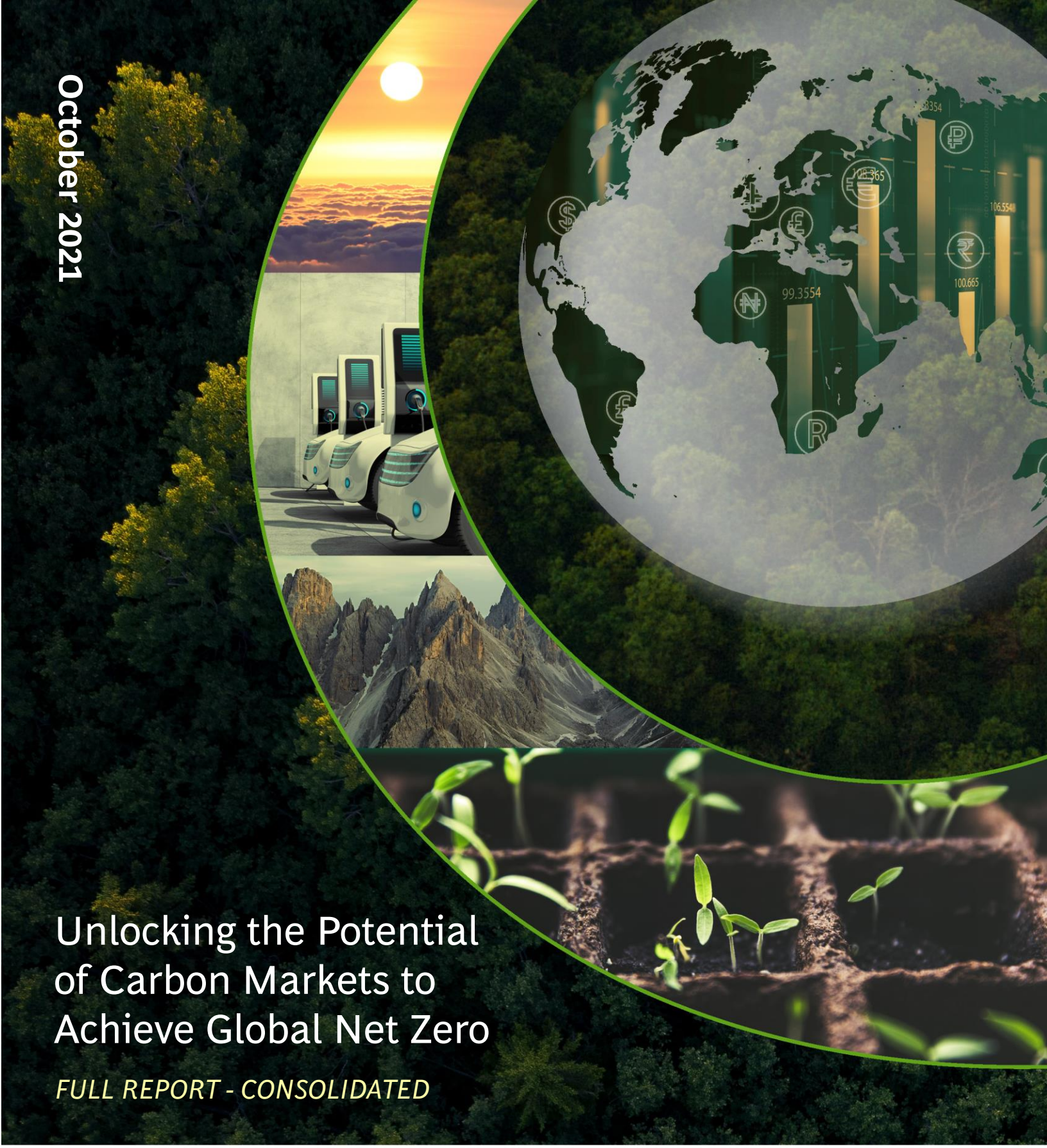
October 2021



Unlocking the Potential of Carbon Markets to Achieve Global Net Zero

FULL REPORT - CONSOLIDATED

BCG BOSTON CONSULTING GROUP
gfma GLOBAL FINANCIAL MARKETS ASSOCIATION
afme/ asifma sifma

Contents

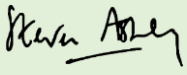
Foreword

Climate change poses significant economic, financial, social, and environmental risks to the world. Limiting global warming to 1.5°C within the century is still within reach but requires transformational changes to the global economy, including the pricing of greenhouse gases (GHGs). Effective carbon markets based on science-based decarbonization pathways are an essential tool in enabling an efficient marketplace for deploying carbon pricing. This report outlines a vision for the evolution of both the compliance and voluntary carbon markets, and outlines key recommendations for market participants, policymakers, regulators, climate science bodies, and other stakeholders.

The recommendations in this report are intended to promote a significant expansion in the scope and coverage of carbon markets to address low coverage of global GHG emissions by regulated pricing mechanisms (~20 percent today), low carbon prices (averaging <$5/tonne of CO_2), and a rapidly depleting carbon budget (300–500 $GtCO_2e$ to limit warming to 1.5°C, with current annual emissions of ~50 $GtCO_2e$).

This report was commissioned to Boston Consulting Group (BCG) by the Global Financial Markets Association (GFMA), with active contribution by GFMA member firms representing the global capital markets industry. This report was developed based on research, interviews conducted with contributing member firms (listed on the right) during the third quarter of 2021, and input from other market participants, climate science advisors, capital markets exchanges, and law firms with particular expertise relevant to the challenges of climate change. It is being published to promote a constructive and robust dialogue on the importance of carbon markets to achieve Net Zero goals

GFMA represents the common interests of the world's leading financial and capital markets participants to provide a collective voice on matters that support global capital markets. It also advocates on policies to address risks that have no borders, regional market developments that impact global capital markets, and policies that promote efficient cross-border capital flows to end users. GFMA efficiently connects savers and borrowers, thereby benefiting broader global economic growth. The Association for Financial Markets in Europe (AFME) located in London, Brussels, and Frankfurt; the Asia Securities Industry & Financial Markets Association (ASFIMA) in Hong Kong; and the Securities Industry and Financial Markets Association (SIFMA) in New York and Washington are, respectively, the European, Asian, and North American members of GFMA.



Steve Ashley
Chairman, GFMA
Head of Wholesale Division, Nomura

Kenneth E. Bentsen, Jr.
President & CEO, SIFMA
CEO, GFMA

Roy Choudhury
Managing Director & Partner
Boston Consulting Group

BANK OF AMERICA
BARCLAYS
BNP PARIBAS
citi
HSBC
Morgan Stanley
MIZUHO
MUFG
NatWest
NOMURA
RBC
standard chartered
UniCredit
WELLS FARGO

Executive Summary

This GFMA and BCG report, "Unlocking the Potential of Carbon Markets to Achieve Global Net Zero," highlights the role and importance of both compliance and voluntary carbon markets to the transition to a low-carbon global economy. It provides an overview of the carbon markets ecosystem, highlights key challenges, and outlines recommendations for policymakers, market participants, and other key stakeholders to scale deep and liquid global carbon markets, while highlighting key enablers and dependencies. It is intended to serve multiple purposes, including (1) creating greater awareness on the need for carbon pricing and the use of carbon markets and their market structure by providing a summary of the current state, leveraging key data, insights, and findings; (2) establishing a vision for the evolution of carbon markets; and (3) providing a set of recommendations to achieve this vision from a practitioner's viewpoint.

Summary of key findings

- **Both compliance markets and the voluntary carbon market (VCM) can play significant and complementary roles** in decarbonization of the global economy. **Compliance markets provide a regulated mechanism—in addition to carbon taxes and other emissions reduction policies—to establish carbon pricing**, thus incentivizing and/or mandating decarbonization and associated investments. However, close to **80 percent of GHG emissions (in excess of 40 gigatonnes (Gt) of carbon dioxide equivalent (CO_2e) annually) is not covered** by regulated carbon pricing schemes today.[1] **Price levels also need to increase from the current global average regulated carbon price of <$5/t$CO_2$ to an estimated average $50–150/t$CO_2$** by 2030 to drive decarbonization aligned with Paris Agreement goals.[2,3,4,5] Considering these ambitious goals and the relatively small amount of GHG emissions subject to regulated markets today, the emerging VCM should play a complementary role to compliance markets.

- **Further scaling and enhancement of Emissions Trading Systems (ETSs) is critical. Despite almost 200 countries having signed the Paris Agreement, the operationalization of the 1.5°C goal into policy measures, such as ETS initiatives, thus far lacks geographic scope, sectoral coverage, and sufficient decarbonization rates.** In an encouraging recent development, the G7 also agreed, for the first time, to work together to consider how best to coordinate carbon pricing initiatives to mitigate emissions, and to explore international solutions to prevent

[1] World Bank Carbon Pricing Dashboard, as of April 2021.
[2] IMF Blog: A Proposal to Scale Up Global Carbon Pricing, June 2021.
[3] CPLC Report of the High-Level Commission on Carbon Prices, May 2017.
[4] OECD Effective carbon rates: pricing carbon emissions through taxes and emissions trading, 2021.
[5] IEA Net Zero by 2050, May 2021; values normalized to 2020 USD, rounded for simplicity.

carbon leakage.[6] Conservative estimates suggest a need to scale ETSs **from ~$170B today**[7] **to $1T+ in absolute size before 2030** (through increased **geographic and sectoral coverage**[8] coupled with **more aggressive decarbonization ambitions** and hence increased price levels)—in conjunction with scaling of other GHG pricing and control-based mechanisms—to achieve Paris Agreement ambitions.[9] ETSs should adopt **(1) steep ~5 percent+ linear reductions per year** in allowances,[10] **(2) fixed-cap (absolute emissions) systems as opposed to intensity-based systems** to align with total carbon budgets, **(3) classification of ETS allowances as financial instruments** to safeguard markets and ensure integrity, **(4) use of auctioning** in lieu of free allocation, **(5) consideration of Carbon Border Adjustment Mechanisms (CBAMs)** when feasible to prevent leakage and maintain competitiveness, and **(6) balancing market-based emissions-reduction mechanisms (such as ETSs) with other control-based mechanisms** (such as technology standards) that also encourage emissions reductions and may be more suited for specific sectors.

- **A clear complementary role for VCM** needs to be aligned **(1) as a transitionary mechanism**—in sectors/regions not fully covered by ETS/taxes/policies—**until regulated mechanisms take over** and ultimately scale down as emissions are reduced, **(2) as a long-term global marketplace for carbon removals** for entities to neutralize residual emissions and pursue negative emissions, and **(3) as a complementary mechanism for corporates and the financial services sector to compensate for their emissions** while they pursue sectoral decarbonization[11] to reduce emissions in their value chains. To strengthen trust in the VCM, and to enable it to grow from the current scale of <0.5 percent global emissions, it is **critical to develop stringent and transparent baselines and Measurement, Reporting, and Verification (MRV) standards to ensure verifiable "additional" emissions reductions**, and robust evaluation of whether MRV standards are met by third-party certifiers.[12] These **standards should also regularly be strengthened and made more stringent** to ensure that VCM projects remain additional. This would be supported by the work of the Taskforce on Scaling Voluntary Carbon Markets (TSVCM) and Voluntary Carbon Markets Integrity Initiative (VCMI) to develop **market consensus on the role of VCM credits**, a **consistent**

---

[6] https://www.gov.uk/government/news/g7-finance-ministers-agree-to-work-together-to-address-global-supply-chain-pressures.
[7] Estimated using the 2021 price and covered GHG of each ETS from World Bank Carbon Pricing Dashboard.
[8] Coverage defined as having a mechanism to incentivize or regulate reduction of GHG emissions. Estimated size assumes 40-50%+ ETS coverage of an estimated ~30—35GtCO_2e emissions at an average price of \$75/tCO_2e+.
[9] Estimates described in figure "Carbon markets in numbers."
[10] Emissions reductions from IAMC 1.5°C scenario modelling across all GHG emissions.
[11] For this report, sectoral decarbonization represents emissions trajectories aligning with requirements as per latest climate science in order to meet the goals of the Paris Agreement.
[12] Ecosystem Marketplace data, as of August 2021.

taxonomy of additional attributes such as co-benefits to biodiversity and socio-economic development, and harmonized MRV standards and registries.[13]

- The interoperability between carbon markets is limited today. Greater interoperability, (1) among ETSs with similar rates of decarbonization and similar pathways and (2) between ETSs and the VCM through tightly controlled mechanisms, would serve to grow carbon markets while driving additional co-benefits. However, there are several prerequisites to maintaining decarbonization ambitions, necessitating stringent controls. Interoperability between multiple ETS initiatives should be pursued only where rates of decarbonization are aligned between regions to prevent dilution of decarbonization ambitions. Interoperability between ETSs and the VCM requires more stringent and continually tightening MRV standards and thresholds to ensure additionality, and limits on eligibility and the quantity of fungible VCM credits (e.g., in terms of geographic and sectoral eligibility) to prevent encroachment on ETS markets. In addition, policymakers should catalogue relevant national assets (e.g., forests) and define eligibility lists for VCM projects to fast-track interoperability.

- Banking and capital markets firms stand ready to support the market through capabilities and product offerings that help market participants in the decarbonization journey by supporting their compliance, risk management, financing, and investment needs; and to enable the establishment of carbon instruments as a mature, competitive, liquid, and investable asset class. Liquidity in mature ETS markets is strong (e.g., with 2021 average daily volumes of ~55M EUA futures and options on the Intercontinental Exchange (ICE))[14]. Still, there is significant room for growth in nascent ETS markets—through geographic and sectoral expansion and the emergence of associated products (e.g., expanding the China ETS to cover sectors other than power, and the emergence of derivatives instruments)—and in the VCM, which largely represents a buy-and-hold/retire market today. This growth would be facilitated by rapid action from policymakers and regulators to scale compliance markets, and from the market more broadly to develop a robust and complementary VCM.

Context

Climate change poses significant economic, financial, social, and environmental risks to the world. The 2015 Paris Agreement aims to keep the global temperature rise this century to well below 2°C compared with pre-industrial levels, and to pursue efforts to limit this rise to 1.5°C. According to the

[13] As identified also by the TSVCM.
[14] Data from the Intercontinental Exchange.

Intergovernmental Panel on Climate Change (IPCC), the world will **likely reach or exceed 1.5°C of warming within just the next two decades** in all five scenarios explored in the IPCC's recent AR6 report. For a greater than 50 percent likelihood of achieving the 1.5°C goal, **our total "carbon budget" would be an estimated ~300–500 $GtCO_2$. At current levels of GHG emissions (estimated ~50 $GtCO_2e$), this translates to less than 10 years for the world to use up this entire budget.**[15] **This ambition is still within reach but requires transformation of the global economy**.

As highlighted in our previous publication, "Climate Finance Markets and the Real Economy," **an estimated $100–150+ trillion in investments across sectors and regions over the next three decades would be required to limit temperature rise to 1.5°C.**[16] **Pricing of GHG emissions, at a sufficiently ambitious level (estimated at $50–150+/$tCO_2e$), coupled with stringent long-term policies to limit GHG emissions, is a critical requirement to mobilize this investment.**[2,3,4,5,17]

Effective carbon markets that drive science-based decarbonization pathways are an essential tool in enabling an efficient marketplace for deploying carbon pricing. There are two key types of carbon markets: compliance and voluntary. In addition, the aviation industry has established its own bespoke sector-specific market, Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), which primarily relies on purchases of VCM credits against a portion of emissions from international aviation.

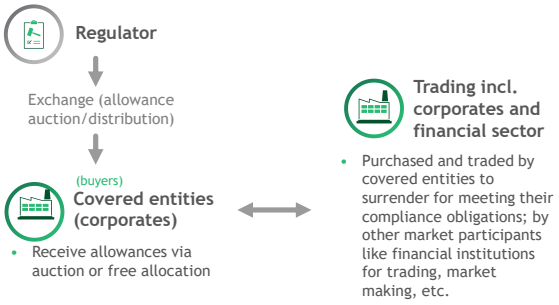
[15] IPCC, Working Group I Sixth Assessment Report (AR6), 2021; full report expected 2022.
[16] GFMA-BCG publication, Climate Finance Markets and the Real Economy, Dec 2020. The investment need reflects a significant financing gap vs. current levels and includes investments across key sectors such as Power, Industry, Transportation, Agriculture, Forestry, etc. which if not met would prevent achievement of the 1.5°C target.
[17] https://home.treasury.gov/system/files/261/FSOC-Climate-Report.pdf.

Both compliance and voluntary carbon markets must play a significant role in science-based decarbonization. Regulated mechanisms (e.g., compliance markets) are critical to incorporating the cost of emissions in economic activity. The VCM is not a silver bullet, since it does not provide a mandatory mechanism to reduce emissions, nor does it penalize emissions. The VCM can be a transitory tool to complement regulated emissions reduction mechanisms and can help channel capital for decarbonization. However, it requires MRV enhancements to play this role effectively and with clear additionality.

High-level description of the compliance and voluntary carbon markets

Compliance Markets

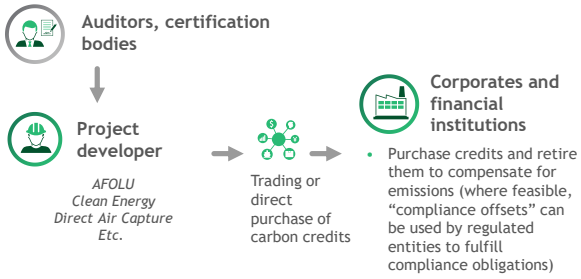
Primarily structured as emissions trading schemes wherein participants **trade allowances (permits to emit supplied by regulators) - reductions in allowance supply enables emissions reductions and regulated carbon price by market**



29 ETSs covering 8.7GtCO2e (~16% of global GHG emissions); representing ~$170B in absolute market value as of 2021, and ~$275B in traded value as of 2020

Voluntary Markets

Buyers (e.g., corporates, financial institutions) **voluntarily purchase carbon credits**—issued by a third party and verified by certification bodies—that **represent a tonne of emissions avoidance (estimated vs. baseline) or removal (from atmosphere)**

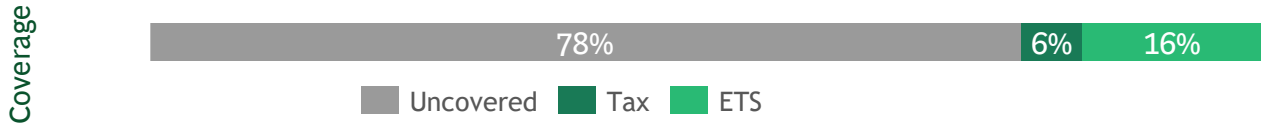


~100MtCO2e emissions retired in 2020 with estimated market size of <$0.5B; on track for annual market value of $1B+ for 2021

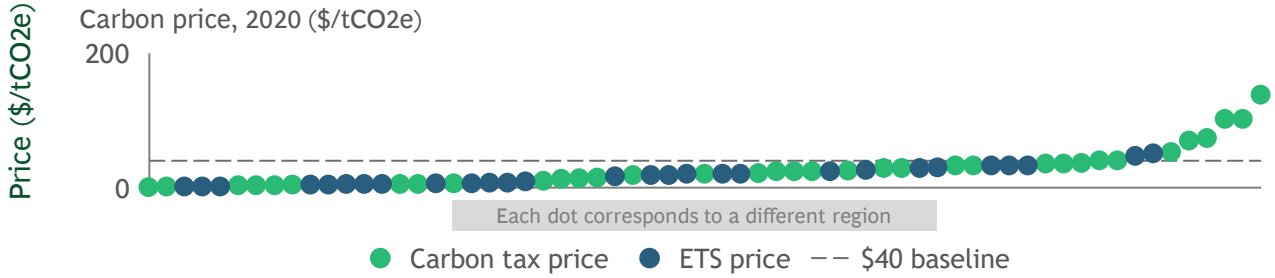
Source: World Bank, Ecosystem Marketplace

Carbon Markets in Numbers

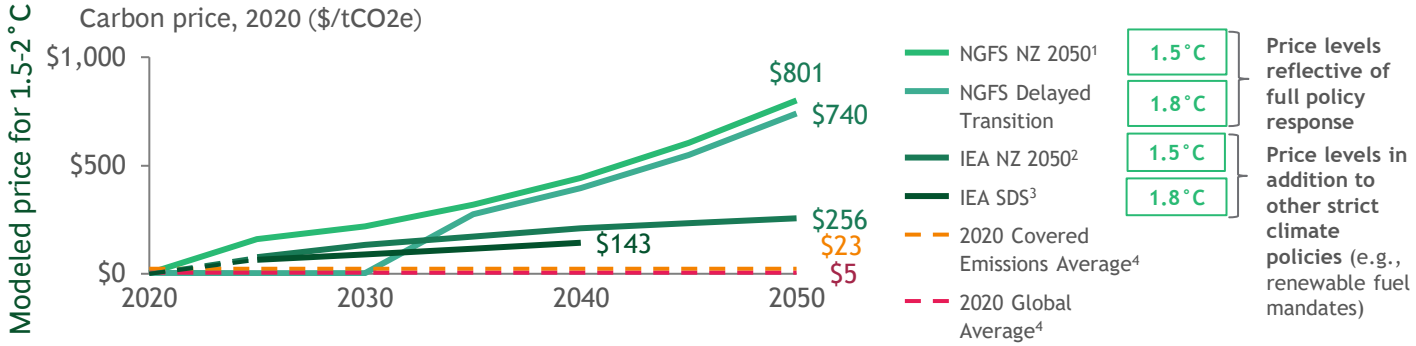
Carbon Pricing (regulated) – incl. Compliance Markets



Only ~15% of prices are above $40/tCO2e



Immediate and significant growth in carbon pricing needed across scenarios



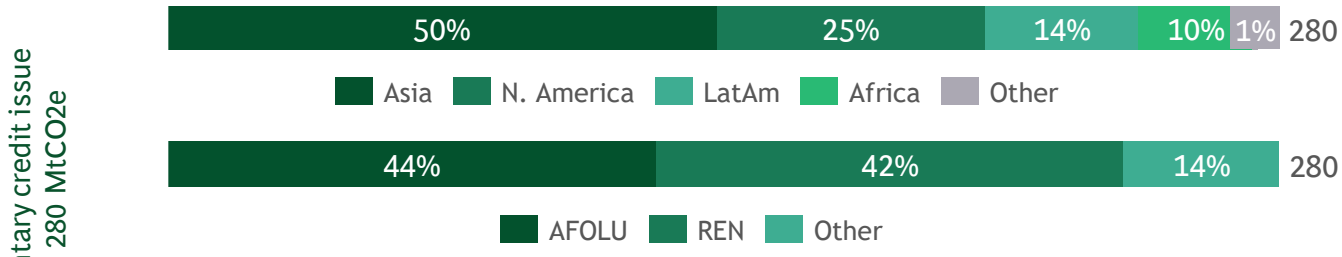
$170B

Value of ETS market allowances in 2021
($275Bn trading volume in 2020)

$1T+

Potential ETS market size by 2030, assuming 40-50%+ coverage of global GHGs; price levels of $50-150

Voluntary Market



$3.1

Average VCM credit price in 2021 YTD
(~$0.8B trading volume)

Up to $50+B

Potential voluntary market size by 2030, assuming ~1-2Gt+ credits at $25-50+

3-10%

Coverage of compliance obligations from VCM credits allowed by 18 ETSs today

1. REMIND-MAgPIE model prices from NGFS Scenario Explorer hosted by IIASA (release 2.2); 2. Future prices for advanced economies from IEA's Net Zero by 2050 Roadmap for the Global Energy Sector, with prices between '20 and '25 estimated; 3. Future prices for advanced economies from IEA's World Energy Model Sustainable Development Scenario, with prices between '20 and '25 estimated; 4. Weighted average of global carbon prices for covered emissions from the World Bank in August 2021 and price of uncovered emissions ($0), normalized to 2020 USD

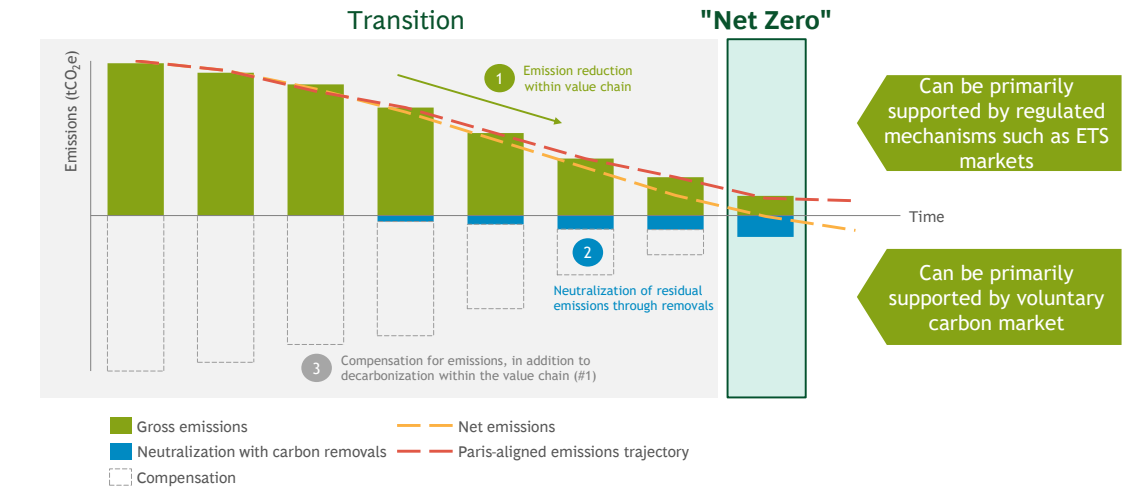
Note: All prices provided in USD from sources, and normalized to 2020 USD using the Bureau of Labor Statistics' CPI inflation calculator

Source: World Bank, ICAP Emissions Trading Worldwide Status Report 2021, TSVCM, Ecosystem Marketplace, IEA, NGFS, Refinitiv, BCG Analysis

Current guidance on decarbonization from leading organizations such as the Science Based Targets Initiative (SBTi) proposes a **preferred approach for corporates composed of (1) reduction of emissions within their value chains with trajectories that are aligned with the goals of the Paris Agreement, (2) neutralization of residual emissions through carbon removals**, and **(3) compensation for emissions during the process of decarbonization** through supporting or financing emissions reductions outside the value chain.[18,19] In-value-chain emissions reductions are incentivized and/or mandated by regulated carbon pricing mechanisms such as compliance markets; neutralization can be enabled through verified carbon removal credits from the VCM, and compensation for emissions can be enabled through the purchase of high-quality credits from the VCM. The additional cost of purchasing high-quality VCM credits will likely also motivate corporates to further explore in-value-chain decarbonization.

Current guidance from SBTi on preferred approach to reach Net Zero

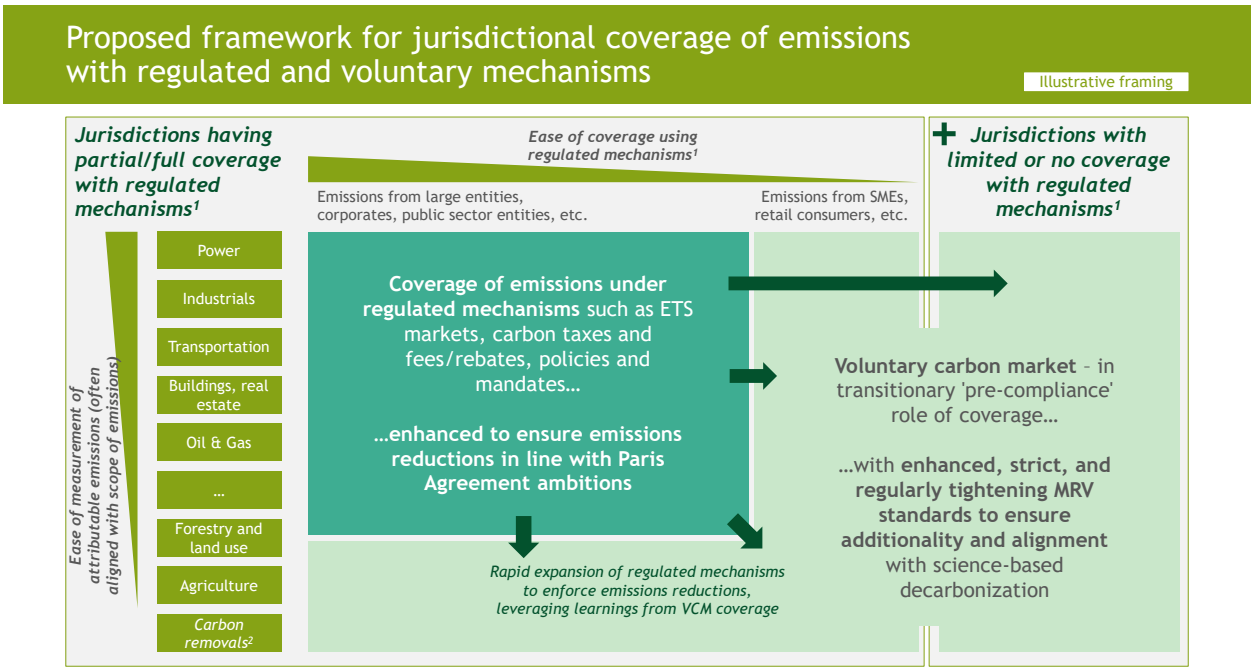
Emissions reductions, neutralization of residual emissions and compensating through the transition



Source: SBTi

From a jurisdictional perspective, where regulated mechanisms already exist at scale, the VCM can serve as a transitionary tool for sectors or entities yet to be covered under these mechanisms. In jurisdictions with limited regulated coverage of GHG emissions, the VCM can act as a starting point to incentivize emissions reductions until regulated mechanisms develop and scale.

[18] SBTi, "The SBTi Net-Zero Manual & Criteria (Version 1.0)," September 2021.
[19] This approach is subject to change as SBTi's September 2021 proposal was open to public consultation.



Key challenges to overcome

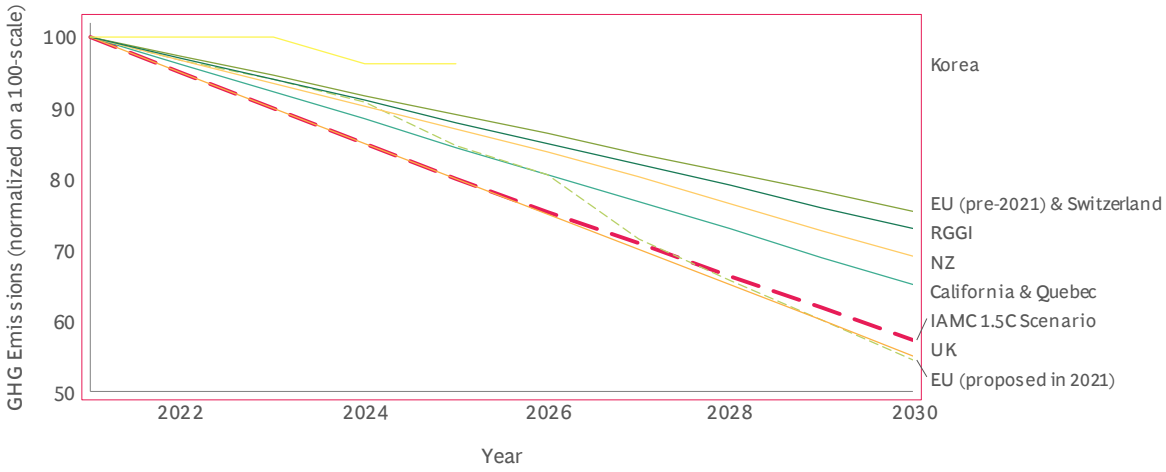
1. Low coverage, price levels, and decarbonization ambitions of regulated carbon pricing

Close to 80 percent of GHG emissions (in excess of 40 $GtCO_2e$ annually) are not covered by regulated carbon pricing today. In addition, most carbon pricing schemes cover less than 40 percent of GHG emissions within a jurisdiction. Further, carbon price levels in several existing compliance markets have remained low because of insufficient carbon emissions reduction goals and overly liberal or free allocation of allowances. A **vast majority (>90 percent) of compliance markets have price levels of less than $40/$tCO_2e$. The global average regulated carbon price is <$5/$tCO_2e$**, with significant disparity in price levels across regions.[1,2]

By contrast, **IEA's Net Zero 2050 scenario estimates the need for a price of ~$75/$tCO_2e$ by 2025, increasing to ~$130/$tCO_2e$ by 2030 in advanced economies along with stringent climate policies**, such as renewable energy mandates, efficiency standards, and the elimination of fossil fuel subsidies.[5] Other organizations, including the International Monetary Fund (IMF), the High-Level Commission on Carbon Prices, and the Organization for Economic Co-operation and Development (OECD), have **estimated that carbon pricing would have to be in the range of ~$50–150/$tCO_2e$ by 2030** to meet Paris Agreement ambitions.[2,3,4] Significant differences between today's prices and target price levels can be addressed through an expanded coverage of GHG emissions and higher

decarbonization ambition levels, as evidenced by the results from the EU ETS, where carbon price levels rose rapidly to >EUR 60/tCO_2e in 2021.

Most regional ETS cap projections are less ambitious than IAMC's 1.5°C projection



Source (data retrieved August 2021): World Bank; IAMC 1.5°C Scenario Explorer and Data hosted by IIASA; EU 2021 Directive 2003/87/EC
BCG Analysis: *IAMC 1.5°C Scenario* - 1.5°C pathways were reported for N2O, CO2, and CH4 separately on IAMC's Scenario Explorer. Data for 1.5°C pathways with low or no overshoot were collected and averaged to create one pathway for each gas. The average pathways were converted to CO2e and then combined to create a single 1.5°C pathway scenario for total GHG emissions. Regional scenarios – derived from regional ETS disclosures reporting future allowance cap plans / projections. All pathways were normalized on a 100-scale to the 2021 value.

2. Credibility of existing VCM

The VCM faces **challenges to the "quality" and credibility of credits, including a skepticism in their emissions impact (additionality, prevention of leakage and double counting, and permanence).** This is exacerbated by inconsistent MRV standards, as well as fragmentation of registries and registry standards.

The VCM credits themselves also are heterogenous by nature given their wide variety of attributes, such as project type, credit type (removal vs. avoidance), vintage, co-benefits to other Sustainable Development Goals (SDGs), etc. **The lack of a taxonomy to define these additional attributes leads to low transparency in the market** regarding the credits being bought. Furthermore, **the absence of a widespread reference index**—that would represent a standard against which credits could be compared and consequently traded with spreads—also leads to **limited trading in the market, making it mostly a buy-and-hold market with limited liquidity and velocity**.

A core underlying challenge is also the lack of market consensus on the eligibility of these credits vis-a-vis climate commitments by corporates and financial institutions. For example, leveraging the credits to assert that an organization is "carbon neutral" is discouraged by leading environmental

groups, such as the SBTi and World Wildlife Fund (WWF). This also raises more fundamental questions about the role of the VCM and the demand driver for VCM credits.

Hence, effective participation in VCM and usage of VCM credits is challenging —except for more sophisticated buyers who understand the intricacies of the market—leading to **low demand and several sub-par credits that sell at low prices. The average price level in this market has remained below $5/credit for several years.** This also leads to **challenges in terms of both supply of high-quality credits that require stronger price levels and long-term demand** for development of projects that deliver robust emissions avoidance or removal.

3. Both compliance and voluntary markets remain fragmented, leading to inefficiencies in decarbonization and smaller, less-liquid markets

Compliance markets are policy-driven and jurisdictional in nature. While some systems are linked—that is, allow fungibility of allowances from other ETSs—most are not. While it is beneficial (from the point of view of efficiency, scale, and liquidity) to ultimately have a large-scale global carbon market, at the same time, **interoperability between ETSs is likely to be productive only between systems with similar rates of decarbonization**. This should still be pursued where feasible, but only with due consideration given to preventing dilution in emissions reduction goals and minimizing disruptions to established ETSs.

VCM markets are also fragmented, with divergent standards and the lack of a single taxonomy with a comprehensive coverage of all relevant attributes. This has also contributed to limited interoperability between voluntary and compliance markets, although there is a small cadre of ETSs that allow for a portion of compliance obligations to be met through compliance offsets. This limited interoperability between compliance markets and the VCM often stems from the potential risks of diluting ETS ambitions, since it is difficult to ensure VCM credits are of "high quality".

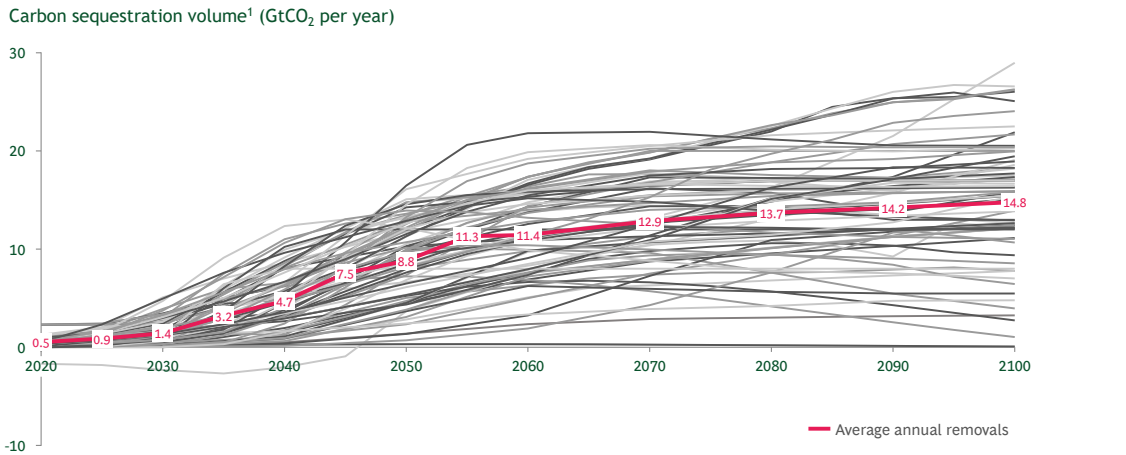
4. Carbon removals are necessary, but the market mechanism remains unclear

Carbon removals are essential for global emissions reduction goals. IPCC-modelled scenarios that restrict global warming to 1.5°C, with limited or no overshoot, **project that on average ~1–10 Gt of annual CO_2 removals** will be needed over the 21st century.[20] At the same time, currently there is **no clear revenue source for removals given the limited use for physical products and an unclear marketplace to connect global buyers and sellers. Without a scaled marketplace to trade carbon**

[20] IPCC Special Report: global warming of 1.5°C, October 2018.

removals and generate revenue, significantly less financing will be channeled toward carbon removal projects and technologies. In turn, this will lead to fewer carbon removal projects, making it difficult to achieve the 1.5°C global warming ambition. **Additionally, without a clear marketplace, there are likely to be persistent inefficiencies given the multitude of available removal technologies and their geographic dispersion, as well as a lack of common understanding** within corporations of these technologies and solutions.

