Assessment of Regulatory Approaches to Project-Based Carbon Credit Markets

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Table of Contents

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Glossary of Key Abbreviations and Terms

Abbreviations

AML	Anti-money laundering: Laws governing the detection and prevention of money laundering in financial markets
ARR	Afforestation, reforestation, and revegetation: A category of land-based carbon removal activities
ART TREES	Architecture for REDD+ Transactions (ART) and the REDD+ Environmental Excellence Standard (TREES)
ASA	Advertising Standards Authority: The UK advertising regulator
BACX	A private carbon trading platform in Argentina formed by a partnership between the ACX Group and the Bolsa Argentina de Carbono
BYMA	Bolsas y Mercados Argentinos: The Argentine stock exchange
CA	Corresponding adjustment: The accounting adjustment applied by participating countries under Article 6 to avoid double counting of Internationally Transferred Mitigation Outcomes (ITMOs)
CCP	Core Carbon Principles: ICVCM's benchmark criteria for high-integrity carbon credits
CCS	Carbon capture and storage: Technologies that capture carbon dioxide and store it to prevent its release into the atmosphere
CDM	Clean Development Mechanism: A carbon crediting mechanism established under the Kyoto Protocol
CCTS	Carbon Credit Trading Scheme: India's national carbon credit framework
CERC	Central Electricity Regulatory Commission: India's federal regulatory authority for the power sector
CNV	Comisión Nacional de Valores: Argentina's national securities regulator
CO_2e	Carbon dioxide equivalent: A metric used to express the climate impact of different greenhouse gases in a common unit

CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation: A global market-based measure that requires airlines to limit their CO_2 emissions by purchasing eligible carbon credits
CRCF	Carbon Removal Certification Framework: The European Union's regulatory framework establishing certification criteria and methodologies for carbon removals and carbon farming activities
DAC	Direct air capture: A technology that removes carbon dioxide directly from ambient air
ETS	Emissions trading system: A compliance market based on a cap-and-trade mechanism, in which a regulator sets a limit on total emissions and issues tradable emissions allowances that covered entities must surrender to match their emissions
FCA	Financial Conduct Authority: The UK financial regulator, referenced in the text in connection with anti-greenwashing and sustainability claims
IA	Implementation agreement: A bilateral agreement between two countries establishing the terms under which ITMOs may be generated, authorized, and transferred under Article 6.2 of the Paris Agreement
ICC	International carbon credit: A credit issued under Singapore's ICC framework, which sets eligibility and quality criteria for carbon credits that companies may use to offset taxable emissions under the country's carbon tax regime
ICVCM	Integrity Council for the Voluntary Carbon Market: An independent governance body that sets quality standards for carbon credits in the voluntary carbon market
IFM	Improved forest management: Practices that increase forest coverage beyond business-as-usual scenarios
IFRS S2	International Financial Reporting Standard 2: Climate-related disclosures
ISDA	International Swaps and Derivatives Association: An industry body that develops standard contracts and legal frameworks for over-the-counter (OTC) derivative markets
ISSB	International Sustainability Standards Board: An independent body that develops standards for companies to disclose sustainability-related information to investors
ITMO(s)	Internationally Transferred Mitigation Outcome(s): Emission reductions or removals that can be transferred between countries

	under Article 6.2 of the Paris Agreement to meet climate targets
JCM	Joint Crediting Mechanism: Japan's bilateral carbon crediting mechanism, linked to Article 6.2
JPX	Japan Exchange Group
K-ETS	Korean Emissions Trading Scheme
KYC	Know Your Customer: Requirements used in financial market compliance to verify the identity of customers and assess potential risks
MMRV	Monitoring, measurement, reporting, and verification
NDC	Nationally determined contribution: Climate action plans submitted by countries under the Paris Agreement
OTC	Over-the-counter: Bilateral or dealer-mediated trading outside centralized exchanges
PACM	Paris Agreement Crediting Mechanism: An international carbon crediting mechanism established under Article 6.4 of the Paris Agreement that generates transferable emissions reduction or removal credits
PCCM(s)	Project-based carbon credit market(s)
REDD+	Reducing emissions from deforestation and forest degradation, plus the roles of conservation, sustainable forest management, and enhancement of forest carbon stocks
SBCE	Sistema Brasileiro de Comércio de Emissões: Brazil's emissions trading framework
SBTi	Science Based Targets initiative: An independent initiative that helps companies set greenhouse gas reduction targets aligned with climate science
UNFCCC	United Nations Framework Convention on Climate Change: A United Nations treaty established to stabilize greenhouse gas concentrations in the atmosphere and provide a framework for international climate negotiations and action
VCMI	Voluntary Carbon Market Integrity Initiative: An independent initiative that provides guidance and frameworks for companies on how to credibly use carbon credits in voluntary carbon markets
VVB(s)	Validation and verification body(ies)

Terms

Additionality	The principle that a credited emission reduction or removal would not have occurred without the financial incentive provided by carbon credit revenue.
Afforestation	The establishment of forest biomass on land that was not previously covered by trees.
Allowance	A tradable compliance unit issued under an emissions trading system, representing authorization to emit one metric ton of CO_2e. Allowances are allocated or auctioned by a regulatory authority rather than generated from discrete mitigation projects, and are distinct from project-based carbon credits.
Avoidance credits	Credits generated by projects that prevent greenhouse gas emissions that would otherwise have occurred, such as displacing fossil-fueled power generation with renewable energy or capturing landfill methane that would otherwise be vented.
Avoided deforestation	Project activities that reduce emissions by preventing forest loss that would otherwise have occurred; often discussed in connection with REDD+.
Carbon credit	A tradable unit representing one metric ton of CO_2e reduced, avoided, or removed from the atmosphere relative to an established baseline.
Carbon offset	A carbon credit that is used to compensate for emissions elsewhere, whether in voluntary claims or in certain compliance systems.
Co-benefits	Additional positive environmental or social outcomes associated with a carbon project, such as biodiversity conservation, water protection, rural livelihoods, or local economic development.
Compliance market or carbon pricing system	A regulatory system in which covered entities are legally required to account for their greenhouse gas emissions—either by surrendering allowances or eligible carbon credits, if permitted, corresponding to their emissions under an ETS or paying a fixed charge per unit of emissions under a carbon tax framework.
Corresponding adjustment	A national greenhouse gas accounting entry applied by both the transferring and acquiring countries when an ITMO is transferred under Article 6.2, ensuring the underlying mitigation outcome is counted toward only one country's NDC.
Double counting	The risk that the same emissions reduction or removal is credited or claimed more than once, whether through duplicate issuance, use by multiple buyers, or simultaneous claiming by more than one country or entity.

Demand-side regulations	Rules governing how carbon credits may be purchased, used, disclosed, and claimed by buyers, including voluntary-use rules, compliance integration, eligibility conditions, and greenwashing-related enforcement.
Emission reduction credit	A carbon credit that is generated by activities that reduce or avoid greenhouse gas emissions compared with a baseline.
Engineered removals	Technology-based methods that remove greenhouse gases from the atmosphere and store them durably, including direct air capture with geological storage and some forms of carbon capture and storage.
Fungibility	The extent to which carbon credits can be interchangeable across systems, registries, and trading venues.
Integrity criteria	The core quality attributes that are required of a credible carbon credit, including being real, additional, quantifiable, independently verified, unique, and permanent.
Interoperability	The ability of registry systems, accounting frameworks, and market infrastructure to interact effectively across jurisdictions while preserving traceability and environmental integrity.
Legacy credits	Credits from older issuance or project vintages, which are often subject to greater scrutiny and tend to trade at a discount relative to newer vintages, reflecting concerns about baseline integrity, methodological robustness, and alignment with current quality standards.
Legal status of a carbon credit	The way a jurisdiction characterizes a carbon credit in law, for example, as an intangible asset, a tradable asset, or in some cases a financial instrument; it affects ownership, taxation, collateralization, transferability, and insolvency treatment.
Letter of authorization or authorization	A host-country approval allowing a carbon credit or mitigation outcome to be used or transferred in a specified way, particularly for Article 6 purposes.
Market-side regulations	Rules governing trading venues, intermediaries, market infrastructure, transaction transparency, legal classification, accounting treatment, and cross-border exchange of credits.
Mitigation hierarchy	The principle that entities should first reduce and avoid greenhouse gas emissions within their value chains before using carbon credits to address residual emissions that cannot be eliminated.
Permanence	The requirement that credited emission reductions or removals are durable and are protected against reversal; approaches to managing reversal risk include buffer pools, insurance mechanisms, and minimum durability thresholds, with some jurisdictions requiring storage periods of 100 years or more.

Project-based carbon credit market (PCCM)	A market covering carbon credits generated from discrete projects that reduce, avoid, or remove greenhouse gas emissions, rather than from the allocation or auctioning of emissions allowances.
Removal credit	A carbon credit generated by activities that physically remove carbon dioxide from the atmosphere and store it in biomass, soils, products, geological formations, or other sinks.
Retirement	The permanent withdrawal of a carbon credit from circulation after it has been used, such that it cannot be traded or claimed again.
Reforestation	Re-establishing forest biomass on land that was previously forested but later lost forest cover.
Science-based target	An emissions reduction target aligned with climate science and typically validated under recognized frameworks such as SBTi.
Supply-side regulations	Rules governing the generation of credits, including integrity standards, MRV/MMRV requirements, registry oversight, methodologies, and sanctions for non-compliance.
Vintage	The year or period in which the underlying mitigation outcome occurred, as distinct from the date of credit issuance.

Executive Summary

Project-based carbon credit markets (PCCMs) facilitate the generation, trading, and retirement of carbon credits from projects that remove, reduce, or avoid greenhouse gas emissions. They offer a pathway to crowd in significant financing for critical decarbonization activities that would otherwise struggle to attract investment, while providing important co-benefits such as the preservation of water, land, forests, and biodiversity.

While PCCMs continue to expand, the pace of that growth has slowed as demand has shifted to high-integrity credits that produce independently verified real, additional, quantifiable, unique, and permanent reductions in greenhouse gas emissions. In response to growing demand for such credits, several credible and robust standards have been proposed, but they remain voluntary by design and therefore cannot, on their own, provide enforceable safeguards, consistent oversight, or dependable recourse for market participants. For PCCMs overall to gain credibility and function with integrity, countries need regulatory frameworks that provide oversight, similar to the role regulation has played in strengthening trust and accountability in broader financial markets. That said, regulatory oversight should still be viewed as an enabling condition rather than a guarantee for a scalable, high-integrity market because structural barriers may keep demand weak and markets fragmented.

To better understand the varying evolution of regulations for PCCMs across the globe, the Center on Global Energy Policy (CGEP) at Columbia University SIPA conducted a year-long project underpinned by research and stakeholder engagement through multiple convenings. The effort examined regulatory frameworks for PCCMs and emerging trends across countries and regions and assessed whether such frameworks could help close the integrity gap. The project aims to inform policymakers and regulators seeking to design or refine regulatory approaches for PCCMs, as well as market participants and other stakeholders for whom these regulations are pertinent.

This white paper provides a comparative analysis of how jurisdictions align and differ across key dimensions of PCCM regulation based on an in-depth stocktake of the regulatory landscape for G20 countries and Singapore, which is included in the appendix. (The United States was excluded from the stocktake and the analysis in this report because it is part of a separate study.)

Several cross-cutting themes emerged from the analysis:

- **Compliance markets are increasingly accepting carbon credits:** Whereas voluntary carbon markets for companies wishing to meet their own climate pledges have been the primary driver of demand for PCCMs, a growing number of countries with compliance mechanisms for mandatory emissions reductions are now permitting the use of project-based carbon credits under binding rules, with varying limits on credits and design frameworks.
- **Supply-side frameworks have advanced:** Early regulatory efforts have concentrated on credit generation, where jurisdictions show the clearest progress in governance and convergence around the quality criteria used to determine credit integrity, although with differences in comprehensiveness and stringency of these criteria across countries.

- **Demand-side rules are emerging but with divergences**: Rules governing how credits are used and disclosed are gaining traction; however, the lack of consistency, especially around assurance and disclosures, impacts buyers' ability to manage exposure to greenwashing, legal, and reputational risks.
- **Market-side rules reflect a spectrum of regulatory maturity:** Market infrastructure for PCCMs across jurisdictions varies, with regulated exchanges in some countries and self-regulated platforms in others, although bilateral transactions dominate. The approach taken impacts market transparency, oversight, and price discovery.
- **Countries are creating national tracking systems instead of relying solely on international registries:** The shift in favor of national, government-supervised systems reflects a broader transition to use registries not just for record-keeping but for authorization, accounting, and market oversight.
- **Progress toward data standardization enables integrity:** To make credits more traceable across domestic and international markets, efforts are being made—such as through a recent proposal of a voluntary carbon data model by the G20 Sustainable Finance Working Group (SFWG)—to achieve stronger digital interoperability, more standardized data, and tighter integration with disclosure and national accounting systems.
- **Legal classification of credits varies**: Jurisdictions differ in how they classify carbon credits and how far they bring them under broader legal and financial oversight. The divergence matters because it not only shapes ownership, taxation, and oversight but also cross-border transferability, which is key to market scalability.
- **Article 6 readiness is a key milestone**: Countries are forming bilateral authorization frameworks and interoperable registry systems to operationalize the Paris Agreement's Article 6 procedures—which allow for voluntary cooperation between countries to reduce emissions using carbon credits—by either incorporating them into regulations or exploring approaches for compatibility.

Looking ahead, PCCM regulation is likely to move toward a more state-anchored, integrity-driven, and interoperable architecture in which credits are treated less as standalone voluntary instruments and more as part of broader climate-governance systems. The next phase of market development is likely to center on deeper integration into national climate law and compliance frameworks, stronger domestic but globally aligned integrity rules, faster development of demand-side governance around claims and disclosure, and clearer differentiation between domestic credits and internationally transferable units. At the same time, sovereign registries are likely to become critical as core regulatory infrastructure, while financial oversight may deepen as carbon credits become more liquid and widely traded.

Introduction

Project-based carbon credits create incentives for private entities—especially companies with net-zero emission targets—to finance decarbonization activities outside the scope of their businesses. These credits can offset residual emissions that may be costly or impossible to avoid. The market for these credits thus facilitates the flow of capital to decarbonization activities that otherwise might struggle to attract investments.

But project-based carbon credit markets (PCCMs) have so far fallen short of their potential. The market's inability to self-regulate has led to several controversies and scandals in recent years, some of which involved explicit fraud.[1] The result has been market stagnation, with a growing surplus of credits that have not been retired and credit prices weakening. In response, independent initiatives have proposed robust standards that strengthen best practices for creating high-integrity credits. However, these standards are voluntary and therefore non-binding. Regulations, on the other hand, though not a guarantee, could restore market confidence by creating enforceable safeguards, enabling liquid and scalable PCCMs.

Use of the term "project-based carbon credit markets" in this paper, rather than the more common "voluntary carbon markets (VCMs)," is intentional. The demand for carbon credits is expanding beyond voluntary use, with a growing number of compliance regimes permitting their use by regulated entities. PCCMs therefore encompass VCMs, compliance-eligible carbon credits, and credits traded under international mechanisms, such as those established by Article 6 of the Paris Agreement and the aviation sector.

The authors undertook an examination of existing PCCM regulatory frameworks for the G20 countries (except the US, which is part of a separate study) and Singapore. The parameters studied across countries—as detailed in Section 4—can help identify gaps within a jurisdiction's regulations and offer a means to compare jurisdictions' efforts to identify areas where approaches align and enable interoperability and where they differ in ways that could fragment the market. The 20-country PCCM regulatory profiles, provided in the appendix, inform this white paper's discussion and findings.

