European Commission 2024).

According to Carbon Gap (2024), a philanthropy-funded organization focusing on CDR in the EU, CDR credits made up only 3% of all VCM transactions in volume but 10% in value in 2022, highlighting the tight supply and high price premium of CDR credits. To secure future supply, buyers have shifted from acquiring issued CDR credits to acquiring future CDR credits (pre-issuance) through advance purchase agreements (Puro.earth 2024a). According to BeZero Carbon, the current ratio of capital flow into the *ex post* market compared to the pre-issuance market for CDR credits stands at 1:4 (Le Dain 2024). For instance, in 2022, Stripe, Alphabet, Shopify, Meta, and McKinsey launched an advance market commitment program known as Frontier. Frontier's goal is to buy CDR credits through offtakes and prepurchases for more than USD1 billion by 2030. As of September 2024, the program had contracted to buy more than 0.57 million CDR credits for USD317 million, of which more than 95% are yet to be delivered (Frontier 2024).

Mandating the purchase of CDR credits sends a strong demand signal to encourage investment in CDR projects. To make this signal effective, however, it is important to bridge the price gap between carbon allowance (e.g., EUR67.6/t CO₂e on 15 July 2024)¹¹ and tech-based CDR credits (e.g., which were transacted at more than double the carbon allowance in July 2024 based on the CORC Carbon Removal Price Index).¹² Furthermore, the price range of CDR credits is wide; for tech-based projects registered with Puro.earth, it ranged from EUR146.7 to EUR540.2/t CO₂e as of 15 July 2024.¹³ The mechanism also needs to address this wide price spread and incorporate advance commitments to improve the bankability of CDR projects.

4.3. Converging with CCM to Incentivize Domestic Decarbonization Activities

To effectively discourage emissions through CCM and promote decarbonization via VCM simultaneously, success hinges on achieving a sufficiently high CCM price while also maintaining a narrow price differential between VCM and CCM. This narrow gap preserves the financial motivation for companies to prioritize real emissions reductions over offsets.

Using a domestic VCM to work alongside CCM reduces the risk of arbitrage, whereby companies might otherwise capitalize on lower international credit prices instead of investing in higher-quality domestic credits that better reflect the local carbon cost. Domestic VCM also establishes a market-based system that channels funds into local decarbonization projects, supporting domestic green infrastructure and advancing climate objectives.

California was an early adopter of integrating a domestic VCM into its cap-and-trade system, starting in 2013. China began implementing a similar approach in 2024, and India is planning a comparable carbon market structure. This section assesses the outcomes of the Californian and Chinese markets and reviews India's planned approach.

In California, covered entities may offset up to 4% of their obligations, and the price gap between allowances and credits ranges from 7% for Direct Environmental Benefits in the State of California (DEBS) to 50% for non-DEBS credits (which do not provide direct environmental benefits to the state) in July 2024. As a result, the average price gap is 28% (see **Exhibit 6**). California allows non-DEBS for offset (up to 50%) because they can provide cost containment for CCM-regulated entities.

In China, CCM-regulated entities can offset up to 5% of their obligations (emissions exceeding free allowances) with credits issued under the China Certified Emission Reduction (CCER) scheme or the country's domestic VCM

¹¹CarbonCredits.com, "Live Carbon Prices Today": <https://carboncredits.com/carbon-prices-today/>.

¹²<https://puro.earth/corc-carbon-removal-indexes>.

¹³Note that many project prices are negotiable based on demand.

Exhibit 6. Carbon Price Comparison by Market (USD/t CO₂e)

	CCM	VCM
EU (as reference; 15 July 2024)	75.2	NA
China (July 2024)	12.7	11.4
California (July 2024)	33.3	Average (DEBs/non-DEBs): 23.8 (30.9/16.6)
CORSIA (5 July 2024)	NA	25.0 (CIX CORSIA X)
Nature-based projects (15 July 2024)	NA	1.22 (CBL N-GEO JUL 2024 futures)

Sources: EU: CarbonCredits.com (2024a); China: MVGX Group (2024); California: ClimeCo (2024); CORSIA and Singapore: Climate Impact X (2024); Australia: CORE markets (2024); Nature-based projects: CME Group (2024a).

(see Yang and Preece 2024 for an overview of the China national emissions trading scheme). In July 2024, the average price of CCER credits was USD11.4/t CO₂e¹⁴ (see Exhibit 6), which was 10% lower than the price of China Emission Allowances (CCM allowances).

Although the price difference between VCM and CCM in China is not large, the current CCM price may be insufficient to effectively deter emissions, a concern that also applies to California's CCM price. According to the International Monetary Fund, a global carbon price of (USD75/t CO₂e) is required to keep global warming below 2°C (Parry 2021). Although the EU allowance price has repeatedly exceeded this threshold in recent years, the prices for emission allowances in China and California remain well below that level.

Meanwhile, the prices of CCER credits, DEBS, non-DEBS, and credits eligible for offsetting under CORSIA were significantly higher than those of nature-based projects, which traded below USD2 per contract throughout 2024. This dynamic suggests that balancing emissions penalties with incentives for carbon reduction/removal may be more feasible within domestic or sector-specific VCM and compliance regimes, where demand is driven by mandatory emission caps, providing high demand predictability. Governments or industry bodies can more effectively manage the supply of allowances and credits in such systems.

According to International Carbon Action Partnership (2024), the Chinese government plans to expand the CCM coverage to 70% of emissions from around 40% now, as well as to cut allowances supply. Such potential changes suggest a promising demand outlook for CCER credits. CCER's current methodological tool, however, largely resembles that of the legacy Clean Development Mechanism. To ensure that this growing VCM supports genuine decarbonization activities, alignment of methodologies with the latest international standards, such as the ICVCM's Core Carbon Principles, will be advantageous.

¹⁴This figure is a simple average of prices for four trading weeks in July 2024.

In 2023, India announced a plan to set an explicit carbon price by the establishment of the Indian Carbon Market under the Carbon Credit Trading Scheme, encompassing both the CCM and the VCM, with Carbon Credit Certificates (CCCs) as the tradeable carbon credit. Compliance-obligated entities are entitled to issue compliance CCCs (equivalent to CCM allowances) if their decarbonization achievements exceed targets, and nonobligated entities meeting eligibility criteria can issue offset CCCs (equivalent to VCCs) (CarbonCredits.com 2024b; OffsetFarm 2023). Obligated entities will be able to offset up to 10% of their obligations if they fall short of their decarbonization targets by the use of offset CCCs (Bureau of Energy Efficiency [BEE], Government of India 2022). Although India has created a two-tier VCM system for export and domestic markets (Section 4.1), it also plans to set different criteria for accreditation of export and domestic credits. The methodologies and other details of the Indian Carbon Market are still pending.