~10 Gt annual removals needed by mid-century to maintain the 1.5°C pathway



1. Average of sequestration volumes in 78 different 1.5°C pathways from the IPCC SR15, including from the GCAM, MESSAGE-GLOBIOM, and REMIND-MAgPIE models, where sequestration volume is the sum of sequestration from biomass, direct air capture, enhanced weathering, and land use
Source: IAMC 1.5°C Scenario Explorer hosted by IIASA

There are a few different options for establishing a carbon removals market mechanism, including (1) ETSs allowing removals as fungible instruments in lieu of carbon allowances, essentially feeding additional permits to emit up to the verified amount of carbon removed; and (2) the VCM taking on an additional role as a marketplace for removals, with ETSs allowing interoperability between verified removal credits from the VCM and their compliance allowances.

5. Lack of standardization of certain dimensions further limits scale and liquidity in both compliance and voluntary markets

Given the rapid yet fragmented development of carbon markets globally, there are **certain challenges involving standardization—of product features, contracts, financial accounting and reporting**

guidelines, carbon accounting, financial and prudential regulations, etc.—resolution of which could enable more rapid evolution and scaling of carbon markets.

Aside from templates for EU and U.K. allowances from the International Swaps and Derivatives Association (ISDA) and the European Federation of Energy Traders (EFET), there's limited broad contract standardization for other ETS instruments and voluntary credit trades, and limited transparency on standardized set of VCM credits attributes. VCM credit taxonomy definitions and standardization are being pursued by industry activities such as the TSVCM, which has proposed the definition of core carbon principles (CCPs) and the creation of a taxonomy with additional attributes. There is also a lack of harmonized financial accounting and reporting guidelines, which hinders comparability between companies and creates uncertainties with respect to tax treatment of carbon instruments, including allowances and credits.

While the GHG Protocol[21] serves as a strong foundation for carbon accounting, it is limited by a lack of clear guidance for all sectors on scope 1–3 emissions and attribution to relevant stakeholders. While sector-specific initiatives such as the Partnership for Carbon Accounting Financials (PCAF) and International Petroleum Industry Environmental Conservation Association (IPIECA) help set guidance for their industries, they need further refinement and consensus to be considered established standards. Such clarity could be helpful in introducing scope 3 emissions wherever needed under ETS initiatives or other coverage mechanisms, thus enabling them to effectively scale.

Furthermore, there are open questions about the appropriate financial and prudential regulations for carbon instruments and derivatives trading, including the implications of proposed changes under Basel III's Fundamental Review of the Trading Book (FRTB), which penalizes banks for holding carbon instruments (through a high risk weight for carbon trades, and high capital charges for carry positions, as per ISDA) and could have negative impacts on their participation in carbon markets.[65]

Finally, there is no standard "playbook" or set of guidelines for designing ETSs based on lessons from past ETSs and to ensure alignment with Paris Agreement ambitions. This leads to fragmentation and heterogeneity across multiple ETSs, however initiatives such as the International Emissions Trading Association contribute to standardization.

[21]A climate science body that provides standards, guidance, and training for businesses and governments to measure their GHG emissions.

Vision for the evolution of carbon markets

This report lays out a **vision for a future for carbon markets—from a practitioner's perspective—that supports efficient science-based decarbonization aligned with Paris Agreement ambitions**. The report describes how carbon markets can leverage lessons from past experiences to overcome key challenges (noted in Section 1), and evolve and expand over the next three decades in support of global carbon neutrality, ultimately scaling down to the level of unavoidable emissions and required carbon removals once Net Zero is achieved globally by 2050.

Vision for Evolution of Carbon Markets to support global decarbonization in line with Paris Agreement ambitions

Topic	Short-term *(within 1-2 years)*	Medium term *(~5 years)*	Long term *(~10 years)*	End-state goal *(global Net Zero achieved/exceeded)*
Policy-based coverage of global GHG emissions with regulated mechanisms aligned with 1.5°C ambition	• Carbon pricing (ETS / tax) **established in majority of carbon-intensive jurisdictions** • **Planned coverage of >50%**	• **Majority (>50%) of GHG emissions covered, allowance retirement aligned with 1.5°C pathway** (>5% linear reductions) • **CBAMs in effect where needed** until globally consistent emissions ambitions	• **Near-full coverage of GHGs** by pricing or control mechanisms • **Absolute ETS market value exceeds $1T+** • **Interlinking of similarly ambitious ETS markets,** incremental moves toward regional/global carbon markets	• Emissions **allowances equivalent only to unavoidable emissions**… • …balanced by **carbon removals, achieving global Net Zero** or global carbon neutrality
Robust global voluntary market for supply of high-quality credits	• **Standardized taxonomy for classifying credits, reference contracts and indices** • **Stricter, science-aligned, harmonized MRV processes** • **Market consensus on use of VCM credits (and accounting)** — driven as per climate science and standard-setting bodies • Selective VCM **interoperability in ETS markets with strict limits and eligibility** as per climate science to ensure additionality	• VCM market supplying **high-quality carbon credits as per taxonomy and MRV standards,** supported by technology-based verification • **Large-scale demand as compensation** for emissions and **neutralization purposes** • **Large-scale interoperability once VCM integrity established**	• VCM supplies **at-scale carbon removals for neutralization purposes** • **Avoidance credits plateau** given coverage instead by regulated mechanisms (ETS, tax, or control mechanisms)	• **No avoidance credits** since all avoidance measures already in effect • **VCM continues as global marketplace for carbon removals to neutralize residual emissions and to pursue negative emissions** as needed for climate trajectory
Scaled market demand and improved market maturity	• **Awareness and clarity for corporates and financial sector** on use of ETS and VCM carbon instruments • **Standardized universal carbon accounting framework**, clarity across sectors on scope 1-3; incl **clarity on terminology of claims** (e.g., "Net Zero", "Carbon Neutral", etc.)	• **Carbon instruments established as mature and investable asset class** with suite of financial products from financial sector to support corporate and investor needs on compliance, risk management, and investment	• Seamless **interoperability between (1) ETS markets that have aligned climate ambitions** and pathways; and (2) **high-quality VCM credits** maintaining stringent eligibility and quality considerations	• **Scaled-down but efficient markets dealing only with residual emissions and requisite carbon removals** to meet climate goals

Recommendations to support the achievement of this vision

#1 (detailed in Section 4.1): We recommend that policymakers and regulators expand the scope of geographic, sectoral, and activity coverage of compliance ETS markets, and strive toward near-full coverage by one or more GHG pricing and/or GHG control mechanisms within the next five years. High-impact ETSs should be designed by incorporating key learnings from other ETSs and stringent allowance reductions aligned with emissions pathways that achieve 1.5°C ambitions.

⇒ Policymakers should **aim for near-full coverage of GHG emissions within their jurisdictions through one or more mechanisms (ETSs, carbon taxes, fees/rebates, and control-based mechanisms).** These should be designed while considering interactions with other environmental, fiscal, and monetary policies that influence emissions (e.g., eliminating fossil fuel subsidies, introducing clean energy mandates, etc.), and supported with long-term policies that promote Paris-aligned decarbonization of the economy.

⇒ For ETS initiatives, policymakers should apply learnings from successful ETSs, including **(1) steep ~5 percent+ linear reductions per year in allowance levels**, aligned and updated with latest climate scenario modeling; **(2) establishment of fixed-cap (absolute emissions) systems** as opposed to intensity-based systems to align with total carbon budgets; **(3) classification of allowances as financial instruments**;[22] **(4) use of auctioning** in lieu of free allocation to maintain sufficient price levels and drive decarbonization; **(5) consideration of CBAMs** to prevent leakage and maintain competitiveness; and **(6) consideration of other emissions-reduction mechanisms** (e.g., taxes, fees/rebates, and policies) when designing ETSs.

#2 (detailed in Section 4.2): We recommend that standard-setting bodies, in coordination with the broader ecosystem, facilitate the transformation and scaling of the VCM to ensure its integrity, role, and additionality.

⇒ **Clarify role of the VCM**. This report envisions 3 key roles:

- Serve as a **transitionary coverage mechanism for sectors or regions that are not covered by ETSs, carbon taxes, fees/rebates, or mandates** until regulated mechanisms take over and ultimately scale down as emissions are reduced
- Serve as a **core long-term global marketplace for carbon removals**, thereby supporting the growth and funding of critical new technologies, and supporting neutralization of residual emissions
- Offer a **complementary mechanism for corporates to compensate for their emissions**, in a way that can help channel capital to the markets with the greatest need (e.g., underdeveloped economies) while entities continue to pursue decarbonization within their value chains

⇒ Develop a set of **stringent baselines and MRV standards across certifiers** that ensure VCM credits can drive **verifiable emissions reductions that are "additional,"** and establish a **regular process to make these standards increasingly stringent with tighter thresholds to ensure that VCM projects maintain additionality** while also ensuring permanence and preventing leakage.

[22] As already done for EU allowances, where they are recognized under MiFID II.

⇒ **The VCM governance body should work to harmonize MRV standards** and leverage new technologies such as satellite mapping for verification, and blockchain/DLT for establishing robust registry systems.[23]

⇒ As part of its mandate to develop and host a set of CCPs, the VCM governance body should establish a **consistent taxonomy with additional attributes characterizing VCM credits**[23] with clear gradations of quality, type of credit (removal vs. avoidance), linkages with broader SDGs goals, etc.; **creation of reference index grades in the VCM**.

⇒ The VCM governance body should help achieve market **consensus on the role of VCM credits in claims** (e.g., "carbon responsible," "net zero," "carbon neutral").[23]

⇒ Set up of a **global meta-registry** to be overseen by the VCM governance body to serve as a common global marketplace and, in the future, interoperate with multiple ETSs.[23]

#3 (detailed in Section 4.3): We recommend that policymakers and regulators, over time, enable selective interoperability among compliance markets with similar ambitions; and permit the use of limited quantities of high-quality verified VCM credits in compliance markets after their credibility and additionality are established.

⇒ Interoperability between multiple ETS initiatives **should be pursued only where ambition levels (i.e., rates of decarbonization) are aligned between markets to prevent dilution of decarbonization ambitions**.

⇒ Policymakers should consider **interoperability for certain high-quality VCM credits within ETS markets for sectors difficult to cover in the short term by ETS/tax/fees/rebates/mandates (e.g., forestry and agriculture) and verified carbon removals.** In doing so, policymakers should catalogue relevant national assets (e.g., forests) and define eligibility lists for VCM projects to fast-track interoperability and to enable development of nature-based solutions. A key prerequisite would be to **ensure additionality as per #2, without which interoperability would be counterproductive**.

⇒ Policymakers should be mindful of the benefits and challenges of interoperability, and put into place appropriate conditions (e.g., **stringent caps on the portion of compliance obligations** that can be met through high-quality VCM credits, **clarity on specific VCM credits that are eligible and additional,** and **stringent quality requirements with high-quality MRV standards).**

#4 (detailed in Section 4.4): We recommend that market participants and infrastructure providers, policymakers, regulators, standard-setters, and climate science bodies drive standardization of carbon market products, accounting, and legal frameworks, and develop best practices for regulating both carbon markets and associated trading activities for allowances, credits, and derivatives.

⇒ Regulators should collaborate with market participants and trade associations such as ISDA to **standardize contracts for different ETS carbon products across markets and refine the application of Basel III and the FRTB** to carbon instruments and derivatives.

⇒ As per TSVCM, the VCM governance body should work swiftly to **set standards such as the Core Carbon Principles (CCPs), define a taxonomy with additional attributes, and oversee the market**,

[23] As identified also by the IIF TSVCM.

all while driving toward harmonized MRV processes and common VCM registry standards, as described in recommendation #2.

⇒ International accounting bodies (e.g., the International Accounting Standards Board (IASB) and Financial Accounting Standards Board (FASB)) should establish a **common financial accounting framework for carbon instruments and derivatives**.

⇒ Policymakers and regulators in compliance markets should collaborate to leverage best practices for regulating ETSs, including development of a **standard framework for developing allowance registry systems[24] for ETSs**.

#5 (detailed in Section 4.5): We recommend that—as a key enabler for carbon markets—leading climate science and standard-setting bodies develop a universal carbon accounting framework that includes policies for measuring and reporting scope 1–3 emissions across different sectors and drives consensus on nomenclature and the definitions of claims such as "net zero" and "carbon neutral."

⇒ Leading climate science bodies should drive the **development of a universal carbon accounting framework in collaboration with sector-specific associations and corporates to expand the scope of measurement to a broader set of entities (including smaller corporates and private companies), enable disclosures, and facilitate application of GHG pricing mechanisms such as ETS markets to mitigate emissions**.

⇒ **Sector-specific accounting methodologies should continue to be refined and aligned** as a prerequisite to accurate disclosures of emissions.

⇒ Policymakers, standard-setters, and climate science organizations should agree on such a framework against which entities should report on their emissions. This carbon accounting framework should also **provide guidance and consensus on terminology and definitions for climate-related claims** and the usage of VCM credits toward those claims.

#6 (detailed in Section 4.6): Banking and capital markets firms are supportive of these recommendations and committed to building a suite of capabilities and product offerings—for both compliance markets and the VCM—to help market participants address their compliance, decarbonization, investment, financing, and risk management needs, thereby supporting robust, competitive, liquid, and mature markets.[25]

⇒ Build out capabilities to provide corporate and investor clients access to **trading infrastructure, advisory services for use of carbon market solutions, risk management and hedging solutions, a suite of carbon market products, and collective action, partnership, and thought leadership** on carbon markets.

⇒ **Scale derivatives markets** associated with new ETS schemes, building exchange-traded and over the counter (OTC) futures, forwards, options, swaps, etc. to meet the risk management and investment needs of clients with exposures to carbon markets.

[24] Registry systems are used to account for carbon instruments such as allowances in ETSs.
[25] Based on broad representation across global banking and capital markets sector that participated in or was interviewed during the development of this report.

⇒ **Develop new investment products** (using ETS carbon instruments and derivatives as an asset class) such as carbon-index-tracking exchange-traded funds (ETFs) and **integrate carbon derivatives as hedging solutions in existing funds** with carbon exposures.

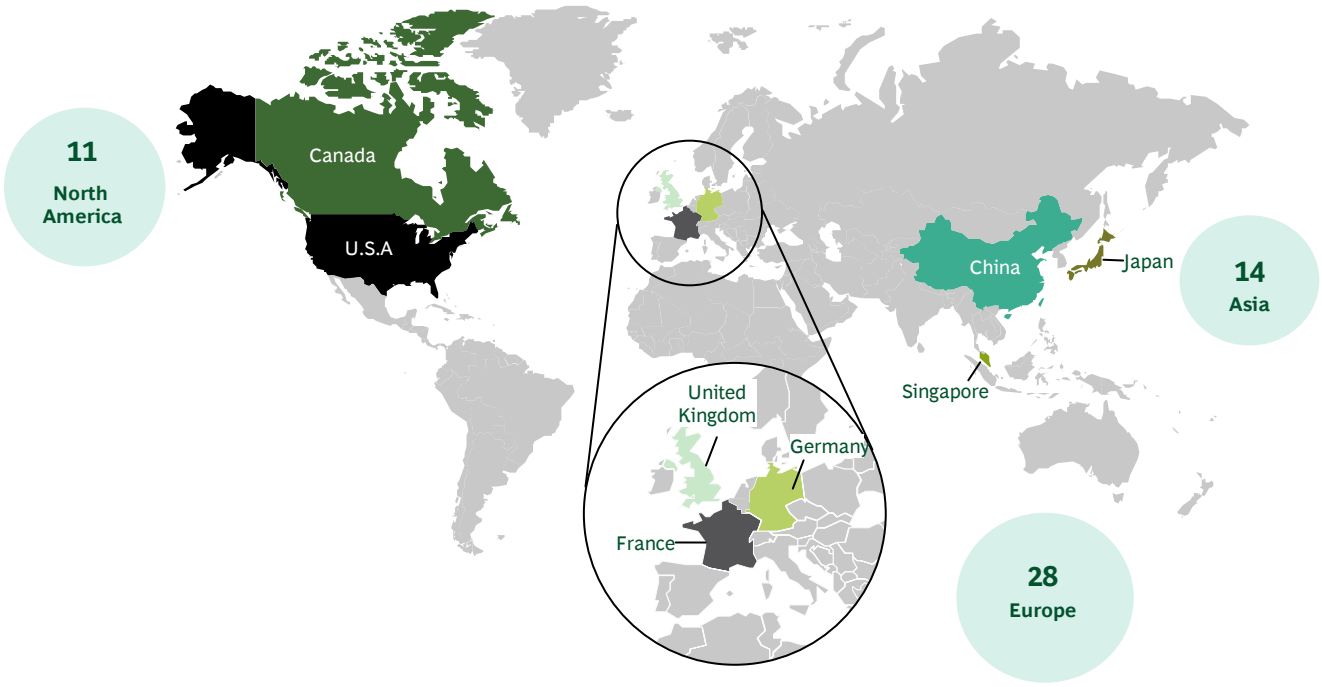
⇒ **Develop new investment products (using VCM credit retirements)** as "carbon responsible" funds (aligning terminology with market-guidance on claims that are allowed) to meet demand from ESG-focused investors and ensure that they do not claim to drive "net zero" as per current guidance and definitions.

⇒ **Facilitate long-term offtake agreements between corporate/investor clients and high-quality project developers** (as determined by stringent MRV standards and a taxonomy as aligned in earlier recommendations) and facilitate both **vanilla and innovative financing solutions** aligned with the risk-return profiles for these projects.

It has been nearly three decades since 150 states signed, in 1992, the UN Framework Convention on Climate Change (UNFCCC), **an international treaty to combat climate change** with the goal of stabilizing atmospheric GHGs to a level that would prevent further global warming. **In that time, annual GHG emissions have increased by more than 50 percent from ~30 $GtCO_2e$ to over 50 $GtCO_2e$.**[1] The world has warmed by approximately 1°C already, with 1.5°C anticipated as inevitable within the next few decades. With 300–500 Gt of total carbon budget left, **a swift decline in emissions must occur during the next three decades, down from the current 50 $GtCO_2e$ per year to a global net zero on GHG emissions.**[1,15] **Action can no longer be delayed. All levers must be pulled immediately, including a rapid scaling of carbon pricing and all carbon markets, in terms of both their GHG emissions coverage and their decarbonization ambitions.**

Table of figures

~60 market participants interviewed across the globe



Sustainability Banking & Advisory: roles including Director of Global Sustainable Finance, Global ESG Products Head, Head of Sustainability, Wealth Management Structuring Specialist, Relationship Banker for Energy Clients, Head of Carbon Markets Development, Sustainable Finance Taskforce Head, and Director of Sustainable Business Origination, Managing Director of Sustainable Markets

Commodities and Trading: roles including Vice President of Commodities Trading, Managing Director of Strategic Commodity Solutions, and Structured Commodity Solutions Specialist

Policy executives: roles including Vice President of Regulatory Policy, Head of Capital Markets Policy, Managing Director and Counsel, and Regulatory Engagement Specialist

Other market participants (exchanges, advisors, legal firms, etc.): roles including Head of Regulatory Affairs, Head of Sustainability and Sustainable Finance, ESG Specialist, Legal Partner, Independent Climate Advisor, Managing Director of Utility Markets, and Executive Director of a Conservation Institute

Contacts

Allison Parent
GFMA
Executive Director
aparent@global.gfma.org

Scott Goodwin
GFMA
Assistant Vice President
sgoodwin@globa.gfma.org

Kathleen Traynor
GFMA
Advisor, Commodities
ktraynor@eu.gfma.org

Rick Watson
AFME
Managing Director, Head of Capital Markets, Membership & Events
rick.watson@afme.eu

Oliver Moullin
AFME
Managing Director, Sustainable Finance & General Council
Oliver.moulin@afme.org

Matthew Chan
ASIFMA
Executive Director, Head of Public Policy & Sustainable Finance
mchan@asifma.org

Melissa MacGregor
SIFMA
Managing Director & Associate General Counsel
mmacgregor@sifma.org

Roy Choudhury
Boston Consulting Group
Managing Director & Partner
Choudhury.Roy@bcg.com

Anders Porsborg-Smith
Boston Consulting Group
Managing Director & Partner
Porsborg-Smith.Anders@bcg.com

Arjun Nath
Boston Consulting Group
Associate Director, Sustainable Finance, Total Societal Impact
Nath.Arjun@bcg.com

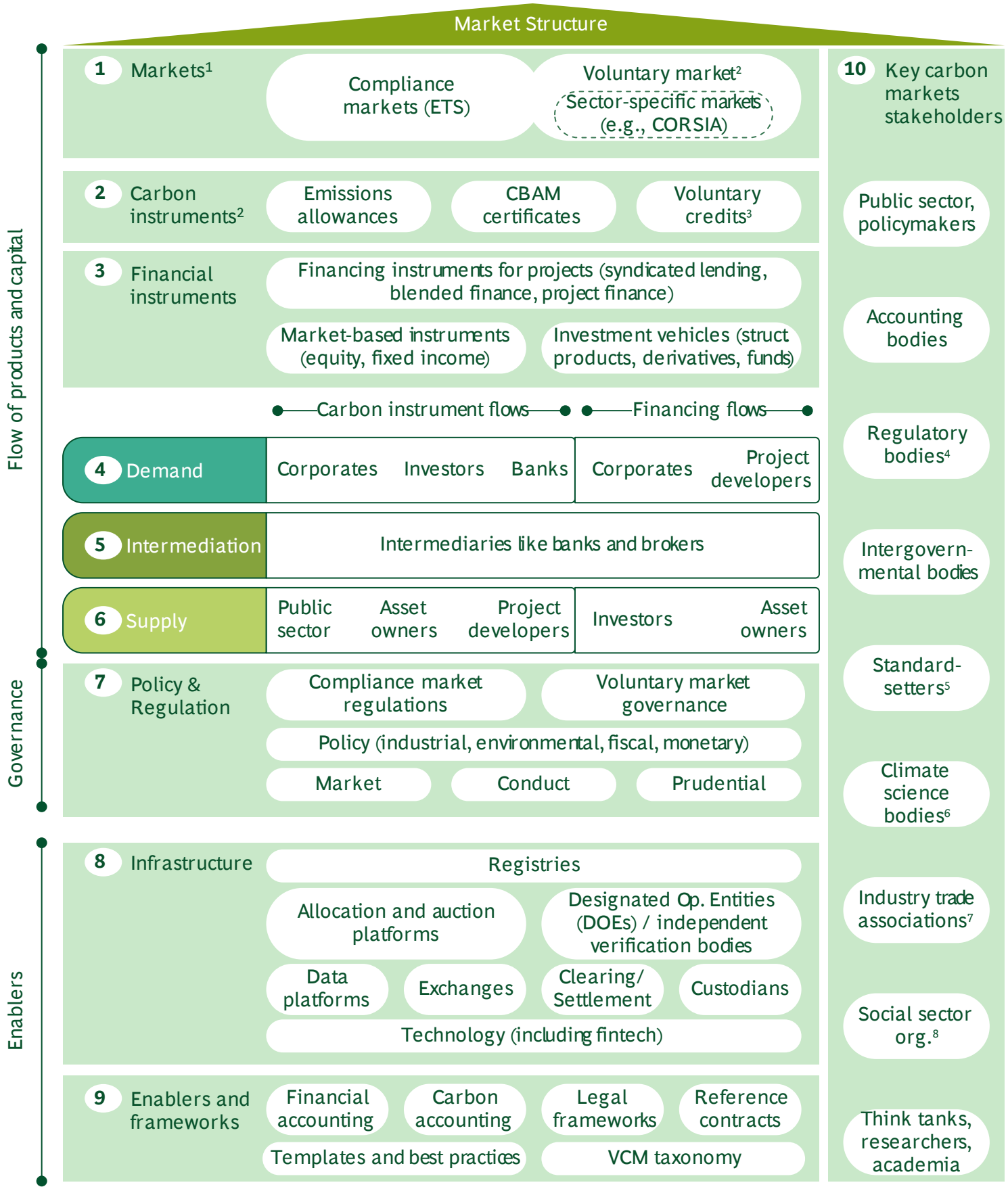
Rich Hutchinson
Boston Consulting Group
Managing Directo & Senior Partner, Global Social Impact Leader
Hutchinson.Richard@bcg.com

Kilian Berz
Boston Consulting Group
Managing Director & Senior Partner, Global Financial Institutions Leader
Berz.Kilian@bcg.com

Gwenhaël Le Boulay
Boston Consulting Group
Managing Director & Senior Partner
LeBoulay.Gwenhael@bcg.com

Veronica Chau
Boston Consulting Group
Director & Partner
Chau.Veronica@bcg.com

Carbon markets structure



1. Some linkages between compliance markets and the voluntary market exist today; 2. In some ETS markets such as the EU, carbon allowances are treated as financial instruments; 3. Includes both credits issued by designated operational entities (DOEs) and independent verification bodies; 4. Such as ISDA and the Basel Committee; 5. Such as Verra and the Gold Standard; 6. Such as SBTi and the GHG Protocol; 7. Such as the International Civil Aviation Organization (ICAO); 8. Such as NGOs and foundations

1 Section 1: Background and context

1.1 The importance of carbon pricing

Climate change poses significant economic and financial risks to the global economy. In order to mitigate climate change, the landmark Paris Agreement aims to keep the global temperature rise (i.e., global warming) this century to well below 2°C above pre-industrial levels and pursue efforts to limit the temperature increase to no more than 1.5°C. The world is already approximately 1°C warmer than pre-industrial levels;[20] intermediate and high-emissions scenarios show warming forecasts between 2.7°C and 4.4°C.[15] For reference, **the last time the global surface temperature was at or above 2.5°C higher than the reference range was over 3 million years ago**.[26]

In order to limit global warming, cumulative carbon dioxide (CO_2) emissions must not exceed a specific carbon budget. **Achieving the Paris Agreement ambition of 1.5°C would mean an estimated 300–500 $GtCO_2e$ of total carbon budget.**[15] **At current levels of GHG emissions, the world would use up this entire budget in less than ten years.**

Meeting the Paris Agreement targets will require a significant reshaping of the global economy, including a transition away from fossil fuels as the main energy source toward renewable alternatives, greater energy efficiency and electrification, and the development of new low-carbon technologies across sectors. **As highlighted in our previous publication, "Climate Finance Markets and the Real Economy," an estimated $100–150+ trillion investment would be needed across sectors and regions over the next three decades** to limit temperature rise to 1.5°C.[16]

CO_2 and other GHG emissions cause negative externalities (indirect costs to individuals and society) that are not adequately priced into the real economy. This has caused **a systemic economic market failure because the environmental costs (e.g., GHG emissions) of products and services are not accounted for, leading to overproduction of GHG emissions.** These unpriced externalities are unevenly distributed across economic sectors and jurisdictions, leading to significant market inefficiencies and distortions. In the absence of regulatory mechanisms to price in these

[26] World Meteorological Organization, The State of the Global Climate 2020, April 2021.

externalities, carbon-intensive technologies remain more viable and competitive, thereby creating an uneven playing field between low-carbon and high-carbon activities.

Adequate pricing of GHG emissions is a critical requirement for the achievement of the Paris Agreement goals—and carbon markets are an essential tool in enabling an effective and efficient marketplace for deploying this lever. Carbon markets offer a flexible market-based approach that creates a responsive price on carbon—a price that proactively adjusts to market supply and demand.

In this report, "carbon pricing" refers to initiatives that put an explicit price on GHG emissions—paid for by the entities that emit the GHGs—expressed in a monetary unit per tonne of carbon dioxide (tCO_2) or carbon dioxide equivalent (tCO_2e).[27] Carbon pricing introduces an economic incentive for corporations to emit less and enhances the competitiveness of low-carbon technologies, thereby mobilizing capital to finance decarbonization. The various mechanisms for pricing carbon (e.g., carbon tax and carbon markets) are discussed in Section 1.2.

There is broad consensus around the need for pricing GHGs. A range of market stakeholders, industry bodies, and societal actors support a market-based approach (such as compliance carbon markets and carbon taxes) to capture the full cost of emissions. For instance, most interviewees from 2020's Climate Finance report, including corporations, asset managers, policymakers, and regulators, voiced their support for introducing carbon pricing in order to reduce climate-change impacts.[16]

"A price on carbon would provide an effective incentive to reduce GHG emissions and mitigate climate change, including through the development and deployment of breakthrough technologies… Establishing a clear price signal is the most important consideration for encouraging innovation, driving efficiency, and ensuring sustained environmental and economic effectiveness." —Business Roundtable[28]

"A key driver of climate change is the failure to account for the externalities associated with GHG emissions, or in other words, the failure of market prices in the economic system to incorporate the social costs of emissions" —Financial Stability Oversight Council[17]

[27] World Bank State of Carbon Pricing, 2020.
[28] https://www.businessroundtable.org/climate.

"If greenhouse gas emissions do not come at a price, we will continue to treat those emissions economically as if they were non-existent. The solution to this problem is a price on CO_2 emissions connected to the market. Carbon pricing is an important part of the strategy towards a low carbon economy." —Climate Alliance[29]

"Financial markets will only be able to channel resources efficiently to activities that reduce GHG emissions if an economy-wide price on carbon is in place at a level that reflects the true social cost of those emissions. Addressing climate change will require policy frameworks that incentivize the fair and effective reduction of GHG emissions. In the absence of such a price, financial markets will operate sub-optimally, and capital will continue to flow in the wrong direction, rather than toward accelerating the transition to a net-zero emissions economy." —The U.S. Commodity Futures Trading Commission (CFTC)[30]

1.2 Mechanisms to establish carbon pricing

Methods of regulating GHG emissions (control-based vs. market-based)

GHG emissions can be regulated through either control-based or market-based mechanisms.

Control-based mechanisms

Control-based (command-and-control) mechanisms use government-set standards to regulate polluters. Typical control-based standards include ambient, technology-based, and performance-based standards. Ambient standards designate the final level of pollutant (e.g., air or water quality) allowed in the environment. They are less common because they are hard to enforce as they do not establish specific limits on polluters' activities. Technology- and performance-based standards, on the other hand, can be directly enforceable and are often the preferred control mechanisms. Technology-based standards designate the specific system or equipment required to reach an abatement level, while performance-based standards designate a maximum level each polluter is allowed to emit without specifying the technology.

A drawback with control-based mechanisms is that they are typically uniform (e.g., requiring all power plants to emit some given level of CO_2 per kilowatt-hour of electricity produced). This

[29] https://www.climatealliance.org/activities/projects/carbon-pricing-for-municipalities.html.
[30] Managing Climate Risk in the U.S. Financial System.

uniformity can lead to sub-optimal scenarios because the chosen pollutant level (performance) or equipment (technology) may not be the most cost-effective for all polluters. Control-based mechanisms can be the more appropriate choice when there is a well-understood technology or emissions profile for a sector, and where implementation of market-based mechanisms is potentially more difficult (e.g., where most emissions fall within scope 3). For example, the U.S. has enacted corporate average fuel economy (CAFE) standards to reduce energy consumption through improved fuel economy in cars and light trucks. This has resulted in significant emissions reductions.[31]

Market-based mechanisms

Unlike control-based mechanisms, market-based mechanisms provide a financial incentive designed to elicit behavior from those responsible for the actions to be mitigated. Market-based mechanisms can, frequently, reduce GHG emissions more cost-effectively by using price-based measures to incentivize polluters to emit less.[32] Revenues from market-based mechanisms for carbon pricing can also be put toward other initiatives that combat climate change. Market-based mechanisms include emissions taxes, ETSs, and fees and rebates.

One drawback of market-based mechanisms is that regulated entities will only have an incentive to reduce their emissions as long as it is financially valuable for them to do so. In this way, if it costs less to be out of compliance with the market-based mechanism (i.e., such as incur a relatively low penalty), the system can be undermined (i.e., entities will pay the price rather than reduce their emissions).

As a means of disincentivizing polluters from emitting, carbon taxes may be applied to GHG emissions and can be levied at any point in the supply chain. As of 2021, 35 carbon taxes have been implemented around the world. The first carbon tax was implemented by Finland in 1990. Sweden followed in 1991, increasing the tax rates since its initial establishment to the highest level in the world at SEK 1,200/tCO_2e (~$137/$tCO_2e$). However, most carbon taxes fall in a lower range, such as Singapore's carbon tax of ~$4/$tCO_2e$, introduced in 2019.[1]

[31] https://www.transportation.gov/mission/sustainability/corporate-average-fuel-economy-cafe-standards.
[32] Center for Climate and Energy Solutions, Market Mechanisms: Options for Climate Policy, April 2020.

An ETS (a compliance carbon market) is another cost-effective market-based approach to carbon pricing that is mainly modeled as a **cap-and-trade** or **baseline-and-credit system** (see Figure 1 for a detailed illustration of a cap-and-trade ETS).

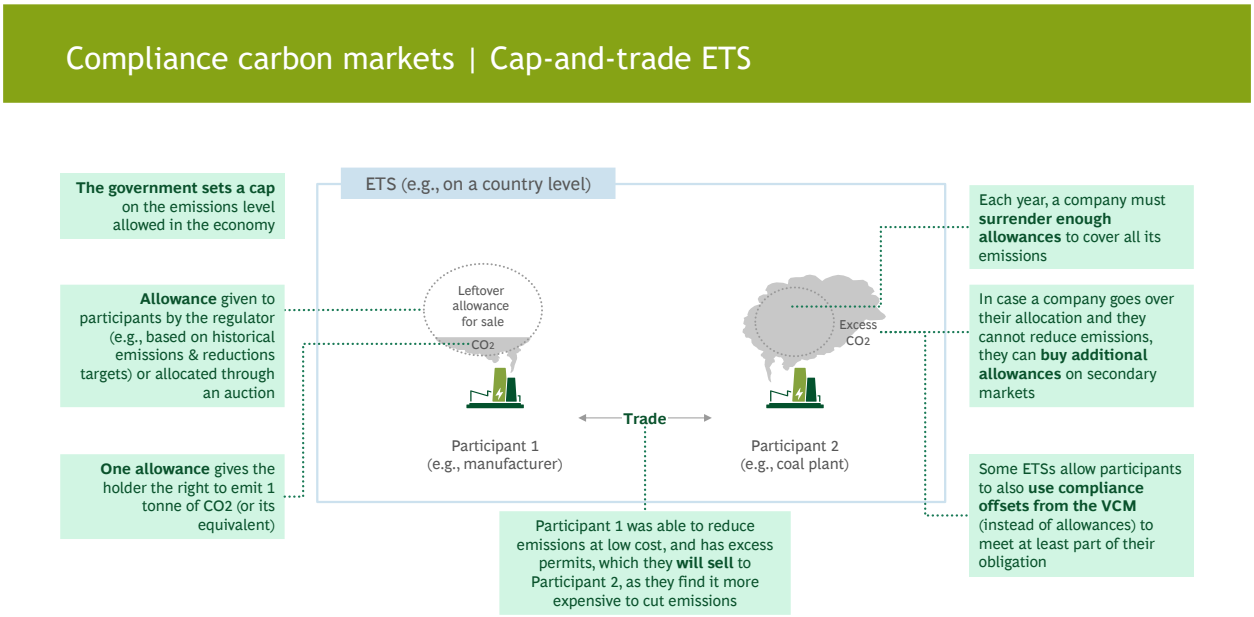


Figure 1: Illustrative cap-and-trade ETS mechanism

In a compliance **cap-and-trade system,** regulatory authorities set a cap, or upper limit, on GHG emissions through a fixed quantity of allowances for a defined compliance period. **This cap on allowances decreases with each succeeding compliance period.** Market participants are issued a number of allowances, designating how much they may emit during a compliance period. Allowances are allocated to covered entities through either free allocation or auctioning in the primary market. In the secondary market, companies can also buy and sell allowances to meet their compliance requirements. **By setting a cap on emissions that declines over time, a cap-and-trade system can theoretically guarantee decreasing emission levels.** However, active cap-and-trade programs such as the EU ETS have faced issues such as volatile emission allowance prices and weak emission caps—issues that must be actively managed to ensure sufficiently high system integrity.[33]

[33] https://www.wri.org/insights/carbon-tax-vs-cap-and-trade-whats-better-policy-cut-emissions.

In a compliance baseline-and-credit system, regulatory authorities establish an emissions limit using an industry-specific baseline calculation methodology. There is no explicit cap on aggregated emissions. Rather, each firm has the right to emit a certain level of GHGs based on their economic activities in baseline years, their current technology constraints, or the average emission intensity of comparable entities in the same industry. Entities that perform better than the baseline—as determined by such factors as industry sector, type of emission, and technology—can accrue credits and sell them to other entities that underperform in terms of GHG emissions reductions. By setting progressively decreasing targets, this type of program incentivizes regulated entities to improve their carbon intensity. However, since there is no cap on total emissions, a baseline-and-credit system can allow for increased emissions as more companies enter the regulated market or as production levels increase. This runs counter to the requirement of limiting global warming to a certain level and reducing overall GHG emissions to a total cumulative budget.

There is also an inherent trade-off between a tax-based regime and an ETS-based system: cost certainty versus environmental certainty.[34] Tax-based systems inherently set a certain price level, but the environmental outcomes must be estimated up front, with price levels subsequently adjusted as needed. And while a tax sets a price on emissions, it does not specify a limit on the amount of emissions. So the actual amount of emissions that will be generated under the tax is uncertain. Conversely, ETS-based cap-and-trade systems introduce greater certainty about emissions levels (and resulting environmental impact). And while ETSs can lead to uncertainty about future carbon price levels, there are mechanisms that help manage this uncertainty (e.g., price floors and ceilings, allowance reserves, etc.), further discussed in the Annex - Use of Market Stability Mechanisms in ETSs.

Compared to carbon taxes and ETSs, "feebates" are more-targeted examples of a market-based mechanism that imposes a "fee" for purchasing a high-emitting product and offers a "rebate" or subsidy to reward those that purchase low-emitting products. As an example, feebates often apply to the transportation industry, where the focus is to encourage drivers to purchase more fuel-efficient vehicles.

Jurisdictions often leverage multiple mechanisms that complement each other to regulate GHG emissions (see Figure 2 as an example of this in California). This is often driven by a combination of

[34] Center for Climate and Energy Solutions, "Market Mechanisms: Options for Climate Policy."

factors such as ease of measurement, administrative ease of implementation, market sentiment, etc.