This paper begins with a broad description of the current landscape of PCCMs, which, despite recent headwinds, has the potential to meet its promise as the demand for high-integrity credits is likely to grow. Realizing this potential requires first understanding the impediments the market faces and needs to address, which Section 2 covers. The next section examines the role of regulations in strengthening market integrity, transparency, and scalability. As noted, Section 4 describes the authors' approach to analyzing existing PCCM regulatory frameworks and provides a snapshot of the current status by country and regulation type, with details covered in the appendix. Section 5 presents the main findings, including the increasing acceptance of carbon credits in compliance markets, regulations evolving from a sole focus on credit generation to also include demand-side use and market-infrastructure controls, and the developing dynamics of registry sovereignty and data standardization.

The authors conclude that PCCM regulatory frameworks are likely to evolve along several converging lines: greater integration of voluntary and compliance markets, further global alignment of integrity rules, expanding demand-side regulations, and increasing financial oversight, with sovereign registries emerging as key regulatory instruments. The future of PCCMs is likely to be guided by the legal architecture being built for governing the issuance,

[1] United States Attorney's Office Southern District of New York, "U.S. Attorney Announces Criminal Charges In Multi-Year Fraud Scheme In The Market For Carbon Credits," Press Release, October 2, 2024, https://www.justice.gov/usao-sdny/pr/us-attorney-announces-criminal-charges-multi-year-fraud-scheme-market-carbon-credits.

use, and oversight of carbon credits, rather than by voluntary, unregulated offsetting commitments.

1 State of Project-Based Carbon Credit Markets

PCCMs are carbon markets covering tradable carbon credits generated from discrete emission removal, reduction, or avoidance projects, which can be used to offset emissions or meet climate goals. Each credit is intended to represent one metric ton of carbon dioxide equivalent (tCO_2e) removed, reduced, or avoided from the atmosphere relative to an established baseline scenario that enables the assignment of a monetary value to a carbon ton.[2] PCCMs are distinct from allowance-based emissions trading systems (ETS)—they generate credits from discrete mitigation projects, whereas in ETSs, a regulatory authority allocates or auctions compliance allowances, each of which represents permission to emit a ton of carbon dioxide.[3]

To be considered credible, credits should generate real, additional, quantifiable, independently verified, unique, and permanent reductions in greenhouse gas emissions.[4] Projects underlying the credits may include reforestation, afforestation, avoided deforestation (more specifically known as Reducing Emissions from Deforestation and Forest Degradation or REDD+), engineered removals, soil carbon sequestration, methane capture, improved cookstoves, renewable energy installations, and other activities that would not otherwise occur without the financial incentive from the credit (i.e., activities for which the emissions removed or avoided from the project are deemed "additional").[5]

In addition to direct environmental benefits, many projects are designed to generate co-benefits such as biodiversity conservation, natural resource preservation—including water, land, and

[2] Dana Ollendyke, "Understanding Carbon Credits and Offsets," PennState Extension, February 13, 2023, https://extension.psu.edu/understanding-carbon-credits-and-offsets; Carbon Neutral, "What Are Carbon Credits," Climate Impact Partners, July 26, 2024, https://www.carbonneutral.com/news/what-are-carbon-credits.

[3] International Carbon Action Partnership (ICAP), "About Emissions Trading Systems", n.d., https://icapcarbonaction.com/en/about-emissions-trading-systems.

[4] The Integrity Council for the Voluntary Carbon Market (ICVCM), "The Core Carbon Principles," n.d., https://icvcm.org/core-carbon-principles/; United States Department of the Treasury, "Voluntary Carbon Markets Joint Policy Statement and Principles," p. 6, May 2024, https://home.treasury.gov/system/files/136/VCM-Joint-Policy-Statement-and-Principles.pdf; Sylvera, "Permanence in Carbon Credits: Why it Matters, and How to Evaluate It," December 12, 2022, https://www.sylvera.com/blog/permanence-carbon-credits.

[5] Annalise Downey, "Additionality Explained," Sylvera, September 9, 2025, https://www.sylvera.com/blog/additionality-carbon-offsets; Integrity Council for the Voluntary Carbon Market, "CCP-Approved Methodologies," Accessed on April 6, 2026, https://icvcm.org/knowledge-resources/ccp-approved-methodologies/; Climate Impact Partners, "Afforestation," Accessed on April 6, 2026, https://www.climateimpact.com/news-insights/learn-about-carbon-projects/afforestation/; Hope Raymond, "Soil Carbon Credits: Opportunities and challenges ahead," S&P Global, February 23, 2026, https://www.spglobal.com/energy/en/news-research/blog/agriculture/022323-soil-carbon-credits-opportunities-and-challenges-ahead.

forests—and local economic development.[6] Credits generated from projects with such co-benefits often trade at a premium.[7]

The PCCM ecosystem encompasses multiple actors:[8]

- **Project developers** originate and implement mitigation projects and are responsible for managing and maintaining project upkeep throughout its duration.
- **Standard-setters** establish methodologies, eligibility rules, and procedural requirements for carbon credit generation, and because of this role, are sometimes viewed as overseers of credit quality.
- **Registries** are systems in which carbon credits are issued, serialized, transferred, retired, canceled, and tracked over their lifecycle. (Sometimes standard-setting and registry functions are performed by the same entity.)
- **Validation and verification bodies (VVBs)** are responsible for validating, auditing, and verifying project performance throughout its lifespan, and are typically accredited by the standard-setter.
- **Intermediaries** such as carbon credit ratings agencies, traders, brokerage firms, online platforms, custodians, insurers, project finance providers, and marketplaces facilitate transactions.
- **Governments and host countries** grant approvals and set rules for domestic use and international transfer.
- **Credit buyers** include corporations, investors, and sometimes sovereigns. Some use the credits as offsets and retire them, while others use them for trading purposes.

1.1 Carbon Credit Demand Drivers

The demand base for project-based carbon credits is broadening beyond voluntary corporate buyers to participants in compliance systems (in jurisdictions that allow it), international market mechanisms (particularly under Article 6 of the Paris Agreement), and specific sectors like aviation. The nature of these emerging demand drivers suggests that the market will consolidate around higher-integrity credits.

Voluntary carbon markets (VCMs) serve as the primary conduit for the issuance and trade of credits to companies seeking to meet voluntary climate targets, satisfy investor expectations, and comply with emerging disclosure requirements.[9] More than 10,000 companies have set or committed to emissions reduction targets validated by the Science-Based Targets initiative (SBTi), which in 2025 updated its guidance to allow high-quality credits for mitigating

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[6] Gold Standard, “Impact Registry,” Gold Standard Registries, n.d., https://www.goldstandard.org/impact-registry.
[7] Green.Earth, “Beyond Tonnes: How Carbon Credit Co-Benefits Elevate Value,” October 30, 2025, https://www.green.earth/blog/beyond-tonnes-how-carbon-credit-co-benefits-elevate-value.
[8] Carbon Knowledge Hub, “Participants and their role in carbon trading,” BloombergNEF, September 25, 2024, https://www.carbonknowledgehub.com/factsheets/participants.
[9] ICVCM, “The Voluntary Carbon Market Explained: Everything You Need to Know About a High-Integrity Voluntary Carbon Market and Why It is So Important,” n.d., https://icvcm.org/knowledge-resources/voluntary-carbon-market-explained/.

greenhouse gas emissions outside a company's scope 1, 2, and 3 emissions.[10] In parallel, emerging disclosure frameworks, including the International Sustainability Standards Board's ISSB IFRS S2 climate disclosure standard, are increasing transparency expectations around corporate climate strategies and the use of carbon credits.[11]

An additional source of demand is compliance markets, which are increasingly permitting the use of project-based carbon credits to meet regulatory mandates for emission reductions, albeit with quality filters, geographic restrictions, and usage caps. The largest compliance market, the EU ETS, currently does not allow use of carbon credits to meet regulatory requirements, though it recently signaled a potential reintroduction of the use of international carbon credits towards its 2040 climate target.[12] But many other compliance markets, such as those in California, China, Japan, and South Africa, already do. Currently, around 40 percent of implemented compliance mechanisms (ETSs and carbon taxes) allow for some use of project-based carbon credits to meet obligations.[13] World Bank data shows that of the total carbon credit retirements, the share of credits retired for regulatory compliance went from nine percent in 2023 to 24 percent in 2024,[14] indicating the increasing relevance of compliance markets as a source of demand.

International carbon markets could also raise demand in the coming years. Article 6.4 of the Paris Agreement establishes the Paris Agreement Crediting Mechanism (PACM), which allows for the trading of project-based carbon credits globally under the auspices of the United Nations. Carbon credits can also be transferred between countries as Internationally Transferred Mitigation Outcomes (ITMOs) under Article 6.2, if authorized, and are subject to "corresponding adjustments" to emissions inventories of the seller and buyer countries.[15] Once these mechanisms reach full operationalization, they are expected to generate additional demand, as they enable countries to achieve national emission reduction targets more cost-effectively.

Aviation and other hard-to-abate sectors are driving a portion of structural demand. One such mechanism is the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), which allows airlines to use eligible credits from approved programs to meet

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[10] Sciened-Based Targets Initiative, "Target Dashboard," 2026, https://sciencebasedtargets.org/target-dashboard; Science-Based Targets Initiative, "Deep dive: The role of carbon credits in SBTi Corporate Net-Zero Standard V2," July 8, 2025, https://sciencebasedtargets.org/blog/deep-dive-the-role-of-carbon-credits-in-sbti-corporate-net-zero-standard-v2; Sciened-Based Targets Initiative, "Beyond Value Chain Mitigation," February 28, 2024, https://sciencebasedtargets.org/beyond-value-chain-mitigation.

[11] IFRS, "IFRS S2 Climate-related Disclosures," 2025, https://www.ifrs.org/issued-standards/ifrs-sustainability-standards-navigator/ifrs-s2-climate-related-disclosures/.

[12] Nasim Pour, Sebastien Cross, and Joel Gould, "Why the EU's 2040 Climate Target Could Reshape Global Carbon Markets," World Economic Forum, July 28, 2025, https://www.weforum.org/stories/2025/07/eu-return-to-international-carbon-credits/.

[13] World Bank, "State and Trends of Carbon Pricing 2025," 51, June 10, 2025, DOI: 10.1596/978-1-4648-2255-1, https://www.worldbank.org/en/publication/state-and-trends-of-carbon-pricing.

[14] Ibid, 8.

[15] United Nations Climate Change, "Article 6 Paris Agreement," Process and meetings, n.d., https://unfccc.int/process-and-meetings/the-paris-agreement/article6.

offsetting requirements.[16] Under CORSIA, airlines must offset emissions above 85 percent of 2019 levels.[17] Under these guidelines, estimated credit demand in 2024 reached 58 million credits and is projected to rise to 160–260 million by 2035.[18] Additionally, CORSIA-approved credits (e.g., Guyana forestry projects) trade at over US$20 per ton, higher than the typical range of $5–$15 per ton for nature-based credits, indicating that aviation can generate a sustained compliance-driven demand while supporting a durable price premium for high-integrity credits.[19]

1.2 Demand Shifting to High-Integrity Credits

PCCMs are undergoing a quality-driven transformation as they move away from oversupplied legacy credits to a smaller pool of newer, higher-quality credits. Even as overall issuance, prices, and market value have fallen, retirements have remained relatively steady, and demand has become more selective, which suggests that the market's next phase will be shaped by credibility, quality, and stronger regulatory foundations.

Cumulative issuance of project-based carbon credits expanded from around 200 $MtCO_2e$ in 2018 to almost 2,500 $MtCO_2e$ in 2025 (see Figure 1).[20] However, issuance and trading activity have slowed dramatically in recent years due to increased credit integrity concerns, lack of regulatory clarity, and broader macroeconomic factors.[21] The annual issuance of credits dropped by 40 percent from the 2021 peak of 500 $MtCO_2e$ to 320 $MtCO_2e$ in 2024 (see Figure 2). A sharp drop in prices has accompanied the slowdown in issuance volume—the market value of issued credits declined nearly 30 percent from 2023 to 2024, falling to US$535 million.[22] Despite

[16] International Civil Aviation Organization (ICAO), "CORSIA Eligible Emissions Units," 2025, https://www.icao.int/CORSIA/corsia-eligible-emissions-units.
[17] International Civil Aviation Organization (ICAO), "Resolution A40-19: Consolidated Statement of Continuing ICAO Policies and Practices Related to Environmental Protection – CORSIA," Montreal: ICAO, 2019, https://www.icao.int/sites/default/files/left-menu-pdfs/Resolution_A41-22_CORSIA.pdf.
[18] Juan Carlos Arredondo Brun, "CORSIA: Airlines Need to Offset 58 $MtCO_2$," Abatable, November 7, 2025, https://abatable.com/blog/corsia-airlines-need-to-offset-58-mtco2/; Josh Cowley, "Demand Tailwinds Meet Supply Headwinds: Forecasting CORSIA's Impact on Carbon Credit Markets," Fastmarkets, September 19, 2025, https://www.fastmarkets.com/insights/demand-tailwinds-meet-supply-headwinds-forecasting-corsias-impact-on-carbon-credit-markets/.
[19] Quantum Commodity Intelligence, "Guyana Made $33 M from Carbon Sales in 1st Nine Months of 2025," Quantum Carbon, January 29, 2026, https://www.qcintel.com/carbon/article/guyana-made-33m-from-carbon-sales-in-1st-nine-months-of-2025-57667.html.
[20] World Bank, "State and Trends of Carbon Pricing Dashboard," June 2025, https://carbonpricingdashboard.worldbank.org/credits/issuance
[21] Ecosystem Marketplace, "2024 State of the Voluntary Carbon Market (SOVCM)," Forest Trends, May 30, 2024, https://www.forest-trends.org/publications/state-of-the-voluntary-carbon-market-2024/; Sanna O'Connor-Morberg & Bodie Cabiyo, "Key trends in the 2026 voluntary carbon market," Carbon Direct, February 20, 2026, https://www.carbon-direct.com/insights/key-trends-2026-voluntary-carbon-market.
[22] Ecosystem Marketplace, "2025 State of the Voluntary Carbon Market (SOVCM)," p. 6, May 29, 2025, https://www.ecosystemmarketplace.com/publications/2025-state-of-the-voluntary-carbon-market-sovcm/

the drop in issuance, supply continued to exceed retirement volumes, contributing to a growing surplus of unretired credits.[23]

FIGURE 1 HERE

FIGURE 2 HERE

Even as annual issuance and market value of carbon credits have slumped, compliance carbon markets continue to expand at a rapid pace. As of June 2025, ETSs and carbon taxes cover 28 percent of emissions globally, and 80 jurisdictions price carbon.[24] The most advanced is the EU ETS, which covers around 40 percent of the region's greenhouse gas emissions.[25] The total trading volume of global compliance carbon markets reached close to US$1 trillion in 2023, with the EU ETS representing almost 90 percent of it.[26] Total global ETS and carbon taxes revenue for the same year was over $100 billion.[27]

While the contrast between the growth of compliance carbon markets and PCCMs may appear concerning for the latter, there are positive indications of demand when stronger integrity standards, transparency, and regulatory safeguards are in place. First, even as annual issuance of credits has slowed, credit retirements have remained steady at around 180 $MtCO_2e$ per year since 2021.[28] Second, demand patterns are shifting, with buyers becoming increasingly selective toward high-quality credits amid a growing stock of low-quality, legacy supply.