Until the new scheme launches (targeted for 2026), India relies on implicit carbon pricing through the Perform, Achieve and Trade (PAT) scheme and the Renewable Energy Certificate (REC) mechanism. Under the PAT scheme, energy-intensive industrial production units are allotted energy consumption reduction targets, and underachievers need to buy Energy Saving Certificates from overachievers. The scheme is similar to the cap-and-trade scheme, but with lenient target settings (Jaspal 2022) along with weak monitoring and enforcement (Chunekar and Apte 2023), it resulted in a supply glut and price slump (Mukherjee 2023). The REC mechanism faces similar oversupply issues. Although excessive inventory is a concern, the government allows credits generated under the PAT scheme and the REC mechanism to be converted into CCCs under the new scheme.

According to the discussion draft of a policy paper by the Bureau of Energy Efficiency (BEE 2022), voluntary trading will start ahead of the compliance scheme. Various international organizations advocate for greater clarity in operationalizing the market and propose piloting phases or projects to ensure readiness to engage with international buyers (IETA 2023) and robust price discovery (Michael 2023). There are also challenges to a broad-based implementation because much of the Indian economy remains informal (Jaspal and Mukherjee 2024).

Ultimately, success hinges on a high-enough CCM price with a narrow-enough gap with VCM prices, primarily by regulating the supply side. The potentially excessive inventory of CCCs resulting from conversion from the legacy PAT scheme and REC mechanism will likely put pressure on VCM prices, send misleading signals to the market, and provide an unstable foundation for price discovery. The potential creation of a two-tier market for domestic and overseas buyers could introduce distinct criteria for CCCs for the domestic market, possibly diverging from A6 requirements for an ITMO export market (BEE 2022). Such differences in criteria between domestic and international markets might hinder the participation of multinational corporations engaging in obligated activities in India.

4.4. An Efficient Market Supporting Genuine Decarbonization

An efficient VCM helps price the benefits generated by carbon reduction/removal activities and thus incentivizes them properly. Key characteristics of an efficient VCM include VCC integrity, information transparency, robust regulatory oversight and enforcement, low transaction costs, fair market access, high liquidity, and efficient price discovery. This section evaluates regulatory efforts based on these characteristics.

The US Commodity Futures Trading Commission (CFTC) proposed guidance concerning derivative contracts and the underlying VCC to address the concerns about integrity of VCC supply and transactions and to prevent manipulation and price distortion (CFTC 2023a). Furthermore, the CFTC, through a whistleblower alert, emphasized its enforcement authority over the VCC spot market to deter fraud and manipulation. Additionally, it established the Environmental Fraud Task Force to investigate fraudulent environmental benefit claims related to VCCs, signaling stringent enforcement actions in line with the Commodity Exchange Act (Jones Day 2023). The CFTC's goal is to foster transparency, liquidity, and, ultimately, price discovery (CFTC 2023b).

The CFTC invited public feedback for its proposed guidance, which outlines the elements required in exchanges' due diligence checklists to ensure the quality and price integrity of underlying VCCs.

Feedback from operators of derivative marketplaces, such as the Intercontinental Exchange, emphasized that operators lack the expertise or resources to perform specific evaluations and verifications and should be permitted to rely reasonably on assurances from crediting programs that meet international standards (Intercontinental Exchange Inc. 2024). CME Group (2024b) urges the CFTC to engage with stakeholders globally to ensure reliable and harmonized VCM standards. ICVCM (2024a) recommends that the CFTC rely on ICVCM's Core Carbon Principles and Assessment Framework as key components to safeguard VCC quality, alongside ISSB and VCM standards for VCC use where applicable. The Core Carbon Principles are standards for crediting programs and methodologies, and only VCCs generated according to the Core Carbon Principles-aligned methodologies can be certified and labeled as such.

It takes time, however, to clarify which programs and methodologies—and consequently, which projects and VCCs—align with the Core Carbon Principles. As of 6 August 2024, ICVCM had completed reviewing 12 methodologies, and more than 60 other methodologies were still pending assessment.

Other feedback to the CFTC proposed guidance included the need for transparency at the project or activity level, rather than solely at the crediting program level (Clean Air Task Force 2024). Sylvera (2024) recommended using the Voluntary Carbon Market Disclosures Act (AB 1305) in California, which mandates disclosure for entities that buy, sell, and market VCCs, as a foundation for establishing public disclosure requirements. Additional

suggested disclosures include financial transparency, which is beyond credit integrity. Currently, there are limited public data providing evidence for the flow of VCC revenues to sustainable activities, particularly benefit sharing. Such data and information are necessary for independent due diligence and ongoing monitoring (Carbon Market Watch 2024). Carbon Market Watch (2023b) reviewed 47 carbon projects, of which 15 claimed benefit sharing, but only 4 were found to contain sufficient evidence. This information is crucial for buyers who use VCCs to meet their Sustainable Development Goals commitments. Disclosure should also include price-sensitive information, such as fees, markups, and conflicts of interest (see Sections 3.1–3.2). Establishing robust public disclosure frameworks ensures that investors have sufficient information to make investment decisions. Both the CFTC and market operators can improve market oversight while leaving quality verification to specialized standards and due diligence processes.

In such countries as China, India, Japan, and Australia, domestic VCMs are established with a centralized approach to ensure conformity of VCC quality, information transparency, and regulatory oversight to serve domestic demand.

Currently, Japan has a climate change mitigation tax at around USD2.1/t CO₂e on fossil fuel and counts on the VCM to provide carbon pricing signals to emitters. The government centralizes issuance, registration, administration, and retirement of VCCs generated domestically (known as J-Credits in the J-Credit Scheme) and outside the country under the A6.2 mechanism (known as JCM credits in the Joint Crediting Mechanism). Additionally, Japan has established a voluntary Green Transformation Emissions Trading System (GX-ETS). Unlike a mandatory cap-and-trade system, GX-ETS operates on a voluntary “target and trade” basis. Participation is voluntary (participants are known as members of GX League), and from October 2024, underachievers that fail to meet their own decarbonization targets or Japan’s NDC equivalent need to either (1) make up the shortfall by purchasing allowances from overachievers (to be issued under the GX-ETS), J-Credits, and/or JCM credits or (2) make public disclosure of the reasons for the underachievement (Miyagawa, Kurano, and Kagawa 2023; Hattori and Kondo 2024).