Use of market-based and control-based mechanisms in California

Non-exhaustive

	Market-based		Control-based
Sector	Cap-and-Trade	Performance Standards with Credit-trading	
Transportation (Emissions: 170.32MtCO2e)		**Low Carbon Fuel Standard -** Petroleum fuel importers, refiners, and wholesalers to reduce carbon intensity across product lines	**Low-emission Vehicles -** Auto manufacturers to introduce progressively cleaner light- and medium-duty vehicles
			Innovative Clean Transit - Transition buses to zero-emission
		Zero-emissions Vehicles (ZEVs) - Auto manufacturers to increase sale of ZEVs	**Zero-emissions Airport Shuttle -** Transition shuttle fleet to zero-emission
			The Advanced Clean Trucks - Truck manufacturers to sell more ZEVs
Electricity Generation (Emissions: 58.97MtCO2e)	**Electric power plants**	**Renewable Portfolio Standard -** Electricity providers to progressively increase renewable energy in their electric load	
Industrial (Emissions: 99.91MtCO2e)	**Industrial plants & fuel distributors**		**Oil and Gas Regulation -** Oil/gas producers to address CH4 emissions from their facilities
Commercial & Residential (Emissions: 57.19MtCO2e)			**Building Energy Efficiency Standards - E**nergy/water efficiencies for newly constructed buildings
			Appliance Energy Efficiency Standards - Minimum efficiency levels for energy and water consumption in products
Agriculture & Forestry (Emissions: 31.75MtCO2e)	**Forestry/ agriculture offsets**[1]		**Short-Lived Climate Pollutant Strategy -** Reduction activities for methane emissions from agricultural operations
Total Emissions[2] : 418.14Mt CO2e			

1. The share of offsets entities can use to reach their compliance target is 4% per year. At least 50% of an entity's offset usage must come from offsets that provide direct environmental benefits to California. Offset credits issued by jurisdictions linked with California are eligible for use. CARB issues Offset Credits to qualifying projects. 2. All emission data are for the year 2019.

Figure 2: California uses both market- and control-based mechanisms

The role of internal carbon pricing

Internal carbon pricing is a growing approach for companies to mitigate their GHG emissions. Under such a system, companies assign a monetary value to the cost of carbon within their businesses to incentivize the use of low-carbon technology and innovation across their businesses and functions. In 2020, more than 850 companies used internal carbon pricing, up 20 percent from 2019.[35] This growth in internal carbon pricing directly corresponds with increased involvement in government-regulated systems, as it is seven times more likely that a company participating in a carbon pricing initiative will also implement an internal price on carbon.[27]

[35] World Bank State and Trends of Carbon Pricing, 2021.

Role of compliance markets and the VCM in carbon pricing and decarbonization

Carbon markets support GHG emissions reduction by enabling market participants to trade instruments that represent the right to a certain volume of emissions, thereby helping them maintain compliance with emission regulations (in **compliance carbon markets**) or voluntarily advance global emissions reduction and positive climate action (in the **VCM**).

In compliance markets, market participants may trade allowances (permits to emit issued by regulators) freely among themselves. Entities covered by compliance markets seek to lower their emissions in order to minimize the cost of purchasing allowances. **The resulting interaction between the demand and supply in the market determines the price of an allowance (also known as the carbon price).**[36] A more ambitious ETS (i.e., one with stringent caps and a steep reduction of allowances) typically leads to higher prices for carbon allowances, as shown by the U.K. ETS price starting higher than the EU's, because there is typically a higher demand for carbon allowances to reach the stringent emissions-reduction goals. The price of carbon also varies as market caps and baselines are adjusted to lower emission levels.

The allocation of allowances plays a direct role in decarbonization of the economy (specifically, the sectors to which the market applies). Decisions concerning allocation amounts and, consequently, their withdrawals or retirement can be made in line with the decarbonization goals of a region. For example, the EU has set an ambition to achieve carbon neutrality by 2050 and is accordingly planning on reducing its allocation of allowances to the market on an ongoing basis.

VCMs, on the other hand, do not have a legal or regulatory requirement. This market comprises a set of buyers (usually corporates) that voluntarily purchase carbon credits—issued by third-party programs (run by Non-Governmental Organizations (NGOs) or governmental bodies)—that each represent a tonne of emissions avoidance or removal.

The VCM does not directly impose a carbon price, since the purchase of carbon credits is an optional activity. VCM credits can, however, have an influence on the carbon price if they are permitted to be used in a compliance market.

[36] https://www.ucsusa.org/resources/carbon-pricing-101.

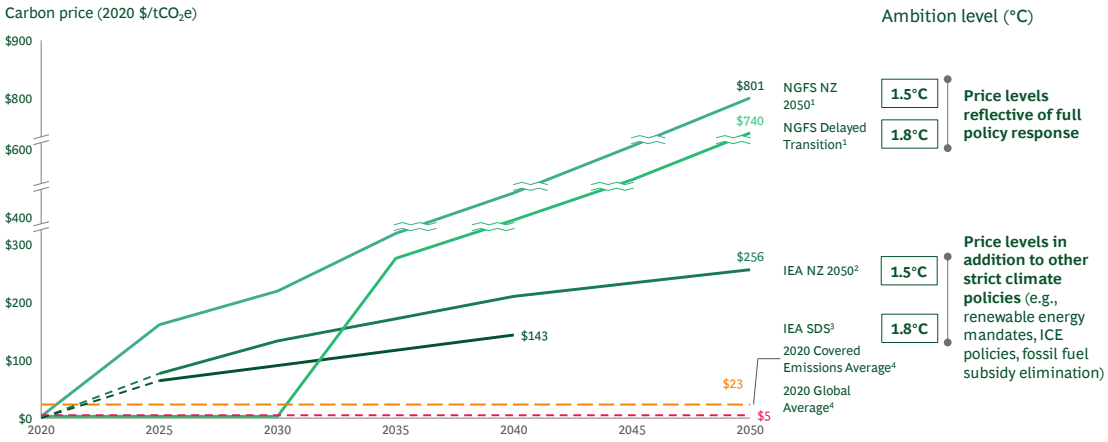
1.3 Key features needed in a carbon pricing system

While carbon pricing is clearly a strong approach to incentivize reducing GHG emissions, the pricing system must be thoughtfully implemented and managed in order to be effective. The key features of an effective carbon pricing mechanism are:

- **A sufficiently ambitious price and/or pace of emissions reduction.** It is essential to have a sufficiently high and globally aligned carbon price that reflects the true social and environmental cost of carbon (see Figure 3 for price levels from climate modeling). IMF has stated that limiting global warming to 2°C or lower demands an immediate global carbon price that reaches \$75/tCO_2 by 2030.[2] Similarly, the High-Level Commission on Carbon Prices has reported a carbon price range of at least \$40–80/tCO_2 in 2020 rising to \$50–100/tCO_2 by 2030 to meet a 2°C target.[3] Alternatively, the OECD estimated a more ambitious price of 120 EUR/tCO_2 (~\$140/tCO_2) by 2030 in order to reach net-zero emissions by 2050.[4] The International Energy Agency's (IEA) Net Zero 2050 scenario estimates a \$75/tCO_2 price for advanced economies by 2025 increasing to over \$130/tCO_2 by 2030, in addition to strict climate policies such as renewable energy mandates, elimination of fossil fuel subsidies, etc.[5] In the case of ETSs, it is important for emissions reduction to occur at a sufficiently fast pace, achieved through steep decreases in the allowance cap over time. The Integrated Assessment Modeling Consortium (IAMC) corresponds to the need for at least ~5 percent linear reductions per year in allowances.[37]

[37] IAMC and International Institute for Applied Systems Analysis, IAMC 1.5°C Scenario Explorer and Data, 2019.

Immediate and significant growth in carbon pricing essential across scenarios



1. REMIND-MAgPIE model prices from NGFS Scenario Explorer hosted by IIASA (release 2.2); 2. Future prices for advanced economies from IEA's Net Zero Emissions by 2050 Roadmap for the Global Energy Sector, with prices between '20 and '25 estimated; 3. Future prices from IEA's Sustainable Development Scenario, with prices between '20 and '25 estimated; 4. Weighted average of global carbon prices for covered emissions from the World Bank in August 2021 and price of uncovered emissions ($0), normalized to 2020 USD
Note: All prices provided in USD from sources, and normalized to 2020 USD using the Bureau of Labor Statistics' CPI inflation calculator

Figure 3: Price levels needed as per select scenario analyses with target warming <2°C

- **A forward-looking direction in price levels and/or emissions allowance reductions.** Policymakers or regulators of the pricing system should provide forward-looking direction about carbon price levels or expected reductions in allowance levels in ETS markets. For example, they could schedule the price for a carbon tax (one of several market-based mechanisms for carbon pricing) to increase gradually over time, which is being done in Canada. Alternatively, in an ETS initiative, this could take the form of transparency into future allowance retirements, which would drive pricing dynamics in the market. Such transparency encourages investors to incorporate these considerations into their long-term investment decisions, which accelerates decarbonization faster than the price alone would.[38]

- **Designed to prevent carbon leakage.** An uneven application of carbon pricing globally encourages industries to transfer their production to jurisdictions with more lenient carbon pricing policies, or for greater imports from these regions. Enforcing mechanisms such as a CBAM could prevent leakage by setting a carbon price on goods imported across national borders.

[38] https://climate-xchange.org/carbon-pricing-101/.

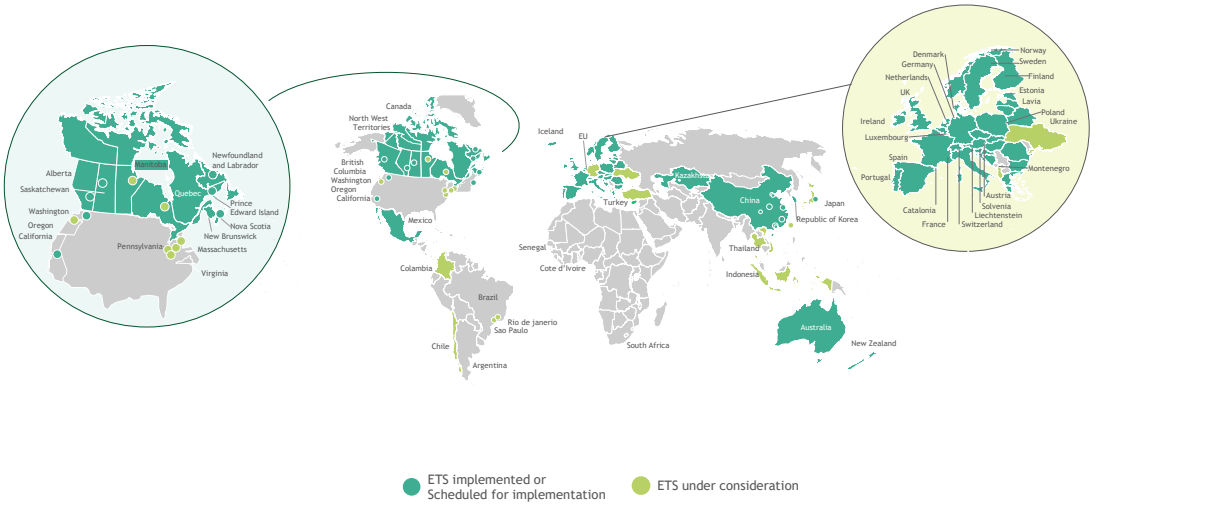
- **An application that encompasses a large proportion of the actual emissions.** Effective coverage of carbon-intensive sectors through appropriate pricing mechanisms is essential to ensure sufficient action in order to meet global emissions reductions goals.
- **Designed and adapted for jurisdictional context.** Transition pathways may vary by sector and region, given technological, geological, and other constraints. These should be accounted for in both the design of the transition pathways and the application of carbon pricing within a jurisdictional context. In these cases, wherever carbon pricing systems are varied based on jurisdictional context, it is important to monitor for and ensure the prevention of carbon leakage.

1.4 Current state of compliance carbon markets

Coverage of compliance carbon markets globally

As of the writing of this report, there are 29 implemented ETS initiatives around the world, consisting of 1 regional (EU), 9 national, and 19 subnational jurisdiction initiatives (see Figure 4). These ETSs together cover 8.7 $GtCO_2e$, representing ~16 percent of global GHG emissions. In addition, there are 35 carbon tax initiatives, covering 27 national jurisdictions and 8 subnational jurisdictions.[1]

29 Emissions Trading schemes implemented today

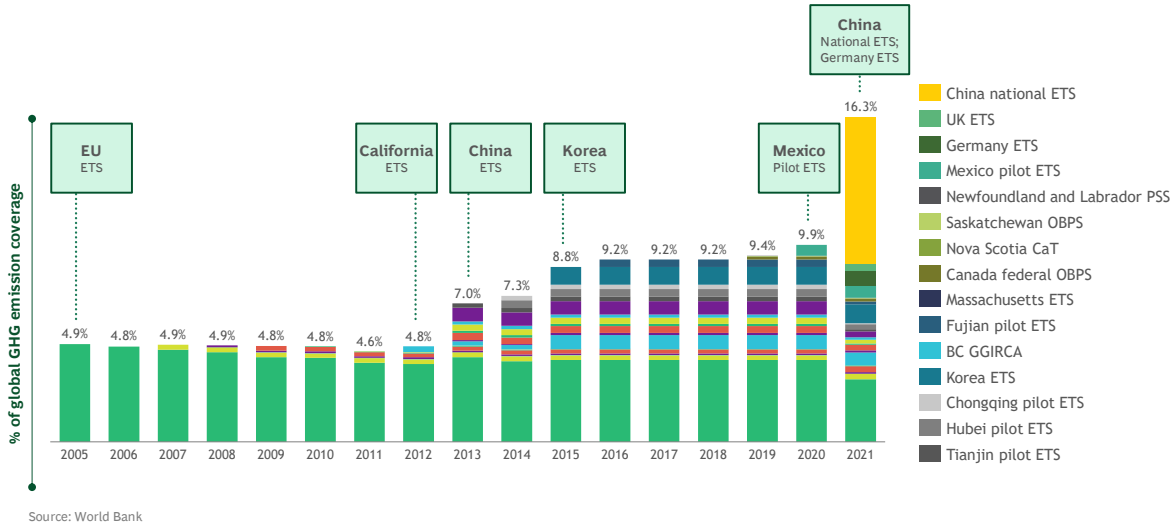


Source: World Bank

Figure 4: ETS implementation—current state

Over the last few decades, ETS initiatives have grown significantly (see Figure 5). While there were only 7 ETS initiatives implemented in 2011, there were 29 as of 2021. Coverage of total global emissions has also grown from 4.6 percent in 2011 to ~16 percent in 2021. The Asia-Pacific region represents the biggest growth in ETS size. The newly launched China ETS alone covers ~7 percent of global emissions. South Korea, Tokyo/Saitama, and New Zealand have already implemented ETSs covering ~0.8 $GtCO_2e$.[1]

Both number of ETS initiatives and ETS total coverage are increasing over time



Source: World Bank

Figure 5: Evolution of global ETS initiative development

It is expected that coverage of carbon markets will continue to increase globally in terms of both geographic and sectoral scope. Other markets such as Indonesia, Pakistan, Thailand, Vietnam, Taiwan, and the Philippines are either developing or considering carbon ETSs in the future. Total emissions in the jurisdictions considering ETS implementation are over 7.5 $GtCO_2e$.[1]

Market characteristics

ETS markets currently have a total absolute value of ~$170B, as of April 2021 (see Figure 6).[7] The EU ETS makes up more than half of the total value, with ~1.7 $GtCO_2e$ covered emissions at a price

of about EUR 60/tonne as of September 2021. The China National ETS covers ~4 $GtCO_2e$ at a price of ~$8/tonne.[1,39]

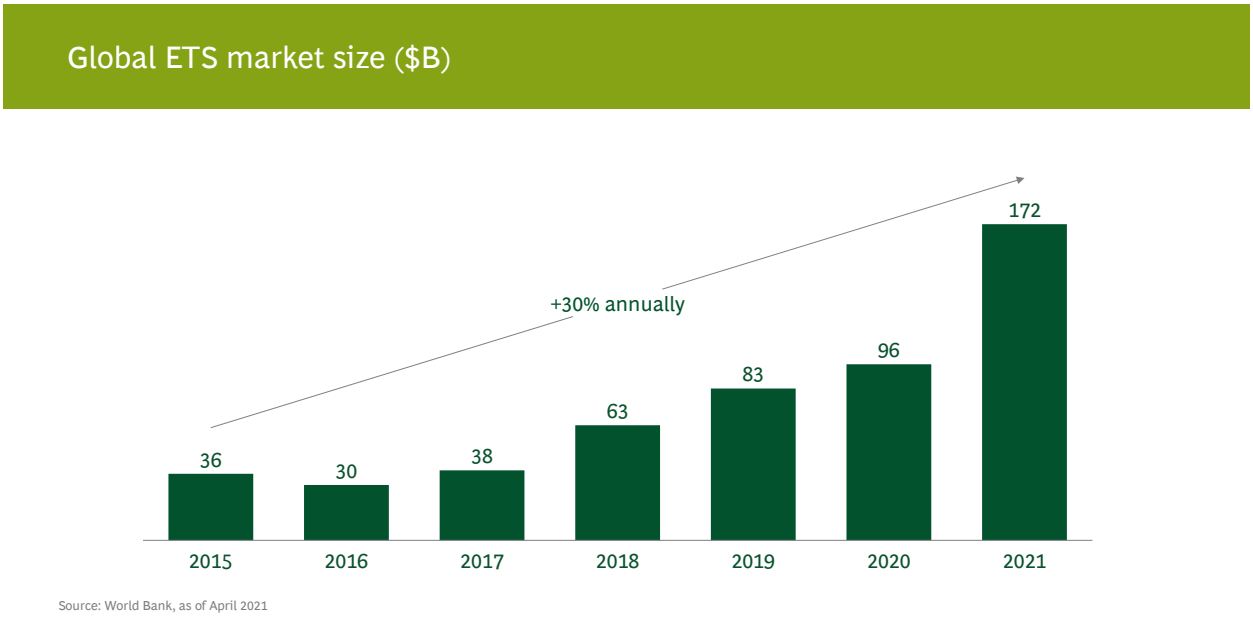
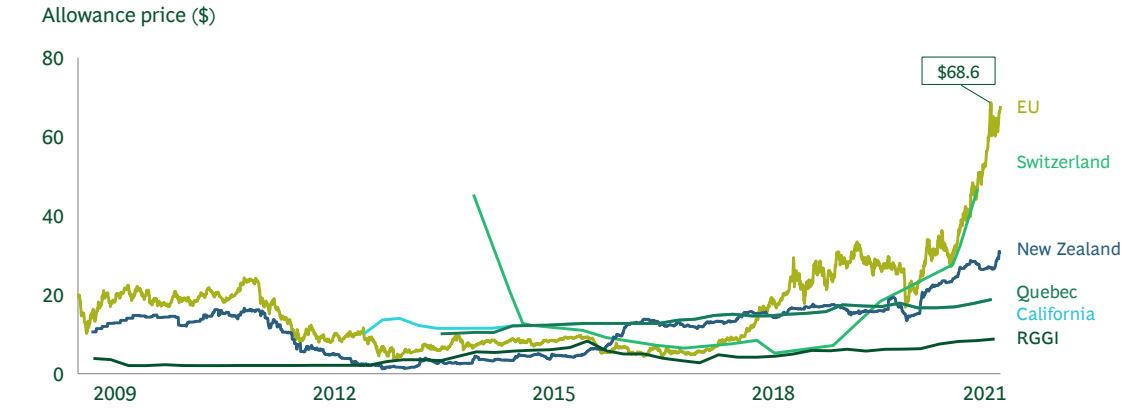


Figure 6: Global ETS market size ($B)

Overall, ETS carbon credit prices have trended upwards with some local short-term volatility (see Figure 7). The increase in prices has been supported by policymakers through revisions to the rules of the systems (e.g., implementation of a market stability reserve (MSR), floor prices, etc., which are discussed in the Annex – Use of Market Stability Mechanisms in ETSs).

[39] First day trading price at 52 Chinese Yuan on Jul 17, 2021.

Compliance allowance price movements in current implemented ETS initiatives

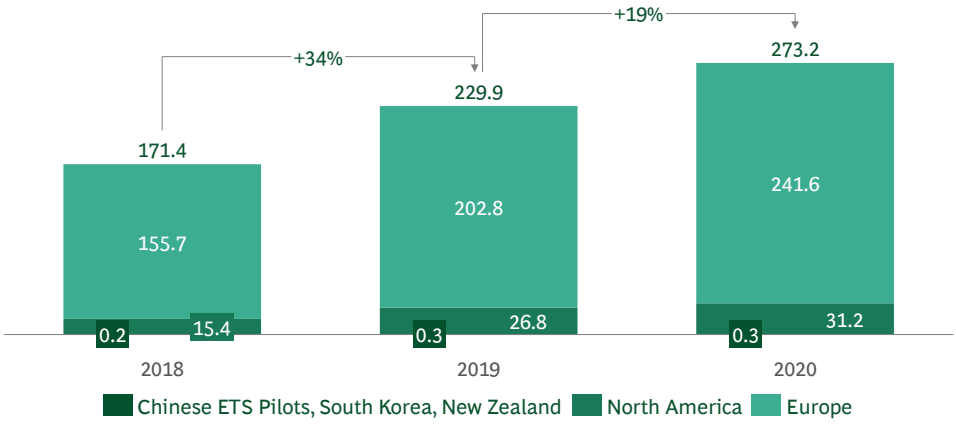


Source: World Bank; Ember Climate

Figure 8: Compliance market price movements in selected ETS initiatives

In terms of total trading volume, the compliance market was estimated at ~$275B as of 2020 (see Figure 8), with the EU market being the largest and most liquid at ~$240B.[40]

Major ETS trading market size ($B)



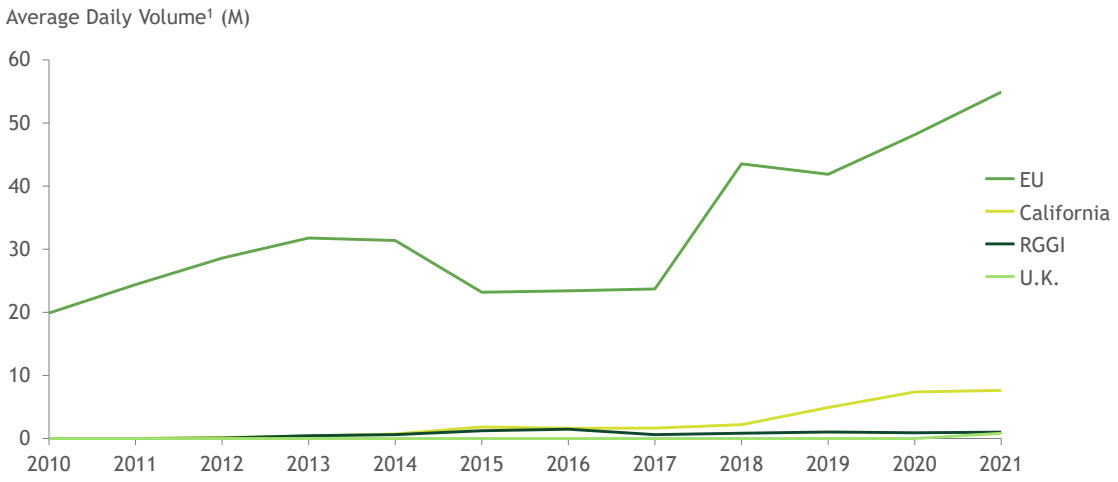
Source: Refinitiv

Figure 7: Major ETS trading market size ($B)

[40] Refinitiv carbon market year in report 2020.

ICE also reports trading volumes for futures and options across ETSs, including the EU, California, RGGI, and U.K. systems (see Figure 9). As shown in the figure, average daily volume in the EU ETS has grown from ~20M in 2010 to ~55M as of August 2021.[14] Volume in the California cap-and-trade has grown significantly from ~0.1M in 2012 to ~7.6M as of August 2021.[14]

ICE average daily volumes over the last decade for four compliance markets



1. Daily volume, averaged over year, of daily futures, futures and options. 2021 trading activity is updated as of August 31, 2021; Source: ICE

Figure 9: Trading activity for ETS futures and options from ICE

While the main emissions unit traded in an ETS is an allowance, there are certain voluntary projects that generate credits that are fungible in compliance markets (known as "compliance offsets"). For the purpose of this report, these compliance offsets are considered part of the VCM; however, regulated entities can purchase and surrender them in lieu of allowances to fulfill a (typically limited) portion of their compliance obligation. A voluntary project can generate compliance offsets if it is approved by a compliance offset program.

1.5 Current state of the voluntary carbon market

Overview of the voluntary carbon market

The VCM channels funding for voluntary projects that avoid/reduce or remove GHG emissions, through both direct actions (e.g., forestation) and emerging technologies (e.g., direct air capture). The carbon credits these projects generate can be traded in the VCM as credits or, for those approved by compliance offset programs, sold as "compliance offsets" to regulated entities for use toward their compliance obligations.

To ensure high integrity, VCM credits should have the following four characteristics:[41]

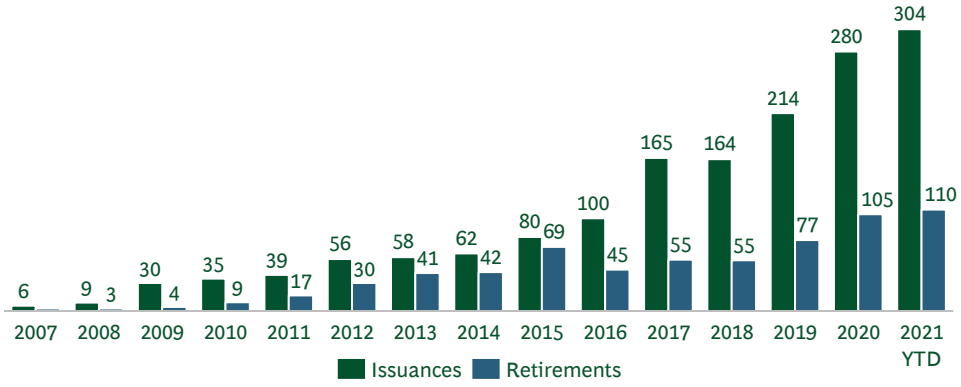
1. Additionality. Carbon credits should be issued for voluntary projects that generate emissions reduction or removals that would not have occurred in the absence of a market to trade carbon credits.
2. Permanence. Carbon credits should represent emissions reductions or removals that will not be reversed (in the long term) after the issuance of that unit.
3. Absence of Leakage. The generation of carbon credits should not lead to an increase in emissions elsewhere, or safeguards must be in place to monitor and mitigate any increases that occur.
4. Monitoring and verification. The underlying emissions reductions of carbon credits should be monitored and reported, and must be verified by an accredited third-party auditor with appropriate measures to prevent double counting.

Market characteristics

Since its initiation around early 1990, the VCM has been growing rapidly. Between 2007 and August 2021, issuances of emissions reductions have grown from ~6 $MtCO_2e$ to ~300 $MtCO_2e$ (see Figure 10). Meanwhile, retirement of voluntary carbon credits also increased, from 2.7 $MtCO_2e$ in 2007 to 110 $MtCO_2e$ in 2021. Although the market has grown manifold, VCM credits still account for only a tiny fraction of global emissions (<0.5 percent of the ~50 $GtCO_2e$ total emissions as of 2020).[1,42]

[41] WWF position and guidance on voluntary purchases of carbon credits, October 2019.
[42] Ecosystem marketplace: State of the Voluntary Carbon Markets 2021.

Annual voluntary carbon credits issuances and retirements



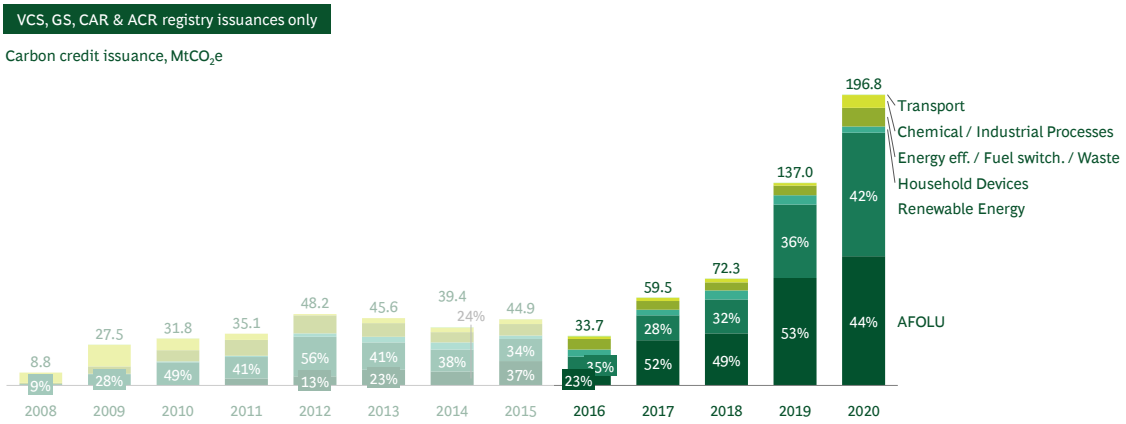
Source: Ecosystem marketplace as of October 12, 2021; data reported by VCS, Plan Vivo, ProClima, Gold Standard, ACR, CARB, CAR, and Climate Forward

Figure 10: Annual voluntary carbon credits issuances and retirements (2007–2021 YTD)

The VCM comprises a range of different project types that either remove carbon from the atmosphere (carbon removals) or prevent more carbon from going into the atmosphere (avoidance/reduction). AFOLU (Agriculture, Forestry, and Other Land Use) projects generate the largest portion of VCM credits, which, together with renewable-energy-related credits, make up about 90 percent of all VCM issuances (see Figure 11). Within AFOLU, REDD (Reducing Emissions from Deforestation and Forest Degradation) projects account for more than 90 percent of issuances. Wind and solar are the primary drivers of renewable energy growth.[42]

Average VCM credit prices have remained low for several years at around $3/tonne (see Figure 11). At the same time, there is wide disparity in price levels based on factors such as project type and vintage. For example, average prices in 2021 (as of August) for afforestation/reforestation credits were $8.10/tonne as compared to $1-2/tonne for renewable energy credits. Similarly, carbon removal credits were priced on average at $7.98/tonne as compared to $1.71/tonne for reduction credits. [42]

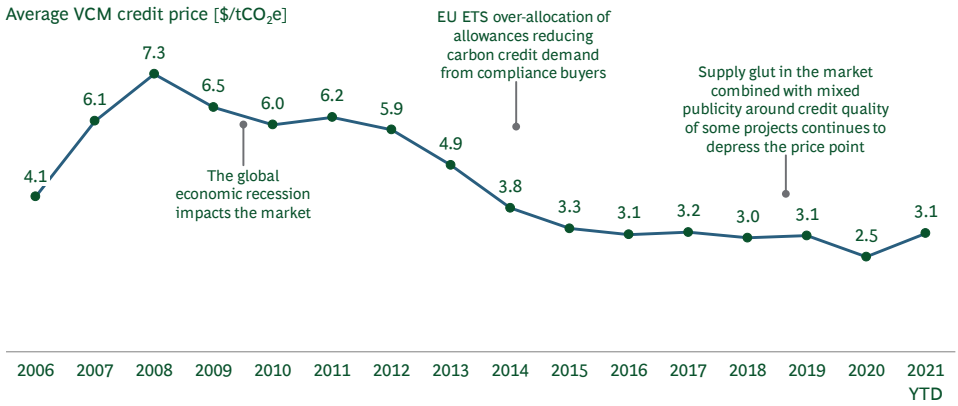
Issuances in 4 key registries has grown ~6x since 2016, driven by AFOLU and Renewable Energy; together the two project types represent ~90% of the total



Note: The underlying data has been collected early July, 2020 (i.e. after the close of H12020); Historical registry-based data is known to undergo slight revisions and updates and more recent pulls of the same historical data (e.g. 2008-2019) might yield slightly different totals
Source: Verra / VCS, Gold Standard, CAR and ACR registries; BCG analysis

Figure 11: VCM project categories and growth

Prices | Average carbon credit prices in the VCM have been hovering around $3/tCO$_2$e since 2016



Source: Forest Trends State of the Voluntary Carbon Markets 2017; Forest Trends Ecosystem Marketplace: Voluntary Carbon Markets Insights: 2018 Outlook and First-Quarter Trends, Financing Emissions Reductions for the Future, State of the Voluntary Carbon Market 2019; Forest Trends Ecosystem Marketplace: State of the Voluntary Carbon Market 2021; press search; BCG Analysis

Figure 12: Price levels in the VCM (2006–2019)

See Figure 13 for a condensed timeline of the history of carbon markets, from the launch of emissions trading by the 1990 amendment to the U.S. Clean Air Act to the recent developments with regions such as Germany, China, and the U.K. launching major ETSs.

Use of VCM credits in sector-specific markets

In 2010, the International Civil Aviation Organization (ICAO) established a global goal of "carbon neutral growth" in the international aviation sector (which was responsible for ~1.3 percent of global CO_2 emissions in 2015) from 2021 onwards.[43] To address this goal, ICAO developed CORSIA, which relies on the use of VCM credits to compensate for any CO_2 emissions from international aviation above a fixed baseline (based on 2019 emissions). As of July 2021, 88 countries, covering >75 percent of all international aviation activity, had volunteered to participate in CORSIA. The first mandatory phase (Phase II) is set to start in 2027, which will expand to cover >90 percent of all international aviation activity.[44,45]

[43] https://www.icao.int/environmental-protection/CORSIA/Documents/CORSIA_FAQs_December%202020_final.pdf.
[44] https://www.icao.int/environmental-protection/CORSIA/Pages/corsia-newsletter-jul21.aspx.
[45] https://www.iata.org/en/iata-repository/pressroom/fact-sheets/fact-sheet–climate-change/.

Brief history of carbon markets

1990	U.S. Clean Air Act Amendment launched an emissions trading program for sulfur dioxide	Introduced emissions trading as a cost-effective market-based mechanism to cut emissions
1992	197 countries ratified the United Nations Framework Convention on Climate Change (UNFCCC)	First global treaty to explicitly address climate change (active as of 1994)
1997	Kyoto Protocol adopted by UNFCCC parties (active as of 2005)	First legally binding treaty to combat climate change; launched carbon markets
1998	GHG Protocol developed by WRI and WBCSD to provide guidance on tracking and reporting of GHG emissions	First global standard established on GHG accounting utilized today by over 90% of Fortune 500 companies reporting to CDP
2005	Launch of the European Union ETS	First mandatory market-based mechanism for trading GHG emissions
2008 - 2012	First compliance period of Kyoto Protocol.	
2013 to present	Seven Chinese provinces and cities launched pilot ETSs: — Beijing, Chongqing, Guangdong, Hubei, Shanghai, Shenzhen, and Tianjin	
2014	California and Quebec ETSs link	First linkage of international ETSs
2015	196 parties signed the Paris Agreement (active as of 2016) at COP21. Article 6 discussions continue to present day.	Legally binding global treaty; requires all countries to set emission-reduction pledges (through NDCs)
	Science Based Targets initiative (SBTi) established, enabling companies to set emission reduction targets in line with the latest climate science	Customized guidance to help companies reduce their GHG emissions and set commitments aligned with climate science
	Republic of Korea launched national ETS	At the time, the second largest ETS after the EU
2018 - 2020	**2018:** The Intergovernmental Panel on Climate Change (IPCC) published a Special Report, revealing the impacts of global warming of 1.5°C above pre-industrial levels	Call for carbon neutrality by 2050; view of GHG emission pathways needed for limiting warming to 1.5°C
	Ongoing improvements and evolution of ETSs. E.g., for EU: • **2018:** Emissions allowances classified as financial instruments • **2019:** Market Stability Reserve (MSR) launched to balance allowance supply and demand • **2020:** Linked with the Switzerland ETS	Classification as financial instruments brings greater security and improved integrity of the market MSR proactively address surpluses and shortages, maintains strong / stable allowance price ETSs link to realize benefits, such as increased market liquidity and carbon price stability
2020	The year of Net Zero commitments by countries, corporates and financial institutions. E.g., • US pledged carbon neutrality by 2050 • China pledged Net Zero by 2060 • EU increased ambition through the Green Deal, including pledge to be carbon neutral by 2050 and to reduce emissions by 55% by 2030, compared to 1990 levels • >10 leading global banks pledged to become Net Zero by 2050; >1000 corporates engaged with SBTi	Bold climate goals established - but with a need for translating into action and operation
2020 to present	Differing points of view on voluntary carbon market credits: • SBTi Criteria and Recommendations • Voluntary Carbon Markets Integrity Initiative (VCMI) • Oxford Principles for Net Zero Aligned Carbon Offsetting	Need for market consensus on role of voluntary carbon market (VCM) and use of VCM credits
2021 to present	Several major national ETSs launched, including China (trading started July 2021), Germany, and the UK	Largest carbon market (i.e., China) covering 4 GtCO2e, but with a low price level at ~$8
	EU adopts "Fit for 55" proposal outlining actions to take to achieve their 2020 pledge, including implementing emissions trading in new sectors, carbon border adjustment mechanisms, and tighter caps under the existing ETS	Adjustments will address need for bolder ambition to limit global warming to below 1.5°C
	CORSIA expected to begin pilot phase	First major industry-specific carbon credits scheme
	IPCC publishes AR6 Climate Change 2021: The Physical Science Basis (SSPs integrated into AR6)	First integrated view of socioeconomic pathways and climate outcomes - likely to form basis of climate scenario analyses going forward
		Reality check - 1.1°C of warming to-date from human activities; without immediate, rapid, large-scale reductions in GHG, limiting to 1.5°C, or even 2°C will be beyond reach

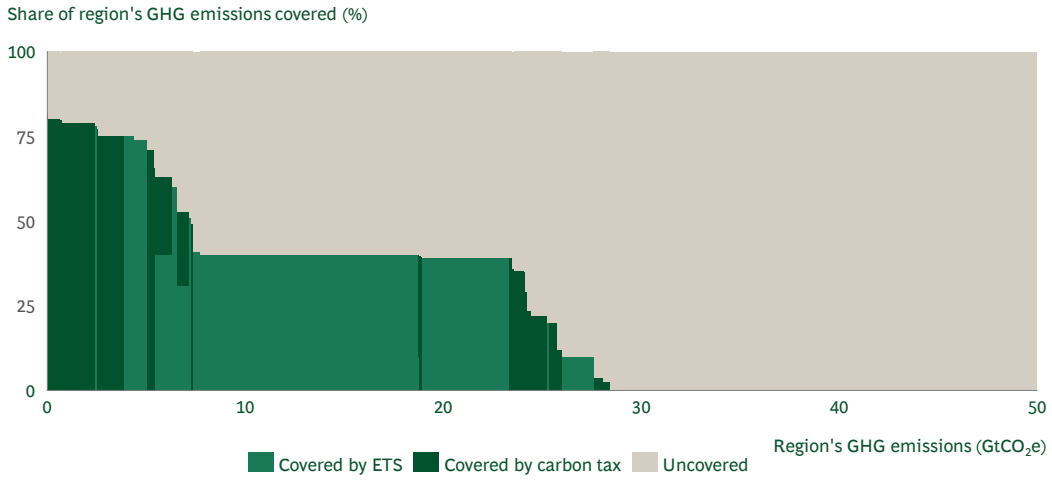
Figure 13: History of the carbon markets (1990–2021)

2 Section 2: Key challenges to overcome

2.1 Low coverage, price levels, and decarbonization ambitions of regulated carbon pricing

While ETS coverage is increasing, there is still a long way to go before ETS markets become prevalent worldwide. **Only ~16 percent of GHG emissions today are covered by an ETS, with an additional 5.5 percent covered by carbon taxes. That leaves close to 80 percent of GHG emissions (>40 $GtCO_2e$ annually) without coverage.**[1] **In addition, even in most regions where carbon pricing schemes exist, fewer than 40 percent of their GHG emissions are covered** (see Figure 14).