Changing demand patterns can be discerned in the data. The price realized for removal credits, on average, was almost five times more than that for reduction credits in 2024 (see Figure 3); it was three and a half times more on average in 2023. Buyers are also concentrating their purchases in newer vintages, which traded at around three times the price of legacy credits in 2024, compared to a 50 percent premium in 2023,[29] as newer vintages are seen as more credible. Older vintage credits face declining demand, with nearly 160 million non-retired

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[23] World Bank, "State and Trends of Carbon Pricing 2025," 8, June 10, 2025. DOI: 10.1596/978-1-4648-2255-1, 2025, https://www.worldbank.org/en/publication/state-and-trends-of-carbon-pricing.
[24] World Bank, "State and Trends of Carbon Pricing 2025," 9, Washington, DC: World Bank. DOI: 10.1596/978-1-4648-2255-1, https://www.worldbank.org/en/publication/state-and-trends-of-carbon-pricing.
[25] ICAP, "EU Emissions Trading System (EU ETS)," n.d., https://icapcarbonaction.com/system/files/ets_pdfs/icap-etsmap-factsheet-43.pdf.
[26] Susanna Twidale, "Global Carbon Markets Value Hit Record $949 Bln Last Year," Reuters, February 12, 2024, https://www.reuters.com/markets/commodities/global-carbon-markets-value-hit-record-949-bln-last-year-lseg-2024-02-12/.
[27] World Bank, "State and Trends of Carbon Pricing 2025," 40, June 10, 2025. DOI: 10.1596/978-1-4648-2255-1, https://www.worldbank.org/en/publication/state-and-trends-of-carbon-pricing.
[28] Ecosystem Marketplace, "2025 State of the Voluntary Carbon Market (SOVCM)," May 29, 2025, https://www.ecosystemmarketplace.com/publications/2025-state-of-the-voluntary-carbon-market-sovcm/.
[29] Ecosystem Marketplace, "2025 State of the Voluntary Carbon Market (SOVCM)," May 29, 2025, https://www.ecosystemmarketplace.com/publications/2025-state-of-the-voluntary-carbon-market-sovcm/; Phoenix Strategy Group, "Carbon Credit Vintage: Study on Valuation Impact," November 3, 2025, https://www.phoenixstrategy.group/blog/carbon-credit-vintage-valuation-impact.

pre-2016 credits seeing waning interest,[30] a pattern reflected in the pool of nearly one billion unretired credits, of which approximately two-thirds were issued before 2022.[31]

FIGURE 3 HERE

Source: Ecosystem Marketplace.[32]

Global retirement data thus reveal that:

- There is a preference for credits issued within two to five years of retirement, driven by regulatory restrictions, compliance eligibility rules, and market perceptions that post-2016 credits align better with Paris Agreement accounting frameworks.[33] For example, Phase 1 eligibility criteria under CORSIA prioritize credits generated from emission reductions occurring after 2021.[34]
- Integrity concerns—including questions around additionality, baseline setting, permanence, double counting, transparency, and lack of standardization—have undermined market confidence and momentum, contributing to the demand shift.
- Fragmented rules governing eligibility, accounting treatment, and cross-border integration remain obstacles to the broader scalability and interoperability of project-based credits across jurisdictions.

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[30] Phoenix Strategy Group, “Carbon Credit Vintage: Study on Valuation Impact,” November 3, 2025, https://www.phoenixstrategy.group/blog/carbon-credit-vintage-valuation-impact.
[31] World Bank, “State and Trends of Carbon Pricing 2025,” 46-49, June 10, 2025. DOI: 10.1596/978-1-4648-2255-1, https://www.worldbank.org/en/publication/state-and-trends-of-carbon-pricing.
[32] Ecosystem Marketplace, "State of the Voluntary Carbon Markets 2020: Voluntary Carbon and the Post-Pandemic Recovery," Forest Trends, September 21, 2020, https://www.forest-trends.org/publications/state-of-voluntary-carbon-markets-2020-voluntary-carbon-and-the-post-pandemic-recovery/; Ecosystem Marketplace, "State of the Voluntary Carbon Markets 2021," Forest Trends, September 15, 2021, https://www.forest-trends.rg/publications/state-of-the-voluntary-carbon-markets-2021/; Ecosystem Marketplace, "State of the Voluntary Carbon Markets 2022 (Q3 Art of Integrity Report)," Forest Trends, 2022, https://www.ecosystemmarketplace.com/publications/state-of-the-voluntary-carbon-markets-2022/; Ecosystem Marketplace, "State of the Voluntary Carbon Markets Report 2023," Forest Trends, November 28, 2023, https://www.ecosystemmarketplace.com/publications/state-of-the-voluntary-carbon-market-report-2023/; Ecosystem Marketplace, "2024 State of the Voluntary Carbon Market (SOVCM)," Forest Trends, May 30, 2024, https://www.forest-trends.org/publications/state-of-the-voluntary-carbon-market-2024/; Ecosystem Marketplace, "2025 State of the Voluntary Carbon Market (SOVCM)," Forest Trends, May 28, 2025, https://www.ecosystemmarketplace.com/publications/2025-state-of-the-voluntary-carbon-market-sovcm/.
[33] Sherry Hu, “Global carbon market trends 2025: Diverging paths, shared ambitions,” Reccessary, January 27, 2025, https://www.reccessary.com/en/insight/global-carbon-market-highlights-2025; Shanshan He, “More than just the year on the label: Understanding the Value of Carbon Credit Vintages,” Ceezer (CZR), April 1, 2025, https://www.ceezer.earth/insights/beyond-the-year-on-the-label-understanding-the-value-of-carbon-credit-vintages.
[34] ICAO, “CORSIA Eligible Emissions Units,” ICAO CORSIA Implementation Element, Annex 16, Volume IV, October 2025, https://www.icao.int/sites/default/files/environmental-protection/CORSIA/Documents/CORSIA-Eligible-Emissions-Units_Oct2025.pdf.

In response to evolving integrity expectations, the launch of voluntary initiatives like the Integrity Council for the Voluntary Carbon Market (ICVCM) and the Voluntary Carbon Market Integrity Initiative (VCMI) provides an anchor for the market. Suppliers are slowly shifting new project activities to align with ICVCM's Core Carbon Principles (CCP), which establishes a global benchmark for what comprises credit quality.[35] Similarly, VCMI's Claims Code of Practice offers guidance for corporate use of credits, focusing on the integrity and transparency of claims.[36]

The 2025 G20 Sustainable Finance Working Group Report, under the South African Presidency, also advanced the agenda of improving the integrity and interoperability, accessibility, transparency, and scalability of carbon credit markets by articulating voluntary guiding principles for carbon credit data models.[37] The proposal was based on the Common Carbon Credit Data Model developed by the Climate Data Steering Committee, which aims to reduce market fragmentation and strengthen traceability across the credit lifecycle.

While the development of rigorous standards and data models is a step forward, they remain largely non-binding and voluntary in nature.

2 Constraints to Scaling Project-Based Carbon Credit Markets

Despite technical advances and growing demand drivers, PCCMs face structural constraints that limit confidence, participation, and scalability. These constraints span integrity concerns, market fragmentation, and gaps in accountability and enforcement.

2.1 Integrity and Credibility Challenges

Heightened scrutiny of methodologies for determining the integrity of carbon credit and climate claims is making buyers more cognizant of reputational risks. In turn, they are attempting to distinguish credits that are considered credible from those that are not.

PCCMs experienced periods of rapid growth in the mid-2000s following the establishment of the Kyoto Protocol's clean development mechanism (CDM)—a means of allowing advanced economies to meet their climate targets more cost-effectively by funding emission-reduction projects in emerging and developing countries. A second phase of VCM expansion happened between 2017 and 2021, with widespread corporate net-zero commitments following the Paris Agreement. Credit issuance increased across numerous project categories, including renewable energy, forestry, and household devices. During this period, the primary focus was on scaling the supply of mitigation credits and mobilizing private capital toward emissions reduction and removal activities.

In recent years, however, greater scrutiny has emerged regarding credit quality and market integrity, which are undermining market confidence and deterring some participation despite

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[35] The Integrity Council for the Voluntary Carbon Market (ICVCM), "The Core Carbon Principles," n.d., https://icvcm.org/core-carbon-principles/.
[36] Voluntary Carbon Markets Integrity Initiative (VCMI), "Claims Code of Practice," n.d., https://vcmintegrity.org/vcmi-claims-code-of-practice/.
[37] G20 Sustainable Finance Working Group, "2025 G20 Presidency and SFWG Co-chairs Sustainable Finance Report," 44-46, G20 South Africa 2025, October 2025, https://g20sfwg.org/wp-content/uploads/2025/10/2025-G20-SFWG-Presidency-and-Co-chairs-Sustainable Finance-report-1.pdf

technical advances.[38] Concerns have centered on methodological robustness, including issues related to additionality, baseline setting, permanence, leakage, transparency, and risks of double counting under the evolving Paris Agreement Article 6 framework.[39]

Although substantial progress has been made in strengthening governance and methodological standards—including the development of supply-side integrity frameworks by ICVCM and demand-side guidance by VCMI—confidence in certain project categories has been affected by high-profile investigations and academic assessments. For example, media reporting and independent research have raised questions about over-crediting in selected REDD+ and cookstove methodologies, contributing to broader debates about methodological rigor and environmental integrity.[40]

In parallel, corporate use of carbon credits has faced increased scrutiny in some jurisdictions from regulators, investors, civil society, and courts. Legal proceedings and public reporting regarding climate-related claims have heightened attention on the conditions under which credits can credibly support net-zero or carbon-neutrality claims.[41]

Market activity has since reflected a degree of recalibration in buyer behavior. Buyers, particularly those with formal sustainability commitments, have demonstrated increased selectivity with respect to project types, vintages, and certification status. Heightened attention to reputational risk, accounting treatment, and regulatory developments coincided with lower voluntary retirement volumes in 2023 relative to preceding years.[42]

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[38] Jonathan Shopley, “Evolution to Revolution: A Journey Through the Voluntary Carbon Market,” Climate Impact Partners, December 12, 2023, https://www.climateimpact.com/news-insights/insights/evolution-to-revolution-a-journey-through-the-voluntary-carbon-market.

[39] The Integrity Council for the Voluntary Carbon Market (ICVCM), “The Core Carbon Principles,” n.d., https://icvcm.org/core-carbon-principles/; Voluntary Carbon Markets Integrity Initiative (VCMI), “Claims Code of Practice”, n.d., https://vcmintegrity.org/vcmi-claims-code-of-practice/.

[40] Patrick Greenfield, “Revealed: More Than 90% of Rainforest Carbon Offsets by Biggest Certifier are Worthless, Analysis Shows,” The Guardian, Wednesday, January 18, 2023, https://www.theguardian.com/environment/2023/jan/18/revealed-forest-carbon-offsets-biggest-provider-worthless-verra-aoe; Heidi Blake, “The Great Cash-for-Carbon Hustle,” New Yorker, October 6, 2023, https://www.newyorker.com/magazine/2023/10/23/the-great-cash-for-carbon-hustle; Public Affairs, “As Carbon Offsets, Cookstove Emission Credits Are Greatly Overestimated,” Berkeley News, January 23, 2024, https://news.berkeley.edu/2024/01/23/as-carbon-offsets-cookstove-emission-credits-are-greatly-overestimated/; Matteo Civillini, “Zimbabwe Forest Carbon Megaproject Generated Millions of Junk Credits,” Climate Change News, September 30, 2025, https://www.climatechangenews.com/2025/09/30/zimbabwe-forest-carbon-megaproject-generated-millions-of-junk-credits/.

[41] Patrick Greenfield, “Delta Air Lines Faces Lawsuit Over $1bn Carbon Neutrality Claim,” The Guardian, May 30, 2023, https://www.theguardian.com/environment/2023/may/30/delta-air-lines-lawsuit-carbon-neutrality-aoe; Natasha White and Akshat Rathi, “Carbon Market Faces Upheaval as 32% of All Credits Fail Test,” Bloomberg, Green ESG & Investing, https://www.bloomberg.com/news/articles/2024-08-06/a-third-of-all-carbon-credits-fail-to-get-key-stamp-of-approval.

[42] World Bank, “State and Trends of Carbon Pricing 2025,” 46-49, Washington, DC: World Bank. DOI: 10.1596/978-1-4648-2255-1, 2025,

Companies are also revising their carbon market strategies due to evolving standards and scrutiny along with political pushback on climate policies, which has led some to backtrack on carbon-neutral claims.[43] This is particularly important because, outside of voluntary net-zero pledges, there are limited policy incentives for companies to purchase credits.

Reflecting a new, early stage of implementation of stringent integrity standards, ICVCM has approved a few methodologies. It stated, for example, that the CCP label could not be used for existing renewable energy projects, which represented almost a third of the market at the time of the announcement.[44]

2.2 Market Fragmentation and Transparency Deficits

Differences in registry designs, eligibility rules, accounting approaches, and disclosure practices across jurisdictions raise transaction costs, limit fungibility, and complicate cross-border transfers, underscoring the need for stronger coordination and harmonization.

Project-based carbon credit markets operate across a heterogeneous landscape of registries, standards, and verification bodies. Independent crediting mechanisms, domestic compliance systems, and the emerging Article 6 framework maintain distinct governance structures, methodologies, and registry infrastructures. Limited interoperability between registry systems increases administrative complexity for project developers, intermediaries, and buyers, and may affect liquidity, price discovery, and transaction costs.

Different jurisdictional approaches to carbon credit eligibility and accounting further contribute to market fragmentation. Compliance markets differ in their acceptance of credits based on the crediting mechanism, permitted vintages, and project types. Under Article 6 of the Paris Agreement, corresponding adjustment requirements and authorization processes introduce additional layers of complexity for countries to reconcile. These variations may shape supply and demand conditions and constrain fungibility across markets.[45]

Transparency practices for project-level and market data are also uneven across jurisdictions. While some registries provide open access to project documentation, monitoring reports, and

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https://www.worldbank.org/en/publication/state-and-trends-of-carbon-pricing; Patrick Greenfield, “Delta Air Lines Faces Lawsuit Over $1bn Carbon Neutrality Claim,” The Guardian, May 30, 2023, https://www.theguardian.com/environment/2023/may/30/delta-air-lines-lawsuit-carbon-neutrality-aoe.

[43] Seneca ESG, “JetBlue to Turn from Carbon Offsets to Sustainable Aviation Fuels,” December 15, 2022, https://senecaesg.com/insights/jetblue-to-turn-from-carbon-offsets-to-sustainable-aviation-fuels/; Nina Lakhani, “’Worthless’: Chevron’s Carbon Offsets are Mostly Junk and Some May Harm, Research Says,” the Guardian, May 24, 2023, https://www.theguardian.com/environment/2023/may/24/chevron-carbon-offset-climate-crisis; Quantum Commodity Intelligence, “BP Steps Back Further from Carbon Market: Sources,” June 16, 2025, https://www.qcintel.com/carbon/article/bp-steps-back-further-from-carbon-market-sources-42959.html.

[44] World Bank, “State and Trends of Carbon Pricing 2025,” 59, June 10, 2025. DOI: 10.1596/978-1-4648-2255-1, https://www.worldbank.org/en/publication/state-and-trends-of-carbon-pricing; Natasha White and Akshat Rathi, “Carbon Market Faces Upheaval as 32% of All Credits Fail Test,” Bloomberg, Green ESG & Investing, August 6, 2024, https://www.bloomberg.com/news/articles/2024-08-06/a-third-of-all-carbon-credits-fail-to-get-key-stamp-of-approval.