Commissioned by the government, the Tokyo Stock Exchange (TSE) opened a public carbon credit market in October 2023 for J-Credits. The objective of having a public marketplace is to improve carbon pricing transparency. To address liquidity challenges, the TSE opens J-Credits for auction twice daily, sets all fees at zero (Baker McKenzie 2023), and implements a market maker program (Japan Exchange Group 2023). The TSE anticipated an annual trading volume of 0.5 million t CO₂e in J-Credits (equivalent to around 9,615 t CO₂e per week) (Recessary 2023), but during the week of 6 September 2024, only 6,340 t CO₂e were traded at a weighted average price of USD32.6/t CO₂e.¹⁵ There are 265 registered participants for the carbon credit market (ASEAN-Japan

¹⁵These data are from RIM Intelligence Co.’s “TSE=Carbon Credit Market: J-Credit Table” for 2-6 September 2024, available at https://eng.rim-intelligence.co.jp/news/dynamic/search.html?page=1&word=J-Credit&category_id=&from_y=2024&from_m=09&from_d=02&to_y=2024&to_m=09&to_d=06.

Centre 2024), representing only around 35% of the 747 GX League members (Ministry of Economy, Trade and Industry, Government of Japan 2024). Mitsui & Co. (one of Japan's largest conglomerates) saw insufficient incentives for companies to purchase J-Credits in the absence of a CCM (Tsugane 2024).

Based on the preliminary results of the GX-ETS, it appears that an efficient and transparent marketplace alone is insufficient to incentivize participation. The limitations of the VCM underscore the need for a comprehensive carbon pricing approach that incorporates the CCM mechanism.

In Australia, the government oversees the certification, issuance, registration, administration, and retirement of carbon projects/credits. Australian carbon credit units (ACCUs) are issued by registered projects in Australia and can be sold to the government or other entities to voluntarily offset their emissions or meet compliance requirements.¹⁶ In December 2023, the Clean Energy Regulator announced a partnership with the Australian Securities Exchange to open a national carbon exchange by early 2025 for trading of ACCUs and international carbon credits issued under UNFCCC initiatives. The objectives are to make ACCU trading simpler, cheaper, and more transparent. Additionally, the government is exploring the possibility of requiring OTC trades to be cleared through the exchange and making transaction data publicly available (Weik 2024). If implemented, this outcome would enable public exchange-level transaction transparency without changing the preference for negotiated deals.

Since 2022, Australia's forest regeneration projects (the key supplier of ACCUs) have faced allegations of lost vegetation coverage (Morton 2022, Macintosh, Butler, Larraondo, Evans, Ansell, Waschka, Fensham, et al. 2024). In 2023, Climate Active, the government-backed offset certification scheme, was criticized for enabling greenwashing by allowing buyers to be certified as carbon neutral solely through offsetting rather than by reducing their own emissions (Hemming 2023). Australia's Department of Climate Change, Energy, the Environment and Water (DCCEEW) plans key reforms for the scheme, such as requiring participants to establish emission reduction targets aligned with Australia's NDC and to stay on track to achieve those targets to be eligible to claim offsets (DCCEEW 2023).

In summary, the following gaps have been identified:

- Unlocking financial support remains challenging because of the slow progress of the A6.4 mechanism and the decentralized nature of the A6.2 mechanism, which have perpetuated mistrust in the integrity of VCCs. The consensus reached at COP29 on the Paris Agreement Crediting Mechanism is crucial to strengthen market integrity and provide greater certainty and confidence for firms operating across multiple jurisdictions.

¹⁶Regulated facilities exceeding emission baselines need to settle the difference by ACCUs or Safeguard Mechanism Credits issued under the compliance mechanism (Clean Energy Regulator, Australian Government 2024).

- Scaling CDR technologies requires a mechanism that addresses the price disparity with compliance allowances and the broad price range of CDR credits and also incorporates advance commitments to improve the bankability of CDR projects.
- Incorporating both CCM and VCM into a carbon pricing strategy requires a holistic approach to balance supply and demand dynamics, fostering an aligned carbon price that integrates compliance costs of emissions with incentives for voluntary decarbonization efforts. Establishing a domestic VCM can be an effective approach, but without aligning with international quality standards, it may weaken incentives for firms (particularly multinational corporations) to participate in carbon markets and develop strong decarbonization plans.
- Making the VCM efficient to support genuine decarbonization requires sufficient disclosure to facilitate informed investment decisions and price discovery. Relying solely on the VCM does not establish a true carbon pricing strategy.
- VCCs are complicated because of their different attributes and multiple crediting mechanisms, and the diverse array of international and jurisdictional rules, regulations, and standards adds another layer of complexity, posing challenges for multinational corporations investing in the VCM. There is an urgent need for consistent, harmonized standards to reduce market fragmentation.

5. Evaluation of Market Efforts

Market participants are actively addressing challenges related to price discovery. Furthermore, they are leveraging technologies to enhance market efficiency and data accuracy while also broadening the array of financial instruments to meet investors' needs and objectives. These efforts collectively contribute to streamlining the investment process in the VCM. This chapter evaluates the latest and upcoming market initiatives, pinpointing areas where enhancements are needed.

5.1. Enabling Adequate Price Discovery

The Taskforce on Scaling Voluntary Carbon Markets recommended that market participants introduce carbon reference contracts that align with the Core Carbon Principles. These contracts, which consist of baskets of VCCs with specific attributes, allow the development of market prices. Transparent and liquid Core Carbon Principles-aligned reference contracts can establish price benchmarks, provide price signals for informed investment decisions, and serve as the basis for terms and conditions in OTC contracts.

Additionally, OTC transparency can be achieved through price reporting agencies (Taskforce on Scaling Voluntary Carbon Markets 2021). For transparency of offtake agreements and advanced market commitments,

McKinsey recommended creating a registry to record such agreements, providing clear demand signals (Blaufelder, Levy, Mannion, and Pinner 2021). The International Carbon Action Partnership also suggested using a registry or central repository for market orders, trade archives, and future obligations to improve the reporting and disclosure of trades. This approach would also help regulators detect and deter risks (Kachi and Frerk 2013) and manipulative market practices.

Carbon exchanges, such as Xpansiv CBL, AirCarbon Exchange, and Climate Impact X's CIX Exchange, have launched spot and future reference contracts. Xpansiv CBL has also introduced a Core Carbon Principles-aligned Core Global Emissions Offset (spot) contract. A liquid reference contract that provides a reliable price signal, however, has yet to emerge.

Today, a lack of transparency remains in both the OTC market and the preissuance market. According to the International Swaps and Derivatives Association (2024), it is typical for OTC markets to provide less pricing information than public markets do, given their bilateral and negotiated nature. Intermediaries are in general wary of onerous disclosure requirements (Futures Industry Association 2024; Global Financial Markets Association 2024; Institute of International Finance 2024; International Swaps and Derivatives Association 2024). In the absence of reporting requirements, large VCC investors rely on price reporting agencies, such as MSCI, S&P Global Platts, and OPIS (Oil Price Information Service) for transaction data, as well as their own due diligence for price and demand signals.