Close to 80% of GHG emissions are not covered by a carbon pricing scheme, and most regional carbon pricing schemes cover below 40% of their GHG emissions

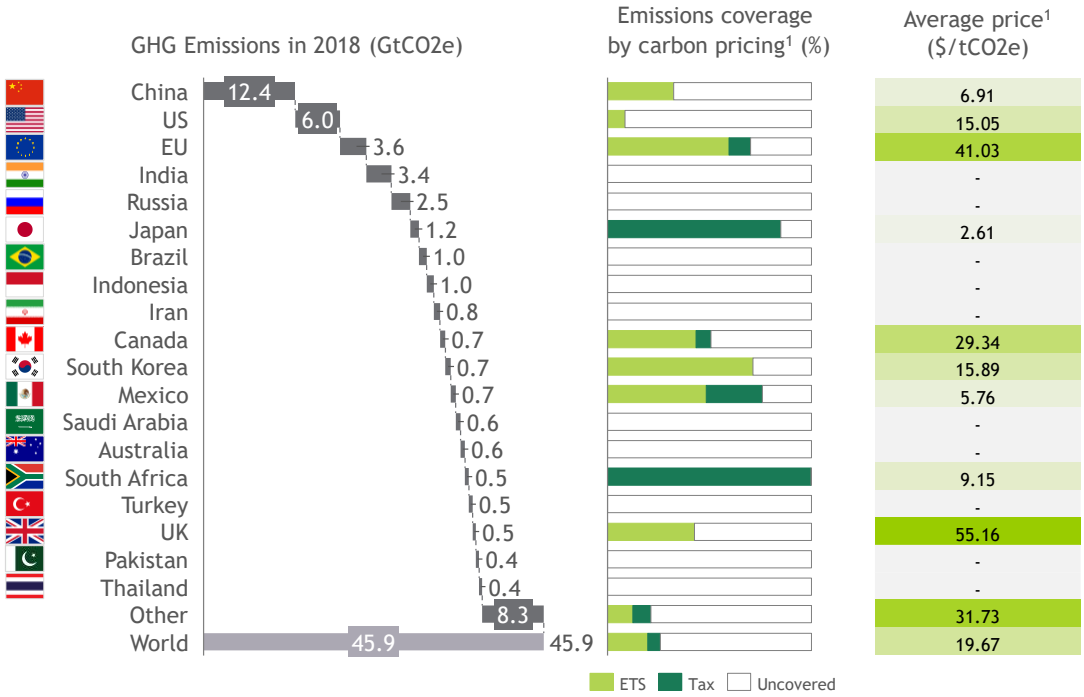


Note: Percent share of region's GHG emissions covered derived from dividing data on carbon pricing scheme's GHG emission coverage by the regional GHG emissions
Source (data retrieved August 2021): World Bank, BCG Analysis

Figure 14: GHG emissions coverage of current jurisdictional carbon pricing schemes

Considering the relative lack of regulated carbon pricing in some of the largest-emitting regions, there is clearly room for greater coverage of GHG emissions. Moreover, in virtually all regulated markets there is a dire need for higher carbon price levels that reflect the real-world costs of emissions (as shown in Figure 15).

Significant room for greater coverage and bolder ambitions across several of the top emitting regions

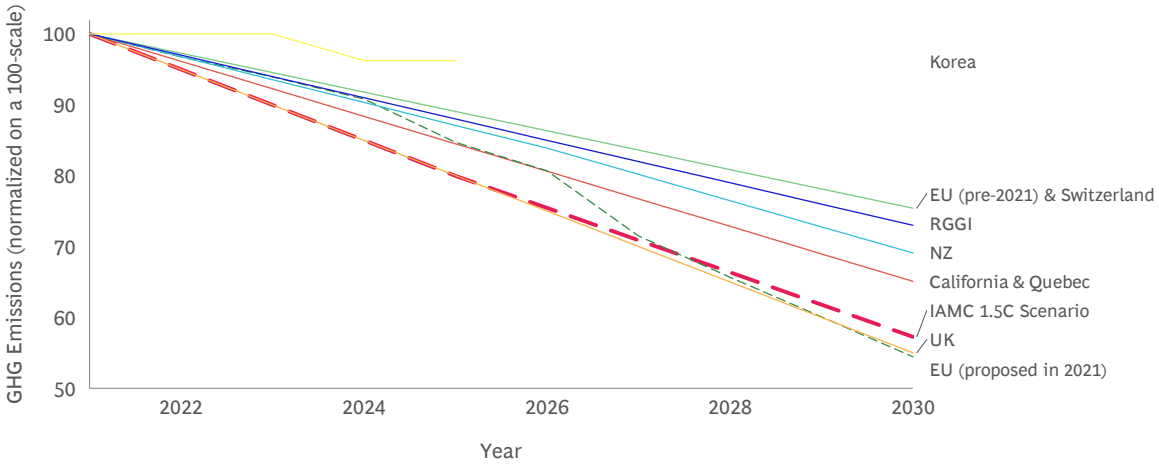


1. Data as of April 1, 2021. Coverage and average pricing for US, Canada, Mexico, and EU were calculated by combining the (weighted, non-overlapping) coverage and prices of multiple carbon pricing schemes in the region. Source: World Bank, Ember Climate, Argus media, BCG Analysis

Figure 15: Regional pricing schemes' GHG coverage and pricing levels have room to grow

Furthermore, **allowance cap reductions for ETS initiatives are often not ambitious enough to meet the reductions needed to achieve a 1.5°C global warming outcome.**[37] Figure 16 shows current allowance levels indexed at 100 for the different ETSs, and their planned reductions projected out versus the absolute emissions reductions needed in IPCC 1.5°C scenarios. Some systems, such as the U.K. ETS and the EU ETS (proposed), have adopted ambitious (i.e., steep) reduction rates in emission caps that will successfully drive emissions reduction in line with the Paris Agreement. However, the majority of systems are less aggressive and do not meet the 1.5°C scenario reduction trajectories. Note that this is meant to be a high-level estimation; specific trajectories also require consideration of sector pathways.

Most regional ETS cap projections are less ambitious than IAMC's 1.5°C projection

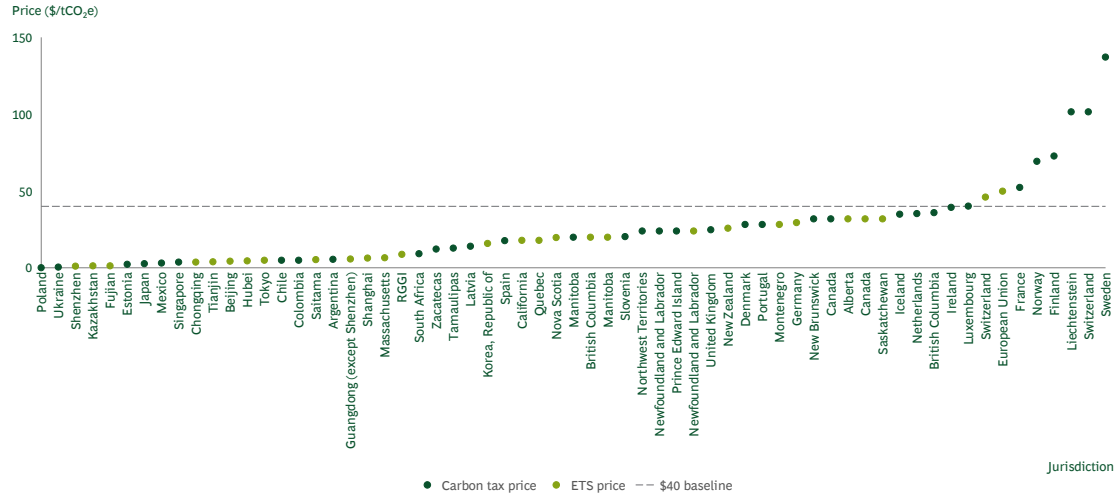


Source (data retrieved August 2021): World Bank; IAMC 1.5°C Scenario Explorer and Data hosted by IIASA; EU 2021 Directive 2003/87/EC
BCG Analysis: IAMC 1.5°C Scenario - 1.5°C pathways were reported for N2O, CO_2, and CH4 separately on IAMC's Scenario Explorer. Data for 1.5°C pathways with low or no overshoot were collected and averaged to create one pathway for each gas. The average pathways were converted to CO_2e and then combined to create a single 1.5°C pathway scenario for total GHG emissions. Regional scenarios – derived from regional ETS disclosures reporting future allowance cap plans / projections. All pathways were normalized on a 100-scale to the 2021 value.

Figure 16: Regional ETS ambition versus IAMC 1.5°C scenario model

Low market cap goals contribute to sub-par prices in the market. Current price levels range from ~$1 to $137, with a **vast majority of pricing schemes (~85 percent) at less than $40/$tCO_2e$** (see Figure 17).[35]

A vast majority (>80%) of carbon pricing schemes have a price below $40/tCO$_2$e



Source (data retrieved August 2021): World Bank

Figure 17: ETS allowance price levels across geographies

Global GHG emissions are currently priced at <$5/tCO$_2$e on average.[2] This is a long way from the ~$50–150/tCO$_2$ (by 2030) necessary in order to achieve net zero by 2050.[4]

> "The cleanest way of doing it is having a robust carbon price. If EUAs were trading at $120, that would be a sufficient price level to incentivize corporates to decarbonize their operations. EUR 50/tonne is pushing the limit, but not close enough to force heavy industry or road transport decarbonization."
>
> — Independent climate transition advisor

Low prices in ETS markets are also driven, in part, by the abundance of allowances that are freely allocated to market participants. Carbon pricing is effective at reducing emissions because it imposes a cost on carbon, but this cost is eliminated for those that receive allowances freely (lessening the incentive to reduce emission) and is diminished for other market participants through a low market price. **Sufficient price levels are essential to achieving emissions-reduction goals, as they support the economic viability of and investments in low-carbon technologies. The interaction between free allowance allocation, market caps, and other mechanisms such as price stability levers**

that influence market prices need to be balanced in order to drive ambitious price levels for decarbonization in line with the Paris Agreement.

2.2 Credibility of the existing VCM an important focus to enable scale

There is widespread concern about the integrity of the VCM, stemming from five crucial shortcomings in the market today:

1. The "quality" of VCM credits vary widely. For the integrity and credibility of every credit, it is critical to establish additionality (i.e., that the emissions reduction activity would not have occurred without the presence of a market to trade carbon credits), permanence (i.e., that the emission reduction is permanent), prevention of leakage (i.e., that it does not lead to a carbon-emitting activity elsewhere) and measures against double counting (i.e., that registration ensures that the removal or avoidance of carbon isn't counted in multiple places). Additionally, the variety of verification processes that exists today is a driving factor for the differences in additionality and perceived quality across credits as well as the skepticism in verifiable emissions impact from the credit-generating project. This is further exacerbated by the current difficulties in measuring voluntary projects' impacts, which, again, hinders the establishment of additionality.

> "It all starts with credit quality. If you can get people comfortable around what's being traded, then exchanges will develop contracts, and products will be developed around it. Until you have confidence in the product, it's hard to advance the level of activity."
>
> — Independent climate transition advisor

2. There is a need for clarity about the use of VCM credits and their alignment with science-based decarbonization pathways to enable confident market participation. Contrary to ETSs, where absolute reductions in allowances lead to reductions in emissions and can be aligned with sector-specific science-based decarbonization trajectories, the VCM—given its voluntary nature—cannot enforce science-based emissions trajectories. As per guidance for corporates, the VCM can be used a complementary mechanism to compensate for their

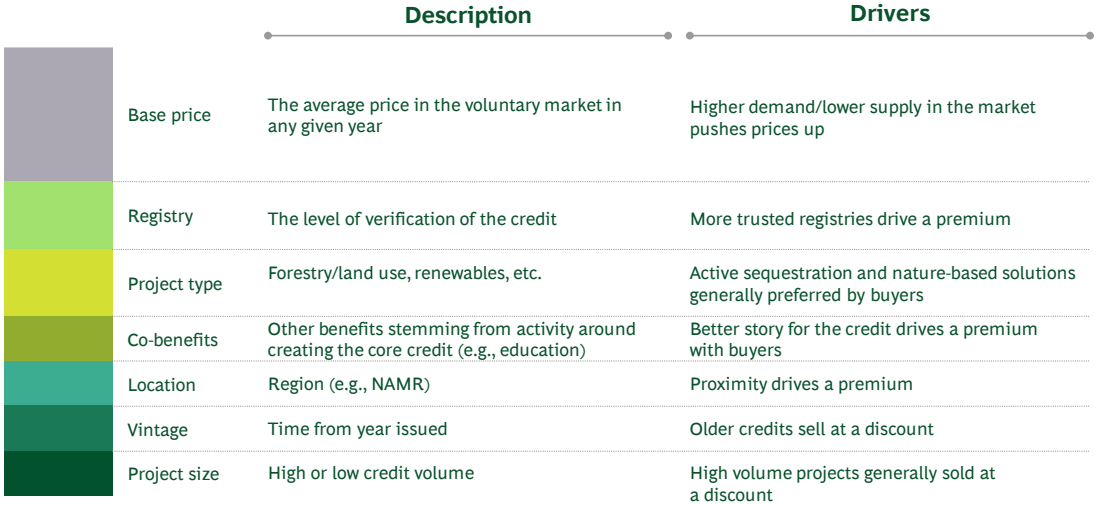
emissions as they pursue in-value-chain decarbonization, or to neutralize residual emissions once all decarbonization levers have been applied.

> "On the voluntary side, there are two drivers today that are limiting adoption by corporates… lack of standards as to how corporates should think about using offsets, and multiple registries, types of qualifying projects, and verification agents, which creates unwillingness to participate in the market."
>
> — Banking executive, global sustainable finance

3. The market **lacks a consistent taxonomy with additional attributes to describe the different VCM credit types, which results in market fragmentation**. The perceived value of a credit depends on several attributes, such as the project type (avoidance of emissions vs. removal of emissions), co-benefits driven (e.g., projects that support other SDGs), region, and vintage (see Figure 18). While there are several existing certification bodies and registries, they all have different processes for assessing and describing projects and credits. The creation of a set of CCPs, with a defined set of attributes, could mitigate this issue, and has been proposed by the TSVCM.[46]

[46] Taskforce on Scaling the Voluntary Carbon Markets, January 2021.

VCM credit pricing: Driven by several factors



	Description	Drivers
Base price	The average price in the voluntary market in any given year	Higher demand/lower supply in the market pushes prices up
Registry	The level of verification of the credit	More trusted registries drive a premium
Project type	Forestry/land use, renewables, etc.	Active sequestration and nature-based solutions generally preferred by buyers
Co-benefits	Other benefits stemming from activity around creating the core credit (e.g., education)	Better story for the credit drives a premium with buyers
Location	Region (e.g., NAMR)	Proximity drives a premium
Vintage	Time from year issued	Older credits sell at a discount
Project size	High or low credit volume	High volume projects generally sold at a discount

Figure 18: Factors that drive VCM credit demand and price

4. **There is very limited liquidity and trading in the VCM**. The market today is primarily a buy-and-hold or buy-and-retire market, with little trading of credits otherwise. In addition to the other challenges described, this is also driven by the **lack of a widespread reference index or grade against which different VCM credits can be compared and traded** at a premium or discount, as well as the lack of standardized contracts and documentation for transactions.

> "Today, there's very little trading of VCM credits; the majority of transactions is by companies purchasing and retiring credits. Until you have a determinant of what can be used, how, and standardization, you can't bring liquidity to this market."
>
> — Banking executive, global sustainable finance

5. **There is a lack of consensus in the market on how companies can claim the use of VCM credits in their reporting and communications**. Existing guidance directs a company to first

reduce its emissions,[47] and then seek to "neutralize" any residual emissions through carbon removals. For example, SBTi states that "we expect most companies to make emission reductions of at least 90 percent to reach net-zero, leaving only a maximum of 10 percent of a company's base year emissions to be addressed through neutralization," and that VCM credits "do not count as reductions toward meeting your science-based targets (SBT). Companies should only account for reductions resulting from direct action within their operations or value chains."[18] In terms of reporting, the GHG Protocol states that "companies should always report their own internal emissions in separate accounts from offsets used to meet the target, rather than providing a net figure."[48] Figure 19 clarifies the link between carbon markets and an entity's GHG emissions.

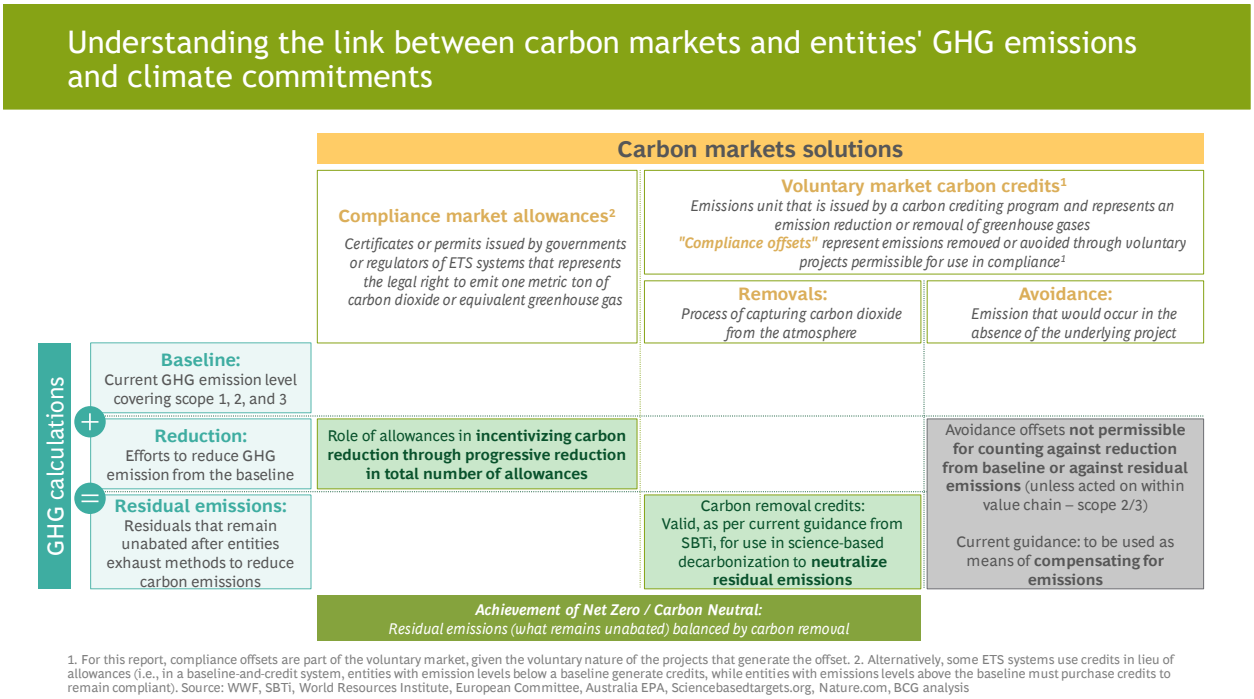


Figure 19: Understanding the link between carbon markets and entities' GHG emissions

[47] Across Scope 1, 2 and 3—based on the relative magnitude of these emissions, as per SBTi. Near-term SBTs must cover >95 percent of company-wide scope 1 and 2 emissions, while >67 percent of scope 3 emissions must be covered for companies with scope 3 emissions >40 percent of total emissions. Long-term SBTs must cover >95 percent of company-wide scope 1–3 emissions.
[48] WWF position and guidance on voluntary purchases of carbon credits, October 2019.

There is a similar lack of consensus for other buyers such as investors. This lack of consensus in the market leads to confusion for corporates and investors in understanding how and where to use VCM credits; it also leads to miscommunication in the market, particularly around claims of "carbon neutrality" and/or "net zero" on the parts of corporates using VCM credits. This can also distract from decarbonization initiatives within the value chains of corporates.

Organizations such as the VCMI, WWF, and SBTi are in the process of defining and working toward reaching a consensus around the role of VCM credits.

Together, these issues result in a lack of supply of "high-quality" projects and VCM credits that can confidently be described as "additional" and drive decarbonization and other co-benefits. For participants, the current state of the market possesses some reputational risk for buyers and necessitates significant time and effort in finding high-quality projects.

Challenge around the use of VCM credits in CORSIA

The issues around VCM credit "quality," discussed earlier in this section, pose a challenge to their application and use in sector-specific markets such as CORSIA. CORSIA aims to achieve "carbon neutral growth" by requiring operators to purchase and surrender eligible VCM credits for international aviation emissions that exceed a set baseline (based on 2019 emission levels). In this way, CORSIA sets no cap on actual GHG emissions from international aviation, thereby enabling emissions to increase as long as VCM credits are purchased for the excess emissions. As a result, there is limited incentive to reduce GHG emissions within the value chain.

Moreover, the lack of "high-quality" VCM credits available for use in CORSIA leads to low price levels in the market and unclear additionality. As evidence, offsetting a tonne of CO_2 under CORISIA costs <$1. According to experts from the ICCT and Ecosystem Marketplace, this price could range from $0.70-12 by 2035.[49]

Additionally, the current lack of clarity around how companies can claim VCM credits toward "carbon neutrality" obscures the credibility and impact of CORSIA's approach to achieve "carbon neutral growth."

[49] https://www.dw.com/en/corsia-climate-flying-emissions-offsets/a-56309438.

2.3 Carbon markets remain fragmented—leading to inefficiency in decarbonization and smaller, less liquid markets

ETSs are policy driven and jurisdictional in nature, with limited interoperability between separate systems. The fragmentation across both compliance markets and the VCM leads to smaller, less liquid markets. Market participants operating in a given compliance market will be limited to trading with other entities within that same market. Entities in the VCM are hindered by the fragmentation of standards and quality of credits, resulting in lower confidence and participation. **Across both markets, fragmentation leads to fewer abatement options for entities, which reduces efficient decarbonization for participants.**

There are some instances today of interoperability between compliance markets. Interoperability between compliance markets is typically found in Asian and North American ETSs (e.g., between California and Québec), with none in Europe aside from the Switzerland ETS (which is interoperable with the EU ETS).

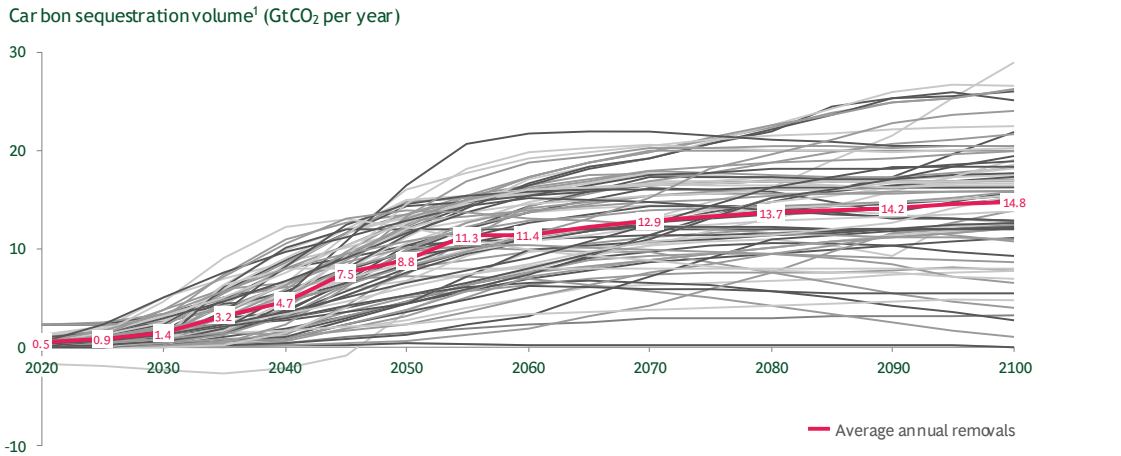
While large-scale linking between ETSs in the manner of California and Québec or the EU and Switzerland may lead to greater liquidity and deeper markets in the long run, it is unlikely to be productive in the short run. A key challenge in this regard is the differing ambition levels found in ETSs today. If ETSs with significantly different allowance limits and emission reduction plans link, the risk of goals dilution rises. Still, large-scale linking should be a key objective to be pursued in the long term.

At the same time, it can be beneficial to design new and upcoming ETSs in a standardized manner and incorporate lessons from mature and successful systems such as the EU ETS. In this way, **future interoperability between ETSs becomes more feasible in the long term once ambition levels are consistent across jurisdictions**. It will be possible to follow an incrementalistic approach toward a global carbon pricing system—first occurring through ETSs with similar ambition levels recognizing each other's allowances, then progressing toward allowing custodians to hold allowances across registries, and finally achieving a common registry for all entities to use.

As discussed in the previous sub-section, the VCM is expected to play a significant role in achieving the 1.5°C goal. However, it currently faces several structural challenges that must be resolved in order to enable scaling (as discussed in detail in Section 2.2), such as a lack of alignment with science-based decarbonization pathways, a lack of consensus around usage of VCM credits, the wide variety in quality of credits available, and the lack of a generally accepted and consistent process for verifying VCM credits. **Compliance markets with linkages to the VCM generally allow covered entities to use VCM credits (in the form of "compliance offsets") to meet between 3 and 10 percent of their compliance obligations**. In some ETS jurisdictions, there are additional restrictions on compliance offset usage, such as the type of project generating the offsets. Many ETSs that permit the use of compliance offsets permit both removals and avoidance offsets. For example, the Regional Greenhouse Gas Initiative (RGGI) ETS allows avoidance offsets from agricultural manure-management operations. However, the majority of compliance markets operate independently, with no linkages to other ETSs or the VCM.

2.4 Carbon removals are necessary, but the market mechanism remains unclear

~10 Gt annual removals needed by mid-century to maintain the 1.5°C pathway



1. Average of sequestration volumes in 78 different 1.5°C pathways from the IPCC SR15, including from the GCAM, MESSAGE-GLOBIOM, and REMIND-MAgPIE models, where sequestration volume is the sum of sequestration from biomass, direct air capture, enhanced weathering, and land use
Source: IAMC 1.5 1.5°C Scenario Explorer hosted by IIASA

Figure 20: Annual removals through 2100 as per modelled scenarios that limit warming to 1.5°C

Carbon removals from the atmosphere are essential in supporting global emissions-reduction ambitions. As evidence, all IPCC-modelled pathways that restrict global warming to 1.5°C, with

limited or no overshoot, **project that on average ~1–10 Gt of annual CO_2 removal** will be needed over the 21st century (see Figure 20).[20]

Carbon removals are needed to achieve global carbon neutrality and/or net zero, as it is believed that not all emissions can be feasibly avoided or mitigated, at least based on current technological progress. Additionally, net negative emissions are also expected to be needed to remove enough GHGs from the atmosphere to limit global warming to 1.5°C (see Figure 21).

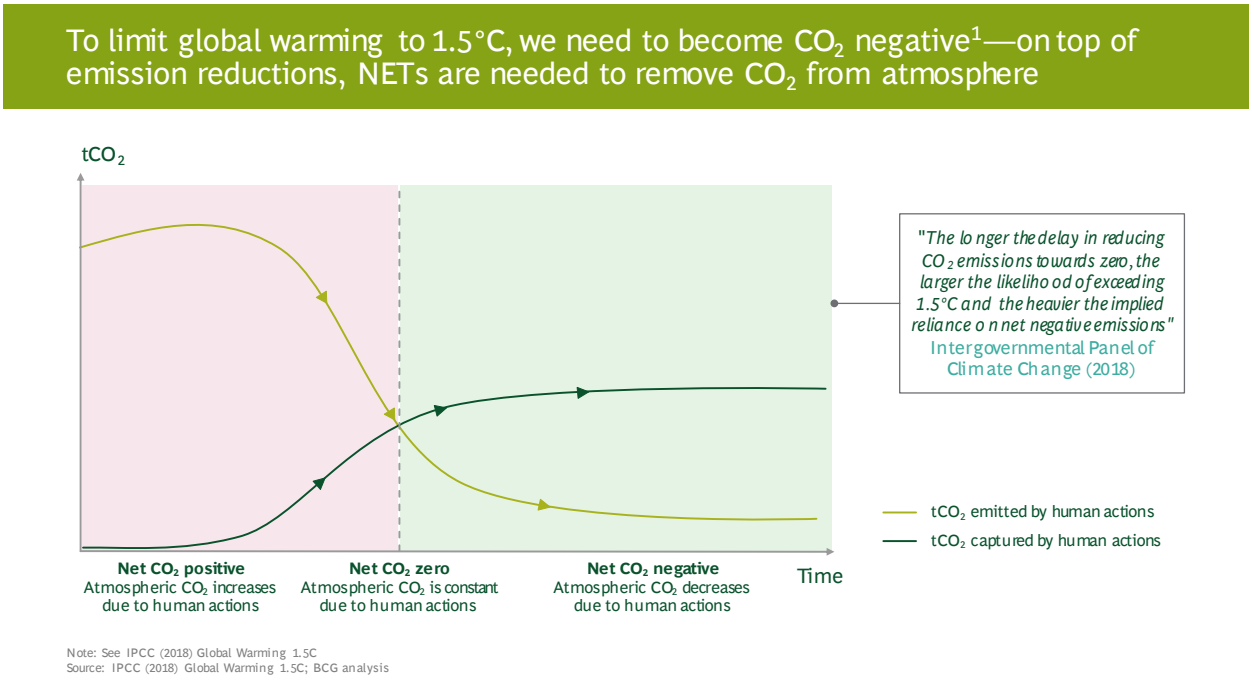


Figure 21: NETs and emissions reduction needed to achieve net CO_2 negative

However, there is currently no clear revenue source for at-scale carbon removals given the lack of a physical product to be sold (in most cases). Additionally, without a marketplace in which to trade carbon removals, significantly less financing will be channeled toward carbon removal projects and technologies. That lack of proper financing will lead to fewer carbon removal projects. There are also likely to be increased inefficiencies in the market, given the multitude of different removal technologies available or being developed, their geographic dispersion, as well as a lack of common understanding within corporations about these technologies and solutions.

The lack of a marketplace, in particular, prevents the development of carbon removals as a service for buyers. Several market options could help circumvent this obstacle. The inclusion of carbon removal credits as "generators" of allowances in ETSs—with each removal effectively creating a number of allowances equivalent to the carbon removed—could create a demand mechanism for such credits. Additionally, the VCM could play the role of a global marketplace for credits from carbon removal projects which the private sector could leverage for neutralizing residual emissions for their net-zero and carbon-neutrality goals. Other mechanisms could include tax, fee, or control-based mechanisms (e.g., tax credits for every tonne of carbon removed). These options could create demand and mobilize capital toward removal technologies (see Figure 22).

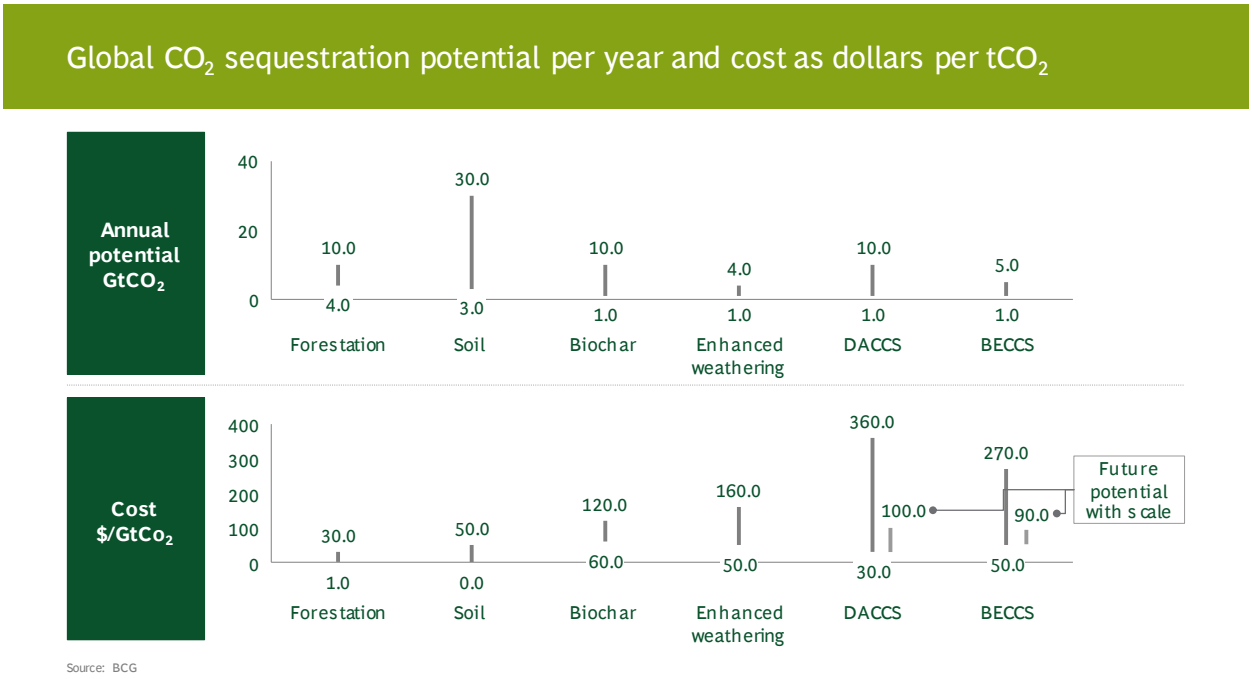


Figure 22: Carbon removal technologies, potential, and cost

2.5 Lack of standardization on certain dimensions further limits scale and liquidity

Product transparency and contract standardization

In compliance markets, carbon allowances and their derivatives have a high degree of standardization. ETS allowances are inherently standardized, as each allowance represents 1 tCO_2 of permitted emissions. Organizations such as ISDA and the European Federation of Energy Traders have also provided some contract templates for trading EU and U.K. ETS allowances as annexes to their general agreements for trading commodities.[50] These annexes serve as standard legal documentation for allowance trading, providing standard terms and conditions for supply, payment, and risk of delivery failure, thereby helping to reduce negotiation times and increase liquidity. However, a **key challenge is that these types of standardized contracts are not extensively developed outside of the EU and U.K. systems.**

> "Without the standards providers we wouldn't have a market, but they're also part of the problem. There's too many flavors, too little barrier to entry to become a standard-setter."
>
> — Banking executive, utility markets

Derivatives and other products structured around allowances and credits lack widespread standardization, especially in the underlying legal contracts for the trading of these products in OTC transactions. ISDA has recognized this lack of standardization across multiple ETSs as well and is in the midst of developing a suite of standard documentation templates for carbon-related derivatives, with some templates for trading swaps, options, and forwards based on allowances from the EU ETS and RGGI.[51] However, ISDA has also recognized the need for further development of both exchange-traded spot and futures contracts and OTC contracts in order to develop the derivatives markets.[52] In the VCM, there will naturally be little standardization of products given the variety of attributes that distinguish different types of credits. However, the lack of both a taxonomy of attributes for categorizing the underlying credits and standardized reference contracts for trading the associated derivatives is a key shortcoming (see Sections 2.2 and 4.4 for more details on taxonomy standardization for VCM credits).

Additionally, there are **limited options to invest in the carbon markets. Instruments beyond spot carbon instruments such as standardized futures and options only exist in more mature ETS markets**

---

[50] European Federation of Energy Traders, "Allowances Appendices to EFET General Agreement," February 2021.
[51] Informal comments from ISDA CEO Scott O'Malia in February 2021, https://www.isda.org/2021/02/18/coming-together-on-climate-risk/.
[52] ISDA, "Overview of ESG-related Derivatives Products and Transactions," January 2021.

such as those in the EU, California, and RGGI. There are also **few investment funds and instruments that use carbon allowances, credits, and their derivatives as underlying assets**. Some, however, have come to market recently. For example, there are exchange-traded products that track carbon indices, such as the KraneShares Global Carbon Exchange-Traded Fund (ETF), an ETF product tracking the IHS Markit Global Carbon Index (covering EUA, California Carbon Allowances and the RGGI); or iPath Series B Carbon exchange-traded note (ETN), an ETN that tracks Barclays Global Carbon II TR USD Index (covering European Union Allowances (EUAs) and Certified Emission Reductions (CERs)).[53]

There are several markets that don't yet have robust futures products available, especially in newly established ETSs, although some products are in the works. For example, Korea's K-ETS has been through a series of upgrades, including the introduction of market makers in spot markets in 2019. K-ETS hopes to introduce derivatives products and allow third-party transactions in Phase 3 (starting in 2021). Similarly, China's National ETS, which represents the largest ETS market by volume covering ~4 $GtCO_2e$ of carbon, has not yet established a carbon allowance futures market, but is expected to develop one in the future.[1] **The current lack of deep secondary markets for products such as indices, derivatives, and other financial products that leverage carbon instruments and the associated lack of awareness about the use of these instruments limits demand and liquidity.**

Financial accounting standardization

Corporates currently employ a range of methods for recording allowances on their financial statements. In 2004, the IASB published IFRIC 3 Emissions Rights, its interpretation of how to apply International Financial Reporting Standards (IFRS) principles to emissions allowances.[54] **IFRIC 3 received criticism from market participants based on three deficiencies**:[55]

1. It did not address financial accounting for allowances purchased by non-participants for trading or investment purposes.
2. It did not provide guidance on the treatment of carbon derivatives.
3. It created a financial accounting mismatch between accounting for allowances as intangible assets (recorded at historical cost and amortized over the compliance period) and liabilities (recorded at market value).

---

[53] https://kraneshares.com/krbn/ | 2020 annual report.
[54] IASB, "IASB withdraws IFRIC Interpretation on Emissions Rights."
[55] Climate Policy Initiative, "Emissions Trading Schemes under IFRS—Towards a 'true and fair view.'"