[45] United Nations Climate Change, “Article 6 Paris Agreement,” Process and meetings, n.d., https://unfccc.int/process-and-meetings/the-paris-agreement/article6.

issuance data, disclosure practices are not uniform. Information related to transaction volumes, pricing, contractual terms, and retirement motivations is often incomplete, missing, or reported with a significant lag. The lack of transparency can complicate price assessment and formation, risk evaluation, and due diligence for market participants. Absence of digitization can also slow down the process of issuing credits.

Efforts to improve coordination across markets and jurisdictions are under development. International initiatives, including the implementation of Article 6 reporting requirements and the efforts to link registry systems, aim to improve tracking of credit use and reduce the risk of double counting. However, differences in registry design, data architecture, and recognition rules continue to require further harmonization to support scalable and transparent cross-border credit transfers.

2.3 Accountability and Enforcement Gaps

Governance and accountability gaps exist because standards and oversight systems remain voluntary, privately administered, and unevenly required across jurisdictions. Differences in VVB oversight, liability frameworks, corrective mechanisms, and regulatory treatment increase uncertainty for buyers, project developers, and long-term investors, reinforcing the need for clearer and more consistent rules across the market.

Many carbon credit standards operate primarily on a voluntary basis and are governed through private contractual arrangements rather than statutory regulatory frameworks. While standards establish rules for methodology approval, validation, monitoring, and verification, enforcement mechanisms may be limited, if any, and those that exist often rely on registry controls, contractual remedies, and market incentives. This has led to variation in how rules are interpreted or applied across participants and jurisdictions.[46]

Oversight of VVBs varies similarly, with accreditation procedures, supervisory practices, and accountability mechanisms differing by jurisdiction and standard. This can create inconsistent—or in some cases perverse—incentives across verifiers. For example, where VVBs are accredited by standard-setters but hired and paid by project developers, there may be a risk of conflicts of interest that lead to overly lenient validation or verification outcomes.[47] These differences in oversight can result in uneven application of methodological requirements and, in turn, undermine the credibility of the market.[48]

Buyers and investors face other challenges as well. Where credits are questioned, invalidated, or determined to have underperformed, legal pathways for recourse are either undefined or

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[46] Silvia Favasuli, Charlotte Radford, Jamila Phillips, and Crown Ashiwaju, “Voluntary Carbon Markets: How They Work, How They’re Priced, and Who’s Involved,” S&P Global, December 3, 2025, https://www.spglobal.com/energy/en/news-research/blog/energy-transition/120325-how-does-the-voluntary-carbon-market-work.

[47] Vittoria Battocletti, Luca Enriques, and Alessandro Romano, “The Voluntary Carbon Market: Market Failures and Policy Implications,” University of Colorado Law Review, Vol. 95 (3), Summer 2024, https://scholar.law.colorado.edu/cgi/viewcontent.cgi?article=1615&context=lawreview.

[48] Carbon Markets Infrastructure Working Group, “Ecosystem Governance for Carbon Markets Infrastructure: Assessment and Recommendations,” Technical Guidance Note, June 7, 2025, https://openknowledge.worldbank.org/server/api/core/bitstreams/d4fc9b83-21c3-4650-8fed-841ff988196e/content.

inconsistent across standards and markets.[49] Approaches to buffer mechanisms, reversals, and credit cancellation also differ across registries, contributing to further variation in how liability and corrective action are managed.[50]

Beyond market-level governance, divergent policy approaches across jurisdictions add another layer of uncertainty. Variations in regulatory treatment—for example, eligibility rules for compliance systems, recognition of project-based credits, and approaches to Article 6 authorization—coupled with evolving policy signals on corporate claims and disclosure obligations, increase perceived regulatory and market risk, particularly for project developers and long-term investors whose crediting horizons extend over multiple decades.[51]

3 Regulatory Frameworks Respond to Market Challenges

3.1 Voluntary Standards Represent Progress, But Are Non-Binding

The voluntary carbon market has made meaningful strides in self-governance over the past several years, helping to raise expectations for integrity in PCCMs, but the non-binding nature of the standards continues to limit the impact. While frameworks such as the ICVCM's CCPs and VCMI's Claims Code are beginning to shape supply- and demand-side behavior, most credits in circulation still fall outside these benchmarks, and persistent gaps in enforceability, market oversight, and transparency continue to constrain broader market confidence and growth.

On the supply side, ICVCM has developed its CCPs, which are 10 science-based criteria covering governance, emissions impact, and sustainable development, to establish a standardized quality floor for what constitutes a credible carbon credit. The ICVCM has approved eight carbon-crediting programs as CCP-eligible so far: American Carbon Registry, Architecture for REDD+ Transactions—The REDD+ Environmental Excellence Standard (ART TREES), Climate Action Reserve, Gold Standard, Verra, Isometric, Puro.earth, and Equitable Earth.[52] As of February 2026, ICVCM has approved 38 methodologies under CCP, with approximately 105 million credits approved to use the CCP label, of which 52 million are available in the market and 53 million have been retired or canceled.[53] Importantly, CCP-labelled credits command an average 25 percent price premium over non-labeled alternatives.[54]

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[49] Marc Roston, "The Carbon Market Can't Trade: Designing Contracts and Institutions for Carbon Removal Assets," Oxford Open Climate Change, February 27, 2026, 6 (1), https://academic.oup.com/oocc/advance-article-pdf/doi/10.1093/oxfclm/kgag003/67158260/kgag003.pdf.
[50] Anna MacDonald, "The Complete Guide to Carbon Credit Buffer Pools," Sylvera, September 20, 2025, https://www.sylvera.com/blog/carbon-credit-buffer-pools.
[51] Abatable, "Developing the Voluntary Carbon Market in Uncertain Policy Landscapes: A Practical Guide to Political and Policy Risks," February 2023, https://abatable.com/reports/voluntary-carbon-market-policy-report/.
[52] Integrity Council for the Voluntary Carbon Market, "Integrity Council Confirms Carbon Crediting Program Puro.earth as CCP-Eligible," December 11, 2025, https://icvcm.org/integrity-council-confirms-carbon-crediting-program-puro-earth-as-ccp-eligible/.
[53] CarbonCredits.com, "ICVCM Adds New CCP-Approved Carbon Credit Methods for Isometric, Gold Standard, and ACR," August 21, 2025, https://carboncredits.com/icvcm-adds-new-ccp-approved-carbon-credit-methods-for-isometric-gold-standard-and-acr/.
[54] Integrity Council for the Voluntary Carbon Market, "Impact Report 2025," December 2025, https://icvcm.org/wp-content/uploads/2025/12/IC-Impact-Report-2025-V7.1-16Dec25.pdf.

On the demand side, VCMI has developed its Claims Code of Practice, which complements the ICVCM's supply-side CCPs by defining what constitutes credible corporate use of carbon credits. Companies must first meet VCMI's four foundational criteria—measurement (maintain and disclose GHG inventory), targets (net-zero commitment and near-term science-based emission reduction targets), progress tracking (demonstrate on-track to meet targets), and policy alignment (public posture supports Paris Agreement goals)—before becoming eligible to make a VCMI carbon integrity claim. Once these prerequisites are met, companies may access the tiered silver, gold, and platinum carbon integrity claims, which recognize progressively higher levels of climate action when retiring high-quality carbon credits. VCMI defines high-quality carbon credits as those that satisfy the ICVCM CCPs and are validated through its assessment framework.[55]

On the market side—the infrastructure that supports pricing, trading, and reporting of credits between issuance and retirement—progress toward developing voluntary standards has been more limited. At COP29 in November 2024, the International Organization of Securities Commissions released a final report setting out 21 good practices for regulators and market participants, covering regulatory frameworks, primary and secondary market structures, and the use and disclosure of carbon credits to improve financial integrity and promote orderly, transparent trading in VCMs.[56] It stated that most carbon credits are traded bilaterally or over-the-counter (OTC), with little information publicly available on prices. In most jurisdictions, only the participants in regulated exchanges, where derivative contracts on carbon credits are traded, are subject to regulatory oversight. In contrast, spot trading in carbon credits remains outside the scope of financial regulation in most jurisdictions, leaving price formation and transaction reporting largely ungoverned. A significant step toward building the necessary infrastructure was the 2025 G20 SFWG report that proposed six voluntary principles to guide the design of common carbon credit data tools to promote transparency, accessibility, and interoperability for improving market integrity and scalability.[57]

Yet despite this progress, the fundamental limitations of voluntary frameworks persist across all three dimensions. While it's still early to judge the impact, only four percent of total carbon credit issuance in 2024 was CCP-approved—the vast majority of credits entering the market have not been assessed against leading quality thresholds.[58] Despite corporate credit retirement patterns indicating a steady shift toward higher-quality credits, most retirements are still mid- to lower-quality credits, as high-quality supply is limited. Sylvera's 2025 report states that the share of high-quality credits (BBB or above) in retirements grew in 2025, but still only to 31 percent from 25 percent in 2024; concurrently, high-rated credits experienced a market deficit for the

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[55] Voluntary Carbon Markets Integrity Initiative, "Frequently Asked Questions," accessed on February 22, 2026, https://vcmintegrity.org/frequently-asked-questions/.; Voluntary Carbon Markets Integrity Initiative, "VCMI Claims Code (2025 Update, v.1.8)," August 2025, https://vcmintegrity.org/wp-content/uploads/2025/08/VCMI-Claims-Code_2025Update_v.1.8-1.pdf.

[56] Ibid.

[57] G20 Sustainable Finance Working Group, "2025 G20 Presidency and SFWG Co-chairs Sustainable Finance Report," pp. 44, 46, G20 South Africa 2025, October 2025, https://g20sfwg.org/wp-content/uploads/2025/10/2025-G20-SFWG-Presidency-and-Co-chairs-Sustainable Finance-report-1.pdf

[58] Integrity Council for the Voluntary Carbon Market, "Impact Report 2025," December 2025, https://icvcm.org/wp-content/uploads/2025/12/IC-Impact-Report-2025-V7.1-16Dec25.pdf.

third year in a row.[59] BeZero Carbon finds a similar trend: the share of retired credits rated A or higher has risen from 17 percent in 2022 to 30 percent in 2025, but 54 percent are still BB or lower (though their share has dropped from 67 percent in 2022).[60] MSCI data based on the first half of 2025 reinforce this pattern, showing that over 60 percent of retirements are still rated BB or lower and, at the same time, retirements of BBB-and-above credits exceeded new issuances for the first time, creating a deficit in high-integrity supply.[61]

One of the reasons lower-quality credits still dominate supply is that standards are non-binding by definition, as they are voluntary, across all three dimensions—supply, demand, and market-side. As such, there is no mechanism to compel crediting programs to seek CCP assessment, require buyers to meet VCMI thresholds, or mandate transparency in market trading. The result is a market where integrity is advancing, but structural gaps to ensure integrity on the supply, demand, and market sides limit its growth. This reflects a broader reality: without legal enforceability, voluntary frameworks can set expectations but cannot guarantee outcomes.

3.2 Lessons from Financial Markets' Evolution

Voluntary standards can help establish early market norms, but durable market growth ultimately depends on binding regulatory frameworks that reinforce those norms through legal enforceability, supervisory oversight, and clear market rules. As has been the case in securities, commodities, and derivatives markets, regulation is most effective when it builds on existing market practices rather than replacing them.

National regulatory frameworks for PCCMs can ensure environmental integrity, strengthen market trust, enhance liquidity through cross-border interoperability, and provide clear avenues for recourse in cases of fraud or non-compliance. Regulations can, for example, make quality thresholds mandatory, requiring additionality, permanence, and robust verification as prerequisites for market access, rather than leave it to a buyer's discretion. An increasing number of countries are either designing or have implemented compliance systems that allow for carbon credits,[62] underscoring a broader move toward binding regulatory frameworks for ensuring the integrity of credits used across both voluntary and compliance systems.[63]

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[59] Sylvera, "State of Carbon Credits 2025," January 16, 2026, https://www.sylvera.com/blog/sylvera-state-of-carbon-credits-2025-market-shifts-from-volume-to-value

[60] BeZero Carbon, "2025 The Global Carbon-Credit Market in Review," January 07, 2026, https://bezerocarbon.com/insights/2025-the-global-carbon-credit-market-in-review.

[61] Tristan Loffler and Anubhav Joshi, "2025 State of Integrity in the Global Carbon-Credit Market," MSCI Research and Insights, September 22, 2025, https://www.msci.com/research-and-insights/paper/2025-state-of-integrity-in-the-global-carbon-credit-market.

[62] OECD, "Effective Carbon Rates 2025: Recent Trends in Taxes on Energy Use and Carbon Pricing," OECD Publishing, October 16, 2025, https://doi.org/10.1787/a5a5d71f-en.

[63] Quantum Commodity Intelligence, "Malaysia Palm Sector Could Sell Offsets Against Carbon Tax," February 9, 2026, https://www.qcintel.com/carbon/article/malaysia-palm-sector-could-sell-offsets-against-carbon-tax-58341.html.; Quantum Commodity Intelligence, "Carbon Credits to Trade on Thai Stock Exchange," February 10, 2026, https://www.qcintel.com/carbon/article/carbon-credits-to-trade-on-thai-stock-exchange-58404.html; International Carbon Action Partnership (ICAP), "Philippines," accessed on March 9, 2026, https://icapcarbonaction.com/en/ets/philippines; Lin, Bo-yu, "Vietnam Eyes 30% Carbon Offset Cap to

The developmental challenges facing PCCMs, such as the need for consistent standards, robust verification, transparency, fungibility, and safeguards against market manipulation, are not unique. Comparable issues have shaped the evolution of commodities, securities, and derivatives markets over more than a century. Their evolution offers two critical lessons. First, enforcement powers are necessary to gain market trust. Second, functional market norms typically emerge through private experimentation that is followed by formal regulation that codifies and enforces the standards already established by early market practice, which then allows markets to scale.

As an example of the first lesson, the introduction of mandatory disclosure and civil enforcement powers in US securities markets under the Securities Exchange Act of 1934, following the 1929 market crash, contributed to a shift in market behavior and illustrates how binding rules and enforcement mechanisms address market integrity gaps that voluntary disclosure cannot.[64] The rigorous enforcement framework established by the Act is a deterrent against misconduct and fosters a transparent marketplace, which has supported greater confidence in US securities markets and underpinned their development into one of the most liquid capital markets globally.