Without an open and liquid market, VCC investing always requires extensive due diligence on quality and price, along with bilateral negotiation, to complete a transaction. One challenge associated with this "private equity approach" is that smaller projects may be excluded if they are cost-inefficient for the due diligence effort, and new or small investors might avoid the VCM because of the high costs associated with due diligence (Nasdaq and ValueExchange 2023).

The International Organization of Securities Commissions recommends regulators require trading venues and registries to report OTC transaction data (Good Practice 12). Although no regulations exist yet for such price reporting, Puro.earth, an accrediting body and registry for tech-based CDR, requires credit owners to provide trade value to initiate any transfer (Puro.earth 2024b), based on which firm builds the CORC Carbon Removal Price Index.

Currently, reference contracts in public markets are not liquid enough to provide confidence in pricing. According to the Taskforce on Scaling Voluntary Carbon Markets (2021), active participation of large investors in these contracts is needed to create liquidity, but their participation is limited by their need for extensive due diligence to avoid potential reputational risks from a basket of credits from different projects. Insufficient price and demand signals deter investment in VCC projects because project investors/financiers cannot accurately assess their risk. In an industry-wide survey by Nasdaq and

ValueExchange (2023), 66% of project financiers had low confidence in the pricing of carbon assets.

OTC market operators should embrace greater transaction transparency, which is crucial for breaking the cycle of poor transparency, liquidity, and confidence.

5.2. Reducing Market Frictions by Technologies

Blockchain technology has the potential to tackle challenges in the VCM by enhancing trading transparency and mitigating the risk of double counting through tokenization. Digital measurement, reporting, and verification (dMRV) technology can enhance data integrity and enable automated and timely reporting and thus more accurate valuation of VCCs (RMI and Climate Collective 2023). An artificial intelligence (AI) model can be used to derive the value of VCCs based on the respective attributes (such as project type, jurisdiction, vintage, permanence, and co-benefits). By leveraging these technologies together, buyers can also save on human capital and time resources required for VCM investing.

The World Economic Forum (2023) described digitizing the VCM as “the leading use case for blockchain innovations in the climate space” (p. 19). Tokenizing VCCs is a suitable approach because of the following:

- **Product nature:** VCCs lend themselves well to tokenization, given their inherent diversity. Originating from more than 170 types of projects, each with distinct characteristics, methodologies, and environmental and social impacts, carbon credits lack homogeneity. Tokenization allows for the inclusion of detailed metadata alongside each token, providing essential information about the specific characteristics of each VCC. This metadata can include project descriptions, verification certificates, and co-benefits, enabling buyers to make informed decisions based on their specific sustainability goals.
- **Transactional preferences:** A significant portion of buyers tend to favor nonstandardized, bespoke deals and OTC transactions. Tokenization can accommodate this preference, providing a flexible and customizable framework for transactions. Tokenization also allows VCCs to be traded globally without needing centralized exchanges, providing more market access to international participants.

Tokenization of carbon credits can improve traceability, lower transaction costs, and streamline the offsetting process. In extreme cases in which registries cancel credits because of overissuance, grievance, or nonconformity, however, risk management could be a challenge if there is no direct connection between buyers and the registries. According to Gold Standard, it is essential for the token to be properly connected with registries rather than being only a crypto representation of a VCC certificate (Leugers 2024). In addition, inputting transaction prices into smart contracts would result in all transaction prices

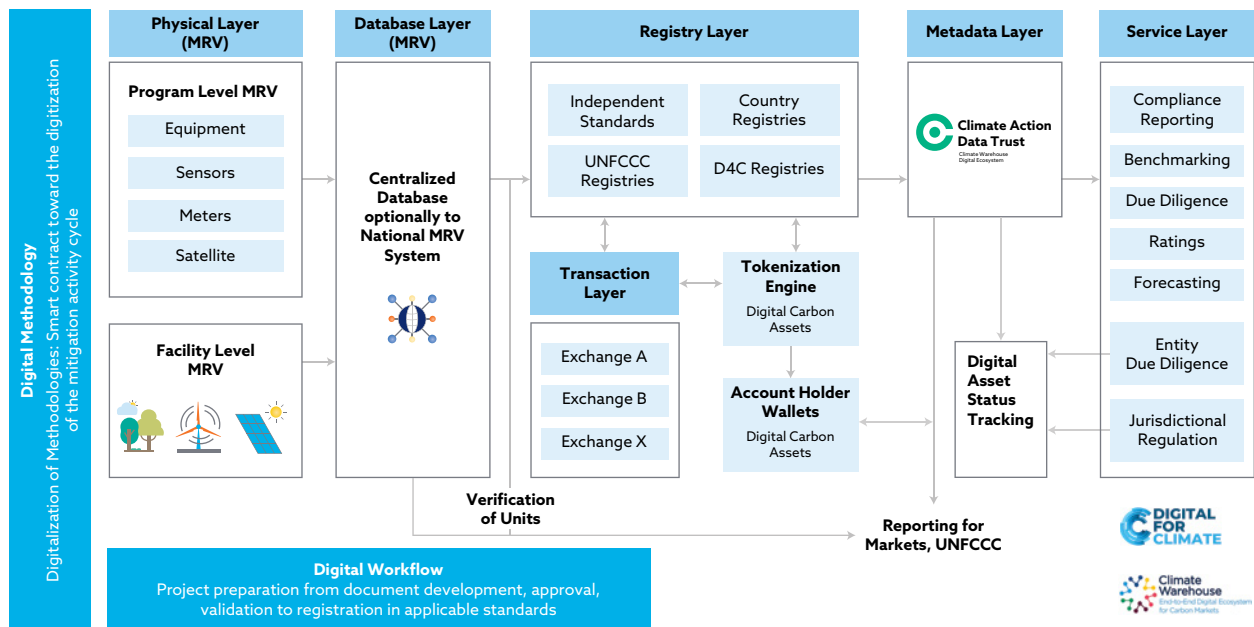
of any tokenized VCCs, whether from public or private deals, being recorded publicly on the blockchain.

Although blockchain technology can improve recordkeeping, trading, tracking, and reporting, it does not verify VCC quality. The development of dMRV technologies is crucial for building an end-to-end digital ecosystem for carbon markets (see **Exhibit 7**). In the World Bank Climate Warehouse’s proposed end-to-end digital ecosystem for VCM, dMRV is “a two-layer system (physical and digital) that automatically collects, stores, analyses, and displays relevant data for users to obtain reliable data aiming at creating carbon credits” (Climate Warehouse 2024). It enables standardized and automated reporting, thus helping resolve the key issue of costly, manual, nonstandardized reporting that has restricted capital flows by more than 51%, according to a Nasdaq and ValueExchange (2023) study.