As a result of these deficiencies, the IASB withdrew the IFRIC 3 interpretation in 2005. Since then, corporates have had discretion as to whether they list emission allowances on their balance sheet as intangible assets or purely as net liabilities, and may choose when to mark their value to the market. In a survey of 26 entities representing ~26 percent of verified emissions in the EU ETS in 2008, the Association of Certified Chartered Accountants (ACCA) found that there was no common practice for how corporates account for these instruments in their financial statements. For example, 11 of the entities recorded purchased EU allowances as intangible assets, 8 recorded them as inventory or other types of assets, and 7 did not disclose where they had recorded them in their financial statements. A similar lack of uniformity was found in other financial accounting aspects, such as whether companies recognized allocated allowances on their balance sheet at nil value or at fair market value balanced by deferred income.[56]

In both the U.S. and the EU, legislative bodies have recognized the need for a consistent financial accounting framework with respect to allowances and credits. Since 2001, the European Commission has acknowledged that a lack of harmonized financial reporting and disclosure guidelines hinders comparability between companies and calls into question the value of information reported by entities.[57] The financial accounting methods used by corporates also create different tax implications, as they impact when and whether corporates recognize the receipt of allowances as income or the surrender and retirement of allowances as expenses. In 2009, the U.S. Senate Committee on Finance held a hearing to discuss these issues and recognized that a clear financial accounting guidance and systematic tax treatment for cap-and-trade programs would reduce both uncertainty for taxpayers and disputes with the government.[58] As of this writing, there is still no comprehensive guidance on financial accounting for emissions instruments from an international body such as the IASB or FASB, and little systemic guidance for tax treatment from national bodies such as the U.S. Internal Revenue Service.

Carbon accounting standardization

Accurately and consistently accounting for GHG emissions is a complex undertaking. Bodies such as the GHG Protocol, which was developed by the World Resources Institute (WRI), have issued

[56] Association of Charted Certified Accountants, "Accounting for Carbon."
[57] European Commission, Commission Recommendation of May 30. 2001 on the recognition, measurement, and disclosure of environmental issues in the annual accounts and annual reports of companies.
[58] Joint Committee on Taxation, "Climate Change Legislation: Tax Considerations," June 2009.

guidance for corporates on how to measure and manage GHG emissions; however, there is a lack of consensus on a harmonized carbon accounting framework that covers all scopes of emissions across sectors. This creates several challenges with respect to the consistency of measuring and accounting for emissions across different sectors and at different points in the value chain for corporates in specific sectors (the "scope" of the emissions). In addition, there is also a lack of consensus on both accounting for VCM credits and the terminology and definitions for claims that corporates and financial sector participants can make with respect to carbon neutrality or net-zero emissions.

The GHG Protocol serves as a strong foundation for a future universal carbon accounting framework that will provide guidance on accounting for emissions within corporates' scope 1–3 emissions. However, in its current guidance, the GHG Protocol leaves three issues unaddressed:

1. It provides limited guidance for corporates in different sectors on how to account for specific types of scope 3 emissions. For each category of scope 3 emissions, the GHG Protocol also defines several different approaches for corporates to measure their emissions—with a large degree of variability today with respect to which methods corporates use and what data is available for each method.
2. It does not include comprehensive policies to ensure the accurate attribution and allocation of scope 3 emissions to all relevant stakeholders. This could lead to risks of under-counting or over-counting emissions. In some cases, one company's scope 3 emissions may be another company's scope 1 emissions. The current GHG Protocol does not provide guidance on allocations.
3. It does not provide the financial sector with specific guidance on accounting for emissions from their investment holdings. For this sector, the primary source of emissions is from companies in which financial institutions such as banks, asset managers, and insurers hold equity or debt stakes. These financed emissions are part of category 15 in the GHG Protocol's scope 3 emissions list; however, there is no explicit guidance for the financial sector to measure and report these emissions.

Several industry trade organizations have recognized the need for sector-specific carbon accounting guidance and developed their own initiatives to address this gap. The PCAF developed a sector-specific accounting standard for the financial industry to provide guidance on topics such as financed emissions. Similarly, the IPIECA has released an emissions accounting manual for the oil and gas

industry. Both of these initiatives are still in early iterations, however, and will continue to be revised by their respective associations.

Outside the need for accounting for scope 1–3 emissions, **there is also a lack of guidance in two other key areas:** standard terminology and definitions for corporate claims (as discussed in Section 2.2) and **policies for reporting VCM credits, including provisions to avoid double counting**.

Limited standardized guidance for ETS market regulation

Currently, there is no centralized or comprehensive "playbook" of learnings from mature ETSs that policymakers can use when designing new compliance markets or in the early stages of implementation. The lack of such guidance may lead to new ETSs experiencing the same issues already resolved by mature ETSs, such as the EU and California systems. **The evolution of mature systems can provide best practices and key lessons for designing and managing compliance markets.**

> "The EU got there through trial and error… Do we have 15 years to let other compliance markets go through trial and error? We don't have time to reinvent the wheel and ignore the lessons we've had 15 years of playing with."
>
> — Partner, law firm engaged in carbon markets

In particular, the EU ETS provides several key lessons from its development over the previous 16 years that policymakers designing new compliance markets can incorporate (for more detail see the Annex - Key lessons from the EU ETS):[59]

1. Since ETSs are market mechanisms, government entities with markets experience should be involved in the design and oversight of compliance markets.
2. Collecting verified annual emissions data from market participants (baselining) to help calculate future market caps on allowances can help ensure appropriate allowance levels.
3. Mechanisms to adjust the supply of allowances—such as an MSR during a compliance period without altering the predetermined cap—can help mitigate changes in the economic environment that affect prices and reductions incentives.

[59] *Carbon & Climate Law Review*, 2016, Vol. 10, No. 3, Special Issue on Carbon Rights (2016).

4. For cross-border or cross-state systems, a common registry built on a single technology platform with consistent data and rigorous cybersecurity is important.
5. A comprehensive legal framework that underpins the compliance system can support confidence and participation in the market.
6. Classifying allowances as financial instruments can help safeguard carbon markets from abuse and other types of misconduct.
7. Transitioning allowance distribution from free allocation to auctions is critical to financially incentivize emissions reduction and raise government revenue that can be channeled into green investments.
8. Where feasible, ETS initiatives with similar emissions reduction goals can consider linking with other compatible systems for greater liquidity and price stability.
9. The ambition level of an ETS should be periodically assessed and adjusted to ensure alignment with Paris Agreement goals.

Trading market regulations for allowances, credits, and derivatives

The secondary markets for emissions allowances, credits, and associated derivatives can play an important role in determining the true price of carbon (and facilitating the necessary investment in abatement technology) by delivering transparency, liquidity, and capital to the carbon markets. **There are open questions in these secondary markets that need to be resolved. Among them, how should emissions instruments be structured, what role should financial market authorities play in these markets, and where should transactions involving these instruments take place**? In more mature ETSs with derivatives markets, steps have been taken by legislative authorities and market regulators to address these issues. For example, in 2018, the European Parliament's revised Directive on Markets in Financial Instruments (MiFID2) **classified EU allowances as financial instruments**, thus placing them in the scope of financial market rules (along with their derivatives).[60] This was done to **ensure high-integrity standards for market participants, prevent market manipulation, and foster market transparency and access to information.** In terms of oversight, this action **placed EU allowance trading under the jurisdiction of each EU member state's national authority, as well as the European Securities and Markets Authority (ESMA)**. In regard to the appropriate venues for secondary trading of allowances, credits, and derivatives, some instruments based on EU, RGGI, and California allowances currently trade across derivatives exchanges, such as the Chicago Mercantile

[60] https://ec.europa.eu/clima/policies/ets/oversight_en.

Exchange (CME) and Nodal Exchange, as well as commodities exchanges, including the Intercontinental Exchange (ICE) and the European Energy Exchange (EEX).

Authorization to trade in the carbon markets exists at two levels: (i) purchasing and trading ETS allowances and VCM credits for compliance obligation or emissions offsetting purposes, and (ii) trading of derivatives for hedging or investment purposes. To trade compliance allowances, entities must open an account with the appropriate registry, such as the Union Registry in the EU ETS.[61] To trade VCM credits, entities must follow a similar process in opening an account with one of the existing VCM registries.[62] In contrast, to trade derivatives with allowances or credits as the underlying product, entities can either do so directly through OTC transactions or on an exchange such as the Intercontinental Exchange. Since derivatives trading is supervised by regulatory bodies, licenses and registration are required depending on the specific market. As carbon-related derivatives are traded on a variety of exchanges in different countries, entities may need licensing from multiple regulatory bodies in order to trade derivatives.

Additionally, the relative immaturity of carbon instruments and derivatives calls into question the application of existing prudential requirements and their impact on regulated financial institutions that participate in the carbon markets. Basel III, developed by the Basel Committee in response to the 2008 financial crisis, is the current international standard for banks' capital requirements and supervision.[63] Under the Basel III framework, banks are recommended to hold a minimum level of capital, maintain sufficient liquidity and funding levels, perform firm-wide risk management, and disclose key prudential metrics. These standards are implemented and enforced in the Basel Committee's member countries by their respective central banks and regulators (e.g., the Bank of England and the Prudential Regulatory Authority in the U.K.).[64]

As carbon instruments and derivatives have become a larger portion of banks' activities and assets, Basel III standards have been applied to carbon trading activities as well, with concerns expressed by organizations such as ISDA on how they are applied. In particular, ISDA has strongly criticized the impact that Basel III's FRTB will have on banks and other financial institutions that participate in carbon trading. According to ISDA, the FRTB, which is scheduled for implementation in 2023, will

[61] https://ec.europa.eu/clima/policies/ets/registry_en.
[62] https://americancarbonregistry.org/how-it-works/membership.
[63] https://www.bis.org/bcbs/basel3.htm.
[64] https://www.bis.org/bcbs/membership.htm.

significantly increase capital costs for banks that trade carbon allowances and credits. The capital costs to banks result from two aspects of the FRTB:[65]

1. Risk weight: Under Basel III, different assets are assigned risk weights with associated minimum amounts of capital that reduce the risk of insolvency. The current application of the FRTB assigns a risk weight of 60 percent to carbon trades, which implies a higher volatility and capital requirement for banks. In its July 2021 report, ISDA observed that a risk weight of 37 percent would be more appropriate.
2. Carry positions: Banks serve as intermediaries in the financial markets, meaning they purchase assets in spot trades and then sell forward contracts on them. The FRTB subjects carry positions for commodities to an additional capital charge, given the storage costs of the physical goods for traditional commodities such as wheat or oil. As currently written, the FRTB would impose the same capital charge on carbon instruments. ISDA argues that a lower capital charge for carbon instruments specifically would be appropriate given that carbon allowances and credits are not physical goods.

In ISDA's view, FRTB's carbon instruments regulations introduce unnecessarily high capital costs that may "impair the ability of banks to act as intermediaries in the ETS market globally."[65] This is problematic because banks and capital markets participants have a significant role to play in scaling and developing carbon markets for both underlying instruments and derivatives. The application of Basel III guidelines will likely need recalibration in order to preserve banks' incentives to participate in carbon markets.

[65] ISDA, "Implications of the FRTB for Carbon Certificates," July 2021.

3 Section 3: Vision for the evolution of carbon markets

This report lays out a **vision for the future of effective carbon markets from a practitioner's perspective** – one that details how carbon markets can **support and enable efficient science-based decarbonization aligned with Paris Agreement objectives** (see a condensed version of this vision in Figure 23). As discussed in the previous section, carbon markets face several challenges today. In this section, we suggest a roadmap for potentially overcoming these obstacles and enabling carbon markets to scale up during the next three decades in support of global carbon neutrality—and ultimately scale down once global net zero is achieved.

Short term (within the next 1–2 years)

This report envisions, within the next one to two years, **bold climate actions on the part of policymakers globally, and a significant increase in emissions-mitigation policies across key carbon-intensive jurisdictions. These activities lead to planned coverage of >50 percent emissions (up from the current ~20 percent) under one or more carbon pricing mechanisms, a first step toward broader coverage in the future.**[1] New ETSs are designed around the earnings and best practices identified through previous initiatives. Existing ETS initiatives also **ratchet up their allowance retirement trajectories to align with a 1.5°C pathway**.

The significant gains in carbon markets coverage are buoyed by collaboration among regulators, policymakers, standard-setting bodies, climate science bodies, and other key stakeholders such as industry associations. Moreover, carbon markets themselves improve substantially with harmonized **global carbon accounting practices across sectors, as well as clarity and consensus around the role of VCM credits in science-based decarbonization. Markets also gain clarity through consensus and guidance from leading bodies in regard to both accounting rules for carbon emissions and when companies can claim to be "net zero" or "carbon neutral." In addition, stricter, tightened, and harmonized MRV processes are established for the VCM.**

During this time-frame, standard-setting bodies align on and establish a clear, standardized taxonomy for VCM credits, reference contracts, and reference indices to enable the development of

this market as a supplementary resource for compensating for GHG emissions through avoidance or neutralizing through carbon removals.

Selective interoperability is established for high-quality VCM credits (as compliance offsets) in certain ETS markets—while maintaining strict limits and eligibility criteria to ensure science-based decarbonization and additionality.

Financial sector participants introduce product innovations aligned with market requirements to enable greater participation in both compliance and voluntary markets, with a certain level of market autonomy made possible by a regulatory environment that is conducive to financial institutions' participation in the carbon markets. Current barriers, such as the strict treatment of carbon instruments under Basel III's FRTB, are amended.

Medium term (in ~5 years)

Continued strong policy and regulatory action on emissions-reduction policies leads to a majority of GHG emissions being covered through carbon pricing or alternative mechanisms. Allowance retirements in ETS initiatives align with 1.5°C pathways (e.g., through >5 percent linear reductions in the allowance cap).[10]

Demand for carbon-market instruments and derivatives starts to scale as carbon becomes a mature and investable asset class, in addition to an instrument for emissions used by corporates, investors, and other participants for their compliance, decarbonization, risk management, and investment purposes.

The VCM continues to develop—now under well-documented and clearly defined taxonomies—and support science-based decarbonization strategies by offering a supply of high-quality credits with clear attributes to be used as compensation for emissions. This leads to larger-scale interoperability between ETSs and the VCM, with the VCM covering sectors and regions that are not yet covered by regulated mechanisms, while developing strict, harmonized MRV processes.

Long term (~10 years)

Emissions-reduction policies (including carbon pricing) reach near-full coverage of GHGs (through ETS, carbon taxes, and other control-based mechanisms), with reduction trajectories aligned to Paris Agreement ambitions.

Emissions reduction goals in different jurisdictions are broadly similar, allowing for more seamless interoperability between compliance markets. This enables the development of a global large-scale carbon market, with an allowance level aligned with remaining carbon budgets as per the latest IPCC estimates.

With nearly all GHG being covered by compliance schemes, the role of the global VCM transitions to primarily supplying carbon removals to neutralize residual emissions. High-quality credits are integrated within compliance markets to the extent feasible (as compliance offsets); carbon removal credits act as "generators" of compliance allowances.

End-state goal (global net zero achieved or exceeded)

Through sustained cooperation of the global economy and adherence to the short-, medium-, and long-term progression previously outlined, this report envisions the final state of the carbon markets reflecting global achievement of Net Zero and further pursuing negative emissions as needed.

In this state, carbon markets exist as scaled-down, efficient markets that support neutralizing of nominal residual emissions, wherein ETS allowances are only available for unavoidable emissions and are counterbalanced by carbon-removal or negative emissions credits (potentially sourced from the global VCM). Compliance markets become net carbon sinks, where entities are required to surrender carbon removal credits in amounts needed to limit global warming.

Effective and constructive collaboration among a broad range of stakeholders, policymakers, and regulators is essential to achieving this vision. In the next section, we explore a set of recommendations for realizing this vision.

Vision for Evolution of Carbon Markets to support global decarbonization in line with Paris Agreement ambitions

Topic	Short-term *(within 1-2 years)*	Medium term *(~5 years)*	Long term *(~10 years)*	End-state goal *(global Net Zero achieved/exceeded)*
Policy-based coverage of global GHG emissions with regulated mechanisms aligned with 1.5°C ambition	• Carbon pricing (ETS / tax) **established in majority of carbon-intensive jurisdictions** • **Planned coverage of >50%**	• **Majority (>50%) of GHG emissions covered, allowance retirement aligned with 1.5°C pathway** (>5% linear reductions) • **CBAMs in effect where needed** until globally consistent emissions ambitions	• **Near-full coverage of GHGs** by pricing or control mechanisms • **Absolute ETS market value exceeds $1T+** • **Interlinking of similarly ambitious ETS markets,** incremental moves toward regional/global carbon markets	• Emissions **allowances equivalent only to unavoidable emissions**… • …balanced by **carbon removals, achieving global Net Zero** or global carbon neutrality
Robust global voluntary market for supply of high-quality credits	• **Standardized taxonomy for classifying credits, reference contracts and indices** • **Stricter, science-aligned, harmonized MRV processes** • **Market consensus on use of VCM credits (and accounting)** — driven as per climate science and standard-setting bodies • Selective VCM **interoperability in ETS markets with strict limits and eligibility** as per climate science to ensure additionality	• VCM market supplying **high-quality carbon credits as per taxonomy and MRV standards,** supported by technology-based verification • **Large-scale demand as compensation** for emissions and **neutralization purposes** • **Large-scale interoperability once VCM integrity established**	• VCM supplies **at-scale carbon removals for neutralization purposes** • **Avoidance credits plateau** given coverage instead by regulated mechanisms (ETS, tax, or control mechanisms)	• **No avoidance credits** since all avoidance measures already in effect • **VCM continues as global marketplace for carbon removals to neutralize residual emissions and to pursue negative emissions** as needed for climate trajectory
Scaled market demand and improved market maturity	• **Awareness and clarity for corporates and financial sector** on use of ETS and VCM carbon instruments • **Standardized universal carbon accounting framework**, clarity across sectors on scope 1-3; incl **clarity on terminology of claims** (e.g., "Net Zero", "Carbon Neutral", etc.)	• **Carbon instruments established as mature and investable asset class** with suite of financial products from financial sector to support corporate and investor needs on compliance, risk management, and investment	• Seamless **interoperability between (1) ETS markets that have aligned climate ambitions** and pathways; and (2) **high-quality VCM credits** maintaining stringent eligibility and quality considerations	• **Scaled-down but efficient markets dealing only with residual emissions and requisite carbon removals** to meet climate goals

Figure 23: Vision for Carbon Markets Evolution

4 Section 4: Recommendations

4.1 Expand coverage and ambitions of ETS markets

We recommend that **policymakers and regulators expand the scope of geographic, sectoral, and activity coverage of compliance ETS markets**, and strive toward near-full coverage by one or more GHG pricing and/or GHG control mechanisms within the next five years. High-impact ETSs should be designed by incorporating key learnings from other ETS schemes and **stringent allowance reductions aligned with emissions pathways that achieve 1.5°C ambitions**.

As identified in Section 2.1, there is significant room to broaden the reach of regulated carbon pricing mechanisms, with close to 80 percent of GHG emissions (>40 $GtCO_2e$ annually) not covered today.[1] In addition, carbon prices in a majority of the covered markets are lagging as a result of lower-than-needed emissions reduction goals and the use of free allocation for allowances.

Policymakers should aim for near-full coverage of GHG emissions within their jurisdictions through one or more emissions-reduction mechanisms (ETSs, taxes, fees/rebates, and control-based mechanisms). This recommendation focuses on expanding the coverage of ETS markets in particular.

To build and expand effective ETSs, policymakers should consider the following practices and learnings:

- **Prioritize sectoral coverage based on materiality of their emissions, ease of measurement, and ease of application of regulated mechanisms—while moving over time toward near-full coverage through one or more carbon pricing levers** (e.g., ETS or carbon tax) and control-based mechanisms (e.g., internal combustion engine vehicle phase-outs).

Evaluating and expanding sector coverage

There are several criteria policymakers can use to evaluate and prioritize sectors for coverage under their ETSs:

1. **Materiality of emissions**: Policymakers designing ETSs may consider incorporating the highest-emission sectors in the earlier phases of an ETS, and then progressively expanding to other sectors over time. In 2019, the power (oil, gas, and coal) and industry (iron and steel, cement, chemicals, etc.) sectors collectively contributed over half of global GHG emissions (see Figure 24). Among mature ETSs, some combination of these two sectors is often included in the first phase or compliance period. For example, Phase 1 of the EU ETS covered power stations and various sub-sectors of industry, such as iron and steel plants and cement producers. The remaining ~50 percent of global emissions in 2019 originated from transportation (including aviation), agriculture (including land use change), buildings, and other sectors. As the EU ETS phased in, additional sectors were gradually incorporated. In Phase 2, aviation operators above a certain emissions threshold were added; and in Phase 3, coverage of industrial producers of various chemicals was introduced. The California ETS followed a similar ordering of sectors, with electric power generation, cement, iron and steel, and some chemicals producers included in the first compliance period, and natural gas and fuel oil incorporated into the second compliance period.[66]
2. **Composition of sectors and feasibility of coverage**: For some sectors, the use of regulated markets such as ETSs may be more difficult, for reasons such as scale or access. For example, the agricultural sector was responsible for ~6 $GtCO_2e$ global emissions in 2019;[67] however, it is not included in any compliance markets today because many of its entities are small and would represent a monitoring and management challenge for an ETS. Additionally, political considerations may stand in the way, as the agricultural sector is heavily subsidized by governments in several countries ($425 billion in subsidies disbursed between 1995 and 2020 in the U.S.).[68]
3. **Ease of measurement of emissions**: The nature of some sectors makes measurement of emissions difficult, and hence coverage by compliance markets less appropriate. Emissions from large stationary installations such as iron and steel plants, for example, are relatively easy to measure and include under ETS coverage. In contrast, measurement of emissions from the agricultural sector is more ambiguous due to factors such as the available technology for measuring and the often individual or non-corporate nature of agricultural entities.

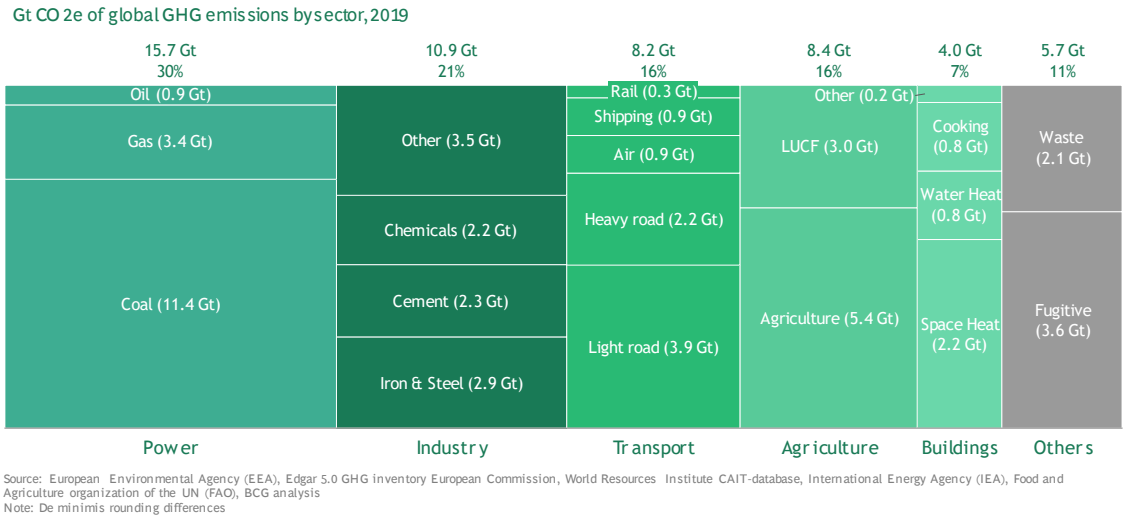
For policymakers choosing sectors for ETS coverage over time, the following prioritization path can serve as a starting point:

1. **Begin with sectors that have the most material emissions, are feasible to be covered by regulated markets, and whose emissions can be accurately measured and attributed**. These characteristics are generally applicable to the power and industrials sectors, where entities are typically large corporate entities and there is confidence in measuring emissions.

[66] ICAP Status Report 2021.
[67] Climate Watch Data Explorer: Historical Emissions (CAIT).
[68] EWG Farm Subsidy Database.

2. Leverage the VCM as a transitionary "pre-compliance" market to cover additional sectors, smaller entities, and other uncovered portions of the market. Establish stringent guidelines to ensure additionality and leverage interoperability between ETSs and the VCM with eligible high-quality credits as "compliance offsets" to push the market toward broader coverage (refer to Section 4.2 for more details).
3. Over time, expand ETS coverage to these other sectors and smaller entities. The German ETS recently added all fuels used in the transport sector, which covers a larger number of small entities compared with, for instance, the power and industry sectors. Some systems, such as the EU ETS, incorporated aviation operators beyond a certain emissions threshold after starting with the power and industrials sectors. Incorporating sectors such as AFOLU in later stages should be considered. For example, the New Zealand ETS, which already covers the energy (power) and industrial processing sectors, is planning to phase in the agriculture sector by 2025.

Estimated 53 Gt of $CO2_e$ emissions in 2019, with majority of emissions from Power, Industry, and Transport sector



Source: European Environmental Agency (EEA), Edgar 5.0 GHG inventory European Commission, World Resources Institute CAIT-database, International Energy Agency (IEA), Food and Agriculture organization of the UN (FAO), BCG analysis
Note: De minimis rounding differences

Figure 24: Power, industry, and transport sectors were major contributors to 2019 emissions

- Establish absolute cap-based ETSs (as opposed to intensity-based or baseline-and-credit systems) to ensure overall decarbonization aligned with a total carbon budget, and aligned with science-based decarbonization pathways that would limit global warming to 1.5°C. Collect verified emissions data to ensure that emissions caps are as accurate as possible and to prevent a potential collapse in price levels.

- **Allocate allowances through an auctioning system, to the greatest extent feasible, so that an actual cost is applied to each unit of emissions reduction allocated to market participants.** If it is not possible to start with 100 percent auctioning of allowances, then the proportion of allowances allotted through the auction system should increase at a rapid pace until the full auctioning of allowances is reached. Revenues raised through auctioning should further be channeled into climate finance investments in a way that mobilizes private sector capital to contribute to the $100–$150+ trillion investment need (specific mechanisms are discussed in more detail in the previous publication, "Climate Finance Markets and the Real Economy," from December 2020).[16] Additionally, revenue from auctioning can be earmarked to support lower-income jurisdictions in their decarbonization efforts. For example, the EU ETS created the Modernisation Fund to fund improvements in energy systems/efficiency in 10 lower-income member states.[69]

> "If you're getting allowances for free but recording them at positive value, it's completely distortionary."
>
> — Independent climate transition advisor

- **To ensure alignment of an ETS with Paris Agreement goals, policymakers should design systems that provide for a steep reduction of the allowance cap in line with the latest in climate-scenario modelling** from leading climate science organizations such as IPCC. Current guidance from climate science indicates a need for achieving carbon neutrality by the middle of the century, and cutting emissions by half by 2030, which translates into **a >5 percent linear annual reduction**.[10] Ambition levels of ETS markets should be **periodically assessed and revised as new climate science data and scenarios are generated.** Allowance cap movements should also be **determined by the industry coverage of an ETS, since sectoral and regional transition pathways may vary based on different availability and cost of abatement levers**. This topic was explored in more detail in our previous publication, "Climate Finance Markets and the Real Economy," from December 2020.[16]

- **When designing an ETS, explore the impact of other emissions-related policies that can potentially support or counteract its effectiveness.** Specifically:

[69] https://ec.europa.eu/clima/eu-action/eu-emissions-trading-system-eu-ets/auctioning_en.

- Policymakers should consider eliminating policies that may create direct or indirect subsidies for high-carbon-intensity activities, such as fossil-fuel subsidies, that act as a negative carbon price.

- Policymakers should contemplate non-ETS mechanisms, such as taxes on fuels or performance standards (e.g., phase-outs of internal combustion engines), in addition to covering other sectors/entities with ETSs.

- Policies that support decarbonization should be factored into the design of an ETS (or other market-based carbon pricing scheme). For example, mandating automobile technologies in line with science-based decarbonization principles may render moot or at least limit the need for vehicle manufacturing coverage under an ETS.

- Classify allowances as financial instruments to help safeguard carbon markets and ensure integrity by enabling enforcement of mechanisms such as Know Your Customer (KYC), Anti-Money Laundering (AML), transparency, rules on inside information, etc. (The benefits of doing so are explored more in the Annex – Key lessons from the EU ETS.)

- Adopt market-based price or supply-adjustment measures in an ETS, such as floor prices, emissions containment reserves (ECRs), and MSRs, to act as a backstop and prevent unduly low price levels. (The mechanisms and their benefits are explored more in the Annex – Use of Market Stability Mechanisms in ETSs.)

- Ensure the maintenance and development of robust systems to increase transparency in MRV standards of GHG emissions. This includes detailed methodologies and guidance for emissions monitoring, leveraging existing data collection activities. Robust registries should be established to record all emissions reduction and this information should be made readily available for the verification process. Policymakers should define standards for compliance verification and involve government regulators to assist with the verification process in the early development of an ETS. Third-party verifiers can be involved once verification guidelines are clear and consistent.

- Consider using CBAMs to prevent leakage and maintain the competitiveness of domestic industries. Due to the jurisdictional nature and uneven carbon pricing across ETSs, there is a risk of carbon leakage, or the shifting of high-emissions production activities outside of an ETS to areas with a lower carbon price or less-stringent emissions regulations.[70] In the

[70] IEA, "Implementing Effective Emissions Trading Schemes: Lessons from International Experiences."

absence of a globally consistent carbon price, which is the ideal mechanism to prevent leakage, some ETSs—such as the EU and California systems—have implemented or are considering CBAMs: systems of tariffs, taxes, and/or rebates on imports and exports to compensate for differences in pricing across jurisdictions and establish level playing fields for international trade, with provisions to ensure developing countries with different transition pathways are not unduly burdened. (For details on the current state of CBAMs and a summary of the impact assessment for the EU CBAM, see the Annex – Details on carbon border adjustment mechanisms (CBAMs).)

4.2 Ensure integrity, role, and additionality of the VCM

We recommend that standard-setting bodies, in coordination with the broader ecosystem, facilitate the **transformation and scaling of the VCM to ensure its integrity, role, and additionality**.

The existing VCM offers the potential for a global pan-jurisdictional construct with a system for verification, certification, registration, trading, and retirement of carbon credits. This construct could serve a useful role supporting global decarbonization.

As discussed in Sections 2.2 and 2.4, there are several challenges that the VCM needs to overcome to achieve broader participation and scale. VCM credits are of varying qualities, and there is no consistent taxonomy with attributes to describe them. There is a lack of clarity about whether specific VCM credits are additional, and lack of consensus on how corporates and investors can use VCM credits toward their net-zero and carbon-neutral claims. There is also currently limited liquidity and trading in the market, with the majority of activity taking place through buy-and-hold or buy-and-retire transactions. Finally, the demand mechanism for carbon removals is unclear as well.

Future roles of the voluntary carbon market

Despite these challenges, the VCM can play a critical role in enabling science-based decarbonization pathways.

This report envisions **three primary roles** for the VCM:

1. Serve as a **transitionary coverage mechanism for sectors or regions, which are not covered by ETSs, carbon taxes, feebates, or control-based mechanisms,** until regulated mechanisms take over and ultimately scale down as emissions are reduced
2. Serve as a **core long-term marketplace for carbon removals, thereby supporting the growth and funding of critical new technologies, and supporting neutralization of residual emissions**

3. Serve as a **complementary mechanism for corporates to compensate for their emissions,** as they continue in-value-chain decarbonization, helping to channel capital to the markets that have the greatest need (e.g., underdeveloped economies)[71]

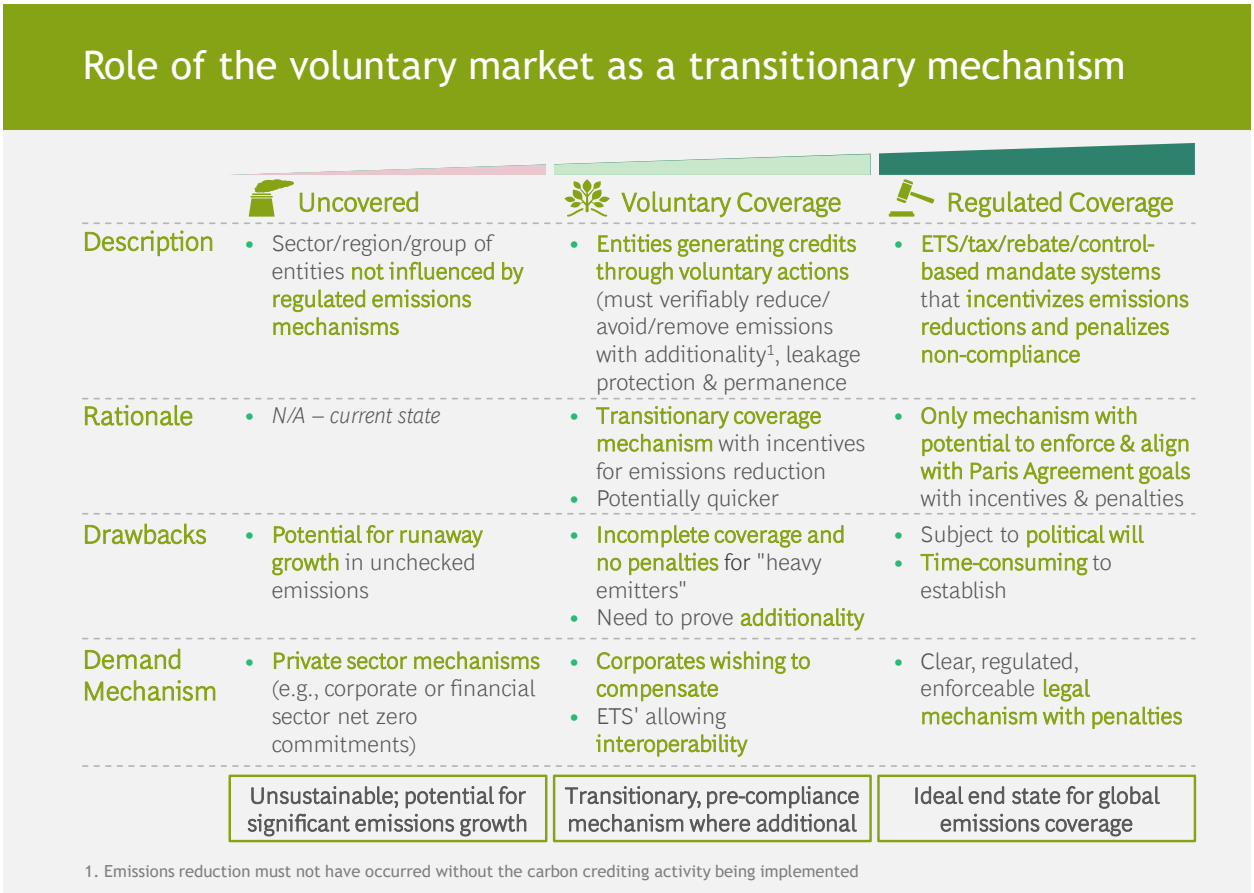


Figure 25: The VCM's role as a transitionary coverage mechanism

[71] Per SBTi guidance, compensation measures are actions companies take to help society avoid or reduce emissions outside their value chain as a way to contribute to the global transition to net zero.

Role #1: Transitionary coverage mechanism for sectors or regions not covered by ETSs, taxes, or mandates, until regulated mechanisms take over and ultimately scale as emissions are reduced

The VCM can play a role in decarbonization in sectors and regions that are not covered extensively by ETSs, carbon taxes, feebates, or control-based mechanisms. In particular, for sectors where the entities are small- to medium-sized enterprises or retail consumers rather than corporates, it may be difficult to measure emissions and enforce compliance obligations. For these sectors, the VCM can play a transitionary pre-compliance coverage role (see Figure 25 for more detail on this role and Figure 26 for a proposed framework for emission coverage).

> "The existence of demand for a voluntary market is the consequence of not enough compliance market coverage today."
>
> — Banking VP, environmental commodities

U.S. agriculture is a good example of a sector in which VCMs are providing transitionary coverage. The primary entities in the U.S. agricultural sector are individual farmers, and not large corporates, which makes coverage through regulated mechanisms more difficult. Additionally, accurate measurement of emissions from agriculture is complicated given the variety of external factors that affect emissions, such as weather patterns and fluctuations in soil carbon. Coverage of this sector has already been partially taken on by the VCM. For example, some ETSs such as the California system allow covered entities to use credits generated by livestock methane management projects and rice cultivation projects toward a portion of their compliance allowances.[66] However, there is an opportunity to expand the scope of credit-generating projects to a broader range of agricultural activities, such as the use of regenerative farming techniques to sequester carbon. In this way, the VCM can also contribute to financing the decarbonization of the agriculture sector.

The Growing Climate Solutions Act, a bill passed by the U.S. Senate, establishes a GHG Technical Assistance Provider and Third-Party Verifier Certification Program to support farmers, ranchers, and private forest landowners in entering/participating in the VCM. Other nations could establish similar advisory/verification resources to ensure proper use of and improve access to the VCM. This would encourage increased participation, and therefore liquidity, in the carbon markets, while channeling funds to local farmers that practice sustainable farming or are reducing their environmental footprint.

In order for the VCM to play this role, and to **ensure true additionality of credits, it is critical to adopt stringent MRV standards that are regularly reviewed and tightened** (similar to allowance caps in ETSs).