As an example of the second lesson, organized trading practices, grading systems, and contract specifications in US commodity markets were defined by the Chicago Board of Trade, which played a central role in establishing standardized terms for forward contracts by the mid-19th century. Federal oversight came decades later, when Congress enacted the Grain Futures Act in 1922 and the Commodity Exchange Act in 1936. These statutes did not replace existing practices; instead, they formalized and expanded on exchange rules, introduced anti-manipulation safeguards, and added supervisory authority, establishing a regulatory framework atop pre-existing market infrastructure.[65] Similarly, in global derivatives markets, the International Swaps and Derivatives Association (ISDA)—established in 1985 as a private trade association—developed its first standard documentation in 1987 and introduced the ISDA Master Agreement in 1992. Although not a legal instrument, the Master Agreement has become the de facto contractual standard for OTC derivative markets worldwide.[66]

For PCCMs, this suggests that regulations are necessary and they will be most effective when they incorporate and strengthen emerging standards—such as ICVCM and VCMI—rather than

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Ease Corporate Burden," Reccessary, April 16, 2025, https://www.reccessary.com/en/news/vietnam-eyes-30-carbon-offset-cap-to-ease-corporate-burden; Verra, "Chile's Carbon Market Grows, Illustrates Potential of Regulatory Frameworks," June 16, 2025, https://verra.org/chiles-carbon-market-grows-illustrates-potential-of-regulatory-frameworks/; Laurie Smith, "Colombia's Carbon Tax Faces New Tensions as Offsets Surge," ClearBlue Markets, September 25, 2025, https://www.clearbluemarkets.com/knowledge-base/colombias-carbon-tax-faces-new-tensions-as-offsets-surge l

[64] Oni Harton, "Securities and Exchange Act of 1934," Findlaw, May 06, 2024, https://www.findlaw.com/consumer/securities-law/securities-and-exchange-act-of-1934.html; Cornell Law School Legal Information Institute, "Securities Exchange Act of 1934," Wex, October 2023, https://www.law.cornell.edu/wex/securities_exchange_act_of_1934

[65] EBSCO, "US Congress Creates Commodity Futures Trading Commission," EBSCO Research Starters, https://www.ebsco.com/research-starters/law/us-congress-creates-commodity-futures-trading-commission .; Commodity Futures Trading Commission, "History of the CFTC," https://www.cftc.gov/About/HistoryoftheCFTC/index.htm.

[66] International Swaps and Derivatives Association, "Home Page," https://www.isda.org.

creating parallel systems that could fragment the market or conflict with existing practices. Of course, every market faces idiosyncratic issues. PCCMs do not perfectly parallel the other financial markets cited here, and their oversight must be adapted accordingly. For example, since third-party verification and validation are essential elements of project-based carbon credits, regulations must ensure the entities performing these functions are independent and free of any vested interests.

But regulations alone will not be sufficient to meet the challenges the market faces. Even if regulations are introduced across jurisdictions, significant differences between them may perpetuate market fragmentation and limit the ability to scale. Even when rules align well across borders, they may not provide buyers with confidence that reputational risks have been sufficiently mitigated. Similarly, if not designed properly, some of the methodological requirements in the regulations may not be necessary for integrity but could make projects uneconomical for developers and hinder the market's growth. There could also be some jurisdictions where the rules are not enforced, creating loopholes in the system. And given the heterogeneity of carbon credit project types, it may be near-impossible to have standardized contracts, proper price discovery, and clearing and settlement mechanisms that institutional capital requires—unlike more homogeneous commodity markets.

Aside from the regulatory system, other structural barriers may exist. For example, corporate net-zero commitments may weaken for political reasons or may not translate into credit purchases even when pledges are sincere, thus keeping demand fragile, which is not something that a regulatory framework can rectify. More fundamentally, absent a domestic compliance obligation or other policy interventions, such as regulated offset allowances, procurement mandates, tax credits, or results-based climate finance, companies face limits on what they are willing to buy on reputational or voluntary commitment grounds alone.

Well-designed regulatory frameworks that strike the right balance for project developers, buyers, and other stakeholders are therefore necessary but not solely sufficient for creating a credible, scalable project-based carbon credit market.

4 Mapping Regulatory Approaches Across G20 Countries and Singapore

4.1 Research Approach and Analytical Framework

The authors performed a detailed analysis of current PCCM regulatory approaches of G20 countries (except the US) and Singapore to assess the state of governmental oversight within supply-side, demand-side, and market-side buckets.

The result—the stocktake provided in the appendix—can be used to identify gaps within a jurisdiction's regulations as well as to compare jurisdictions' efforts to identify areas where approaches align and enable interoperability and where they differ in ways that could fragment the market. The findings could also be used to assess how well each country's regulations are aligned with international frameworks, particularly progress toward integrating domestic credit markets with the Paris Agreement's Article 6—both 6.2 and 6.4—and their intersection with stakeholder-led initiatives like ICVCM and VCMI.

To facilitate the analysis, the regulations were divided into three broad categories: supply-side regulations to oversee credit generation, demand-side regulations to govern credit use, and market-side rules to administer credit trading infrastructure.

Supply-side regulations cover the following parameters:

- **Credit integrity standards:** These are requirements that credits meet pre-defined criteria upon issuance, including standards for additionality, permanence, quantification accuracy, and avoidance of double counting.
- **Monitoring and verification regimes:** These cover rules governing MMRV (monitoring, measurement, reporting, and verification) providers, third-party auditors, and verification processes to ensure credits deliver claimed emissions reductions.
- **Registry and issuance oversight:** These include regulatory frameworks for carbon credit registries, standard-setters, and the processes by which credits are issued, tracked, and retired.
- **Sanctions:** These cover penalties and enforcement actions for non-compliance with the regulations.

Under demand-side regulations, the following characteristics are examined:

- **Voluntary use framework:** This can be guidance or requirements for corporations and other buyers for what constitutes acceptable credit use to meet voluntary climate commitments, carbon neutrality claims, corporate sustainability reporting, and accounting treatment of credits by buyers.
- **Compliance market integration:** These are rules governing contexts in which credits can be used to meet regulatory obligations under emissions trading systems, carbon taxes, CORSIA requirements, or carbon border adjustment mechanisms.
- **Eligibility and quality criteria:** These specify standards for which types of credits are eligible for various uses, whether there is a mitigation hierarchy, and what the verification or auditing process is.
- **Sanctions:** These cover enforcement actions against greenwashing or misleading climate claims by the buyers of carbon credits.

Finally, market oversight regulations cover the following parameters:

- **Transparency requirements:** These mandate disclosure of transaction volumes, prices, project-level data, and verification documentation to enable informed market participation.
- **Legal classification:** The legal status of a carbon credit shapes its ownership, transferability, taxation, and oversight, with key implications for interoperability.
- **Market infrastructure regulation:** These provide oversight of intermediaries, including exchanges, trading platforms, custodians, and other entities that facilitate credit transactions.
- **Cross-border trading:** These define the rules of engagement with other carbon markets, including those falling under Article 6.

4.2 Regulatory State of G20 Countries and Singapore

The analysis found that while PCCM regulatory frameworks have broadly advanced in recent years, wide disparities remain across G20 countries and Singapore. As such, countries in more advanced stages of implementing detailed regulations could serve as models for those in earlier stages.

Figure 4 provides a summary of the state of regulations in the form of a color shading scheme—with the darkness of the shade reflecting greater maturity of the regulation—complemented with design overlays to capture further details. The table is meant to provide a snapshot of regulatory status across these countries rather than explain every nuance, which can instead be found in the appendix.

FIGURE 4 HERE

The snapshot reveals that regulatory approaches to PCCMs are developing at different speeds across jurisdictions, with Australia, China, Japan, South Korea, and Singapore in more advanced stages than others in developing supply-side, demand-side, and market infrastructure regulations for both compliance markets that allow credits and voluntary carbon markets. Overall, early regulatory efforts have concentrated on the supply side, where jurisdictions show the clearest progress in governance and some convergence around core integrity criteria. By contrast, demand-side rules remain more fragmented and largely guidance-based. On the market side, only a few countries demonstrate well-developed trading architectures. These and other themes emerging from the analysis are discussed in more detail in the next section.

5 Cross-Cutting Themes and Insights from the Regulatory Stocktake

Stakeholder engagements by CGEP in the form of private convenings with many of the relevant parties in the PCCM ecosystem over the past year have underscored broad agreement that regulations governing the full carbon-credit lifecycle are necessary for the market to scale up.[67] Stable institutional arrangements and durable policy commitments were viewed as essential to sustaining market confidence and enabling long-term investment in carbon mitigation projects, as companies seek an environment in which the purchase and retirement of carbon credits does not expose them to reputational, legal, or compliance risks.[68]

Inconsistencies in regulatory development across various categories for the 20 jurisdictions examined limit price transparency, increase reputational risk for corporate buyers, and constrain the scaling of PCCMs, despite growing policy attention to integrity and market oversight.

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[67] Gautam Jain, Preetha Jenarthan, Luisa Palacios, Victoria Prado, and Shubham Deshmukh, "Regulatory Approaches for Project-Based Carbon Credit Markets: Roundtable Summary," Columbia University Center on Global Energy Policy, October 28, 2025, https://www.energypolicy.columbia.edu/publications/regulatory-approaches-for-projectbased-carbon-credit-markets-roundtable-summary/.

[68] Gautam Jain, Preetha Jenarthan, Luisa Palacios, Victoria Prado, and Shubham Deshmukh**, "**Regulatory Approaches for Project-Based Carbon Credit Markets: Roundtable Summary," Columbia Center on Global Energy Policy, October 28, 2025, https://www.energypolicy.columbia.edu/publications/regulatory-approaches-for-projectbased-carbon-credit-markets-roundtable-summary.

This section highlights the primary themes that emerged from the stocktake of countries'/region's PCCM frameworks, which can be found in the appendix along with detailed citations. Figure 5 provides a snapshot of how each country has progressed on these themes, followed by a summation analysis.

FIGURE 5 HERE

5.1 Increasing Acceptance in Compliance Markets

Key Takeaways:

- *Areas of convergence: Compliance markets are increasingly relevant as a demand source and a driver of improving credit integrity because of their growing acceptance of carbon credits with clear and binding rules on eligibility and accounting.*
- *Areas of divergence: Wide variation in limits and design features shows that governments still differ on the role credits should play in meeting regulated obligations. They also diverge on whether voluntary crediting frameworks should be integrated with compliance systems or governed separately.*
- *Implementation outlook: A shift toward more structured regulatory treatment of carbon credits through clearer rules on eligibility will improve the integrity of PCCMs. The unresolved question is the extent to which voluntary and compliance markets converge over time.*

A review of regulatory frameworks shows that countries with established compliance mechanisms in the universe analyzed are increasingly permitting the use of carbon credits by regulated entities to meet a portion of their obligations. In these systems, governments have issued binding regulations defining what types of credits are eligible, how they must be generated, and the conditions under which they may be used. Countries that fall within this group of the 20 studied are Australia, Canada, China, Singapore, South Africa, and South Korea.

However, the amounts of credits accepted vary considerably across jurisdictions:

High Limits

Under Australia's reformed Safeguard Mechanism, regulated facilities may use Australian carbon credit units or safeguard mechanism credits without quantitative limits to offset emissions above their baselines. While use is unlimited, facilities that rely on offsets for more than 30 percent of their baseline are required to explain why onsite emissions reductions were not undertaken.

In Canada's federal output-based pricing system, facilities exceeding their assigned emission limits may use both federal and approved provincial credits. Since 2022, regulations have required that at least 25 percent of compliance must be met through payment into the federal system, effectively capping carbon credit use at 75 percent of a facility's compliance obligation.

In Indonesia, the ETS is currently operational for the power sector and allows the use of eligible carbon credits without a binding quantitative limit. However, as Indonesia expands its ETS to additional sectors, credit-use rules are expected to become sector-specific based on regulations issued by relevant ministries, indicating that a quantitative limit could be set in the future.

Low Limits

China, Singapore, and South Korea allow entities to use only a limited share of carbon credits—capped at 5 percent each—toward meeting their compliance obligations.

South Africa permits facilities to use carbon credits for between 5 and 10 percent of their taxable emissions, depending on sector and activity, though this limit is expected to increase by an additional 5 percentage points pending parliamentary approval.

Prohibited

A notable exception to these trends is the compliance systems of the EU, France, and the UK, all of which currently prohibit the use of carbon credits to meet compliance obligations. The EU ETS previously accepted international credits under the Kyoto Protocol, but phased out its use in 2021. However, the EU is exploring limited use of high-quality international credits: a December 2025 political agreement on a 2040 climate target permits the use of such credits for up to 5 percent of the 1990 EU net emissions toward the required reduction goal.[69]

Another area where jurisdictions differ is whether VCM frameworks are being developed separately or in conjunction with the compliance markets:

Joint VCM and Compliance Frameworks

China, South Africa, and South Korea developed voluntary crediting frameworks to function alongside compliance mechanisms that interface through shared registries, methodologies, or eligibility criteria. In these cases, regulations are structured to ensure consistency with national mitigation accounting and to prevent double counting. As an example, South Africa's national consultation paper on developing the country's carbon credit market made several recommendations, including establishing a clearer link between compliance and voluntary markets and introducing exchange-control rules for voluntary carbon credits to facilitate investment, trading, and hedging while minimizing administrative burdens.

Singapore maintains binding rules for carbon credit use within its compliance regime, while voluntary corporate use of credits is addressed primarily through guidance rather than prescriptive regulation.

Mexico does not currently have formal regulations governing PCCMs, though the government has recognized that guidance on carbon credit use for the Mexican ETS should be issued once the ETS's operational regulations are finalized.

Independent VCM Framework

Jurisdictions that prohibit carbon credit use for compliance—such as the EU, France, and the UK—have separate VCM frameworks. These countries regulate essential aspects of voluntary markets through registry infrastructure, tracking systems, and broader legal frameworks governing corporate claims and sustainability disclosures.

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[69] European Council, "2040 Climate Target: Council and Parliament Agree on a 90% Emissions Reduction," Press Release, December 10, 2025, https://www.consilium.europa.eu/en/press/press-releases/2025/12/10/2040-climate-target-council-and-parliament-agree-on-a-90-emissions-reduction/.

In more nascent markets, such as Argentina's, carbon credit tracking mechanisms via a national registry have emerged, which record mitigation activities and support transparency in carbon reporting, even though project issuance and verification continue to rely heavily on international standards and public registries. Legislators were considering drafting a national voluntary carbon market law in November 2024, but a comprehensive domestic VCM regulatory framework has not yet been finalized.

Divergence in the carbon credit limits allowance and design frameworks within compliance systems suggests that, despite their growing acceptance by governments, there is no clear consensus on the role carbon credits should play in meeting regulated obligations.

5.2 Supply-Side Frameworks Have Advanced

Key Takeaways:

- *Areas of convergence: Supply-side oversight has advanced the furthest in PCCMs, with growing alignment on core credit features, including integrity criteria, eligible credit-generating activities, registry-level controls, verification requirements, and enforcement mechanisms.*
- *Areas of divergence: There is a wide variation in the comprehensiveness and specificity of the methodologies used for integrity criteria. Jurisdictions also diverge on the strictness of penalty regimes and whether verification is managed domestically through prescribed VVBs or delegated to approved international registries.*
- *Implementation outlook: How far countries move from broad principles to harmonization of rules will determine the level of integration of markets.*

A consistent trend across jurisdictions is a focus on ensuring the quality of carbon credits generated by projects by addressing core integrity criteria such as additionality, permanence, avoidance of double counting, robust quantification of emission reductions and removals, sustainable development safeguards, and alignment with net-zero objectives. However, the scope and level of detail vary across countries:

Additionality

Although additionality has been outlined differently across countries, common tests have emerged. The most widespread is a regulatory and statutory baseline test—requiring that projects go beyond existing legal requirements—incorporated in Australia, Canada, and Singapore.

Many jurisdictions also apply a financial or investment test, requiring demonstration that the project would not have proceeded without the carbon credit revenue; this is reflected in the frameworks of China, the EU, France, India, Italy, South Africa, South Korea, and Türkiye.

As Brazil's and Indonesia's frameworks continue to develop, they are likely to address additionality primarily through project-level methodologies rather than explicit overarching regulatory definitions.

Permanence

While many frameworks acknowledge the concept of permanence, few specify buffer pools, reversal-risk mechanisms, or a defined duration for what qualifies as permanent, instead deferring to project-level methodologies to set those parameters.

Australia is on the more prescriptive end: it defines permanence as a pre-defined duration based on the project type and requires a dedicated permanence plan as part of project registration.