Examples of VCC projects equipped with dMRV include the following:

- The World Bank projects in Colombia and Mozambique, chosen as pilot testing grounds for the Next Generation Measurement, Reporting, and Verification system designed by the World Bank’s Forest Carbon Partnership Facility and BioCarbon Fund Initiative for Sustainable Forest Landscapes. (Forest Carbon Partnership Facility 2022)
- The Electric Cooking Program in Cambodia and Bangladesh (with real-time tracking of emission reductions and other impact outcomes), the African Clean Energy Carbon Offset Programme (with smart technology to enable

Exhibit 7. Climate Warehouse’s End-to-End Digital Ecosystem for Carbon Markets



Source: Climate Warehouse (2024). Credit: World Bank Group. All rights reserved. www.theclimatewarehouse.org/work/climate-warehouse.

real-time quantification of social and environmental impact), and the Deployment of LPG Cookstoves in Kenya program (with sensors for tracking and reporting consumption at the household level)—all of which are on the Goldman School of Public Policy (2024) list of quality projects.

Note that the Climate Warehouse’s digital ecosystem for the carbon market does not cover price, so the digital ecosystem cannot be considered truly end to end for investors.

AI is a powerful tool to help VCC investors assess the more than 170 types of carbon credits of varying vintage accredited by different crediting programs, which are subject to a diverse array of international and national rules and regulations. In a market without price transparency, S&P Global Platts serves as one of the price reporting agencies for the VCM. S&P Global Platts has also partnered with Viridios AI to generate current values for various types of VCCs, considering such attributes as certification standard, project activity, geography, and contributions to the UN Sustainable Development Goals. The model uses historical relationships between transaction prices of diverse carbon projects and selected commodities (such as crude oil, natural gas, and thermal coal) and indexes (such as the Dow Jones Sustainability World Index and the S&P Green Bond Index) to construct indexes for VCCs originating from projects that provide co-benefits, such as cookstove initiatives, sustainable agriculture, reforestation, and coastal/marine ecosystem preservation (S&P Global 2023).

Although digital technologies and data analytics are effectively improving physical measurement, reporting, and verification to ensure the integrity of VCCs, their potential is not fully leveraged because of the fragmented data infrastructure. Such limitations could deter new or small investors from participating in the VCM more actively. To lower the entry barrier, new VCM products can help, as discussed in the next section.

5.3. Diversity of VCM Products and Funding Mechanisms

The diversity of VCM products and funding mechanisms can play a crucial role in scaling the market. New products can help project investors pursue diverse carbon reduction/removal initiatives to increase supply, while offering flexibility, accessibility, and risk management tools to VCC investors, catering to demand.

5.3.1. VCC-Linked Bonds, Blended Finance Facilities, and Debt-for-Climate Swaps

The A6 mechanism aims to unlock financial support for developing countries through sales of carbon credits, which sometimes require upfront capital for project development. VCC-linked bonds and blended finance facilities can help bridge this funding gap.

In 2023, the World Bank issued the world's first Emission Reduction-Linked Bond, an outcome-based climate finance instrument. The USD50 million, five-year, principal-protected bond is used to finance the World Bank's sustainable projects. Bondholders forgo ordinary interest payments. Instead, the coupons are converted to a sum of USD7.2 million, which the World Bank will transfer to the project developer as upfront payment through an offtake agreement of VCCs to be generated by a project in Vietnam. The project distributes water purifiers to schools to reduce burning of biomass used in boiling water for safe consumption. Proceeds from the subsequent sale of VCCs will serve as coupon payments to bond investors, but the actual payment depends on the number of VCCs produced during the period. (World Bank 2023).

In 2024, the World Bank issued a USD225 million, nine-year, principal-protected Reforestation-Linked Bond. The coupon payments comprise a fixed guaranteed portion, together with a variable portion that is linked to the generation of CDR credits from reforestation projects in the Amazon rainforest. The World Bank (2024) will make payment of up to approximately USD36 million to a project developer for land acquisition to plant native tree species. The project has secured Microsoft as a buyer of CDR credits to be produced, and a portion of the sales proceeds is designated for coupon payments to the bondholders (World Bank 2024).

Fund for Nature, Africa's first debt fund for nature-based VCC projects, is one of the innovative finance solutions endorsed by the Global Innovation Lab for Climate Finance (funded by the UN; the governments of the United States, the United Kingdom, Germany, and Canada; and Bloomberg Philanthropies). The fund intends to raise USD100 million to build a portfolio of carbon removal/reduction VCC projects through the restoration of tropical forests and mangroves and the conservation of irrecoverable carbon sinks, such as peatlands. It extends loans to project owners and secures the first rights of repayment via VCC sales. Through the open-sourced Simple Agreement for Future Offtake platform developed by the Fund, buyers and project owners can reduce transaction costs by using standardized agreements, and the agreements are transparent and will serve as collateral for commercial debt. The fund aims to catalyze up to USD900 million of commercial capital through direct investment/financing and VCC sales (Lonsdale and Azhar 2022).

There have been discussions about using VCCs or ITMOs in the repayment of loans (McCartney 2023), including to development finance institutions (Lazard 2024), to incentivize creditors undertaking debt-for-nature or -climate swaps (Chamon, Klok, Thakoor, and Zettelmeyer 2022), or as collateral for debt issuance (Walsh 2023). So far, we have found only one example: In 2006, the Spanish government agreed to cancel USD10.5 million of Uruguay's USD77 million debt, providing the full amount released be spent on a 10-megawatt wind plant equipped with Spanish turbines. Spain was also granted the first rights of refusal for any VCCs (issued under the Clean Development Mechanism) generated by the wind plant (Cassimon, Prowse, and Essers 2014).

5.3.2. Advance Commitments or Contracts

Advance commitments or contracts, a concept developed more than a decade ago, were primarily used to support the development and delivery of vaccines or other essential health products. This funding approach sends clear demand signals to technology and project developers, as well as project investors and financiers, rendering VCC projects “bankable” for external financing and incentivizing investment. As mentioned earlier, the ETA platform plans to provide advance purchase commitments, and CDR credit buyers are keen to secure future supply via a preissuance market. VCC-linked bonds and blended finance facilities also incorporate early offtake.

The Monetary Authority of Singapore (MAS) has launched the Transition Credits Coalition to use VCCs generated from early retirement of coal-fired power plants in Asia as a complementary financing instrument to fill the economic gap to finance the respective early retirement. These VCCs are called “Transition Credits.” The coalition’s members include Citi, DBS Bank, Temasek, the Rockefeller Foundation, the Asian Development Bank, the International Energy Agency (IEA), and WWF-Singapore. According to a report by MAS and McKinsey & Company (2023), early retirement of a typical coal-fired power plant in Asia faces an economic gap of USD70 million per gigawatt (22.6% of financing needed for early retirement) if it is retired five years early (see **Exhibit 8**), which could be filled by selling 4.5 million Transition Credits each year for five years at a nominal price of USD11/t CO₂e–USD12/t CO₂e. The MAS is working on two pilot projects in the Philippines, together with the Rockefeller Foundation (one of the steering partners of the ETA platform), ACEN Corporation (an energy supplier operating in the Asia-Pacific region), and the Asian Development Bank.