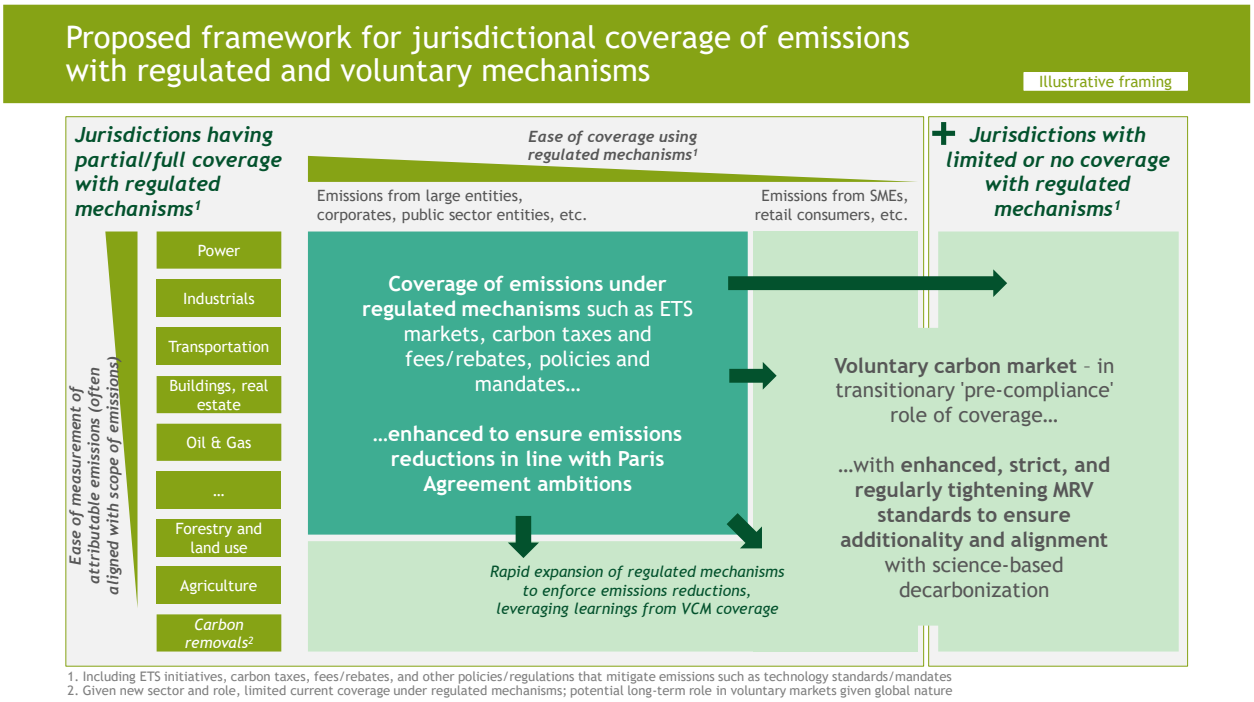


Figure 26: Framework for emissions coverage through regulated and voluntary mechanisms

Enhancing CORSIA to drive increased decarbonization

To drive sufficient climate action, ICAO should consider bolder ambition levels that are in line with Paris Agreement targets. These objectives should be driven by a greater emphasis on emissions reduction within the sector in addition to compensation for emissions using VCM credits. Specific strategies could include:

- **Incorporation of in-value-chain emissions reduction** with Paris-aligned sector-specific trajectories in addition to appropriate neutralization of GHG emissions through carbon removals
- **Establishment of a sufficiently ambitious decarbonization trajectory for the sector.** This can be aligned with existing guidance for the aviation sector from organizations such as the SBTi, which requires a reduction of average carbon intensity by ~35–40 percent between 2019–2035, or ~65 percent from 2019–2050.[72]

[72] SBTi Science-based target setting for the aviation sector (Version 1), August 2021.

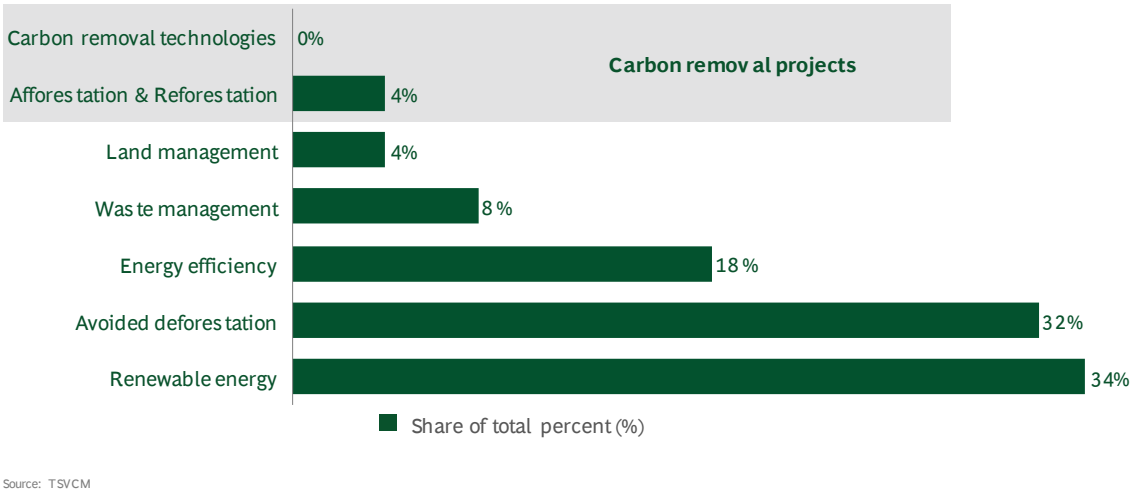
- **Reconsidering baseline.** According to an analysis based on International Council on Clean Transportation data, the CORSIA baseline, set to exclude 2020, is at a level such that airlines are unlikely to need to buy credits for the next 5 years.[49]
- **Stringency on VCM credits that are eligible for use.** Limiting eligibility based on stringent MRV standards that ensure additionality and use of only high-quality credits)

Role #2: A marketplace for carbon removals

The VCM is well positioned to become an essential marketplace for carbon removals given that (i) removals are region independent, so they can go beyond the regulation-driven boundaries of compliance markets, and (ii) the existing infrastructure in the VCM can be leveraged to enable efficiency in market matching (between corporate buyers and vendors for carbon removal technologies and projects). In so doing, project developers and/or companies that are deploying new negative emissions technologies (NETs), which remove CO_2 from the atmosphere, can leverage the VCM as a critical source of capital and funding to support their growth. Further innovations from the banking and capital markets sector (e.g., the use of long-term offtake agreements, forward contracts, financing arrangements, and credit intermediation/hedging) can further de-risk capital flows and promote new innovations and cost improvements in these technologies.

At the moment, the VCM is primarily composed of avoidance credits rather than removals (see Figure 27) as a result of the lower price point. This will need to evolve over time to a **significantly greater proportion of carbon removal projects.**

Removal projects make up ~4% of all projects in the voluntary carbon market



Source: TSVCM

Figure 27: Removal projects make up a minor portion of VCM projects

Role #3: Mechanism for corporates to compensate for their emissions using high-quality VCM credits as they continue in-value-chain decarbonization

VCM credits often help channel capital to underdeveloped economies and, importantly, help drive other SDGs. For example, several credits from forestry-related projects help support biodiversity, local community development, and protection of other natural resources such as water bodies and habitats. These credits can help corporates achieve a **greater stakeholder acceptance and recognition of their ESG (Environmental, Social, and Governance) actions**. The additional cost of purchasing high-quality VCM credits will likely also motivate corporates to further explore in-value-chain decarbonization.

Climate action organizations such as the WWF, SBTi, and VCMI are still in the process of aligning the market on guidance for the role avoidance credits play in terms of corporate claims. As per current guidance, buyers cannot use VCM credits to "net" their own emissions. However, these credits can still offer a mechanism for corporates to "compensate" for their emissions. Figure 28 exhibits this guidance.

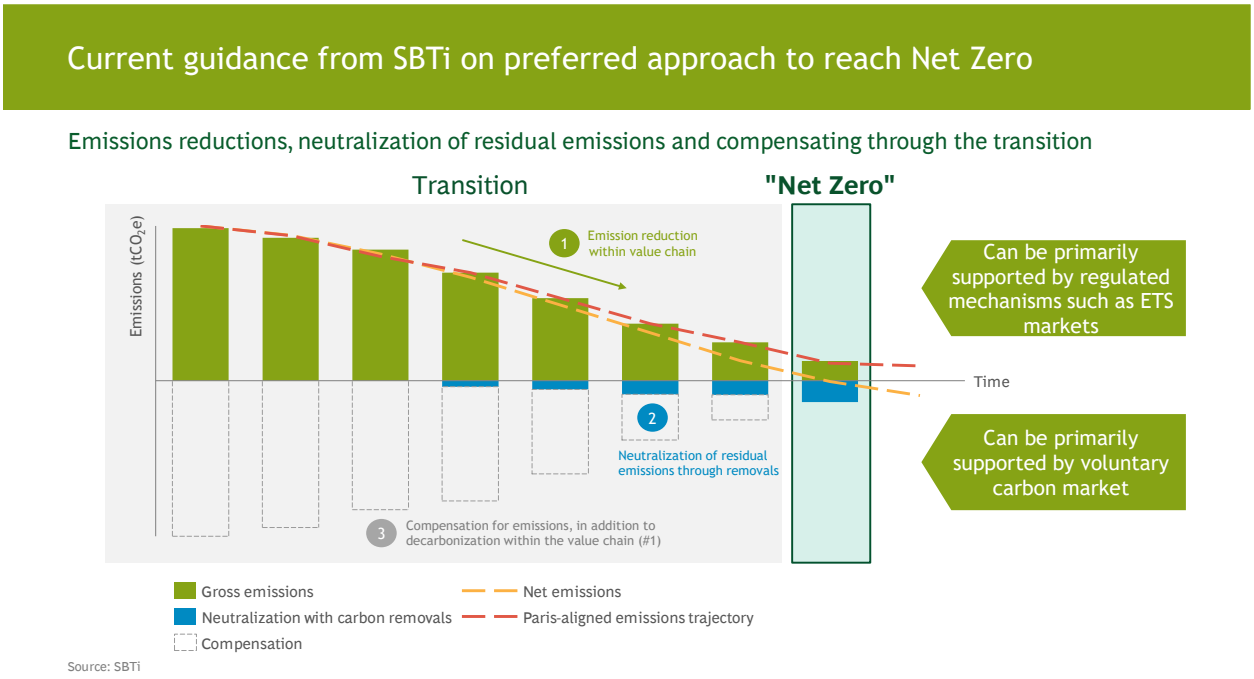


Figure 28: Guidance on preferred approach to reach Net Zero

Recommendations to enable VCM to play these roles

The VCM governance body, [73] standard-setting bodies, and leading climate science organizations should develop stringent MRV standards that ensure additionality of VCM credits, and these standards should be regularly updated to ensure continued additionality.

[73] Recently established as a result of the work of the TSVCM.

As discussed in Section 2.2, there is currently a lack of trust in VCM credits' verifiable emissions impact, including their additionality, permanence, prevention of leakage, and avoidance of double counting. In its current state, the VCM employs a variety of MRV processes to assess credits.

> "With the CDM, how to prove additionality was a large point. One of the arguments was that even if something is additional now, during the crediting period, there might be regulation introduced, and if a majority of practitioners comply with the regulation, then the project may now longer be additional."
>
> — Banking executive, business promotion

- To enhance trust in and usage of the VCM, **stringent MRV standards must be developed that organizations can use to evaluate VCM credits and ensure that they are truly additional**—that is, that they contribute to decarbonization beyond what would have already occurred without such voluntary projects. In the absence of standards that ensure additionality, the use of credits generated by emissions reduction that would have otherwise occurred directly threatens environmental integrity, as the users' emissions are not being accurately compensated for.[74] **To establish additionality, verification processes must account for a baseline level of emissions, and then evaluate whether a given voluntary credit reduces emissions below the baseline scenario**, along with the other attributes of high-quality credits, such as permanence and low risk of leakage. Organizations such as the Brookings Institute have recognized the challenge of baselining in establishing additionality as well in their recent report, "A framework to ensure that voluntary carbon markets will truly help combat climate change."[75]

- **A regular process must be established to make these standards increasingly stringent over time, with tighter thresholds and lower baselines to ensure continued additionality.** This can be achieved by periodically re-assessing expected future emissions levels and accounting for future "flattening" of the baseline. In addition, new mandated regulations may render certain projects non-additional.

- Even with the clear establishment of additionality, the VCM will not be able to guarantee industry, sectoral, or jurisdictional emissions trajectories aligned with Paris Agreement ambitions in the same way ETSs can, due to their inability to penalize emissions. In this

[74] Partnership for Market Readiness, Carbon Credits and Additionality, May 2016.
[75] Brookings Institute, "A framework to ensure that voluntary carbon markets will truly help combat climate change," September 2021.

sense, the VCM is best served as a transitionary coverage mechanism for pre-compliance jurisdictions, as outlined earlier in this recommendation.

Standard-setting bodies and the VCM governance body should establish harmonized MRV standards for underlying projects, and a shift toward high-quality, high-integrity credits.

- Given the variety of verification methodologies for VCM credits today and the associated uncertainty about quality as a result of those processes, market participants should drive toward a harmonized MRV process for VCM credits. Consistency in the type of information provided by the various registries in the VCM—such as the Gold Standard, the Verified Carbon Standard (VCS), and the ACR—should also be a goal for participants. The TSVCM has acknowledged this fragmentation as well and has called for a consistent verification process across both the compliance and VCMs.[46] This report seconds that call for consistency.

Standard-setting bodies, leading organizations that are setting the agenda for science-based decarbonization pathways, and the VCM governance body should develop a consensus on the role of VCM credits in corporate and investor claims, such as net zero/carbon neutral or potential new terms.

- The new VCM governance body and standard-setting bodies should continue to align market participants—such as corporates, investors, banking and capital markets players, project developers, and registries—on clear guidance for the use of VCM credits in claims and communications. Additionally, the guidance should explain how companies can use credits outside their operating region (e.g., a company with operations only in the U.K. purchasing carbon credits from a project in Uganda).

- As needed, new terminologies may be coined—such as "carbon responsible," proposed by Bloomberg in July 2021[76]—to recognize corporates and financial institutions using avoidance credits to compensate for emissions. This could prevent any confusion involving the use of terms such as "carbon neutral" or "net zero," while still providing an explicit incentive in the form of a label or recognition for buyers.

[76] Bloomberg, "Net Zero is Hard Work, So Companies Are Going Carbon Neutral," July 2021.

- Article 6 of the Paris Agreement is relevant to this recommendation in that it would enable the "use of internationally transferred mitigation outcomes."[77] However, there are concerns about the potential for double counting and such a mechanism distracting from decarbonization initiatives. **The upcoming discussions concerning Article 6 at COP26 should be factored into the guidance to ensure that the latest internationally agreed-to standards are reflected** to prevent double counting while ensuring fair division of the "claim" between project developers and carbon credit buyers.

As part of its mandate to develop and host a set of CCPs, the VCM governance body should drive toward the establishment of a taxonomy with consistent attributes for describing VCM credits.

- **Currently, a variety of credits exist in the market, with diverse attributes (e.g., vintage, geography, and project type; avoidance or removal), but they are not easily distinguishable from one another.** Given the large variety of attributes and the multiple standards and frameworks in the market, matching buyers with sellers poses challenges. Moreover, without the proper classification of credits, it is difficult to differentiate "high-quality" credits from "low-quality" credits, leading to market forces creating a demand for low-price—and often low-quality—VCM credits.

- While VCM credits themselves are by definition unable to be standardized due to the diversity of their attributes, the attributes used to describe these credits should be standardized to ensure **transparency and consistency.** Importantly, this should provide categorization for credits associated with avoidance as opposed to those that are awarded for carbon removal. This would bring **greater transparency to the differences between VCM credits offered in the market**.

- The TSVCM has recently outlined a vision to achieve a large, transparent, verifiable, and robust VCM. This includes a recommendation to **establish CCPs that designate threshold quality criteria for a carbon credit and attributes, which will be part of the mandate of the new VCM governance body.** The WWF has similarly developed the "Carbon Credit Guidance for Buyers" to establish criteria for assessing carbon credit quality and the definition of a "high-quality" credit. This report endorses the **establishment of such a standard and**

[77] UNFCCC—text from Paris Agreement.

taxonomy to make the important attributes of VCM credits transparent—and for standard-setting bodies to further leverage this taxonomy to drive consensus on the role of carbon credits in science-based decarbonization pathways and target setting. Such a taxonomy would contribute to scaling up a high-integrity supply of credits, lead to greater transparency in the market, and increase participants' confidence in the credits being traded.

Additionally, standard-setting bodies should collaborate with capital markets participants to create reference grades and indices of VCM credits, against which other VCM credits can be purchased or sold at a premium or discount, in order to facilitate liquidity and trading activity.

- The TSVCM has proposed the development of "core carbon reference contracts" that will be based on the CCPs, with price premiums and discounts driven by the presence or lack of specific attributes. This report endorses the establishment of such a reference grade of VCM credit, as well as the creation of indices of VCM credits. Such instruments will enable comparisons with other VCM credits, as well as contribute to VCM liquidity through the trading of premiums and discounts to the reference instruments. Ultimately, this will be a catalyst for generating high-quality credits to advance decarbonization efforts outside of an entity's value chain.

The VCM governance body should seek to create a meta-registry to serve as a common platform across all existing VCM registries.

- As announced by the TSVCM in September 2021, a new governance body will be established for the VCM, with a mandate to build the market by ensuring a sufficient supply of high-quality credits, developing and hosting the CCPs, and provide oversight over the standard-setters. This report recommends that this body also be responsible for implementing and administering a global meta-registry. Additionally, the governance body may serve as a liaison to regulators in compliance markets to facilitate potential interoperability with the VCM. For the VCM to become a meaningful market at scale, the governance body should use all the tools it creates to engage with ETSs and help incorporate high-quality, verified additional credits for complementary and transitional use in different compliance markets (see Section 4.3).

- As part of this potential future meta-registry, the **market should seek opportunities to incorporate technologies such as blockchain or distributed ledger technologies.** Because it enables secure transactions directly between counterparties, blockchain reduces the need for intermediaries in peer-to-peer transactions. At the highest level, blockchain serves as a common version of the "truth" to verify transactions among parties.

> "Blockchain has always been purported to be the guiding light, and for such a nascent topic like this market, it could be that blockchain technology is the best way to mitigate market fragmentation."
>
> — Banking executive, equities commodities and fund structure

4.3 Enable interoperability between markets, with strict controls

We recommend that policymakers and regulators, over time, enable **selective interoperability among compliance markets with similar ambitions, and permit the use of limited quantities of high-quality verified VCM credits in compliance markets, after their credibility and additionality are established.**

Context

As discussed in Section 2.3, **a key challenge for both compliance and voluntary markets is fragmentation.** Compliance markets are jurisdictional and have limited interoperability with each other today, resulting in smaller, less-liquid markets. In the VCM, fragmentation arises from the varied registries, verification processes, and qualities of credits, resulting in lower confidence and market participation. In both markets, fragmentation presents an obstacle to scaling—issues that can be mitigated to some degree through interoperability. Over time, under ideal conditions, interoperability can grow the carbon markets and further advance global decarbonization.

For the purpose of this report, "interoperability" refers to the ability to use carbon instruments—such as allowances and credits—from a particular market or system in a different market (i.e., two-way integration of instruments). In practice, there are two specific types of interoperability:

1. **Between ETSs**[78]: entities in one ETS being able to purchase and surrender compliance allowances from a different ETS toward their obligations
2. **Between ETSs and the VCM:** entities in an ETS being able to purchase and retire select eligible, high-quality VCM credits toward their compliance obligations

The implementation of interoperability between markets will typically progress through several stages:

1. **Two or more markets recognize each other's instruments, thereby creating fungibility of the instruments**. A link is established between the registries in the markets, enabling participants to trade both markets' instruments on the secondary market, but participants in each market cannot directly purchase and hold instruments in the other market's registry.

[78] According to ICAP, direct interoperability between ETSs can occur as either unilateral or bilateral links; for the purposes of this report, interoperability between ETSs refers to bilateral linkages.

2. The link between registries is strengthened, and **custodial services enable participants in one market to directly purchase and hold instruments on the other market's registry**, rather than purely acquiring instruments via secondary trading.
3. **A single registry is established for the interoperable markets**, with participants purchasing instruments via joint auctions or other unified distribution processes, and holding them in the unified registry.

The establishment of interoperability—even in the most basic form previously outlined—can bring several benefits to the markets that are linked. This reduces fragmentation by effectively combining markets and giving entities access to a deeper, more liquid pool of instruments to trade. This also increases efficiency, as a wider variety of decarbonization options becomes available to participants. For the VCM, interoperability with compliance markets can facilitate scaling by providing a more certain demand mechanism for high-quality credits. For carbon instruments as a whole, interoperability can also facilitate market scale and price discovery, creating signals for investors and corporates to use in pricing climate risk into their investments and business planning.

Recommendations

Interoperability between multiple ETS markets

- As of 2021, there are three instances of linkages between ETSs: California and Québec, Switzerland and the EU, and Tokyo and Saitama.[1] **If implemented well, and provided the different ETSs have similar ambition levels, interoperability between ETS markets could help create deeper, more liquid markets for compliance allowances, improve the economic efficiency of entities' decarbonization, and make both markets more resilient to economic shocks**. This could also incentivize greater sectoral coverage as an ETS with narrower sectoral scope might widen its reach to include industries covered by the ETS that it is linking to. In turn, this would provide more equitable emissions requirements for specific industries over a larger region. For example, as a result of linking with the EU ETS, the Swiss ETS expanded its coverage to include aviation and fossil-thermal power plants in order to match the sectors covered in the EU.[79] From an administrative standpoint, linking ETSs could be particularly

[79] Switzerland Federal Office for the Environment (FOEN).

beneficial for smaller ETSs that could use the existing infrastructure and processes of a larger ETS to, for instance, improve efficiency of auctions or operating a registry. [80]

- For policymakers considering interoperability with another ETS, ICAP has published a practical guide for exploring and evaluating potential partner systems. At a summary level, interoperability can be progressively implemented through four steps:

    1. Policymakers and regulators in ETSs that have agreed to link together must **recognize each other's allowances**, and permit entities to purchase and surrender allowances from the other system by establishing a link between the two registries. As a prerequisite to this, regulators in both ETSs must understand the regulatory context of the other ETS, including its legislative processes and legal principles. Some alignment of design elements—including allowance cap targets, distribution methods, and flexibility mechanisms—should also be considered.[80]

    2. **Shift purchasing of allowances from the other system from the secondary market to auctions—**either by allowing entities in one system to participate in another system's auctions, or by holding joint auctions. In the case of the California and Québec linkage, which began in 2014, joint auctions were not held until 2018; prior to that, purchases of allowances from the other system occurred only on the secondary market.

    3. **Create a unified registry for all entities across the linked systems**. The California and Québec systems use the Western Climate Initiative's Compliance Instrument Tracking System Service, where entities in both jurisdictions can register for an account and engage in trading.

    4. Over time, seek to **coordinate reductions in compliance allowances** and other policy features of both ETSs so that decarbonization levels continue to progress at ambitious rates.

At the same time, there are risks arising from interoperability. For interoperability between ETSs to be effective in decarbonization, policymakers should ensure that these conditions are present:

1. **Similar decarbonization targets between the ETSs,** in order to avoid dilution of either system's goals.

[80] "A Guide to Linking Emissions Trading Systems," September 2018.

"[When considering distinct ambition levels of different ETSs for interoperability], you would probably have to settle for some lowest common denominator; it's too tough getting all the markets on the same plane."

— Commodities trader

2. **Similar eligibility criteria for potential interoperability with VCM credits**. If either ETS in an interoperable system allows the use of VCM credits (as "compliance offsets"), policymakers in both systems must consider the criteria for usage and ensure that they are stringent enough. In these cases, some alignment of criteria and restrictions for usage may also be needed.

3. **Robust MRV processes and accuracy of how emissions and allowances are accounted for across the linked markets** to prevent the risk of double counting. Policymakers in both ETSs need to clearly understand which emissions are being counted and how allowances are being used.

It is important to note that this report is not suggesting a single global ETS in the short term. Due to the prerequisites, as well as myriad political, economic, and social considerations, establishing linkages between different ETSs is not a process that can be feasibly achieved quickly. Rather, **as ambition levels are aligned across different jurisdictions and more linkages are established between ETSs in the medium term, a long-term vision for a global unified carbon market may become more viable.** In order to enable this vision, however, policymakers designing and implementing new ETSs currently or in the immediate future should do so in a manner that will facilitate the potential future interoperability of their ETS with other systems (see Section 4.4 for more details).

Interoperability of the VCM with ETSs

- By linking the VCM to compliance systems, both markets can realize several benefits, including the scaling of new decarbonization technologies such as carbon removals, greater efficiency for corporates in compliance markets, and the channeling of capital toward decarbonization technologies. This can be achieved by **allowing regulated entities to meet a portion of their compliance obligations through the use of specific, eligible, high-quality, additional VCM credits (compliance offsets)** (see Figure 29 for an illustrative example of

market interoperability). There are several benefits that could be realized for both compliance markets and the VCM:

1. **If implemented well, interoperability could enable the VCM to serve as a complementary mechanism to regulatory mechanisms (as detailed in Section 4.2) and provide greater coverage of emissions**. This would be especially relevant for non-corporate sectors such as the AFOLU sectors, for which coverage through regulatory mechanisms is currently difficult due to the non-corporate nature of entities and measurement difficulties.
2. **From an economic perspective, linking the VCM to compliance markets could introduce greater market efficiency**. By incorporating specific eligible, high-quality credits from sectors not covered by an ETS (as compliance offsets), the sectoral scope of the system is amplified. This introduces a diversity of decarbonization options for regulated entities.

3. **From a climate science perspective, carbon removals will play a necessary role in science-based decarbonization.** And in linking compliance and voluntary markets, the future role of the VCM as an essential marketplace for removals (as detailed in Section 4.2) will be strengthened.

4. **An overarching benefit to the VCM from interoperability with compliance systems is greater market participation and liquidity**. In its current state, VCM transactions are primarily conducted on an OTC basis; linkages with compliance systems can create a

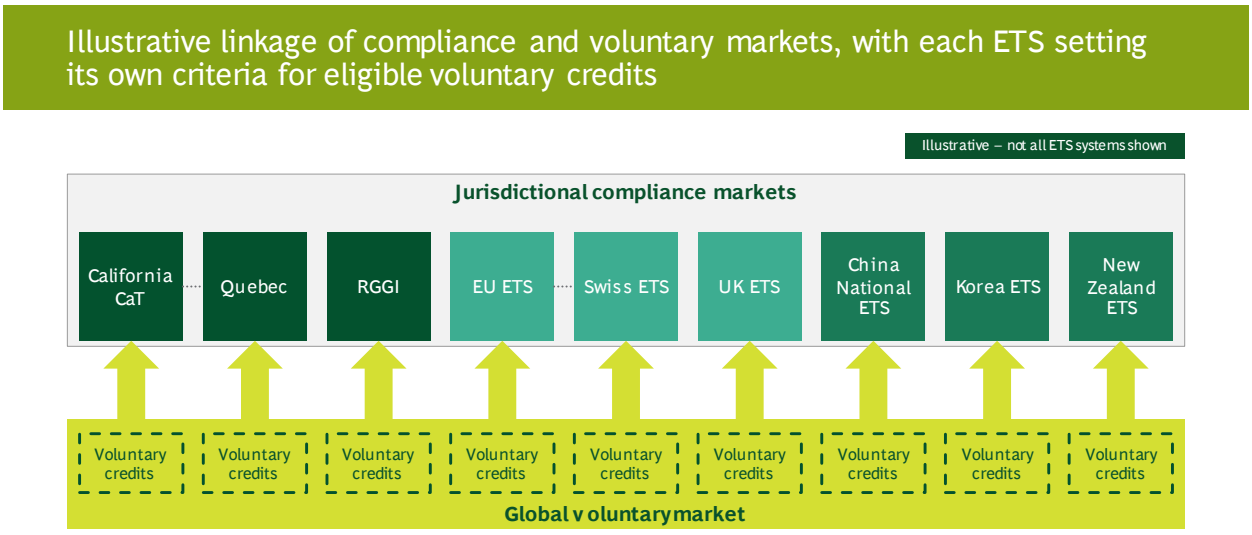


Figure 29: Illustrative interoperability between compliance and voluntary markets

more certain demand mechanism for high-integrity VCM credits, helping the market scale and achieve greater liquidity as a result.

As policymakers seek to establish interoperability with the VCM (see Figure 30 for examples of existing links between compliance markets and the VCM), there are **four key prerequisites to ensure that decarbonization ambitions are maintained (see Section 4.2 for more details), without which interoperability would be counterproductive.**

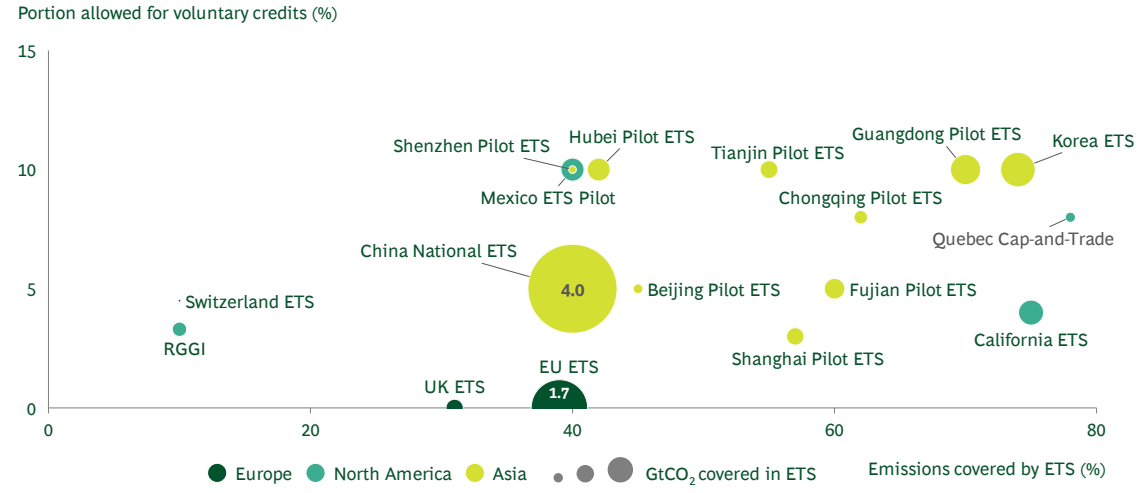
1. **Stringent MRV processes that ensure additionality;** with harmonized verification processes from standard-setting organizations and third-party auditors for assessing VCM credits' additionality, permanence, risks of leakage, and double counting

2. The creation of a **taxonomy for categorizing VCM credits**

3. **Clarity on the eligibility** of specific VCM credits in order to **maintain additionality/complementarity to regulated mechanisms**

4. **Stringent limits on the portion of participants' compliance targets that may be fulfilled by VCM credits, and buffer mechanisms** in case the permanence or additionality of the VCM credits is compromised. For ETSs that allow the use of VCM credits today, entities are typically allowed to fulfill between 3 and 10 percent of their compliance obligations with eligible VCM credits.

Current ETS schemes linked to the VCM



Source: ICAP Status Report 2021

Figure 30: Current ETSs linked to the voluntary market

- In practice, the establishment of interoperability between compliance markets and the VCM requires several concrete steps to be taken by policymakers. (Figure 31 illustrates an example exchange between compliance and voluntary markets).

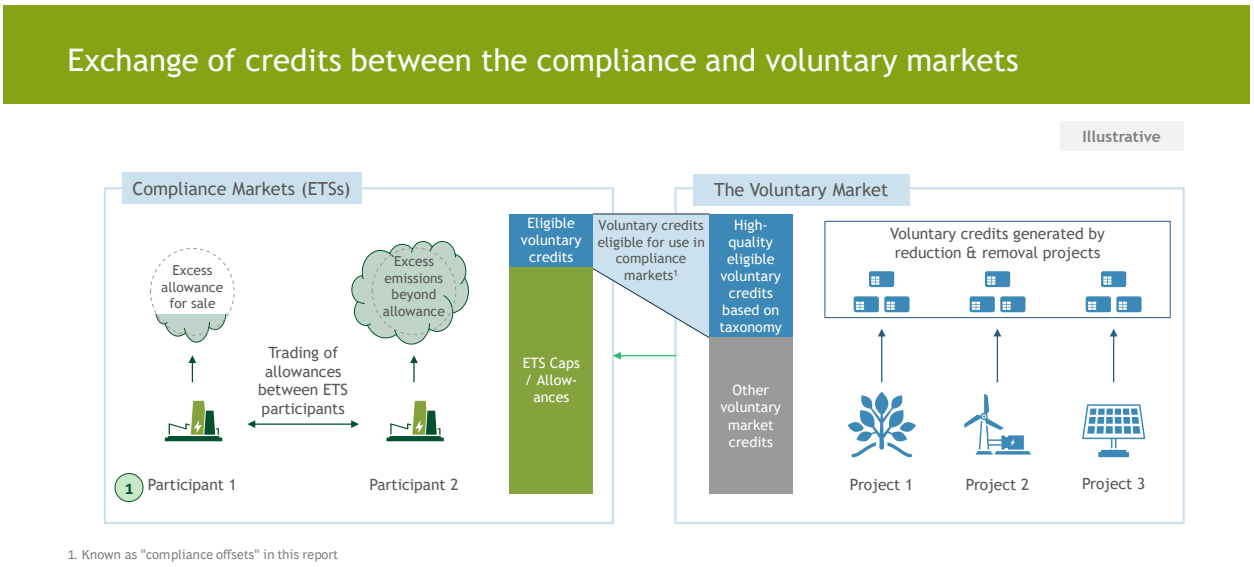


Figure 31: Exchange of credits between compliance and voluntary markets

1. **Policymakers must determine strict eligibility criteria** (e.g., non-covered sectors/entities, MRV processes, MRV update timelines, etc.) **for the types of VCM credits to be allowed into ETSs**. As part of the process of determining eligibility, policymakers in each country should also catalogue the relevant natural assets (e.g., forests, agricultural lands, peatland, etc.), and prioritize their eligibility for VCM projects. **This would simultaneously fast-track their interoperability while allowing the VCM to serve as a complement to sectors covered under ETSs.** For example, the California ETS allows credits from six specific project types.[81]

2. **Once eligibility criteria are established, policymakers should put in place a clear process for entities to purchase eligible VCM credits and surrender them for their compliance obligations**. In the California ETS, for example, VCM credits must be verified by one of three bodies (American Carbon Registry (ACR), Climate Action Reserve (CAR), or Verra)

[81] Livestock, mine methane capture (MMC), ozone depleting substances (ODS), rice cultivation, U.S. Forest Projects, and urban forest projects.

that have been approved by the California Compliance Offset Program.[82] Once verified, eligible credits are listed in California's ARB offset credit issuance table on a periodic basis. Entities may then purchase these specific credits from the VCM registries and retire them for compliance.

3. Policymakers should also set up processes to **ensure proper usage of VCM credits by compliance entities, with the appropriate provisions in place in case of misuse**. For example, the California system incorporates the principle of buyer liability: If a credit retired for a compliance obligation is later found to have been double counted or over-issued, the entity that purchased it for compliance must then substitute a compliance allowance or other valid credit instead.[82]

[82] California Air Resources Board.

4.4 Drive standardization and maturity

We recommend that market participants and infrastructure providers, policymakers, regulators, standard-setters, and climate science bodies **drive standardization of carbon market products, accounting, and legal frameworks**, and develop **best practices for regulating both carbon markets and associated trading activities** for allowances, credits, and derivatives.

Context

As identified in Section 2.5, **different ETS markets for emissions allowances have limited** product standardization and no standard legal and accounting frameworks, emissions system regulations, and trading market regulations. Aside from the compliance markets, there also exists a fragmented global VCM that lacks a set of guidelines and principles, a taxonomy to classify VCM credits, and consistent registries to track credits. **Improving standardization across products, accounting, ETS market regulations, and trading regulations can contribute to the integrity and scaling of both compliance markets and the VCM** (see Figure 32).

Why standardization is beneficial

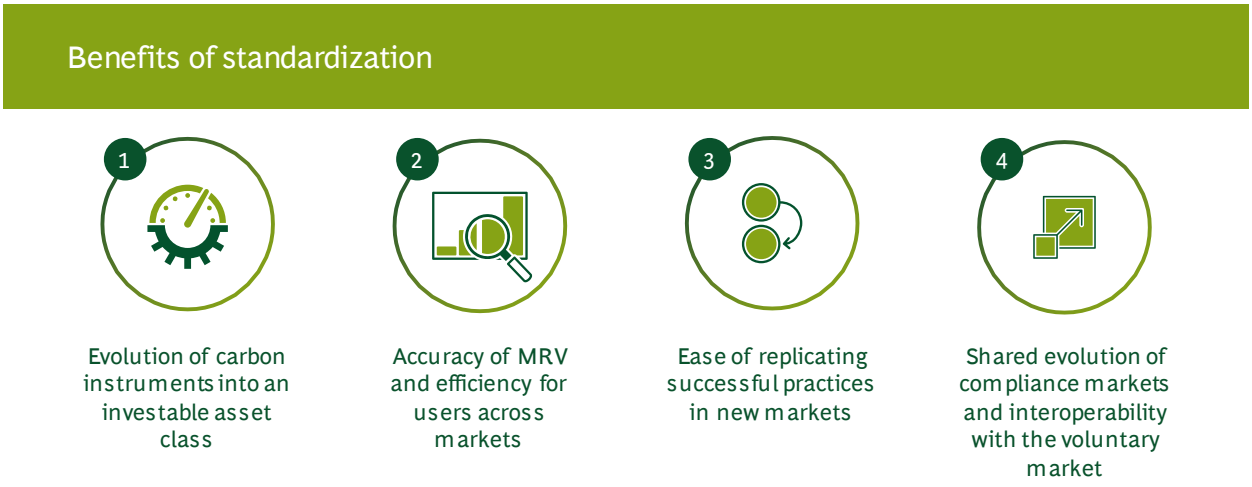


Figure 32: Benefits of standardization

Standardization can generate four critical benefits related to the development of carbon markets:

1. Standardization of products (both underlying assets and their derivatives), financial and carbon accounting frameworks, and legal and regulatory frameworks in ETSs and the derivatives market could help transform carbon instruments into an at-scale investable asset class with greater liquidity. Consistent product attributes, financial and carbon accounting treatment, and regulatory guidelines for market participation could increase confidence in carbon markets and bring liquidity and scale to both emissions and derivatives trading.

2. Standardization of financial and carbon accounting frameworks would help ensure ease of use and accurate MRV of ETS allowances and VCM credits on an aggregate global basis. A robust financial accounting framework for entities to record emissions allowances, credits, and derivatives in a transparent and consistent manner reduces uncertainty about reporting and tax treatments. Additionally, when allowances and credits are exchanged between market participants across jurisdictions, additional accounting complexity is introduced, including the risk of double counting (i.e., the counting of carbon credits by both buyers and sellers toward their emissions targets). To reduce this risk, a robust universal carbon accounting framework for corporates and financial entities is critical for confidence in carbon markets. Additionally, pending resolution on Article 6 discussions, standardization can also reduce the risk of double counting at a national level.

> "If you look at the documentation for buying and selling VCM credits, each document is slightly different between counterparties. It would be easier just to have a standard document."
>
> — Banking executive, structured commodities

> "We need standards as to what can be credited versus not; only then will you be able to compare claims across companies."
>
> — Banking executive

3. For policymakers and regulators developing new compliance markets, best practices for ETS regulations and trading market regulations can simplify replication. A centralized or comprehensive "playbook" of best practices and lessons from mature ETSs can be developed and brought to new markets under development, providing policymakers and

regulators with guidelines for governance, auction processes, and registry infrastructure. This playbook should also provide details about integrating with existing financial market infrastructure as derivates based on ETS allowances are developed.

4. **Additionally, consistent principles for regulating both emissions instrument trading systems and derivatives trading markets will enable the shared evolution of compliance markets and potential future interoperability between markets**. As compliance markets are scaled, the best practices from mature systems such as the EU ETS may be developed, refined, and integrated into other markets to accelerate their development and growth. Additionally, some degree of standardization between compliance markets and the VCM would support a pathway for graduating select eligible high-quality VCM credit categories into various compliance markets (see 4.3 for more details).