France and Singapore take a less prescriptive approach, referencing permanence as a quality criterion for carbon credits without specifying parameters such as duration requirement, reversal-risk mechanisms, monitoring and mitigation obligations, likely relying on project-specific methodologies for details.

Mexico, despite currently lacking a formal regulatory framework for PCCMs, recognizes the need for permanence standards, articulating that carbon credits should have a duration comparable to the emissions they offset.

Indonesia, Russia, and Türkiye may implicitly rely on project methodologies to address permanence, as it is not referenced in their current overarching regulations.

Double Counting

Most jurisdictions attempt to address double counting by requiring that offset activities occur outside compliance obligations and that issuance, transfer, cancellation, and retirement are tracked exclusively within national registry systems. Registry controls are often the primary institutional mechanism to prevent duplication, as elaborated in a later section.

Verification

Most jurisdictions mandate some form of measurement and reporting, with third-party verification through approved VVBs, a common feature across both advanced markets, such as Japan, and developing countries, such as Brazil and India.

Singapore takes a different approach, relying on approved international registries to manage the verification process rather than prescribing VVB requirements.

Co-benefits

The greatest heterogeneity is observed in approaches to sustainable development benefits and alignment with net-zero transition goals.

South Africa adopts an ambitious approach, requiring that eligible projects actively deliver sustainable development benefits aligned with national priorities such as job creation, rural development, and biodiversity protection, and explicitly excludes activities that achieve emissions reductions without wider co-benefits.

Türkiye frames co-benefits through alignment with the UN Sustainable Development Goals, while Canada supports projects that contribute to ecosystem integrity, biodiversity conservation, and sustainable land use.

Singapore addresses this through a “no net harm” requirement. China, India, and Italy similarly require project-level impact assessments—typically embedded in project design

documentation—to demonstrate that activities do not result in significant negative environmental or social impacts.

Japan encourages co-benefit delivery but relies primarily on sector-specific safeguards, particularly for land use and forestry projects.

Less developed PCCMs like Mexico's and Russia's have not yet addressed this issue in their regulations.

Sanctions

Enforcement mechanisms on the supply side vary considerably across jurisdictions. The most extensive frameworks—such as Canada, China, and South Korea—combine financial penalties, credit cancellation, and criminal liability. In Canada, for example, financial penalties apply specifically to the misuse of credits in breach of compliance obligations.

The EU's carbon removal and carbon farming (CRCF) regulation establishes a tiered sanctions regime, with consequences ranging from suspension to full exclusion from certification schemes, including safeguards against "scheme hopping"—the practice of switching certification schemes to avoid penalties or exploit weaker standards elsewhere.

Less punitive frameworks, such as Italy's, rely primarily on registry controls, buffer reserves, and compensation requirements rather than administrative fines. South Africa's 2024 law introduces criminal penalties, though these apply to emissions reporting obligations rather than carbon credit project developers. Russia's framework is limited to procedural remedies, allowing resubmission of rejected applications, but it does not specify broader sanctions. Indonesia's regulations do not explicitly define consequences for non-compliance, though this may be addressed through future sector-specific regulations.

The regulatory stocktake also revealed different approaches to governance:

Central Governance Models

In this approach, one or two government ministries define regulations across the carbon credit lifecycle and designate other entities to operationalize them and develop supporting procedures. In the EU, for example, the European Commission develops regulations across the supply and demand sides of the market. In China, the Ministry of Ecology and Environment has led the development of overarching regulations governing carbon credit generation and use, receiving consent from other ministries and designating agencies.

Coordinated Multi-ministry Models

In some jurisdictions, several government agencies develop and oversee different parts of the regulatory framework. Indonesia's Ministry of Environment, for example, leads the development of supply-side regulations, while sectoral ministries set parameters for implementation within their respective sectors. South Africa's model is similar: the National Treasury leads the design of carbon pricing and offset regulations, while the Department of Electricity and Energy develops the framework for domestic carbon credit standards. Australia represents another variation of this approach, with responsibilities for policy design, credit issuance, market oversight, and integrity oversight distributed to multiple institutions, creating checks and balances across the carbon market framework.

India represents a hybrid model, with central leadership from the Ministry of Power and the Bureau of Energy Efficiency, alongside coordination with other ministries, resulting in a centrally anchored but multi-institutional governance framework.

Overall, variations in the stringency of credit integrity criteria and governance models suggest that jurisdictions are setting different thresholds for what counts as a robust framework. This can contribute to market fragmentation, as credits may not be viewed as equally credible or substitutable across systems, and may therefore attract different levels of demand and pricing.

5.3 Demand-Side Rules Are Emerging, but Vary Greatly

Key Takeaways:

- *Areas of convergence: There is a growing recognition that clear demand-side rules on buyers' credit use and disclosure, mitigation hierarchy, and claims oversight are necessary to rebuild trust and enable scale.*
- *Areas of divergence: Regulations for credit buyers across jurisdictions remain fragmented in both legal force and scope, particularly around mitigation hierarchy, transparency, and third-party assurance, lessening buyers' confidence in using credits and making related climate claims.*
- *Implementation outlook: The view that robust credit integrity standards must be matched by clearer and more durable disclosure and credit use rules for buyers to rebuild trust and enable scale is gaining traction. However, how quickly jurisdictions move from fragmented to binding demand-side obligations remains uncertain.*

While supply-side frameworks have matured considerably in many markets, the regulatory landscape governing how companies purchase and use voluntary carbon credits is at a much earlier stage of development globally. Demand-side rules addressing buyer obligations, mitigation hierarchy, disclosure, third-party verification, and the integrity of climate claims remain uneven across jurisdictions. This sentiment was echoed in CGEP's roundtable convenings, in which experts underscored that buyers are more likely to engage when they can transact under clear, stable, and durable rules that reduce legal and reputational risk, and that robust credit integrity standards and a predictable operating environment for buyers must advance together to rebuild trust and enable scale.[70]

One area among the G20 countries and Singapore where approaches to demand-side use rules vary considerably is in ambition and legal force:

Strict Rules for Use

Demand-side frameworks in several countries reflect a clear policy direction toward more structured and integrity-focused voluntary credit use, even if legal obligations have not yet been proposed.

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[70] Gautam Jain, Preetha Jenarthan, Luisa Palacios, Victoria Prado, and Shubham Deshmukh, "Regulatory Progress for Project-Based Carbon Credit Markets: Pre-COP30 Roundtable Summary," Columbia University Center on Global Energy Policy, December 4, 2025, https://www.energypolicy.columbia.edu/publications/regulatory-progress-for-project-based-carbon-credit-markets-pre-cop30-roundtable-summary.

Italy is in a more advanced position as it imposes a legally binding mitigation hierarchy on buyers participating in the national registry, requiring companies to measure, avoid, reduce, and compensate in strict sequence before credits can be used as offsets, with their use legally restricted to residual emissions only—defined in practice by reference to sector-specific decarbonization benchmarks rather than physical abatement limits.

The UK positions credits as a complement to, not a substitute for, deep emissions reductions, and requires transparency in how credits are used within transition plans; net-zero or carbon neutrality claims relying on offsets must be substantiated and transparent, with civil and, in serious cases, criminal consequences for non-compliance. France similarly codifies a mitigation hierarchy for signatories and requires reporting across all three emission scopes with time-bound reduction commitments.

The EU requires disclosure of carbon credit use in transition plans and investor-facing communications, though the scope of sustainability reporting has been narrowed following recent reforms.

Less Strict Rules for Use

In India, Japan, and Singapore, companies are strongly encouraged to prioritize internal emissions reductions before using credits, but no binding legal obligation enforces this hierarchy. Singapore is notable for its dual-track structure linking compliance and voluntary framework, but demand-side rules for voluntary corporate buyers in these jurisdictions remain guidance rather than statute.

Similarly, South Korea's Korean Emissions Trading Scheme (K-ETS) embeds credit use within a compliance architecture with defined eligibility, quantitative caps, and traceability, but it does not extend to rules governing voluntary corporate buyers or climate claims made outside the ETS. For voluntary use, Korea is expanding corporate climate disclosures, but neither system as yet imposes a binding mitigation hierarchy or substantiation requirement for offset-based claims.

The least developed areas of demand-side regulations are on transparency and assurance, including public reporting and third-party verification requirements:

Strict Disclosure and Verification Requirements

Japan imposes robust public disclosure and verification obligations under its compliance framework. Participants must report annual emissions, allowance holdings, compliance status, and credit use, while project-level data, including methodology, issuance volumes, and retirements, is publicly accessible. Credits must be independently validated by government-accredited third-party bodies, and corporate emissions reports require verified submissions.

The UK has concrete regulations governing claims disclosures for voluntary use, combining legally binding obligations across multiple regulators. Companies face fines of up to 10 percent of global annual turnover (i.e., worldwide revenue of the entire corporate group) for misleading environmental claims. There is an advertising regulator with powers to ban ads and require corrective public statements, and a financial regulator requiring sustainability-related claims by authorized firms to be fair, clear, and not misleading. While still under consideration, credit use is expected to be disclosed separately rather than netted into emissions figures, and the

transition planning framework encourages organizations to detail the role and volume of credits used toward targets.

Partial Disclosure and Verification Requirements

France mandates registry-level transparency—all issuances, transfers, and retirements are publicly published—and requires independent auditor validation and regional government approval for project credits under its low-carbon label. However, demand-side disclosure for voluntary users outside of the label carries no legal obligation, and additional corporate assurance over offset claims remains voluntary.

The EU requires third-party verification only on the supply side for credit issuance and re-certification. Companies within the scope of mandatory corporate sustainability reporting must disclose credit use, but this flows through corporate reports rather than registries. There is no requirement to disclose who retires or uses credits for voluntary purposes, nor any demand-side assurance obligation for buyers.

Singapore presents a split picture. On the compliance side, transparency is largely achieved through the approved programs themselves, all of which publish project documentation, methodologies, and issuance and retirement records in publicly accessible registries, rather than through a standalone national requirement. A dedicated national registry for compliance credits is also being developed. In the voluntary market, companies are encouraged but not required to disclose credit type, volume, project location, and any third-party ratings obtained.

Italy's registry is publicly accessible, providing project and transaction-level data including issuance, transfers, and retirements. Corporate buyers face no disclosure obligation unless they make public environmental claims, in which case, the competition authority may investigate and require substantiation. There is no standing mandatory assurance requirement for buyers.

Minimal Disclosure and Verification Requirements

Canada, India, Mexico, Russia, and Saudi Arabia impose no meaningful demand-side transparency or assurance obligations.

As demand-side rules develop, a move toward harmonization across jurisdictions will be important. If rules vary too widely, buyers may continue to face uncertainty over permitted use, claims, and regulatory durability, undermining confidence and slowing the market’s ability to scale.

5.4 Market-side Rules Reveal a Spectrum of Regulatory Maturity

Key Takeaways:

- *Areas of convergence: Market-side infrastructure is becoming more formalized in several countries, with growing attention to registry-linked trading, settlement, retirement, and safeguards. Even where trading platforms are not yet under full financial supervision, there is a clear move toward more structured market design and stronger oversight.*
- *Areas of divergence: PCCM trading infrastructures vary widely across jurisdictions, from fully regulated exchange environments to markets where trading remains largely*

bilateral and outside formal oversight. They also differ in how far rules extend to market conduct, price transparency, clearing, and settlement.

- *Implementation outlook: There is a gradual shift toward more formal and scalable trading infrastructure, supported by clearer legal treatment of credits and stronger market oversight. Whether nascent and self-regulated systems will evolve into fully regulated market ecosystems is unclear.*

Market-side infrastructure for carbon credit trading spans a wide institutional spectrum across countries: from fully regulated exchange environments to jurisdictions where no formal trading venue has yet been established.

Formally Regulated Trading Platforms

At the most regulated end of the spectrum, Indonesia has established a regulated national carbon exchange that is licensed, supervised, and overseen by the financial services authority, integrating carbon credit trading directly into the country's capital market infrastructure. All units must be recorded in the national registry and the carbon credit registry, with trading, clearing, settlement, and retirement conducted under formal regulatory oversight to ensure that credits are not reused or double-counted.

The Japan Exchange Group (JPX) Carbon Credit Market is operated by the Tokyo Stock Exchange, commissioned by the Ministry of Economy, Trade and Industry, as part of the country's decarbonization policy. Day-to-day market rules covering participant eligibility, settlement, price discovery, and trade reporting are set by JPX's own operating protocols. Since the credits generated under Japan's J-Credit scheme are classified as non-financial instruments under Japanese private law, rather than securities, there is no financial regulatory supervision of carbon credit trading. However, in June 2024, Japan's financial regulator launched a study group that examined trading transparency, investor protection, and infrastructure design ahead of Japan's mandatory ETS, due to launch in 2026. The group's draft report, published in June 2025, recommends developing high-level principles for carbon credit trading aligned with international frameworks, including the International Organization of Securities Commissions, signaling that closer financial regulatory oversight is anticipated as the market matures.[71]

Self-Regulated Trading Platforms

South Africa has developed several formal exchange infrastructures, including the Johannesburg Stock Exchange's V-Carbon platform, launched in partnership with Xpansiv in February 2025. The V-Carbon platform provides order-book trading, OTC settlement, and connectivity to both international and domestic registries. However, it currently operates on a self-regulatory basis rather than under dedicated government carbon market legislation, meaning formal regulatory oversight remains limited. South Africa's Green Asset Exchange, which is a private platform that facilitates voluntary carbon credit trading, announced in January 2026 a platform upgrade as well as a partnership with Credible Carbon, a local voluntary registry, reinforcing reliance on private infrastructure in the absence of a sovereign equivalent. A government consultation paper proposes legislative changes to clarify the legal and financial status of carbon credits, exploring their recognition as tradable intangible assets and adjusting

[71] Japan FSA, "Draft Report of the Study Group on the Future of Financial Infrastructure for Carbon Credit Trading," June 2025, https://www.fsa.go.jp/singi/carbon_credit/siryou/20250529/01.pdf.

financial market regulation to support both exchange-based and bilateral trading. Similar to Japan, this reflects an incremental shift toward a more formalized and scalable market ecosystem, though regulated derivatives, clearing, or cross-exchange carbon trading infrastructure are not yet in place.

Formal Trading Platforms Nascent or Absent

In Argentina, trading activity occurs primarily via OTC transactions or through the private BACX platform, which implements its own risk management procedures and due diligence processes but operates without formal government regulation or endorsement. The local stock exchange, BYMA, registers credit trading via an Excel database, although the CNV, Argentina's national securities commission, has clarified that it does not supervise these transactions, having authorized BYMA to register them only as a complementary activity. While the national registry supports project-level tracking, it does not govern trading or settlement processes.

At the least regulated end of market-side rules, Türkiye has not yet established a formal trading venue for PCCMs. The country's draft crediting framework focuses primarily on a state-run registry for issuing credits rather than on trading infrastructure. In the absence of a regulated exchange or marketplace, trading may occur through bilateral private transactions between market participants.

As trading infrastructures evolve, differences in how markets are regulated will shape transaction and pricing transparency, the strength of oversight, and the capacity of markets to support broader participation and growth in the future.