The Transition Credits Coalition, like the ETA initiative, needs to generate sufficient demand for Transition Credits. Singapore allows carbon tax-liable companies to use VCCs to offset up to 5% of taxable emissions. According to a CoherentMI (2024) estimate, however, the Singapore VCM will grow to only USD55 million in 2030 and is too small to support the Transition Credit market. Additionally, financing for the early retirement of coal-fired power plants is

Exhibit 8. Simplified Cash Flows from Retirement of an Illustrative Coal-Fired Power Plant in Indonesia Five Years Early

		USD Million/Gigawatt
	Financing needed, based on the net present value of a subcritical coal-fired power plant in Indonesia: 50% capacity factor, 10–12 years of age, 15 years of power purchasing agreement tenure remaining, and 8%–9% cost of capital in local currency	310
-	Net present value of 10 years of operating cash flow	240
=	Economic gap, equivalent to the net present value of the five years forgone	70

Source: MAS and McKinsey (2023).

required years before closure, which is when the Transition Credits would be issued. According to MAS and McKinsey (2023), although advance market commitment is needed, committing to purchases with such long tenures introduces risks: What if, for instance, the retirement is delayed because of economic or political reasons? This challenge applies to participants of the ETA initiative as well.

The dynamics of the CDR market can introduce other challenges for investors making advance purchase commitments: Fluctuations in demand, technological risks, or evolving market standards may impact the value and availability of CDR credits. VCC investors navigating the evolving CDR market landscape need to adopt robust risk management strategies.

5.3.3. VCC and Project Investment Funds

New or small VCC investors that lack sufficient resources and capabilities to conduct due diligence and ongoing monitoring can invest in VCCs through VCC investment funds to mitigate their reputational risks. Large VCC investors can use VCC investment funds to diversify their VCC portfolio.

The London Stock Exchange's VCM framework allows closed-end fund or project owners (or operating companies) to be listed on the main board or the Alternative Investment Market (AIM). The London Stock Exchange VCM framework represents a new channel for suppliers to raise capital for VCC projects, for investors to fund VCC projects, and for users to buy VCCs. Foresight Sustainable Forestry, which invests in UK forestry and afforestation assets, is the first fund listed on the main board using the framework. Unlike the private equity approach, this public market approach provides transparent demand and price signals for both project financiers/developers and VCC buyers.

VCC investors can also opt for nonpublic, actively managed VCM investment funds, which have built portfolios of VCCs and/or carbon projects. Examples of VCM investment funds backed by international institutions are Climate Asset Management's Natural Capital Fund and the Nature Based Carbon Strategy (Climate Asset Management 2022) and Manulife Investment Management's (2024) Forest Climate Fund. Investors can opt for either financial return or in-kind VCC distributions.

Other innovative offerings are available as well. Rubicon Carbon constructs a portfolio of VCC projects and retires additional credits for offsetting purposes based on proprietary risk assessment methodology. This strategy aims at addressing non-permanence risk resulting from insufficient buffer pool (see Section 3.1), delivery risk, and other external and internal risks (Clough, Jenkins, and Montag 2023).

5.3.4. Carbon Insurance

Insurance policies can de-risk VCM investing and create new VCC demand. The UNFCCC recommends the use of insurance policies or comparable guarantee products to address the risk of reversal (carbon removed being released back to the atmosphere; see Section 3.1) under the A6 mechanism (UNFCCC 2023). Six independent crediting programs undertook to jointly pursue measures to ensure VCC permanence through innovative insurance mechanisms, together with other actions that promote the scale and integrity of the VCM (Climate Action Reserve 2023).

Innovative insurance products now available to VCC buyers include carbon credit invalidation insurance, which protects against VCC invalidation caused by misreporting or fraudulent overstatement of carbon sequestration, and carbon delivery insurance, which covers the risk of delivery shortfalls in advanced purchase agreements (see **Exhibit 9** for more). Claims can be settled through financial compensation, allowing buyers to purchase replacement credits, or by providing like-for-like replacement VCCs. Separately, AXA launched an Excess Emissions Insurance product, which indemnifies shipping companies' higher-than-expected emissions resulting from unavoidable external factors, such as the 2021 Suez Canal obstruction. The claim payments are made in VCCs for offsetting the excess emissions (AXA 2023).

In summary, the following gaps have been identified:

- The lack of transparency in OTC transactions has undermined confidence in carbon asset pricing. The market has yet to fully utilize registries' potential to enhance transparency and enable adequate price discovery.
- The market also has not fully leveraged blockchain's potential for risk management and transaction recording. The World Bank's Climate Warehouse has left price transparency out of the end-to-end digital ecosystem, leaving data infrastructure fragmented. AI, although a powerful tool for reducing market frictions, is hindered by this broken chain of evidence.

Exhibit 9. Examples of Carbon Insurance Facilities

Companies	Carbon Insurance Facilities
Howden	Carbon Credit Invalidation Insurance (due to third-party negligence and fraud), Carbon Capture and Storage Insurance (liabilities arising from leakage)
CFC and Kita	Carbon Delivery Insurance (for advanced/forward purchase of VCCs)
Oka	Cover postissuance risks, including invalidation and reversal (due to natural catastrophes and human-induced activities)
CarbonPool	Carbon Shortfall Insurance, Carbon Reversal Insurance, Unintended Emissions Insurance

- The Paris Agreement uses the VCM to unlock financial support for developing countries, but VCCs are not widely accepted as a currency for coupon payment or loan repayment for developing countries.
- Current risk management tools are insufficient. Risk management is particularly important for advance commitments, which are needed to improve the bankability and economic feasibility of carbon removal and energy transition projects. Investors making advance purchase commitments need to adopt robust risk management strategies but can count only on carbon insurance.

6. Potential Solutions

This chapter explores the potential solutions to fill the gaps identified in governmental and market efforts for making VCM investing viable and thus scaling the VCM.

6.1. Enhance Price Transparency Through Regulations, Registries, and Blockchain Technologies

Policy and/or Market Gaps:

- Enhanced disclosure, including price-sensitive information, is needed to facilitate informed investment decisions and price discovery.
- The lack of transparency in OTC transactions undermines confidence in carbon asset pricing. The market has yet to fully utilize registries' and blockchain's potential to enhance transparency and enable adequate price discovery.
- Price transparency is left out of the end-to-end digital ecosystem, leaving data infrastructure fragmented and hindering AI's potential to reduce market frictions.