Recommendations

- **In the compliance markets, regulators should collaborate with market participants and industry trade associations such as ISDA to bring standardization to carbon-related products, including both cash and derivatives products.** Figure 33 shows a proposed framework for standardization. Indices that track and reflect carbon prices at an ETS, national, or global level should be established. For carbon-related derivatives, reference contracts should be developed for both exchange-traded and OTC transactions. These reference contracts should include specific legal clauses, such as terms and conditions and reps and warranties, that will contribute to standardization of the products and facilitate at-scale trading of carbon-related derivatives. As derivatives markets mature, the stakeholders should drive toward a uniform derivatives agreement with a comprehensive annex for carbon trading.

Proposed framework for standardization

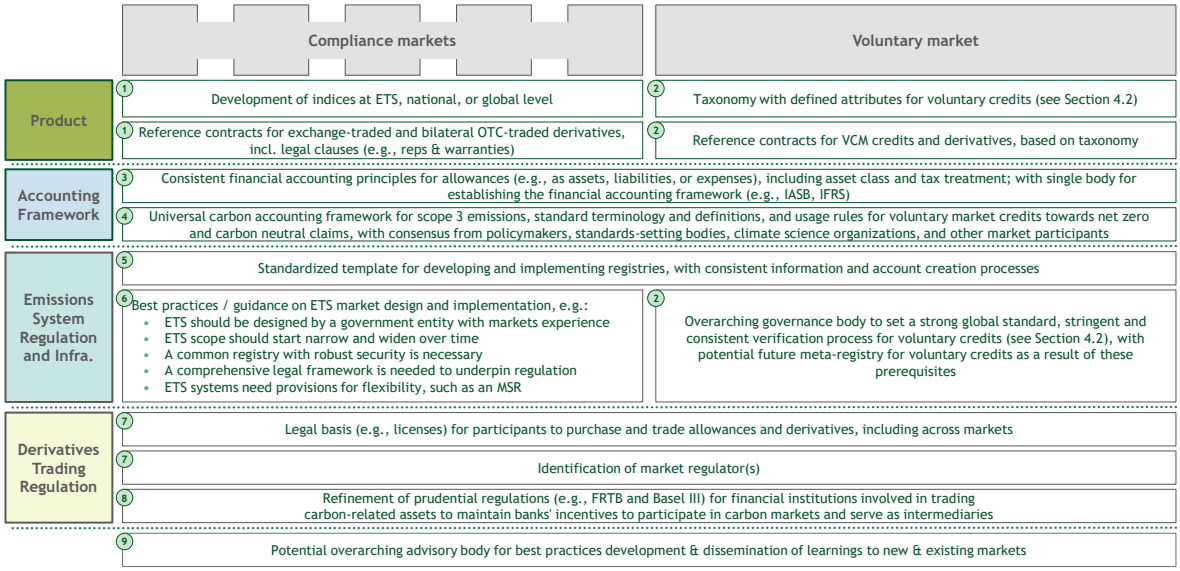


Figure 33: Proposed framework for standardization

- In the VCM, the new governance body (recommended by the TSVCM) should set a strong global standard and a taxonomy with additional attributes of VCM credits. The creation of these prerequisites may lead to the development of a meta-registry for VCM credits in the future (see Section 4.2 for more details). Additionally, this body should work with organizations such as ISDA to develop standardized core carbon contracts for spot and futures transactions, as per the TSVCM.

> "Standardization is key; not only the market aspects, but also documentation. The more standardization there is, the more scalable markets are."
>
> — Banking director, commodity markets

- From an accounting perspective, an international accounting body such as the IASB or FASB should develop a robust framework that establishes guidance for corporates and other entities pertaining to recording compliance allowances, VCM credits, and CBAM instruments in their financial statements. As much as possible, this framework should be based on existing internationally accepted accounting and financial reporting principles and address the issue of entities using multiple methodologies for accounting for carbon instruments.

The framework should establish clear policies on corporates disclosure of financial information related to carbon instruments. Additionally, to avoid the risk of tax arbitrage, national authorities should aim for global standardization of tax treatment for transactions in carbon markets.

- **Policymakers, standard-setters, and climate science organizations should agree on a universal carbon accounting framework that is consistent with emissions reporting standards for corporates and the financial sector.** This framework should establish policies on what information corporates and other entities must report related to their scope 1–3 emissions, how to report compliance allowances and VCM credits, and what claims entities can make toward their net-zero or carbon-neutral targets (see Section 4.5 for more details).

- **Regulators in the compliance market should collaborate with the VCM governance body and existing standard-setters in the VCM to develop a standardized template for developing and implementing registry systems.** This template should serve as a basis for new ETSs and a potential global meta-registry for the VCM. It should make it possible for individual registries in different markets to have a streamlined account-creation process and to provide consistent information for all entities. Blockchain should also be considered as part of this registry template, as it can contribute to the security and efficiency of accessing registries and trading. It may also facilitate potential interoperability between ETSs and the VCM from a systems standpoint in the long term.

> "It would be helpful to have a master template for the compliance market which can be copied and help the proliferation and growth of more compliance markets in the world."
>
> — Banking executive, equities commodities

- **Policymakers and regulators in compliance markets should collaborate to leverage best practices for regulating ETSs.** These best practices should be based on key learnings from mature and successful compliance markets today, such as the EU ETS, and cover a) design aspects such as the incorporation of comprehensive legal frameworks to underpin regulation; b) flexibility provisions such as an MSR; and c) consistent registries with robust cybersecurity (see Section 4.1 for more details).

- As derivatives and other structured products based on emissions allowances and VCM credits are developed for more mature ETSs and the VCM, compliance market regulators and capital markets participants should collaborate on best practices for leveraging financial markets infrastructure for carbon asset trading. These best practices may also be developed based on lessons from ETSs that have already been integrated with financial markets infrastructure, such as the use of ICE and the EEX for EU allowance futures trading or the CME for RGGI and California allowance derivatives trading. As derivatives markets develop, policymakers and capital markets participants should also work to identify the appropriate regulatory bodies in each region that should be involved in monitoring the trading systems. The VCM governance body should also collaborate with capital markets participants to integrate VCM credit derivatives trading into financial market infrastructure and set up the appropriate trading regulations and oversight.

> "The infrastructure for EU ETS is very strong—equally as good as you'd get for any other derivatives market. The EU registry is very secure. ISDA is there; EEX and ICE provide good systems for trading allowances and derivatives."
>
> — Banking executive, carbon markets development

- Banks and other capital markets participants should collaborate with industry bodies such as ISDA and the Basel Committee to refine the application of the Basel III framework for carbon trading and the treatment of carbon markets under the FRTB. The proposed changes to carbon instruments under the FRTB hinders banks' ability to serve as intermediaries for the carbon markets and contribute to their scaling. The FRTB's assessment of carbon instruments—in terms of their risk weight, correlation parameter, or both—should be recalibrated in order to reduce the capital costs for banks to participate in the markets for carbon allowances, credits, and derivatives.

4.5 Develop a universal carbon accounting framework as an enabler

We recommend that—as a key enabler for carbon markets—**leading climate science and standard-setting bodies develop a universal carbon accounting framework that includes policies for measuring and reporting scope 1–3 emissions across different sectors and drives consensus on nomenclature and the definitions of claims** such as net zero and carbon neutral.

The need for a universal carbon accounting framework

Achieving consensus on a universal carbon accounting framework can be instrumental in helping compliance markets scale as they cover more sectors and geographies. Among other things, this framework should offer **sector-specific guidance on measuring and reporting scope 3 emissions so they can be included in** ETS initiatives. For example, the new German ETS covering the transportation sector plans to include scope 3 emissions for all fuel distributors and suppliers, and all fuels used in the transport sector.[83] In order for scope 3 emissions to be incorporated within ETSs for more sectors, corporates will need robust frameworks for measuring and reporting on these emissions.

Additionally, the application of sector-specific scope 3 emissions calculation frameworks can help policymakers and regulators identify pockets of emissions that may not be covered by ETSs for administrative or data reasons. **For these uncovered areas of the market, other types of carbon pricing instruments such as carbon taxes may be more appropriate.** For example, allocating emissions produced by automobiles between automobile manufacturers and oil companies and the actual measurement of these emissions may prove to be logistically complex, and a fuel tax at a sufficient price point that reflects the cost of emissions and incentivizes decarbonization may be more feasible.

Beyond Scope 3, specific carbon accounting guidance for small- to medium-sized enterprises can also help achieve more complete market coverage and reduce the risk of leakage from segments of entities not covered. Smaller companies often do not have the resources or capabilities to adequately calculate their current emissions or set reductions targets. The development of a more comprehensive carbon accounting framework may make it more feasible for ETS coverage to be

[83] Fuels covered include fuel oil, liquified petroleum gas, natural gas, coal, gasoline, and diesel.

extended to smaller corporates over time, or for policymakers to cover them more easily through other mechanisms.

This universal carbon accounting framework should also provide guidance and consensus on terminology and definitions for climate-related claims and the usage of VCM credits toward those claims. Consensus on what net-zero and carbon-neutral claims (or new terminologies such as "carbon responsible") mean and what types of VCM credits may (or may not) be used toward those claims will clarify the role of these markets and improve participation, facilitating liquidity and scale (see Section 4.2 for more details).

The need for a universal carbon accounting framework has been recognized by some sector-specific initiatives and organizations. For example, **the PCAF developed a "Global GHG Accounting and Reporting Standard for the Financial Industry"** based on the GHG Protocol's "Technical Guidance for Calculating Scope 3 Emissions." The PCAF acknowledged that until they published their guidance, "there [had] not been a globally accepted standard for the measurement and disclosure of financed emissions," and that the lack of a harmonized methodology and reporting policy led to inconsistency in financial sector participants' financed emissions disclosures.[84] This is a significant obstacle for banks, as the lack of a harmonized methodology means it is more difficult to properly account or compensate for their financed emissions. For the same reason, banks also have an interest in their corporate clients' decarbonization targets, as they impact the banks' own financed emissions targets. The PCAF Standard lays out detailed guidance for calculating financed emissions from six asset classes and serves as a framework to enable financial institutions to set targets, report to stakeholders, and develop climate strategies and products to support the transition to net zero.[85] In future versions of the PCAF Standard, emissions accounting for more asset classes will be added and the application of the current guidance will continue to be refined. In this sense, the PCAF Standard takes the existing GHG Protocol guidance on scope 3 emissions one step further by outlining specific approaches for the financial sector.

The IPIECA's "Estimating petroleum industry value chain (Scope 3) greenhouse gas emissions" manual accomplishes a similar objective for the oil and gas industry. Like the PCAF Standard, IPIECA's manual is based on the GHG Protocol's existing guidance for scope 3 emissions calculations.[86] For the oil and gas

[84] PCAF, "Global GHG Accounting and Reporting Standard for the Financial Industry," November 2020.
[85] The six asset classes are listed equity and corporate bonds, business loans and unlisted equity, project finance, commercial real estate, mortgages, and motor vehicle loans.
[86] IPIECA, "Estimating petroleum industry value chain (Scope 3) greenhouse gas emission," 2016.

industry, this extension of the GHG Protocol is especially relevant, as scope 3 emissions often comprise a significant portion of oil and gas companies' overall emissions.

The PCAF Standard and IPIECA manual serve as sector-specific guidebooks that bridge the gap between the GHG Protocol's corporate accounting standard and its scope 3 emissions guidance. In order for corporates in different sectors to set net-zero and carbon-neutral targets, they need this type of sector-specific guidance that enables them to apply the GHG Protocol and accurately calculate their specific emissions. Scope 3 emissions are difficult to measure, so having appropriate guidelines and specific calculation methodologies for relevant sectors will help corporates set SBTs and accurately report their emissions against those targets. However, these approaches should continue to be refined based on the initial results of their implementation for financial institutions and oil and gas sector participants, respectively.

Recommendations

- Leading climate science bodies such as the GHG Protocol, SBTi, and IPCC should drive the **development of a universal carbon-accounting framework in collaboration with sector-specific associations and corporates.** The framework should include the following components:
    - Clear sector-specific guidance for accounting for scope 1–3 emissions
    - Standard nomenclature and definitions for carbon claims, such as "net zero" and "carbon neutral"
    - Explicit usage and reporting guidelines for VCM credits
- To establish clear sector-specific guidance for accounting for scope 1–3 emissions, leading climate science bodies should consider **working with existing industry associations and partnerships in each sector.** For example, the PCAF Standard was developed by an association of 14 Dutch financial institutions and then scaled to the broader financial sector in the Netherlands and North America.[87] Similarly, the scope 3 emissions manual for the oil and gas sector was developed by IPIECA, a nonprofit oil and gas industry association that has existed since 1974.[88] Climate science bodies should leverage existing work from relevant

[87] https://carbonaccountingfinancials.com/about.
[88] https://www.ipieca.org/about-us/.

industry associations and partnerships to develop sector-specific emissions accounting guidelines. Clear guidance for scope 3 emissions in particular will be a prerequisite for accurate disclosures from all industries, including non-corporate sectors such as AFOLU (see the Annex – Details on Agriculture, Forestry, and Other Land Use (AFOLU) coverage for more details on this sector).

4.6 Commitment and support from the banking and capital markets sector

Banking and capital markets firms are supportive of these actions and **committed to building a suite of capabilities and product offerings** (for both compliance markets and the VCM) to **help market participants address their compliance, decarbonization, investment, financing, and risk management needs**—thereby supporting robust, competitive, liquid, and mature markets.

Context

Banking and capital markets players have a unique position in the carbon markets—with relationships and access to multiple participants, including corporates, institutional investors, high net worth individuals, public sector participants, exchanges, and other market actors. This provides a unique opportunity to play a multifaceted role in the carbon markets that ranges from advisory to market access to financing to intermediation to thought leadership and advocacy.

Role that banking and capital markets players can serve in the market

The banking and capital markets sector can be pivotal in helping corporates and investors leverage carbon markets, both compliance and voluntary (see Figure 34). We envision five key roles that they can play:

1. **Trading platform** for customers to access compliance and voluntary markets, including underlying allowances and credits and associated derivative products
2. **Market maker for carbon credits and derivatives** providing price discovery and taking principal risk in matching buyers and sellers of both VCM credits and derivatives as well as compliance market derivatives
3. **Advisor for carbon market participants,** counselling compliance-covered corporates on their transition risk and hedging; helping corporates and investors neutralize or compensate for emissions through VCM credits; and sharing expertise on decarbonization strategies more broadly
4. **Financing provider and facilitator for VCM project developers,** acting as both a financier of projects and an intermediary to source public and private capital toward high-quality projects

5. **Thought leader and market research provider,** driving information, data synthesis, and analysis about carbon markets and advocating for stronger carbon markets that can support science-based decarbonization

Figure 34: Key roles the banking and capital markets sector can play in carbon markets

To effectively play these roles banks would need to develop several capabilities, including the right talent and expertise, data and analytical research skills, deep relationships with market participants, and a range of innovative carbon markets product offerings.

- **A core capability essential for banking and capital markets players is to understand decarbonization at a sector-specific level.** This includes fundamental expertise in decarbonization technologies, as well as a deep understanding of science-based transition pathways, carbon accounting practices, and the design of carbon markets and their use for clients. These capabilities are critical to advise corporate clients on decarbonization and provide the right climate finance solutions (see report on "Climate Finance Markets and the Real Economy")[16] as well as to offer insight about the right carbon market solutions (from both compliance markets and the VCM). Given the fast pace of development of policies,

standards, and technologies, staying up to speed on the latest developments is a notable differentiator.

- Expertise in and knowledge of carbon markets is an essential cross-cutting capability that serves the series of different roles banks can play. Understanding the dynamics within and across different ETS markets; important political and policy development and expectations; and connections between carbon markets and other economic indicators would help enable their key roles in providing advice—and in structuring and providing the right products and solutions for their clients. For participation in the VCM, knowing the varied types of projects, their quality, and their additionality; the process of carbon credit generation and verification; and price movements and demand analysis can be highly beneficial in uncovering potential financing opportunities as well as to guide corporate clients in purchasing of high-quality credits.

- Another important capability is product expertise. There is a range of product innovations and developments that would be beneficial for carbon markets participants and that would provide new opportunities for banking and capital markets firms. These include the development of carbon market derivatives for hedging and investment, structured lending and blended finance solutions for financing projects, offtake agreement design, project financing, designing OTC products, and many others. Wherever needed, banks should seek to develop and scale these product capabilities.

- Banking and capital markets players should also develop the necessary climate risk management capabilities to aid in their advisory capacity for corporates, investors, and asset managers. Being able to assess climate risks both quantitatively and qualitatively can help in guiding clients to hedge these risks effectively using carbon market instruments. Furthermore, depth in climate scenario design and analysis would also strengthen management of their own climate risks as well as those of their clients. An additional related capability is data and analytics concerning climate risk management—specifically, data related to their clients' transition and physical risks captured through their disclosures and "know-your-customers" documents. Analytical capabilities are necessary to translate this data into financial and valuation modelling that can help assess customer climate risk and recommend appropriate transition and mitigation strategies and carbon market products.

- Banking and capital markets providers can also provide solutions such as a digital marketplace to match carbon credit buyers with sellers. Such a platform could connect with the various registries and/or exchanges and host trading accounts, and then execute trade

orders and clear trades on the back end efficiently. This type of capability and offering can help expand carbon markets supply and demand.

- **Banks are also well positioned to generate market insights on carbon market development. A strong research-focused offering, based on both qualitative insight as well as quantitative analytics of the range of available data** can help market participants analyze carbon market data, build market forecasting models, and accurately price in risk to a range of asset classes (credit, equity, project financing, derivatives, etc.) This would allow banks to produce thought leadership and research about carbon market developments and trends, help further develop capabilities to assess carbon pricing risks and climate risks for their clients and industries, and develop risk-monitoring tools to support their clients..

Product innovations: types and roles

Banking and capital markets players are also well positioned to help market participants meet these needs through innovations in products, services, and solutions offerings (see Figure 35). There are four key use cases across the range of market participants (corporates, investors, etc.) that banking and capital markets players can help serve.

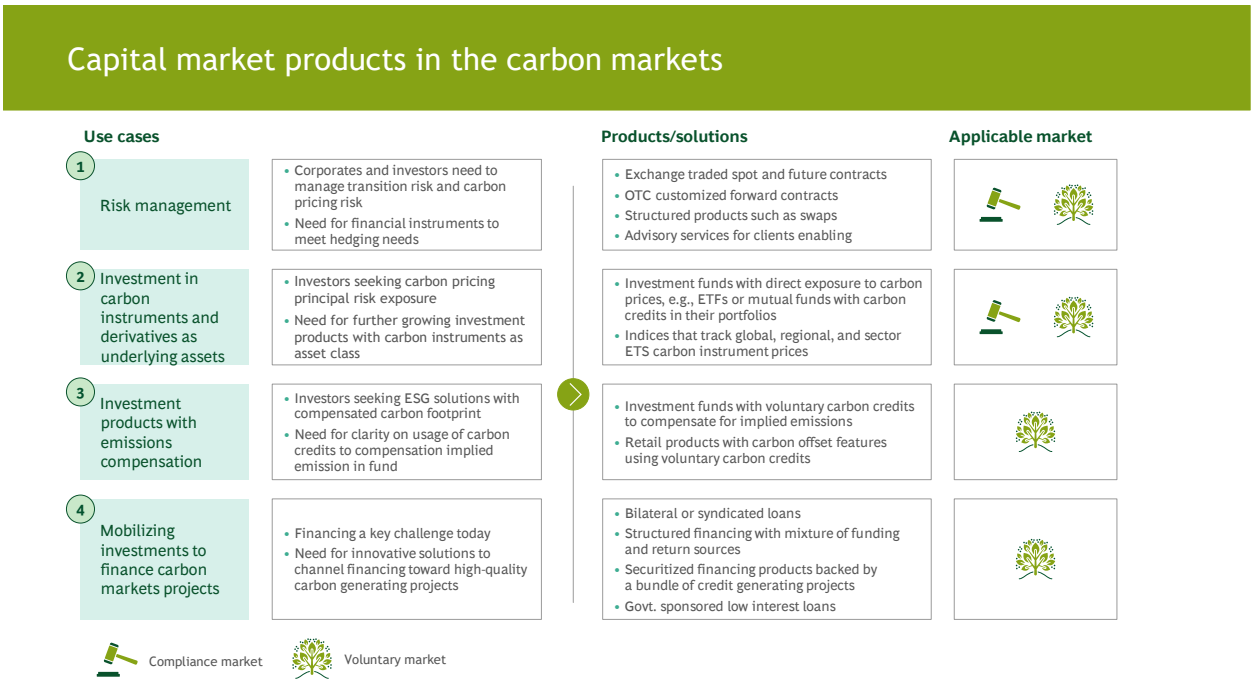


Figure 35: Capital markets products in the carbon markets

Risk management

- Banking and capital markets players can leverage their expertise in financial products to design customized risk management solutions for their clients and customers.

  Carbon prices in compliance markets are volatile, and they vary significantly by market and over time. This price volatility and disparity can create challenges for corporates in managing their risk exposure and navigating unpredictability in cash flow and compliance costs. Carbon markets participants are expected to have increased requirements for hedging carbon pricing risk as part of their corporate enterprise risk management framework.

  To properly manage market risks arising from VCM credit price volatilities, banking and capital markets players should also look to introduce a range of standardized and OTC derivatives such as futures, forwards, and swaps. Currently, in the VCM, corporates are mainly purchasing VCM credits to compensate for their carbon footprint. As corporates integrate longer-term strategies for carbon credits, banking and capital markets players can help offer long-term solutions such as forwards contracts to enhance the stability of market prices and mitigate future cost uncertainties.

Investment solutions in carbon markets—making carbon an investable asset class

- Some investment products have come to market recently that leverage carbon instruments (based primarily on compliance markets) as an asset class. This includes exchange-traded products that track carbon indices, such as the KraneShares Global Carbon ETF, an ETF product tracking the IHS Markit Global Carbon Index, or iPath Series B Carbon ETN, an ETN that tracks Barclays Global Carbon II TR USD Index.[89] The financial sector has an opportunity to further scale these types of solutions as carbon markets grow and become an investable asset class.

- Firms can also help investors leverage carbon market financial instruments as an additional asset class in existing or traditional investment vehicles such as equity or fixed income funds to diversify the portfolio risk and alter the risk-return profile of the assets. For example, adding carbon allowance futures contracts in an existing portfolio with exposure to ETS-

[89] https://kraneshares.com/krbn/.

covered heavy-emission sectors can provide protection against financial impacts of transition risk. For corporates as well, the use of such instruments can present a hedging opportunity.

Banking and capital markets players can play a significant role in supporting the development of investment products that leverage carbon allowances and their derivatives as an asset class in new solutions as well as for inclusion in existing products.

Integration of VCM carbon credits in traditional financial instruments to compensate for emissions footprints

- ESG-themed investment assets are currently at $35 trillion globally, and with strong growth trajectories are expected to exceed $50 trillion by 2025, or more than a third of global assets under management.[90,91] This reflects increasing demand for investments that satisfy ESG criteria (e.g., funds that engage corporates through shareholder action, ESG screening, etc.).

- Banking and capital markets firms have the opportunity to support their clients in leveraging the VCM to **compensate for emissions associated with existing investment portfolios or neutralize emissions through carbon removals, while continuing to focus on transition and decarbonization of the underlying assets.** Such strategies can be used, for example, to compensate for portfolio emissions associated with hard-to-abate sectors and satisfy potential demand from ESG-focused investors.

Mobilizing investments to finance high-quality VCM projects with proven additionality

- **Banking and capital markets players can also play a significant role in intermediating capital flow and supplying capital for projects that support generation of high-quality carbon credits.** This can span a range of products and services aimed at various buy-side participants, such as private and public capital, public sector and philanthropic capital, corporates, etc.

- There is a **deficit of financing for these projects today**, as VCM projects sometimes take years of development before generating carbon credits. For projects that use existing and mature technologies (e.g., afforestation, reforestation, or soil carbon sequestration), the time frame for development (including scoping, securing resources, planning, developing, validating, and registration) is estimated at 12–15 months.[92] For projects that are still in the research phase,

[90] GSIA, "Global Sustainable Investment Review 2020."
[91] Bloomberg, "ESG assets may hit $53 trillion by 2025, a third of global AUM," February 2021.
[92] UN Food and Agriculture Organization.

particularly those related to carbon removals such as direct air capture, the time frame can be much longer, depending on the stage of research and maturity of the technology for commercialization.

- Financing for these projects can be facilitated by banks and capital markets players by leveraging their existing relationships with corporate customers to structure long-term offtake agreements. This can enhance stability in revenue expectations for projects, create higher demand expectations, and de-risk projects to enable project developers to access more traditional financing, thereby accelerating credit generation. By supporting the financing of high-quality carbon-credit-generating projects, banks and capital markets players can also drive co-benefits to other SDGs, including biodiversity, socioeconomic development, etc.

- Carbon removal projects are another key potential target for such financing arrangements. They are often not economically viable given the lack of revenue-generating capacity and lack of appetite for long-tenure financing. However, access to long-term demand for carbon removals can make these projects feasible. For example, direct air capture technology, a promising approach to remove CO_2 from the atmosphere using chemical processes, is estimated to have a cost of $250–600/tonne today and could fall to around $150–200/tonne in the next 5–10 years.[93]

- There is also a significant role for structured and blended financing solutions to fund these types of projects from multiple sources such as banking, the public sector, development finance institutions, the social sector, and market-rate investors. Banking intermediaries can help tranche the investments into grant investments for public sector and philanthropic investors and varying risk tranches for mezzanine financing, subordinated loans, and market-rate investors, thus mobilizing greater private capital.

- While building these offerings, it is crucial for banks to consider the quality and additionality of both the projects and the credits they generate. Banks and capital markets should follow market consensus and guidance from leading standard-setting and climate science organizations to ensure additionality and the appropriate use of market claims against these projects.

- Additionally, banking and capital markets firms can also support development of platforms to digitalize and scale VCM trades (which are highly limited given the buy-and-hold/retire

[93] WRI, "Direct Air Capture: Resource Considerations and Costs for Carbon Removal," January 2021.

nature of the market). This would bring transparency to the types of credits offered and match buy and sell orders. While first steps have been taken by banks and infrastructure providers to create platforms for voluntary credit trading (e.g., Climate Impact X, a joint venture by DBS Bank, the Singapore Exchange, Standard Chartered, and Temasek),[94] these platforms are yet to scale and there is a need for further digitalizing of transactions in the VCM.

[94] https://www.climateimpactx.com/.

5 Section 5: Conclusion and call-to-action

It has been nearly three decades since 150 states signed, in 1992, the UN Framework Convention on Climate Change (UNFCCC), an international treaty to combat climate change with the goal of stabilizing atmospheric GHGs to a level that would prevent further global warming. In that time, annual GHG emissions have increased by more than 50 percent from ~30 $GtCO_2e$ to over 50 $GtCO_2e$.[1,67] The world has warmed by approximately 1°C already, with 1.5°C anticipated as inevitable within the next few decades. With 300–500 Gt of total carbon budget left, a swift decline in emissions must occur during the next three decades, down from the current 50 $GtCO_2e$ per year to a global net zero on GHG emissions.[1,15] Action can no longer be delayed. All levers must be pulled immediately, including a rapid scaling of carbon pricing and all carbon markets, in terms of both their emissions coverage and their decarbonization ambitions.

Summary of recommendations

1. We recommend that policymakers and regulators expand the scope of geographic, sectoral, and activity coverage of compliance ETS markets, and strive toward near-full coverage by one or more GHG pricing and/or GHG control mechanisms within the next five years. High-impact ETSs by incorporating key learnings from other ETSs and stringent allowance reductions aligned with emissions pathways that achieve 1.5°C ambitions.

(detailed in section 4.1)

2. We recommend that standard-setting bodies, in coordination with the broader ecosystem, facilitate the transformation and scaling of the VCM to ensure its integrity, role, and additionality.

(detailed in section 4.2)

3. We recommend that policymakers and regulators, over time, enable selective interoperability between compliance markets with similar ambitions, and permit the use of limited quantities of high-quality verified VCM credits in compliance markets, after their integrity and additionality are established.

(detailed in section 4.3)

4. We recommend that market participants and infrastructure providers, policymakers, regulators, standard-setters, and climate science bodies drive standardization around carbon market products, accounting, and legal frameworks, and develop best practices for regulating both carbon markets and associated trading markets for allowances, credits, and derivatives.

(detailed in section 4.4

5. We recommend that—as a key enabler for carbon markets—leading climate science and standard-setting bodies develop a universal carbon accounting framework, with policies for measuring and reporting scope 1-3 emissions across different sectors, and drive consensus on nomenclature and the definitions of claims such as net zero and carbon neutral.

(detailed in section 4.5)

6. Banking and capital markets firms are supportive of these recommendations and committed to building a suite of capabilities and innovative product offerings (for both compliance markets and the voluntary market) to help market participants address their compliance, decarbonization, investment, financing, and risk management needs—thereby supporting robust, competitive, liquid, and mature markets.

(detailed in section 4.6

Effective collaboration is essential to achieve Net Zero (1/2)

Recommendations by market participant

Policy-makers

- **Aim for near-full coverage of GHG emissions within their jurisdictions through one or more mechanisms (ETS markets, carbon taxes, fees/rebates, and control-based mechanisms)**, while considering other environmental, fiscal, and monetary policies that influence emissions, (e.g., eliminating fossil fuel subsidies, introducing clean energy mandates, etc.), and supported with long-term policies that promote Paris-aligned decarbonization of the economy (4.1).
- For ETS markets, apply learnings from successful ETSs, including: **(1) steep ~5 percent+ linear reductions per year in allowance levels**, aligned and updated with the latest climate scenario modeling; **(2) establishment of fixed-cap (absolute emissions) systems** as opposed to intensity-based systems to align with total carbon budgets; **(3) classification of allowances as financial instruments**; **(4) use of auctioning** in lieu of free allocation to maintain sufficient price levels and drive decarbonization; **(5) considering CBAMs** to prevent leakage and maintain competitiveness; and (6) consideration of other emissions-reduction mechanisms (e.g., taxes, fees/rebates, and policies) when designing ETSs (4.1).
- **Consider selective interoperability between ETS initiatives; and selective use of high-quality verified VCM credits within ETS markets (as compliance offsets) for sectors difficult to cover in the short-term by ETS/tax/mandates (e.g., forestry and agriculture) and verified carbon removals**. Catalogue relevant national assets (e.g., forests) and define eligibility lists for VCM projects to fast-track interoperability to enable development of nature-based solutions. Remain mindful of the benefits and challenges of interoperability, and put into place the appropriate conditions, such as **stringent caps on the portion of compliance obligations** that can be met through high-quality VCM credits, **clarity on specific VCM credits that are eligible and additional**, and **stringent quality requirements with high-quality standards and MRV** (4.3).
- Collaborate with regulators to **leverage best practices for regulating ETSs**, including development of a standard framework for developing allowance registry systems (4.4).

Banking & Capital Markets firms

- Build out capabilities to provide corporate and investor clients access to **trading infrastructure, advisory services for use of carbon markets solutions, risk management and hedging solutions, a suite of carbon markets products, and collective action, partnership, and thought leadership** on carbon markets (4.6).
- **Scale derivatives markets** in new ETS schemes, building exchange-traded and OTC futures, forwards, options, swaps, etc. to meet clients risk management and investment needs of clients (4.6).
- **Develop new investment products** (using ETS instruments and derivatives as an asset class) such as carbon-index-tracking ETFs and **integrate carbon instrument derivatives as hedging solutions in existing funds** with carbon exposures (4.6).
- **Develop new investment products (using VCM credit retirements)** as "carbon responsible" funds (aligning terminology with market-guidance on claims that are allowed) to meet demand from ESG-focused investors and ensure that they do not claim to drive "net zero" as per current guidance and definitions (4.6).
- **Facilitate long-term offtake agreements between corporate/investor clients and high-quality project developers** (as determined by stringent MRV standards and a taxonomy) and facilitate both **vanilla and innovative financing solutions** aligned with the risk-return profiles for these projects (4.6).
- Work with regulators and trade associations to **standardize contracts for different ETS carbon products across markets and refine the application of Basel III and the FRTB** to carbon instruments and derivatives (4.4).

Industry trade associations

- **Work with climate science bodies to develop universal carbon accounting framework** that expand the scope of measurement across entities, scopes of emissions, etc. (4.5)
- Work with regulators and banks to **standardize contracts for different ETS carbon products across markets and refine the application of Basel III and the FRTB** to carbon instruments and derivatives (4.4).

Effective collaboration is essential to achieve Net Zero (2/2)

Recommendations by market participant

Regulators

- Collaborate with policymakers to **enable the selective linking of compliance markets to the VCM over time** while ensuring stringent verification processes and eligibility criteria to maintain additionality (4.3).
- Work with banks and trade associations to **standardize contracts for different ETS carbon products across markets and refine the application of Basel III and the FRTB** to carbon instruments and derivatives (4.4).
- **Facilitate the efforts of the new VCM governance body** to set standards such as the core carbon principles, define a consistent taxonomy with additional attributes characterizing VCM credits, and oversee the market, while driving towards harmonized MRV processes and common VCM registry standards, as per TSVCM (4.2).
- Collaborate with trade associations and capital markets participants on **best practices for leveraging financial markets infrastructure** for carbon asset trading (4.4).
- Collaborate with policymakers to **leverage best practices for regulating ETSs**, including development of a standardized template for developing allowance registry systems (4.4).

Standard-setters and climate science bodies[1]

- **Clarify the role of the voluntary market:** (1) serve as a **transitionary coverage mechanism for sectors or regions that are not covered by ETSs, carbon taxes, feebates, or mandates** until regulated mechanisms take over and ultimately scale down with reducing emissions, (2) serve as a **core long-term global marketplace for carbon removals,** thereby supporting the growth and funding of critical new technologies, and supporting neutralization of residual emissions, (3) offer a **complementary mechanism for corporates to compensate for their emissions,** in a way that helps channel capital to markets with the greatest need (e.g., underdeveloped economies) while entities continue to pursue in-value-chain decarbonization (4.2).
- Work with the new VCM governance body to develop a set of **stringent baselining and MRV standards** that ensure VCM credits can drive **verifiable emissions reductions that are "additional,"** and establish a **regular process to make these standards increasingly stringent with tighter thresholds to ensure that VCM projects maintain additionality** while also ensuring permanence and preventing leakage (4.2).
- **Work with the new VCM governance body to harmonize MRV standards** and leverage new technologies such as satellite mapping for verification, and blockchain/DLT for establishing robust registry systems (4.2).
- Establish a consistent **taxonomy with additional attributes characterizing VCM credits**, with clear gradations of quality, type of credit (removal vs. avoidance), linkages with broader SDG goals, etc.; **creation of reference index grades in the VCM** (4.2).
- As per the TSVCM, **set up a global meta-registry** to be overseen by the governance body to serve as a common global marketplace and, in the future, interoperate with multiple ETSs (4.2).
- **Develop a universal carbon accounting framework in collaboration with sector-specific associations and corporates to expand the scope of measurement to broader entities (including smaller corporates), enable disclosures, and facilitate application of GHG pricing mechanisms such as ETS markets to mitigate emissions. Sector-specific accounting methodologies should continue to be refined and aligned** as a prerequisite to accurate disclosures of emissions, and this framework should **provide guidance and consensus on terminology and definitions for related claims** and the usage of VCM credits towards those claims (4.5).
- Accounting bodies: **establish a common financial accounting framework for carbon instruments and derivatives** (4.4).