5.5 Moving from International Registries to National Tracking Systems

Key Takeaways:

- *Areas of convergence: There is a movement toward national registry architectures that record issuance, ownership, transfers, and retirements, creating an authoritative domestic accounting layer. Across jurisdictions, registries are being used as regulatory instruments to control eligibility, enforce MRV and disclosure, prevent double counting, and support traceability, rather than merely as record-keeping tools.*
- *Areas of divergence: Some countries use centralized national registries, others rely on a sovereign accounting layer over external registries, and some integrate VCM and ETS registry infrastructures. These models also vary in how they handle interoperability, government control, and linkages with external or international registries.*
- *Implementation outlook: Registry design is viewed as the authoritative layer for carbon credit accounting and oversight, helping strengthen traceability and domestic control over issuance, transfers, and retirements. What remains challenging is interoperability across multiple registries, particularly how reconciliation, serialization, and Article 6 controls will be coordinated in practice.*

Sovereign registries are no longer merely passive record-keeping tools; they are increasingly functioning as regulatory instruments to:

- Control eligibility and authorization
- Enforce domestic MRV and disclosure rules

- Prevent double issuance and double claiming
- Anchor compliance-grade accounting
- Enable chain-of-custody traceability
- Support potential Article 6 interoperability

Importantly, “registry sovereignty” does not always mean constructing a single, state-operated registry for all credits. Rather, it means ensuring that the government retains a binding ledger function either by directly operating a national registry or by requiring regulated evidence of issuance and retirement to be recorded within a government-controlled system that serves as the authoritative accounting layer.

Models of registry sovereignty include:

Centralized National Registry

Italy’s PCCM is centered on the National Public Registry of voluntary carbon credits, which is designed to function as the official system of record for credits issued under the domestic forestry crediting framework. The registry assigns unique serial numbers, records issuance and retirement, and coordinates with national land and forestry information systems to enhance traceability and reduce the risk of double counting. The Italian Integrity controls, such as serialization, cancellation or retirement controls, and cross-checking with land-use databases, are embedded at the registry layer itself, rather than left solely to project-level documentation.[72]

India’s Carbon Credit Trading Scheme (CCTS) similarly embeds a registry with a centralized design that records the issuance, transfer, banking, and retirement of carbon credit certificates and is institutionally linked to scheme administration and trading oversight bodies.[73] The CCTS framework goes a step further than Italy as it anticipates the registry acting as a meta-registry, capable of establishing linkages with other registries subject to government approval. This signals a policy intent to centralize lifecycle accounting domestically while enabling controlled interoperability, which is relevant in the context of India developing procedures for the authorization of corresponding adjustments under Article 6.[74]

Sovereign Accounting Layer over External Registries

Singapore’s compliance-use channel allows facilities to use international registries from approved programs, but requires evidence of retirement via a government ledger entry. Under the country’s International Carbon Credit (ICC) Framework, tax-liable facilities must submit a

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[72] Rinnovabili.it, "Crediti di carbonio forestali: nasce il registro nazionale" (Forestry Carbon Credits: National Registry is Born), October 19, 2025, https://www.rinnovabili.it/mercato/politiche-e-normativa/crediti-di-carbonio-forestali-nasce-il-registro-nazionale/.

[73] International Emissions Trading Association, "IETA business brief: India," 5, July 2025, https://www.ieta.org/uploads/wp-content/Resources/Busines-briefs/2025/IETA_Business_Brief-India_July_final-one.pdf
/en/news/india-notifies-emission-intensity-targets-nine-sectors-under-carbon-credit-trading-scheme

[74] Government of India, Ministry of Environment, Forest and Climate Change, "National Designated Authority for the Implementation of Article 6 of the Paris Agreement (NDAIAPA) - Office Memorandum," September 2025, https://ca1-aip.edcdn.com/S1-2_MOEFCC-Engagement_in_Article_6_of_Paris_Agreement_v3.pdf

“Notice of ICC Use,” retire the credits on an approved carbon-crediting-program registry,[75] and then submit evidence of retirement through a government system, which becomes the official compliance record for the state.[76] This structure preserves market access to multiple international registries while anchoring compliance integrity in a government-controlled reporting and validation process, thereby creating a “sovereign accounting layer” that sits above external registries.

Integrated Carbon Credit and ETS Registry Infrastructure

South Korea employs a unique state-operated model in which the carbon credit registry is integrated with the K-ETS registry.[77] This enables carbon credits to move into compliance surrender without losing traceability. The key design feature is interoperability within government systems: units maintain chain-of-custody integrity across issuance, conversion (where applicable), trading, and compliance surrender.[78] This integration reduces risks associated with registry fragmentation and reinforces the credibility of carbon credits used within K-ETS.

Registry as Regulatory Backbone

Brazil's national registry carries both regulatory and legal weight, functioning not only as a credit record-keeping system but also as an instrument of official climate policy enforcement. Following the enactment of a law in 2024 establishing the emissions trading system (SBCE), Brazil has announced development plans for the digital infrastructure that will operate as the central registry layer for the compliance market. [79] Official communications describe the registry as consolidating emissions reporting, target tracking, and registration of tradable instruments, positioning it as core financial-market infrastructure rather than a peripheral database.[80]

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[75] Carbon Markets Cooperation (Government of Singapore), “Implementation Agreements,” Government of Singapore, accessed October 22, 2025, https://www.carbonmarkets-cooperation.gov.sg/newsroom/implementation-agreements/; Carbon Markets Cooperation (Government of Singapore), “How Article 6 Works (Authorisation, Corresponding Adjustments, Overall Mitigation and Share of Proceeds),” Government of Singapore, accessed October 22, 2025, https://www.carbonmarkets-cooperation.gov.sg/what-is-article6/how-article-6-works/

[76] Ministry of Sustainability and the Environment and National Environment Agency, “Surrendering International Carbon Credits (ICCs) for the Payment of Carbon Tax under the Carbon Pricing Act,” p. 6, Government of Singapore, December 19, 2023, https://www.nea.gov.sg/docs/default-source/default-document-library/icc-guidance-document---surrendering-of-icc-for-payment-of-carbon-tax-under-cpa-final-_.pdf

[77] Republic of Korea, "Act on the Allocation and Trading of Greenhouse-Gas Emission Permits," (Act No. 11419, May 14, 2012), Art. 36, Korea Legislation Research Institute, May 14, 2012, https://elaw.klri.re.kr/eng_mobile/viewer.do?hseq=24561&type=new&key=

[78] Maeil Business Newspaper, "Coscom Completes Relay Management System - Infrastructure Connects GIR, KRX, Securities Firms, ETRS, ORS," November 24, 2025, https://www.mk.co.kr/en/stock/11476478

[79] Brazil Federal Government, “Law No. 15,042 of December 11, 2024,” Federal Official Gazette, December 11, 2024. https://www.in.gov.br/en/web/dou/-/lei-n-15.042-de-11-de-dezembro-de-2024-601124199.

[80] Brazilian Securities and Exchange Commission (CVM), "FAQ - Mercado Regulado de Carbono,” p.3 September, 2025, https://www.gov.br/investidor/pt-br/educacional/publicacoes-educacionais/cvm-sustentavel/faq-mercado-de-carbono-set-2025-cvm.pdf/.

Registry systems are increasingly shifting toward sovereign models that go beyond record-keeping, serving instead as tools for domestic control over the accounting, authorization, and oversight of credits.

5.6 Data Standardization Enables Integrity

Key Takeaways:

- *Areas of convergence: Registry development is increasingly being paired with data standardization, with growing alignment around three principles: standardized unit metadata and unique identifiers, interoperable machine-readable systems, and public transparency.*
- *Areas of divergence: Jurisdictions differ in how fully they implement these principles and how far registry systems have evolved from basic record-keeping to integrated market infrastructure. Jurisdictions also diverge on public transparency versus confidentiality in registry design.*
- *Implementation outlook: Registry systems built on standardized data, traceability, and stronger integration with broader regulatory functions that support integrity, transparency, and interoperability are effective. Gaps remain in automated reconciliation, robust audit trails, and cross-border interoperability under Article 6.*

Integrity failures in PCCMs often manifest as data failures: inconsistent unit attributes, incomplete public documentation, limited traceability of transfers, or unclear retirement claims. Jurisdictions addressing these weaknesses are gravitating toward three data principles:

1. Standardized unit metadata and unique identifiers to make credits traceable and reduce double counting,
2. Interoperable, machine-readable data systems to connect registries and enable automated checks, and
3. Public transparency to improve market confidence and oversight, while balancing confidentiality.

Several countries are already implementing some of these three. The UK's registry illustrates principles 1 and 3 in a voluntary context: it provides a consistent, publicly accessible ledger for the issuance and retirement of units associated with UK standards (Woodland Carbon Code and Peatland Code), enabling buyers to verify status and confirm retirement.[81]

Australia's approach demonstrates all three principles at the compliance level—its registry uses serialized unit tracking, conducts account-based transfers, and supports interoperability with third-party trading platforms.[82] Japan's crediting frameworks (J-Credit scheme and JCM) similarly rely on registry systems to manage issuance, ownership, and transfer, supporting

[81] Woodland Carbon Code, "About the registry," accessed December 2025, https://www.woodlandcarboncode.org.uk/about-registry.
[82] Clean Energy Regulator (CER), "Australian National Registry of Emissions Units (ANREU)," n.d., https://nationalregistry.cleanenergyregulator.gov.au.

traceability for domestic use cases and, increasingly, alignment with international cooperation pathways.[83]

The path forward, especially as Article 6 infrastructure matures, is registries that can support automated reconciliation and robust audit trails, similar to other financial markets.[84] The UNFCCC's explicit emphasis on registries as official tracking tools, unique identifiers, and interoperability between national and international systems signals what best practices will be for cross-border carbon market operations. The 2025 G20 SFWG principles reinforce this direction, explicitly calling for data tools that are publicly accessible, span the entire credit life cycle, use widespread interoperable formats, and leverage best practices from financial markets while remaining consistent with UNFCCC and Article 6 reporting structures.[85] In that context, machine-readable, interoperable data is the mechanism through which markets can scale while preserving environmental integrity.

A practical implication for regulators is that registry policy is becoming inseparable from: (i) MRV rules (data inputs), (ii) claims guidance (how retirements are used and disclosed), and (iii) cross-border authorization and accounting (Article 6 readiness). Countries that treat registry design as a standalone database could risk perpetuating fragmentation; those treating it as an integrated regulatory function are moving faster toward supporting international carbon credit trades. India's meta-registry framing and planned linkages, Indonesia's consolidation of national carbon economic value instruments within its national registry while simultaneously tracking its carbon units separately, and Brazil's SBCE platform build-out each point to this integration logic of registry sovereignty and standardized data as the operational foundation for integrity, transparency, and eventual interoperability.

5.7 Divergence of Legal Classification

Key Takeaways:

- *Areas of convergence: Legal clarity is essential for market development, particularly for ownership, transferability, and cross-border transactions. Clarifying legal status is also important for market liquidity and financial intermediation.*
- *Areas of divergence: The legal status of credits across jurisdictions ranges from undefined to still being developed to expressly classified. Where defined, credits are classified in different ways, including as intangible assets, tradable assets, or securities.*
- *Implementation outlook: Greater legal clarity is helping support ownership rights, transferability, accounting treatment, and market confidence. It remains uncertain whether different domestic legal classifications can support cross-border interoperability*

[83] Joint Crediting Mechanism (JCM), "Common Specifications of the JCM Registry," https://www.jcm.go.jp/jc_decisions/2532/JCM_UZ_Spec_Registry_ver01.0.pdf
[84] United Nations Framework Convention on Climate Change (UNFCCC), "Development of Paris Agreement Article 6 Registry Infrastructure Begins," UN Climate Change, January 23, 2026, https://unfccc.int/news/development-of-paris-agreement-article-6-registry-infrastructure-begins
[85] G20 Sustainable Finance Working Group, "2025 G20 Presidency and SFWG Co-chairs Sustainable Finance Report," pp. 44, 46, G20 South Africa 2025, October 2025, https://g20sfwg.org/wp-content/uploads/2025/10/2025-G20-SFWG-Presidency-and-Co-chairs-Sustainable Finance-report-1.pdf

without full harmonization but with alignment on core principles such as ownership, transparency, and credible standards.

Understanding the legal status and classification of carbon credits has become essential to the expansion of PCCMs because of their relevance in cross-border transactions. The regulatory stocktake across the G20 and Singapore shows that the legal nature of credits is either undefined, in the process of being defined, or classified in different ways—for example, as intangible assets or financial instruments. These differences have important implications for how carbon markets operate in the future, because they determine key aspects of market functioning, including ownership rights, taxation, collateralization, and treatment in insolvency, but most importantly, transferability, which is key to creating interoperable markets.

Without clarity about the legal status of credits, buyers may face uncertainty over whether they acquire valid ownership, whether credits can be pledged as collateral, whether claims to credits would survive insolvency, or whether security interests can be enforced in international carbon markets.[86] Classification also affects fungibility, or the ability of credits to be treated as interchangeable units across registries and trading platforms—an essential feature for liquidity, price discovery, and the development of standardized trading and financial products.

Most countries covered in the stocktake define carbon credits in broadly functional terms as certified units representing one ton of CO_2 equivalent avoided, reduced, or removed, without specifying if they are legally classified as a distinct asset class, thus leaving their legal status ambiguous. This approach is reflected across jurisdictions at different stages of PCCM development, including France, India, Japan, Singapore, and South Africa.

Differences emerge even in how these units are defined within domestic frameworks across compliance and voluntary use of carbon credits. South Africa distinguishes between “carbon credits” and “carbon offsets,” defining the latter as a specific type of credit issued under international standards that are eligible for use by regulated entities to reduce their carbon tax liability. India, by contrast, does not make this distinction depending on carbon credit use.

In Indonesia, carbon units are classified as securities when traded on exchanges, placing them under the supervision of the financial market authority and subjecting transactions to financial market regulation. In Brazil, under SBCE, carbon credits are defined as tradable assets (“civil fruits”) representing one ton of CO_2 equivalent generated from verified mitigation projects or programs under approved methodologies. However, when carbon credits are traded in financial markets, they may be treated as financial securities and fall under the regulatory oversight of the Brazilian Securities and Exchange Commission.

Despite the absence of established legal definitions for carbon credits in some countries, several have begun examining how to provide greater clarity. Studies in France, Japan, and South Africa illustrate different approaches to two key questions: the legal nature of carbon credits and their treatment under financial market regulation. France adopts a property law

[86] United Nations Commission on International Trade Law (UNCITRAL) and International Institute for the Unification of Private Law (UNIDROIT), “UNCITRAL/UNIDROIT Study on the Legal Nature of Verified Carbon Credits Issued by Independent Carbon Standard Setters,” UN Doc. A/CN.9/1191, March 14, 2024, https://documents.un.org/doc/undoc/gen/v24/049/44/pdf/v2404944.pdf; International Swaps and Derivatives Association (ISDA), “Legal Implications of Voluntary Carbon Credits,” December 2022, https://www.isda.org/a/VTqgE/Legal-Implications-of-Voluntary-Carbon-Credits.pdf.

approach, concluding that voluntary carbon credits should be treated as intangible assets recorded in registries, rather than securities or contractual claims, with ownership determined by registry entries. It also suggests that regulators monitor market development and consider extending financial market rules, particularly for derivatives, if secondary markets expand.[87]

Japan takes a more cautious approach, avoiding formal legal classification and instead treating credits as environmental value certificates generated under baseline-and-credit systems, with policy attention focused on strengthening trading infrastructure, transparency, and market conduct rather than integrating credits into securities regulation.[88]

South Africa may adopt a finance-integrated model in the future, recommending that carbon credits be defined as intangible assets while proposing that they may be treated as "unlisted securities" when traded in financial markets, enabling trading, clearing, and settlement through regulated financial infrastructure and providing clearer accounting, tax, and regulatory treatment.