Section 4.4 discussed the importance of robust public disclosure, including price-sensitive information, to guide investment decisions, and Australia's proposal to move the clearing process of OTC trades to a public exchange could help achieve greater transparency. Alternatively, a potential commercial solution could involve carbon registries updating their credit transfer rules to require the inclusion of pricing information. Requiring price data to be input into smart contracts for tokenized VCCs is also a feasible approach.

With disclosure of pricing information, registries could use the price data to create price indexes based on various attributes, which could then be leveraged to develop valued-added services or licensed to funds for creating investment and risk management products.

6.2. Harmonize VCC Integrity Standards and Align Risk Assessment Methodologies

Policy and/or Market Gaps:

- The heterogeneous nature of VCCs, together with the diverse array of international and jurisdictional rules, regulations, and standards, poses challenges for multinational corporations investing in the VCM.
- Establishing domestic VCMs can be an effective approach, but without aligning with international quality standards, it may weaken incentives for firms (particularly multinational corporations) to participate in carbon markets and develop strong decarbonization plans.
- The inadequacy of existing risk management tools beyond carbon insurance can limit the extent to which investors can make advance purchase commitments.

Harmonization of standards among independent crediting programs, Core Carbon Principles, the Paris Agreement A6 mechanism (including the PACM), and crediting mechanisms for domestic VCMs will bolster market participants' confidence in VCC integrity and facilitate investor participation.

There is a growing emphasis on using extra credits for risk adjustment or benefit enhancement among both policymakers and commercial operators. Risk adjustment approaches are still under development, including:

- Measurement, reporting, and verification approaches that independently assess the number of credits created by VCC projects and use extra credits to account for discrepancies with the respective reported figures on registries (Clough, Jenkins, and Montag 2023).
- Discounting approaches that quantify risk adjustment factors to account for project-specific differences based on carbon credit ratings of VCC projects, and using more than one credit to compensate for one tonne of CO₂e if applicable (Downey 2023).

If the use of extra VCCs becomes widely adopted, aligning the key assumptions or the risk assessment methodologies will become essential to ensure consistency. This alignment is particularly important for multinational corporations that source VCCs globally and need to comply with varying rules governing VCC usage in different jurisdictions and/or plan to use extra credits as part of their proprietary risk management strategies. Policymakers and commercial operators could work together to support this alignment.

6.3. Promoting Effective Price Signaling and Incentivizing CDR Investment

Policy and/or Market Gaps:

- Raising capital to scale CDR technologies requires a mechanism that addresses the price disparity with compliance allowances and the broad price range of CDR credits and incorporates advance commitments to improve the bankability of CDR projects.

Section 4.4 discussed the need for a comprehensive carbon pricing approach that incorporates both VCM and CCM to create reliable carbon price signals. Section 4.3 also discussed that a domestic VCM can be an effective approach to align carbon prices that integrates compliance costs of emissions with incentives for voluntary decarbonization efforts. With effective integration, this approach can also encourage carbon removals.

Apart from the EU, California proposes to establish a CDR market by 2027, and the United Kingdom intends to include tech-based CDR credits in the UK Emissions Trading Scheme. For effective integration, however, CDR credits created by different methodologies must be considered to have equivalent value and be reflected in the price, as well as be interchangeable (i.e., fungible). There are mechanisms that help to address the price disparity and fungibility in the United Kingdom's consultation on integrating CDR in the UK ETS and the California CDR Market Development Act (in progress).

For instance, a separate CDR market and allocation of removal obligations in California will allow differentiating prices of CDR credits and emission allowances. In the United Kingdom, introduction of measures such as a buffer pool (where projects with higher reversal risk are required to contribute more to the buffer pool) and an "equivalence ratio" (which requires extra credits from projects with shorter durability to offset 1 tonne of CO₂e) will serve as adjustment factors to help address the fungibility issue (see **Exhibit 10**). Advance commitment is not incorporated in the UK ETS, however, nor is it addressed in the discussions for establishing the California CDR Market, although advance commitment can be vital for incentivizing CDR investments because it enhances project bankability.

Academic studies suggest that an intermediary can be established to regulate the supply and price of CDR credits. Rickels, Proelß, Geden, Burhenne, and Fridahl (2021) proposed an intermediary that buys CDR credits and supplies them to obligated emitters to support price collars (price ceilings and floors). An intermediary will also open up the possibility for the government to bridge the price gap between the high cost of certain CDR projects and allowance prices (La Hoz Theuer, Doda, Kellner, and Acworth 2021). Rickels, Rothenstein, Schenuit, and Fridahl (2022) suggested establishing a carbon central bank,

Exhibit 10. Selected Discussions in the UK ETS Consultation and California CDR Market Development Act

	UK ETS Consultation ^a	California CDR Market Development Act ^b
Price disparity with emission allowance	An emission allowance will be replaced every time a CDR allowance is issued, thus keeping the total number of allowances in the system unchanged. Cutting emission allowances is not considered because there is risk of low supply and thus a high price of CDR allowances, placing undue burdens on participants.	Obligations of certain emitting agencies to purchase CDR credits equivalent to a specified percentage of their emissions, with that percentage increasing over time.
Wide price range	CDR projects with higher risk of reversal need to contribute a percentage of removals into a buffer pool. Allowances allocated to projects with short-term durability will be adjusted based on a predetermined “equivalence ratio,” which is set according to their net present social value. Consequently, projects with higher risk of reversal and/or shorter durability will be allocated fewer allowances compared to those with lower risk and/or long-term durability.	CDR approaches with short-term durability must be complemented with CDR with long-term durability.
Advance commitment	An <i>ex ante</i> approach, where CDR allowances are awarded to operators based on expected delivery before the removal has taken place, is not considered. Issuing <i>ex ante</i> allowances will make it harder for the market to assess the current and future supply, and if operators fail to deliver as expected, it could affect the overall UK ETS.	NA

^aSee UK Emissions Trading Scheme Authority (2024). ^bSenate Bill No. 308, introduced by Senator Becker in the 2023–24 California legislature regular session on 2 February 2023, available at https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202320240SB308.

and Meyer-Ohlendorf (2023) further proposed that this central bank could also manage buffer pools. A carbon central bank of this nature could also make advance commitments.

Regardless of the mechanism design, governments should consider setting up registries to document offtake agreements and advanced market commitments for eligible CDR projects (Blaufelder et al. 2021; Kachi and Frerk 2013). Additionally, establishing reserves to assist participants who make advance commitments in mitigating delivery risk is beneficial. Similar to the rationale behind the United Kingdom’s rejection of the *ex ante* approach, the absence of records for offtake agreements and advanced market commitments could impede regulators and participants from accurately assessing the current and future supply of CDR credits. Any failure in delivery could have

significant impacts on the overall system, making it challenging for regulators and participants to plan and budget for emission targets.

6.4. Incentivize Demand by Reframing VCM

Policy and/or Market Gaps:

- The ETA initiative needs to generate sufficient demand to achieve its ambitious goals.
- VCCs are not widely accepted as a currency for coupon payment or loan repayment for developing countries.

The ETA credits proposed by the ETA initiative and Transition Credits proposed by the Transition Credits Coalition are outcome-based climate finance instruments, which is one of the three use cases for VCCs issued as “mitigation contribution” under the A6.4 mechanism (see Section 4.1), to support the climate mitigation efforts of developing countries.

Without monetary or social incentives to encourage mitigation contributions beyond buyers’ compliance requirements or net-zero targets, however, the A6.4 mechanism may struggle to reach its full potential. Intergovernmental bodies (such as the United Nations and the World Bank Group) could consider two options. First, they could support the evolving role of VCCs as “mitigation contributions” within a just transition framework, rather than limiting their use solely to offsets. This approach could encourage philanthropic organizations, multilateral development banks, development finance institutions, and other impact investors to accept mitigation contribution credits generated under the A6.4 mechanism as coupon payments or loan repayments. Second, they could advocate for tax relief on mitigation contributions, such as eligibility for value-added tax exemption and tax deductions as charitable contributions.

Additionally, small changes to the penalty mechanism of sustainability-linked loans and bonds (SLLs and SLBs) could create new demand for mitigation contributions. For example, HSBC’s transition loan to Etihad Airways includes a penalty in the form of VCCs to offset the excessive emissions if the airline fails to meet its performance target (17.8% reduction in carbon intensity in 2024 from 2017 baseline). If all borrowers/issuers of SLLs and SLBs that fail to meet decarbonization targets faced a similar penalty in the form of VCCs, on top of the standard step-up coupon, it could create new demand for these instruments.

For illustration, Public Power Corporation (PPC) in Greece issued a EUR775 million SLB, with a sustainability performance target (SPT) set at a 40% reduction of Scope 1 emissions in 2022 from a 2019 baseline and a 57% reduction in 2023. PPC managed to reduce emissions by only 36% in 2022, falling short of the 40% SPT (equivalent to 0.93m t CO₂e). PPC is thus required to pay an additional 50-bp coupon from 2023 through to 2026.

Exhibit 11. Illustration of Step-Up Mechanism

		SLB	2022	2023–2026
Principal	A	EUR775m		
Step-up coupon	B	50 bps		
Target reduction (SPT)	C		9.26m t CO ₂ e	
Actual reduction	D		8.33m t CO ₂ e	
Shortfall	C – D		0.93m t CO ₂ e	
50-bp step-up coupon p.a.	A × B			EUR3.9m
2022 recurring EBITDA	E		EUR954m	
Step-up coupon as a % of 2022 recurring EBITDA	(A × B)/E			0.40%

Sources: Data from PPC SLB framework and FY2022 financial results (Public Power Corporation 2021, 2023).

The annual step-up punitive fee is EUR3.9 million, however, this is equivalent to only 0.4% of its 2022 recurring EBITDA (see **Exhibit 11**).

In theory, if PPC were also required to purchase VCCs to offset a portion of the 0.93m t CO₂e shortfall, it could better internalize the cost of the excess emissions and provide more demand for VCCs.

A Climate Bonds Initiative study of 50 SLB issuers (10% of the total) found that 16% of issuers were off track with all key performance indicators (KPIs). The majority of issuers adopted climate mitigation KPIs, primarily related to greenhouse gas (GHG) emissions or intensity. GHG-related KPIs were more frequently off track compared with other KPI categories. Additionally, the average step-up coupon is a relatively modest 24.8 bps per KPI (Almeida 2024), which may not adequately reflect the environmental materiality. Because carbon pricing theoretically captures the external cost of emissions, using the VCM to establish a market-based mechanism for pricing the punitive fee could help address this gap. Moreover, pricing the environmental cost of shortfall can act as an additional incentive for issuers to achieve their decarbonization targets.

7. Conclusion

The Kyoto Protocol, established in 1997, allowed developed countries to meet their carbon reduction targets by investing in emission reduction in developing countries. The idea was to leverage the lower cost of emission reduction in developing countries to reduce the overall cost for the world to achieve net zero (Wessel and de Boer 2023). This approach was inherently flawed, however, because it undermined collaborative efforts worldwide to mitigate climate risk.

The VCM emerged outside the Kyoto Protocol framework with the good intention of providing a platform for entities seeking accountability for their carbon footprint to channel capital toward climate action. Over the years, however, concerns about fake impacts and misleading claims have deterred investors, again undermining collaborative climate risk mitigation efforts.

In recent years, governmental bodies, industry organizations, and market participants have made significant efforts to improve the viability of the VCM for climate action, as highlighted in this report. Efforts to revive and strengthen the functioning of the VCM are important because it can be an effective channel to redirect funding to developing countries and for scaling clean technologies such as low-emissions hydrogen and sustainable aviation fuel (International Energy Association 2024), among many others.

In this critical phase for the VCM's development, building momentum through the collective efforts of all stakeholders is essential. Robust, harmonized policies and standards can ensure that only high-integrity projects survive and contribute to the VCM's success. Market enhancements, such as a bigger and formal role for registries to improve the reporting and dissemination of pricing and transaction data, as well as the use of blockchain technologies to improve traceability and end-to-end digital transparency, can further accelerate the development of the VCM. A transformative change in mindset is also needed—recognizing that neutralizing residual emissions is an immediate concern and that high-integrity VCCs can serve as a currency for supporting a just transition in developing countries.

BloombergNEF projects VCC prices to remain at USD14/t CO₂e by 2050 if integrity concerns persist and demand remains ad hoc, but it also predicts that prices could rise to USD238/t CO₂e if integrity issues are resolved and demand becomes consistent (BloombergNEF 2024). Ensuring integrity and consistent demand are crucial for maintaining adequate pricing to incentivize carbon reduction and removal activities.

Additionally, although the VCM is a niche market for experts, its fundamental purpose is to create real-world impact, with the global community as the "ultimate beneficiary." The VCM's role is not only a scientific or legal matter but also a social one. Market reforms and innovations must be communicated widely and show demonstrable benefits to local communities.

The VCM is one among many tools for climate finance. Nevertheless, the scale of the climate challenge requires maximizing the potential and effectiveness of every tool available.

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Author

Winnie Mak
Former Senior Affiliate Researcher,
CFA Institute Research and Policy Center

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