Stakeholder engagement conducted through CGEP roundtables broadly reinforced the importance of clarifying the legal status of carbon credits to support market development.[89] Participants noted that uncertain legal classification across jurisdictions can constrain market liquidity, particularly for cross-border trading and financial intermediation. Clear legal characterization—whether as property rights, securities, or other tradable assets—helps establish ownership, accounting treatment, and regulatory oversight, all of which are necessary for scaling participation by financial institutions and improving market liquidity.[90]

At the same time, stakeholders emphasized that full harmonization of legal classifications across jurisdictions may not be necessary. Even when approaches differ, participants suggested that interoperability between registries and regulatory frameworks could still enable cross-border trading if core principles such as clear ownership, transparency, and credible standards are aligned.[91]

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[87] Haut Comité Juridique de la Place Financière de Paris, "Report on the Legal and Regulatory Aspects of Voluntary Carbon Credits," October 16, 2024, https://www.hcjp.fr/sites/default/files/2024-10/report_on_the_legal_and_regulatory_aspects_of_voluntary_carbon_credits.pdf.

[88] Japan FSA, 'Draft Report of the Study Group on the Future of Financial Infrastructure for Carbon Credit Trading," June 2025, https://www.fsa.go.jp/singi/carbon_credit/siryou/20250529/01.pdf.

[89] Gautam Jain, Preetha Jenarthan, Luisa Palacios, Victoria Prado, and Shubham Deshmukh**,** "Regulatory Approaches for Project-Based Carbon Credit Markets: Roundtable Summary," Columbia Center on Global Energy Policy, October 28, 2025, https://www.energypolicy.columbia.edu/publications/regulatory-approaches-for-projectbased-carbon-credit-markets-roundtable-summary.

[90] Gautam Jain, Preetha Jenarthan, Victoria Prado, Luisa Palacios, Josh Zoffer, and Shubham Deshmukh, "Regulatory Progress for Project-Based Carbon Credit Markets: Pre-COP30 Roundtable Summary," Columbia Center on Global Energy Policy, December 4, 2025, https://www.energypolicy.columbia.edu/publications/regulatory-progress-for-project-based-carbon-credit-markets-pre-cop30-roundtable-summary.

[91] Gautam Jain, Preetha Jenarthan, Luisa Palacios, Victoria Prado, and Shubham Deshmukh**,** "Regulatory Approaches for Project-Based Carbon Credit Markets: Roundtable Summary," Columbia Center on Global Energy Policy, October 28, 2025, https://www.energypolicy.columbia.edu/publications/regulatory-approaches-for-projectbased-carbon-credit-markets-roundtable-summary.

5.8 Article 6 Readiness Is a Key Milestone

Key Takeaways:

- *Areas of convergence: Article 6 readiness is becoming a practical test of whether jurisdictions can connect domestic frameworks to international carbon markets. Countries are codifying corresponding adjustment functions in domestic rules and building the registry, reporting, and bilateral infrastructure needed to transfer ITMOs.*
- *Areas of divergence: Some countries have embedded Article 6 functions directly into policy design and operational structures, while others are targeting compatibility, enabling conditions, and readiness infrastructure.*
- *Implementation outlook: Countries that are embedding authorization procedures, registry upgrades, and bilateral transfer arrangements into their systems are better positioned to support credible cross-border PCCM activity.*

Across jurisdictions, Article 6 readiness is increasingly treated as a practical milestone for scaling cross-border PCCMs. This readiness is showing up in two reinforcing moves: (i) codifying authorization of corresponding adjustment (CA) functions in domestic rules or government operating procedures, and (ii) building the bilateral and technical infrastructure (registries, reporting workflows, and mutually recognized processes) needed to transfer ITMOs while keeping traceability and environmental integrity intact.

Several countries have established governance architecture or are explicitly upgrading registries to host CA modules. Many systems are now designed with binding regulations for Article 6, even if they have not executed any international transfers yet, while others are not.

Countries Incorporating Article 6 Functions into Policy Design

Japan's framework explicitly ties procedures to its Article 6 reporting architecture and to the official Joint Crediting Mechanism (JCM) program documentation, anchoring transfers in a formal governance and accounting channel.[92] The JCM program is structured as a bilateral crediting mechanism under Article 6.2, with partner-country cooperation enabling ITMO transfers, authorization by both countries, and corresponding adjustments to prevent double counting.

Singapore has also built a bilateral Implementation Agreement (IA) approach to operationalize Article 6.2 transfers.[93] Under this model, Singapore uses legally binding IAs with host countries to establish transfer procedures consistent with Article 6.2 and linking eligibility to the domestic carbon credit framework.[94]

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[92] Ministry of Foreign Affairs (MOFA), Japan, "Joint Crediting Mechanism (JCM)," September 1, 2025, https://www.mofa.go.jp/ic/ch/page1we_000105.html.

[93] Ministry of Trade and Industry (Singapore), "Singapore Signs Implementation Agreement on Carbon Credits Collaboration with Mongolia," Ministry of Trade and Industry (Singapore), October 6, 2025, https://www.mti.gov.sg/Newsroom/Press-Releases/2025/10/Singapore-signs-Implementation-Agreement-on-carbon-credits-collaboration-with-Mongolia; Carbon Markets Cooperation (Government of Singapore), "Implementation Agreements," Government of Singapore, accessed October 22, 2025, https://www.carbonmarkets-cooperation.gov.sg/newsroom/implementation-agreements/

[94] Latham & Watkins, "Singapore Signs Further Implementation Agreements and Announces Nature-Based Carbon Credit Projects," September 25, 2025,

South Korea provides another example of advanced Article 6 operationalization. As of November 2025, Korea had signed 10 bilateral agreements under Article 6.2. Korea has articulated a quantitative target of securing approximately 37.5 million carbon credits through Article 6 cooperation mechanisms to help achieve its 2030 NDC, which commits to a 40 percent reduction in greenhouse gas emissions from 2018 levels by 2030.[95] Singapore is among the most engaged countries in Article 6.2, out of necessity to utilize international credits.

India is positioning Article 6 readiness as an extension of its national market infrastructure. Its roadmap notes that the institutional architecture for Article 6 participation is in place through the notification of the National Designated Authority for Article 6 and activity lists for cooperative approaches, while registry upgrades for authorization, transfer, and corresponding adjustments are underway.[96] The registry is being developed to include technical modules for Article 6.2 authorization, tracking, and reporting, explicitly framed to enable registry-level interoperability for bilateral arrangements—for example, in the India-Japan JCM.[97]

Countries Exploring Compatibility and Preparing Enabling Conditions

Policy work in Australia, Brazil, Canada, and China is oriented toward ensuring compatibility with Article 6, even if detailed authorization, corresponding adjustments, and registry transfer mechanics are still evolving. The common feature across these jurisdictions is the development of readiness infrastructure, such as exploring:

- Which domestic instruments could be authorized as ITMOs (or linked to ITMO issuance)?
- Which institutional authority could approve transfers and apply corresponding adjustments?
- What type of registry architecture (or registry linkages) would be required for secure tracking across borders?

The framework and supporting infrastructure build-out matter because Article 6 functioning requires not only rules on paper but also credible operational structures: registries, reporting channels, and data controls that allow governments to reliably apply corresponding adjustments when needed to prevent double counting.

6 Future Considerations as Carbon Market Regulation Evolves

Carbon market regulations are likely to evolve toward a more state-anchored, integrity-driven, and interoperable architecture in which carbon credits are treated less as a stand-alone voluntary instrument and more as one component of a broader climate-governance policy framework. Across the jurisdictions examined in this paper, the broad direction is toward a more

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https://www.lw.com/en/insights/singapore-signs-further-implementation-agreements-and-announces-nature-based-carbon-credit-projects.

[95] Ecco Climate, "Article 6 of the Paris Agreement," September 10, 2025, https://eccoclimate.org/article-6-of-the-paris-agreement/.

[96] Ministry of Environment, Forest and Climate Change (India), “India’s Engagement in Article 6 of Paris Agreement,” presentation, September 23, 2025, https://ca1-aip.edcdn.com/S1-2_MOEFCC-Engagement_in_Article_6_of_Paris_Agreement_v3.pdf

[97] Carbon Pulse, "India Prepares Portal for Cross-Border Trading as Article 6.2 Implementation Advances," October 7, 2025, https://carbon-pulse.com/443062/

structured landscape in which governments play a distinct role in defining eligible activities, approving methodologies, operating or supervising registries, controlling authorization for international transfers, and shaping how credits may be used in compliance systems and corporate claims, even if the approach differs across countries. In this setting, some of the following themes are likely to play out as well:

- **PCCMs will become more integrated with the compliance market.** PCCMs are increasingly being embedded within countries' wider policy toolkits, including a greater integration with the compliance market, rather than operating as isolated carbon credit markets. The implication is not that all countries will adopt the same model but that PCCMs will increasingly be judged by how well they fit into domestic mitigation systems, NDC implementation, and long-term net-zero strategies. Jurisdictions with mature frameworks are already moving in this direction, while systems under development, such as in Brazil and Indonesia, are building the institutional components that could support more integrated compliance and VCM models over time. In that sense, the next stage of market evolution is likely to be less about whether governments regulate PCCMs and more about how deeply they integrate them into national climate law, compliance market design, and public climate-accounting systems.
- **Integrity rules will develop domestically but be more globally aligned.** Looser, market-shaped crediting practices are moving toward more formalized, regulator-backed integrity frameworks. The EU's CRCF, for example, is built around EU-level methodologies, independent auditing, registry controls, enforceable sanctions, and differentiated permanence treatment. Similarly, Australia's framework relies on legally binding method determinations reviewed against statutory carbon credit integrity standards, with independent audits and permanence obligations for sequestration projects.

  Looking ahead, this suggests that credit quality will increasingly be defined by domestic regulations rather than by market standards alone. The most likely direction is not full international harmonization but a narrowing consensus around core integrity expectations: additionality, conservative quantification of credit issuance, independent validation and verification, serialized registry accounting, stronger reversal management, and clearer double counting controls. Jurisdictions may continue to differ on eligible project types and market design, but the space for low-governance, weakly evidenced crediting is likely to shrink as sovereign systems mature and voluntary systems come under greater public scrutiny.
- **Demand-side governance will speed up.** Across jurisdictions, the gap between supply-side maturity and demand-side regulation remains the defining characteristic of PCCMs and represents the area where regulatory development is most likely to accelerate in the near term. With governments and corporations increasingly concerned about greenwashing accusations, the importance of rules governing how credits are used, disclosed, and marketed is already gaining traction. The UK now applies a multi-layered regime involving government integrity principles, the Green Claims Code, ASA advertising guidance, and FCA anti-greenwashing rules for authorized firms. Australia combines the measure-reduce-offset logic and disclosure obligations with

enforcement against misleading sustainability or offset claims, while requiring separate disclosure of gross emissions and the role of carbon credits in net targets. The EU, despite the weakening of corporate sustainability reporting, continues to shape demand-side rules through consumer protection law amendments.

Future regulation may increasingly distinguish between the legal validity of a credit and the legal defensibility of the claim built around it. A unit may satisfy issuance rules and still be unsuitable for an unqualified "carbon neutral" or "net zero" claim. This separation is likely to become one of the defining features of the next generation of PCCM regulation. Mitigation hierarchies, gross-versus-net disclosure, claim substantiation, and registry-linked transparency are all likely to be key elements of regulations. In practical terms, the future credibility of PCCMs may depend as much on how credits are used and disclosed as on how they are generated.

- **Article 6 will further boost credit integrity and market size.** As Article 6 gets fully operationalized,[98] international transferability is likely to become a critical differentiator of credits, commanding a premium—at least initially, because of the UNFCCC umbrella—compared to domestic credits. The increasing integration with Article 6 across jurisdictions points toward a future two-tier architecture. One tier will consist of domestic credits that contribute to host-country targets and remain within national registries or domestic compliance and voluntary frameworks. The second tier will consist of units for international transfer that require additional legal steps, clearer accounting treatment, more explicit host-country authorization, and transparency around the first transfer and CA.

  Article 6 will not fully harmonize domestic integrity rules across jurisdictions. Differences in national regulatory frameworks, methodological requirements, and institutional capacity could still create some scope for regulatory arbitrage or "jurisdiction shopping," particularly where market participants seek host countries with less stringent rules or oversight. This risk is at least partially constrained by the UNFCCC reporting and review processes, which impose safeguards on internationally transferred mitigation outcomes. However, if this risk turns out to be greater than expected, more stringency may be needed in UNFCCC rules.

- **Sovereign registries will act as regulatory vehicles.** Nearly every mature or emerging framework among the jurisdictions studied points to the same conclusion: the sovereign-level registry is no longer just an administrative ledger but increasingly the legal conduit for issuance, ownership, transfer, retirement, cancellation, authorization status, and double-counting prevention. Some countries, such as Australia and India, are establishing integrated national registries that track credits across their lifecycle. Others, including Indonesia and South Korea, are linking credit registries with ETS infrastructure or NDC accounting systems. Other frameworks, such as those in the EU

[98] Gautam Jain and Shubham Deshmukh, "How to Fully Operationalize Article 6 of the Paris Agreement," Center on Global Energy Policy, Columbia University, September 11, 2025, https://www.energypolicy.columbia.edu/publications/how-to-fully-operationalize-article-6-of-the-paris-agreement/.

and Singapore, include developing registries that interface with international credit systems.

The future direction is similarly likely to be geared towards stronger digital interoperability and tighter integration with disclosure and national accounting systems. That could include tagging units by methodology, permanence profile, authorization status, use restrictions, claim purpose, and corresponding adjustment status. It could also push markets toward common data models and interoperability initiatives that make credits more traceable across national and international systems. As regulatory systems mature, registry design may become one of the main determinants of market credibility, comparability, and cross-border usability.

- **Financial oversight will deepen as carbon credits become more liquid.** As markets scale, carbon-credit regulation is likely to expand beyond project integrity to trading conduct, market infrastructure, and financial oversight. Australia already treats carbon credits as regulated emissions units and, in relevant contexts, as financial products subject to licensing and conduct rules. Brazil's framework anticipates securities law oversight where credits are treated as financial assets and traded on financial platforms. India's draft market design points toward exchange-based trading, surveillance, position controls, and reporting under CERC oversight.

  Over time, this suggests that the boundary between carbon market regulation and financial market regulation will become more porous. Credits that are exchange-traded, warehoused, securitized, or used in investment products will increasingly attract questions of licensing, market abuse, disclosure, settlement integrity, AML (anti-money laundering) laws, KYC (know your customer) rules, and prudential treatment. The more PCCMs move from bilateral transactions to exchange-based trading, similar to other liquid markets, the harder it will be to keep them outside broader financial-market regulation.

Taken together, the evidence across jurisdictions suggests that PCCM regulation is entering a more mature phase. The strongest regulatory trend is not market expansion but institutional and regulatory strengthening: more laws, more public oversight, more registry dependence, more integrity-based differentiation among credit types, tighter controls on claims and disclosure, and a clearer legal boundary between domestic mitigation and internationally transferred outcomes. That said, robust regulatory frameworks should still be viewed as an enabling condition rather than a panacea for a scalable and interoperable PCCM, particularly because it is still too early to conclude that these institutional changes are consistently leading to higher-quality credits, fewer integrity failures, and stronger market confidence.

Nevertheless, the future of PCCMs is likely to be shaped less by the broad idea of "offsetting" and more by the legal frameworks governing how credits are issued, authorized, transferred, retired, disclosed, and used. Jurisdictions that can combine integrity, operational clarity, and interoperability without weakening domestic decarbonization incentives are more likely to see their PCCMs expand and reach their full potential.

Notes