1. Including accounting standard bodies, sustainability standard organizations, industry associations, climate science community

6 Glossary of key terms

Terms	Definition	Source
abatement	Measures to avoid, reduce, or remove sources of GHG emissions	GHG Protocol
additional	When emissions reductions would not have occurred in the absence of a market to sell carbon credits	SBTi, Offset Guide
allowance	A commodity (used in compliance markets) that gives its holder the right to emit a certain quantity of GHGs	GHG Protocol
avoidance	Difference between emissions that would occur in the absence of a project and emissions from a project activity	European Commission
Banking and capital markets firms	Specific to "sell-side" firms; does not include insurance and asset-management companies	As defined for this report
base year emissions	GHG emissions for a specific year or an average over multiple years against which a company's emissions are tracked over time	GHG Protocol
baseline	A hypothetical scenario for what GHG emissions, removals, or storage would have been in the absence of a GHG project or project activity	GHG Protocol
blended finance	Use of catalytic capital from public sector or philanthropic sources to increase private sector investment in sustainable development	OECD
carbon accounting	The accurate tracking of emissions and use of various instruments to compensate for or neutralize those emissions	GHG Protocol
carbon budget	The maximum amount of cumulative net global anthropogenic CO_2 emissions that would still enable limiting global warming to a specific level	IPCC

carbon leakage	The shifting of emissions and production from a jurisdiction with carbon pricing to another jurisdiction with more lenient constraints on emissions	ICAP
carbon removals	Absorption or sequestration of GHGs from the atmosphere	GHG Protocol
clearing and settlement	Clearing refers to the process of ensuring the terms of a trade contract are confirmed and fulfilled Settlement refers to the physical or digital change of ownership of the assets and cash being traded	AFME
climate neutrality	A state in which human activities result in no net effect on the climate system. Achieving such a state would require the balancing of residual emissions with emissions (CO_2) removal	IPCC
climate science bodies	Organizations that provide regular scientific assessments on climate change to drive climate action by the public and private sectors, such as the SBTi and the GHG Protocol	As defined for this report
carbon dioxide equivalent	CO_2e; amount of CO_2 emission that would cause the same integrated radiative forcing or temperature change, over a given time horizon, as an emitted amount of a certain GHG or a mixture of GHGs	IPCC
compensate	An action that companies take to help society avoid or reduce emissions outside their value chain	SBTi
compliance market	Regulated markets that enable participants to trade emissions instruments in order to meet compliance obligations	GHG Protocol
compliance offsets	Carbon credits from voluntary projects approved by compliance programs, permissible for use toward an entity's compliance obligations	As defined for this report
corporates	Non-financial companies	As defined for this report
credits	Electronic and serialized unit (from the voluntary market) that represents one tonne of CO_2 equivalent that is reduced, avoided, or sequestered from voluntary projects applying an approved carbon credit methodology	WWF

double counting	The claiming of the same unit of emissions reduction by two separate entities	GHG Protocol
Emissions Trading Systems (ETSs)	Market-based mechanisms that incentivizes entities to reduce GHG emissions in the most cost-effective way. Entities regulated under this mechanism can trade emissions allowances to maintain compliance.	IEA
exchange	A marketplace for buyers and sellers to trade securities, commodities, derivatives, and other financial instruments	AFME
financial services sector	The entirety of the financial services industry, including banks, asset managers, insurance companies, financial market utilities, etc.	As defined for this report
GHG	Greenhouse gases (GHGs) are the six gases listed in the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6)	GHG Protocol
high-quality credits	Credits generated by high-quality projects that have verified permanence, additionality, and a low risk of leakage and double counting. (The criteria for defining high quality are still being developed by organizations such as the WWF.)	As defined for this report
interoperability	The ability to use carbon instruments (e.g., allowances, credits, etc.) from one market in another market (i.e., a two-way integration of instruments). For example, the use of allowances from one ETS for compliance purposes in another, or the use of select VCM credits to meet compliance requirements in an ETS	As defined for this report
market stability reserve (MSR)	An adjustment mechanism that holds excess allowances in a compliance market and adjusts the stock of allowances in circulation in response to supply and demand or external shocks	European Commission
nationally determined contributions (NDCs)	Public outlines of climate actions countries intend to take under the Paris Agreement	UNFCCC

net-zero (global) CO_2 emissions– also termed "carbon neutrality"	Anthropogenic CO_2 emissions are balanced globally by anthropogenic CO_2 removals over a specified period	IPCC
Net Zero (company level)	Reaching net-zero emissions for a company involves achieving a state in which its value chain results in no net accumulation of carbon dioxide in the atmosphere and no net impact from other GHG emissions	SBTi
Net Zero (global level)	Anthropogenic emissions of GHGs to the atmosphere are balanced by anthropogenic removals over a specified period	IPCC
neutralize	Balancing a company's residual GHG emissions with an equivalent amount of removals	SBTi
offtake agreement	An agreement in which buyers purchase portions of producers' goods	As defined for this report
over the counter (OTC)	Trades executed on a bilateral basis, outside a regulated market, exchange, or other trading venue	AFME
Paris Agreement	The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by keeping global temperature rise this century to well below 2 degrees Celsius above pre-industrial levels, and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. The Paris Agreement opened for signature on April 22, 2016.	UN-FCCC
primary market	The first point of distribution for emissions allowances in the compliance market (via free allocation or auctioning) and the first purchase of credits from voluntary project developers in the VCM	As defined for this report
public sector	Governments, multilateral organizations, and development finance institutions	As defined for this report
reduction	Amount of emissions reduced by companies	SBTi

regulators	Prudential, market, and conduct regulators (not including self-regulatory bodies)	As defined for this report
residual emissions	Emissions that remain unfeasible to be eliminated	SBTi
science-based decarbonization	Emissions trajectories (e.g., for regions, sectors, etc.) that align with requirements as per latest climate science in order to meet the goals of the Paris Agreement	For report, adapted from SBTi
science-based targets (SBT)	Targets that are in line with what the latest climate science says is necessary to meet the goals of the Paris Agreement	SBTi
scope 1–3 emissions	Scope 1 emissions are direct emissions from owned or controlled sources; scope 2 emissions are indirect emissions from the generation pf purchased energy; scope 3 emissions are all indirect emissions (not included in scope 2) that occur in the value chain of the reporting company.	GHG Protocol
secondary market	The market for trading emissions allowances, VCM credits, and derivatives after the first point of distribution or purchase	As defined for this report
industry associations	Organizations operated and funded by companies in a specific sector or industry, such as the International Civil Aviation Organization (ICAO)	As defined for this report
social sector	Philanthropic donors, civil society, and other NGOs	As defined for this report
standard-setting bodies	Supranational or national bodies that establish guidelines, principles, or standards (e.g., Basel Committee, IOSCO, SASB)	As defined for this report
voluntary carbon market (VCM)	The market wherein carbon credits are purchased and retired to offset individual and organizational emissions on a voluntary basis	World Bank

Annex – Supplementary details

1 History and evolution of carbon markets

The adverse impact of GHGs was first discovered by Swedish scientist Svante Arrhenius in 1896, who suggested that rising CO_2 emissions could lead to global warming (i.e., the greenhouse effect). In 1938, British scientist Guy Callendar built upon Arrhenius' research with a study showing that the Earth's climate was already increasing in temperature. But it wasn't until 1988 (when North America endured a severe heat wave and drought) that the concept of GHGs driving global warming was broadly recognized. In response to increased acknowledgement of the crisis globally, in 1988. the World Meteorological Organization (WMO) and the United Nations Environmental Programme (UNEP) founded the IPCC to research and provide assessments on climate change science as well as introduce adaption and mitigation strategies. The following year, the UN General Assembly endorsed the UNEP Governing Council's request to start negotiating a framework convention on climate change.[95]

In the late 20th century, the U.S. Environmental Protection Agency (EPA) began phasing in emissions trading as a mechanism to control pollution. A 1990 amendment to the U.S. Clean Air Act—a federal law that regulates air emissions from stationary and mobile sources to protect public health and welfare)— initiated a trading program for sulfur dioxide emissions, which were weakening air quality.[96] In this program, companies could trade sulfur emissions allowances to cover their pollution activities. Economists argued that putting a price on sulfur emissions cut back the use of this chemical and spurred the development of new technologies to manage it better than any set of regulations governments might have mandated.[97] Soon after, a second trading program was launched to control nitrogen oxide emissions. And by the next decade, the notion that market-based emissions trading could reduce GHG effects on global warming gained significant support and development efforts to build these programs began in earnest.

In 1992, the United Nations (UN) General Assembly convened the UN Conference on Environmental Development (UNCED). During this conference, the UN Framework Convention on Climate Change (UNFCCC) was adopted with the goal of stabilizing atmospheric GHGs to a level that would prevent

[95] UN Chronicle, Stockholm to Kyoto: A Brief History of Climate Change, accessed August 2021.
[96] https://www.epa.gov/laws-regulations/summary-clean-air-act.
[97] Burtraw et al., Economics of pollution trading for SO2 and NOX. Annual Review of Environment and Resources, 30(1), 2005.

further interference with the global climate, allow the environment to adapt to climate change, and support sustainable economic development. By the end of June 1993, UNFCCC had 166 signatures.[98] UNFCCC entered into force in 1994, and its members hold an annual meeting known as Conference of the Parties (COP) to assess their progress in reaching its goals. In 1997, as part of UNFCCC efforts, participating countries adopted the Kyoto Protocol, which pioneered carbon emissions trading. The Kyoto Protocol aimed to reduce GHG emissions between 2008 and 2012 (the first compliance period) to 5 percent below 1990 levels.[99] The targets for the first commitment period covered emissions for carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride. Parties committed to an emission limitation or reduction quantity that was expressed as a percentage of emissions in a chosen base year. For example, the EU committed to an 8 percent reduction from 1990 emission levels.[99] The percent reduction values were translated into assigned amounts units (AAUs), which expressed the level of allowed emissions for the first compliance period. The Kyoto Protocol commitments were only binding to developed countries (37 nations plus the EU), as they were recognized to be more responsible for the high levels of GHG emissions.[100] However, many of the most prominent GHG emitters were left out, including China and India.

Under the Kyoto Protocol, countries were encouraged to meet their targets primarily through their own national measures, but three market-based mechanisms were introduced as additional means of meeting these targets, thereby creating what is known now as the carbon market.[101] The mechanisms included the CDM, Joint Implementation (JI), and Emissions Trading between developed countries. CDM addressed concerns about market-based approaches diluting developed countries' responsibility toward reducing emissions. This mechanism enabled countries to implement an emissions-reduction project in a developing country and earn certified emissions reduction (CER) credits, which could count toward their Kyoto Protocol targets. JI allowed developed countries to implement emissions reduction or removal enhancement projects in other developed countries and earn emissions reduction units (ERU) that could also count toward their Kyoto target.[101] International Emissions Trading permitted countries with emission units in excess of what they need to meet their Kyoto commitment to sell emission units to countries that weren't meeting their target. In order to ensure compliance to commitments, the Kyoto Protocol established systems

[98] UNFCC, Status of Ratification of the Convention.
[99] https://ec.europa.eu/clima/policies/strategies/progress/kyoto_1_en.
[100] https://unfccc.int/kyoto_protocol.
[101] https://unfccc.int/process/the-kyoto-protocol/mechanisms.

to monitor countries' actual emissions and record their trade transactions under the mechanisms. Governments reached broad political agreement on an operational rulebook for the Kyoto Protocol in July 2001 at COP6. By November 2001, COP7 had set the stage for ratification of the Kyoto Protocol. The final instrument of ratification for the Kyoto Protocol was submitted in 2005, allowing it to enter into force. CDM and JI mechanisms became active in 2006 and 2008, respectively, the first compliance periods of the Protocol.

In 1998, the GHG Protocol was developed in response to the need for guidance on tracking and reporting GHG emissions for furthering climate ambitions. The GHG Protocol emerged from a report published by World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD). Titled "Safe Climate, Sound Business," it defined an action agenda to address climate change.[102] The GHG Protocol offers accounting and reporting standards, tools to calculate GHG emissions, sector guidance, and online training for businesses and governments to help them track their progress toward climate goals. **Most notably, the GHG Protocol developed a standardized framework for measuring and managing emissions, which categorizes a company's GHG emissions into three scopes** (see more detail in the Annex – Details on current state of carbon markets). This framework is meant to help businesses identify the biggest generators of GHG emissions in their value chain. The first edition of the GHG Protocol's Corporate Standard was published in 2001 and it has since been updated to include guidance on how companies can measure emissions from electricity and other energy purchases. By 2016, more than 90 percent of Fortune 500 companies reporting to the CDP used GHG Protocol resources.[103]

The Kyoto Protocol also planted the seeds for the concept of REDD projects to financially incentivize the reduction of deforestation, thereby preventing the release of corresponding CO_2 emissions.[104] REDD is a mechanism through which countries, the private sector, multilateral finance institutions and others can **pay countries to prevent them from cutting down their forests**. The payment can occur through a direct exchange of either money or carbon emission credits, which can be traded in the VCM.[105] One of the world's first large-scale REDD projects was The Noel Kempff Mercado Climate Action Project (NKCAP)—developed in 1996 by The Nature Conservancy, which in collaboration with Bolivian conservation organization Fundación

[102] https://files.wri.org/d8/s3fs-public/pdf/scsb_action_agenda.pdf.
[103] GHG Protocol.
[104] Trees sequester carbon dioxide and release oxygen during photosynthesis. When trees are cut down and burned, the stored carbon is released as carbon dioxide, thus furthering GHG emissions and global warming.
[105] International Finance Corporation (World Bank Group): REDD Market Overview, October 2016.

Amigos de la Naturaleza, worked with the government of Bolivia to prevent the deforestation of ~832,000 hectares of tropical forest in Bolivia's Noel Kempff Mercado National Park.[106] Three companies helped fund the project and in exchange were given rights to a portion of the verified carbon benefits. The concept of REDD was formalized at COP13 in 2007.[107] Projects can be verified for authenticity by independent bodies such as the VCS, which was launched in 2007.

In 2008, at COP14 in Poznan, the concept of REDD+ was introduced by the UNFCCC's Subsidiary Body for Scientific and Technological Advice (SBSTA). In response to pressure from countries such as India, the plus sign was added to denote that the role of conservation, sustainable management of forests, and enhancement of forest carbon stock was to be prioritized as much as deforestation and forest degradation.

In 2005, the Kyoto Protocol entered into force, **the EU established its own ETS,** which allowed ~11,000 power stations and manufacturing plants to trade carbon credits in order to meet their emissions-reduction targets in its ETS.[108] The EU ETS was implemented over several phases, the first being from 2005 to 2007 and the fourth starting in 2021. The EU ETS functions under a cap-and-trade model, so participants are allocated a number of allowances equivalent to the amount of emissions they can emit. As evidence of this trading system's success, **factories and utilities covered by the ETS reduced emissions by ~35 percent between 2005 and 2019.**[109] (Lessons from this experience are further explored in the Annex – Key lessons from the EU ETS.)

In 2007, as knowledge about the VCM developed**, Ecosystem Marketplace published its first "State of the Voluntary Carbon Markets" report.[110] This report provided independent information about the emerging VCM,** including project, credit, transaction, and pricing information from market participants. Updated versions of this report continue to be published by Ecosystem Marketplace annually to provide insights on the VCM. In 2008, **the International Carbon Reduction and Offset Alliance (ICROA) was created to ensure credibility and quality for corporates using VCM credits.** By 2014, over 200 $MtCO_2e$ of GHG emissions reduction had been issued through the VCM and there

[106] Conservation Gateway (The Nature Conservancy): Noel Kempff Mercado Climate Action Project: A Case Study in Reducing Emissions from Deforestation and Degradation, October 2010.
[107] Carbon Planet White Paper: The History of REDD Policy, December 2009.
[108] European Commission Factsheet: The EU Emissions Trading System (EU ETS), 2016.
[109] https://ec.europa.eu/clima/policies/ets_en.
[110] Ecosystem Marketplace: State of the Voluntary Carbon Markets, 2007.

were an increasing number of corporates using VCM credits, such as Microsoft, La Poste, and Walt Disney.[111]

After the first commitment period of the Kyoto Protocol ended in 2012, parties developed the Doha Amendment for the second commitment period (2013–2020), which increased the goal from a 5 percent reduction in GHGs to at least an 18 percent reduction from 1990 levels.[100] This amendment was short-lived, however, as all UNFCCC participants signed another pact three years later, the Paris Agreement, effectively replacing the Kyoto Protocol.

In 2015, the Paris Agreement emerged from the COP21 meeting to strengthen the global response to climate change. In total, 196 Parties (195 countries plus the EU) adopted the legally binding international treaty, which entered into force in November 2016.[112] The treaty calls for limiting global warming to well below 2°C, and to pursue efforts to limit the increase to 1.5°C, as compared with pre-industrial levels, by the end of the century. By 2020, countries had to submit their climate action plans for reducing their GHG emissions, known as nationally determined contributions (NDCs). The Paris Agreement marked the first binding agreement to draw virtually all nations together to confront climate change. Article 5 of the Paris Agreement also formalized the concept of REDD.

The debate on Article 6

The first version of the Paris Agreement included an Article 6, which introduced the concept of internationally transferring mitigation outcomes toward NDCs (i.e., internationally trading credits). Countries participating in COP meetings agreed to implement the Paris Agreement, but have yet to reach a consensus about Article 6. Under the Article 6 system, countries that have already achieved emissions reduction in line with their NDC target could sell their unused allowances to polluters that were struggling to reduce emissions to meet their own NDC targets.[113] This cooperative approach to emissions reduction would create internationally transferred mitigation outcomes (ITMOs) that are meant to replace other

[111] ICROA working group, Evolution of Voluntary Carbon Market, 2020.
[112] https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement.
[113] https://www.wri.org/insights/what-you-need-know-about-article-6-paris-agreement.

existing forms of international carbon credits.[114] The interaction between supply and demand across country borders would lead to a global price on carbon, so polluters buying carbon allowances were still paying for the negative externality.[115]

Article 6 was left unresolved during COP21 Paris negotiations due to **differing viewpoints from COP participants and overall concern around the proposed carbon market structure. "Depending on how [the rules] are structured, Article 6 could help the world avoid dangerous levels of global warming or let countries off the hook from making meaningful emissions cuts."**[113]

In 2019, COP 25 was the longest in the history of the UNFCCC, as discussions regarding Article 6 continued without consensus. In the Article 6 discussion, many participants emphasized the importance of establishing a system or mechanism to prevent double counting if Article 6 were approved. Representation for the Group of 77 and China noted that Article 6 negotiations should, among other things, "reflect the diversity of NDCs, and focus on avoiding double counting, and providing predictable funds for adaptation."[116] Finland, for the EU, called for "robust and comprehensive" accounting rules for Article 6 to prevent double counting.[116] Switzerland said Article 6 was an "unprecedented opportunity" to advance NDC ambition.[116]

On one hand, international cooperation in carbon markets could increase the amount of emissions reduction opportunities, introduce additional public and private funding, and bring flexibility and efficiency to the carbon reduction process.[113] According to the IETA, cooperation in achieving the NDCs under Article 6 could generate significant benefits to all parties. For example, they estimated a ~$250 billion annual cost reduction in implementing countries' NDCs, which reflects a more than 50 percent reduction in current costs.[117] Furthermore, if countries invested these cost savings in climate combat initiatives, they could drive about 50 percent more emissions reductions (~5 $GtCO_2$/year in 2030) under the Paris Agreement. On this note, it is essential that these cost savings be reinvested in climate combat initiatives rather than rewarding a lack of increased ambition after initial pledges are reached.[117]

On the other hand, countries could take advantage of the trading system, thereby ruining its integrity, by double counting their emissions credits. In response to this potential issue, Metcalf and Weisbach (in 2011) developed economic literature that explores how to effectively establish linkages between different emissions reduction programs, such as ETSs, while avoiding double counting or emissions leakage.[117] In

[114] IISD, Current Status of Article 6 of the Paris Agreement: International Transferred Mitigation Outcomes (ITMOs), December 2019.
[115] https://iccwbo.org/media-wall/news-speeches/article-6-important/.
[116] https://enb.iisd.org/events/chilemadrid-climate-change-conference-december-2019/summary-report-2-15-december-2019.
[117] IETA, the economic potential of article 6 of the Paris Agreement and implementation challenges, September 2019.

summary, "linkage problems can be reduced to the extent that different [emissions reduction] systems harmonize *ex ante* on a desired price for GHG emissions."[118] According to Metcalf and Weisbach, one way systems can harmonize is by agreeing on a price band on emissions. In the case of linking market-based systems, this price band can be achieved by setting tax rates within a band or defining allowance allocations that drive allowance prices to be traded within a band.[118]

The discussion around Article 6 is expected to continue at COP26 in 2021.

The recent emergence of carbon pricing and trading systems has accelerated as the worst effects of climate change are already being chronicled in, for instance, rising sea levels, shrinking glaciers, drought, and storms. As discussed in Section 1.4, ETS initiatives have grown significantly over the last decade, from 7 ETS initiatives implemented in 2011 to 29 as of 2021. Coverage of total global emissions has also increased from 4.6 percent in 2011 to ~16 percent in 2021.[1] Several VCM registries and verification standards have been established and over 1,100 companies had committed to net-zero targets.[111] ICAO launched a sector-specific carbon market mechanism, CORSIA, with the goal of stabilizing net GHG emissions from international flights at 2019 levels. (Details on CORSIA are further discussed in the Annex – Details on current state of carbon markets.) Furthermore, despite decreased economic activity during the COVID-19 global health crisis, countries continued to push forth with new and increasingly ambitious carbon pricing systems.[35] This year (2021), trading began under the Chinese National ETS.[1] Germany and the U.K. also each launched an ETS early this year.

[118] Metcalf, G.E. and Weisbach, D. 2011. "Linking policies when tastes differ: Global climate policy in a heterogeneous world."

2 Details on current state of carbon markets

Compliance carbon markets

As mentioned in Section 1.4, there are 29 implemented ETS initiatives around the world, covering ~16 percent of global GHG emissions. In addition, there are 35 carbon tax initiatives.[1] There are an additional 21 ETS initiatives scheduled or under consideration (see Figure 36).[35]

21 Emission Trading Schemes are scheduled or under consideration

World Bank region	National	Subnational
East Asia and Pacific	Indonesia ETS Japan carbon pricing mechanism Thailand ETS Vietnam ETS	Shenyang pilot ETS Taiwan ETS
Europe and Central Asia	Montenegro ETS Serbia ETS Turkey ETS Ukraine ETS	Sakhalin ETS
Latin American and the Caribbean	Chile ETS Colombia ETS	
North America		
South Asia	Pakistan ETS	Manitoba ETS New Brunswick ETS Ontario EPS Oregon ETS Pennsylvania ETS TCI-P ETS Washington CAR

Figure 36: Scheduled ETS initiatives in each region

Before 2021, the largest GHG emissions coverage was the EU ETS, with a coverage of 1.7 $GtCO_2e$ as of April 2021. It covers nearly 40 percent of the EU's total emissions, or ~3 percent of global GHG emissions.[1,109] In July 2021, China's national ETS came online and became the largest ETS in the world (in terms of absolute volume) with an estimated coverage of ~4 $GtCO_2e$, 30 percent of total national emissions, or ~7 percent of global GHG emission.[1]

Currently, the five largest ETS initiatives are the China National ETS, EU ETS, Korea ETS, Germany ETS, and California ETS. These initiatives cover ~13 percent of global GHG emissions, or ~80 percent of all covered emissions across currently implemented ETSs.[1]

Sectoral coverage also varies between the different ETS initiatives. The power sector is the most commonly covered sector, given that it is generally responsible for the largest proportion of GHG emissions (20–80 percent in most jurisdictions). Other sectors such as industry, transport, buildings, and waste are also widely covered by different ETS initiatives (see Figure 37). Some ETSs, such as the post-Phase 3 EU ETS and the U.K. ETS, also cover aviation.[119]

Sectors covered in selected main ETSs

Sectors	China National ETS	EU ETS	Korea ETS	Germany ETS	California ETS
Power	✓	✓	✓		✓
Industry		✓	✓		✓
Aviation		✓	✓		
Buildings			✓	✓	✓
Waste			✓		
Transport				✓	✓

Note: Transport in EU ETS covers road transport; Germany ETS in general covers all sectors not covered by the EU ETS, mainly transport and heating for building, Transport and Buildings sectors in California ETS cover upstream emissions

Figure 37: Sector coverage in largest ETS initiatives

Coverage of carbon markets is expected to continue expanding globally, both from a geographic and sectoral perspective. In Europe, some regions not currently covered by the EU ETS, such as Serbia, Turkey, and Ukraine, are considering their own ETSs. In Latin America, Chile and Colombia are both exploring ETSs. In North America, there are already several regional ETSs in place, such as the California ETS; the RGGI consisting of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Vermont, and Virginia; and the Québec ETS. Several other initiatives are either scheduled or under consideration, such as New Brunswick ETS and Oregon ETS.

[119] International Carbon Action Partnership, "Emissions Trading Worldwide," 2021.

Key types of compliance market systems

As discussed in Section 1.2, there are two main types of programs under the umbrella of ETS: cap-and-trade (or quantity-based) programs and baseline-and-credit (or intensity-based) programs.

A compliance cap-and-trade program explicitly sets a cap on aggregated GHG emissions that denotes the total number of carbon allowances in each compliance period.

Policymakers can effectively define the speed and magnitude of reducing carbon emissions from economic activities in society by setting lower caps over time and through different phases. Phase 4 of the EU ETS, for example, has a cap of ~1.7 $GtCO_2e$ in 2021.[1] When phase 1 started in 2005, it had a cap of ~2.1 $GtCO_2e$, which dropped to ~2.05 $GtCO_2e$ in phase 2 (2009). During phase 3 (2013–2020), the EU ETS implemented a mechanism to reduce the cap on allowances linearly every year by ~38.3 $MtCO_2e$. This amounted to a cap of ~1.8 $GtCO_2e$ in 2020.[120] With more sectors being included in the scheme and a lowered cap, the EU can control a steady transition pathway to its climate commitment.

A compliance baseline-and-credit program sets a performance standard, or a level of emission in the absence of the project, against which the actual emission is compared.

In both cap-and-trade and baseline-and-credit compliance programs, corporates have incentives to reduce GHG emissions when the carbon price/tCO_2e is above the cost of reducing emissions by 1 tCO_2e. Theoretically, the two types of programs can yield the same results if the cap implicit in the baseline-and-credit plan is fixed and equal to the fixed cap in a cap-and-trade program. In practice, however, the emissions cap imposed in baseline-and-credit programs varies with the level of output, which is equivalent to an output subsidy. The more output the sector generates, the more carbon allowances it is "entitled" to. Unless carefully designed and executed by re-examining and lowering the baseline over time, it merely reallocates the allowances from more-intense to less-intense polluter within the sector without incentivizing a sector as a whole to lower its total carbon emissions.

Overview of market characteristics & structures

Market characteristics

[120] ICAP, ETS Detailed Information: EU Emissions Trading System, as of August 2021.

ETS carbon credit prices have generally trended upwards with some local short-term volatility. The upward trend is supported by policymakers through revisions to the rules of the systems (e.g., implementation of MSR, introduction and expansion of auctioning, etc.). The local volatility is driven by various factors such as unexpected surpluses of allowance (e.g., economic slow-down caused by COVID-19), general economic conditions, and changes in market expectations of future allowance scarcities. Still, carbon prices vary in different jurisdictions. In the EU, the carbon allowance price in the compliance market ranged from EUR 33 ($38.93) to over EUR 60 ($69.60) in September 2021, whereas in China, the first day's (July 16, 2021) closing price was 52 CNY (~$8).

Attainment of sufficiently high price levels that reflect the cost of emissions is critical to producing a meaningful reduction in GHG emissions and driving achievement of countries' NDCs. It is estimated that an increase in the effective carbon rate of EUR 1/tCO_2 leads, on average, to a 0.73 percent reduction in emissions over time.[121]

NDCs are public outlines of climate actions countries intend to take. They are at the heart of achieving the long-term goals of the Paris Agreement to limit global warming to well below 2°C, and to pursue efforts to limit it to 1.5°C. Currently, 192 Parties of the Paris Agreement have submitted their first NDCs, with 11 having submitted their second NDC.[122]

Interoperability between multiple compliance markets

As policymakers in different jurisdictions are designing and implementing ETSs to meet their climate goals, **interoperability between these initiatives has become a topic of international interest and a consideration in designing and evolving regional ETSs**. Two systems can be made interoperable directly or indirectly, and unilaterally or bilaterally.[80] Two fully interoperable systems mutually recognize emission allowances issued in these systems. **Interoperability between ETSs can be the first step in creating an integrated global carbon market with cohesive carbon pricing across the markets.** Interoperability can prevent leakage due to differences in or a lack of carbon pricing. It also lowers the transaction cost for carbon trading by enlarging the market and increasing liquidity.

[121] OECD Effective carbon rates, 2021.
[122] United Nations Framework Convention on Climate Change, NDC Registry, as of August 2021.

However, interoperability between ETSs can also have its challenges. Like any trade agreement, it involves meticulous negotiation between regulators and officials in different jurisdictions. Differences such as scarcity of allowances in each system, VCM credit eligibility and quality, trading products availability, and banking and borrowing policy can all create unexpected results if not handled carefully and delicately. One of the key shortcomings that would prevent the effective interoperability of ETS initiatives is a difference in decarbonization goals between markets, which poses the threat of dilution of goals.

Interoperability between ETSs is still relatively new in carbon markets. For example, the link between the EU and Swiss ETS that took effect in January 2020 permits covered entities in both systems to use allowances from either ETS for compliance. In September of that year, transfers of allowances between registries on pre-announced dates were allowed. California linked with Québec's ETS on January 1, 2014, as well. The two expanded their joint market by linking with Ontario on January 1, 2018, until the termination of Ontario's system in mid-2018. As another example, interoperability between Tokyo and Saitama Prefecture ETSs grant eligibility to trade allowances between the two jurisdictions. During the first compliance period, 15 credit transfers took place between the Saitama Prefecture and Tokyo (9 cases from Tokyo to Saitama and 6 cases from Saitama to Tokyo).

There are several other ETSs that are having ongoing conversations on interoperability. The U.K. government has indicated that it is open to the possibility of linking the scheme internationally in the future, but has not yet made a decision on preferred partners. The post-Brexit Trade and Cooperation Agreement between the EU and U.K. stipulates that the jurisdictions "shall give serious consideration to linking their respective carbon pricing systems in a way that preserves the integrity of these systems and provides for the possibility to increase their effectiveness." The "General Law on Climate Change" foresees possible linkages between the Mexican ETS and ETSs in other countries. Various cooperation activities have taken place in recent years. Mexico signed a Memorandum of Understanding with California in 2014 and with Québec in 2015 that includes cooperation on ETSs. In August 2016, Mexico, Québec, and Ontario issued a joint declaration on carbon markets collaboration. Additionally, in December 2017, Mexico—together with four countries and seven subnational governments—issued the Paris Declaration on Carbon Pricing in the Americas for carbon pricing implementation, which creates a platform for cooperation among countries in the region.

In addition to direct interoperability between national or regional ETSs, central- and local-level ETSs in the same region can also complement each other. Local-level ETSs can utilize central ETSs as a baseline to build their own more ambition levels to reduce emission. For example, in 2021, Germany launched its national ETS that covers transportation and buildings, two sectors not covered by the EU ETS. In China, entities covered in pilot ETSs are transitioning into the national ETS, and the pilot ETSs continue to operate to cover sectors and entities not included in the national market.

Interoperability between ETS and VCMs

Some ETSs allow covered entities to utilize VCM credits to cover a portion of their compliance requirements. For the purpose of this report, these fungible VCM credits are known as compliance offsets and are considered part of the VCM. When an entity has or expects to have GHG emissions higher than the cap or the baseline, it can either participate in the ETS to purchase carbon allowances from other entities or purchase compliance offsets generated from eligible emissions reduction projects (i.e., projects that have been approved by a compliance offset program). Given that the current VCM has a wide variety of quality of credits (see Section 2.3 for more detail), it is critical to have strict eligibility criteria as well as restrictions on the total number of credits to prevent slippage on decarbonization ambitions.

ETS initiatives that allow compliance offsets often have qualitative and quantitative restrictions on the eligible projects and a defined maximum amount or percentage of GHG emissions that can be covered using VCM credits. For example, the China National ETS allows covered entities to use China Certified Emissions Reduction (CCER) to offset up to 5 percent of their verified emissions. South Korea's K-ETS also allows covered entities to use domestic credits—the Korean Offset Credit (KOC)—for up to 5 percent of their compliance obligation.

Some ETSs, such as the EU, don't allow the use of any compliance offsets. In phase 1 (2005–2007), the EU allowed unlimited use of CDM credits, although no credits were used. As the EU ETS developed in maturity and defined its ambition, stricter rules were imposed for the eligibility of projects, and a quantitative limit was imposed as well. Starting in phase 4 (2021–2030), the use of such credits is no longer allowed. (This topic is discussed in further detail in the Annex – Key lessons from the EU ETS.)

Market structure for a compliance market

Allowance generation

Policymakers set an aggregated allowance cap in the beginning of a compliance period (cap-and-trade program) or during the compliance period when covered entities generate less-than-baseline emissions (baseline-and-credit program).

Primary market

There are two main methods for distributing allowances in the primary market: free allocation and auctioning.

Free allocation provides an entryway to carbon markets for covered entities. There are two common methods in free allocation of allowances: grandfathering and benchmarking. In grandfathering, allowances are allocated based on covered corporates' historical emissions in a base period. A drawback to this practice is it tends to reward historically high emitters and may require additional adjustment for new market entrants (due to a lack of historical corporate emissions data). In benchmarking, allowances are allocated according to performance. This method rewards efficient installations and can be easily applied to new entrants. For example, the Shanghai pilot ETS in China employs a grandfathering method that's generally based on emissions data from the previous three years, whereas the Shenzhen pilot ETS uses a benchmarking method based on sectoral historical emissions intensity.[123]

Auctioning, on the other hand, allows regulatory bodies to collect revenues from selling allowances to covered entities. This has the benefit of providing transparency for allocating allowances and gives covered entities equal opportunity to buy allowances. It also helps raise revenues for regulators that can be further allocated to other measures to counter climate change, such as the development of renewable energy technology, using rebates to incentivize the use of clean energy, and supporting lower-income regions to transition carbon intensive industries.

A simple and transparent carbon allowance allocation process is one of the most critical aspects of a successful ETS initiative. ETS initiatives around the world are continually increasing the portion of auctioned allowances over time. For example, in phases 1 and 2, the EU ETS did not specify a system-

[123] https://icapcarbonaction.com/en/allocation.

wide allocation plan, allowing member states to establish their own allocations. ~90 percent of allowances were allocated for free. In phases 3 and 4, the program significantly increased the average auctioning proportion to about 57 percent (the rest through benchmark-based free allocation), with power sectors having full auctioning. The China National ETS, currently using 100 percent free allocation at 70 percent of 2018 output of covered entities (adjusted by a benchmark factor), has indicated that auctioning may be subsequently introduced.

Secondary market

Secondary compliance markets have more participants. In addition to covered entities that are involved in trading emissions allowances post-allocation, other players such as financial intermediaries, institutional investors, and retail investors can all participate in the secondary market. It is an essential component of the ETS architecture that can provide greater depth and liquidity and facilitate price discovery in the market. It provides a marketplace for investors to trade carbon allowances as an asset class, and for financial intermediaries to connect buyers and sellers and discover and provide liquidity where needed. Exchanges play a key role in the clearing and settlement of trades and help provide trade data and price information.

Enabling activities (legal, trade settling, accounting, disclosure)

ETSs require solid, stable, and comprehensive infrastructure. Legal support, trade clearing and settling, registries, an accounting framework for GHG emissions, and credible and accurate data disclosures are key enabling activities in carbon markets.

These institutional resources can shape the effectiveness of an ETS. Trade clearing and settling capabilities, either through public service or through private companies, ensure integrity of carbon allowance trades. Registries keep a reliable record of ownership of carbon allowance, ensuring the reliability of the entitlements in the market.

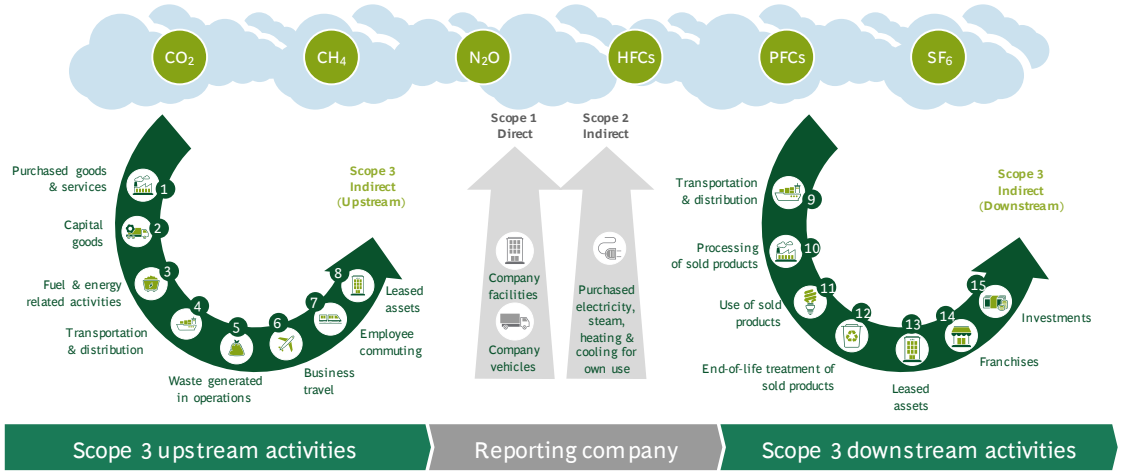
Globally recognized and accepted financial and carbon accounting frameworks are critical enablers in providing transparency in the compliance market and reducing transaction costs. Section 4.5 discusses this in more detail.

Current state of carbon accounting frameworks

The GHG Protocol and SBTi have both issued guidance to companies on accounting and setting reduction targets for their GHG emissions, respectively. In its Corporate Accounting and Reporting Standard, the GHG Protocol outlined five underlying principles for GHG accounting (relevance, completeness, consistency, transparency, and accuracy), set approaches for corporates to claim emissions across different levels of their organization and subsidiaries, and defined the concept of "scope" of emissions. **Per the GHG Protocol, emissions fall into three different scopes**:[124]

1. **Scope 1:** Direct GHG emissions from company-owned sources (e.g., emissions from the operation of a furnace owned by the company)
2. **Scope 2:** Indirect GHG emissions from the generation of electricity purchased and used by the company (e.g., emissions from burning coal to generate electricity)
3. **Scope 3:** Other indirect GHG emissions as a result of company activity, from sources not owned by the company (e.g., upstream emissions from employee business travel, downstream emissions from the use of the company's products). The GHG Protocol segments scope 3 emissions into 15 different categories, which are illustrated in Figure 38.

Scope 1–3 emissions definitions, per the GHG Protocol



Note: CO_2, Carbon dioxide; CH4, methane; N2O, Nitrous oxide; HCFs, Hydrofluorocarbons; PFCs, Perfluorocarbons; SF6, Sulfur hexafluoride
Source: GHG protocol

Figure 38: Scope 1–3 emissions definitions, per the GHG Protocol

[124] GHG Protocol, "A Corporate Accounting and Reporting Standard"

The SBTi's target-setting guidance for corporates takes the GHG Protocol as a basis, with a direct recommendation for companies to follow the GHG Protocol's accounting and reporting principles as inputs to its science-based target setting processes.[125] Per the SBTi, companies setting SBTs should aim to cover at least 95 percent of their scope 1 and 2 emissions, as well as set a target for scope 3 emissions if they comprise more than 40 percent of the company's total emissions. SBTi's September 2021 guidance proposes to increase the target ambition such that long-term SBTs cover at least 95 percent of scope 3 emissions.[18]

Governing framework

The governing framework is the overarching construct that ensures effective implementation of an ETS. This includes decisions on ETS design (allocation of credits, budget of aggregated emissions, eligibility of VCM credits, etc.), audit authorities to verify emission disclosures, book-keeping functionality to record carbon allowance entitlement statuses, and enforcement for non-compliant covered entities.

Current ETSs have various forms of governing frameworks. For example, the China National ETS has a three-tiered governance structure: The Ministry of Ecology and Environment (MEE) acts as the national competent authority, setting the rules and overseeing the system, with joint oversight of trading activities with other regulators, while its subsidiaries at the provincial level oversee the implementation of these rules and the municipal-level authorities take on local management duties. Meanwhile, there is regulatory coordination between MEE and other national-level regulators such as the Ministry of Industry and Information Technology, the National Energy Administration, etc. The EU ETS, on the other hand, is governed by EU legislative structure and EU environmental law. The primary institutions involved are the European Parliament, the European Commission, and the European Council. The European Commission has the power to initiate a legislative proposal or amendments in the EU ETS to the EU ETS Directive. The European Council and Parliament can suggest amendments to the proposal. In the end, the Council and Parliament both need to approve proposed legislation.

[125] SBTi, "Science-Based Target Setting Manual," April 2020.

Voluntary carbon market

Overview of the voluntary carbon market

VCM channels provide funding for the avoidance or reduction of emissions and removal/sequestration, through both direct actions, such as forestation, and emerging technologies, such as carbon capture. The carbon credits these projects generate can be traded in the VCM. During transition, VCM credits are viewed as an effective mechanism for the sector to compensate for their emissions.

CORSIA: a sector-specific market

CORSIA was developed in 2016 and launched its first phase in 2021 to address annual increases in total CO_2 emissions above 2020 levels from international civil aviation.[126] It is a market-based mechanism wherein airlines can buy emission credits from other sectors to compensate for increases in their own emissions or use lower-carbon "CORSIA-eligible" fuels. It was developed by ICAO and agreed to by 192 countries. As of January 2021, 88 countries representing more than 85 percent of international aviation activity have volunteered to participate. Aviation (both domestic and international) accounts for ~2 percent of global CO_2 emissions, with international aviation alone responsible for around 1.3 percent. The aviation sector is expected to have a growing amount of emissions, since the current trajectory of fuel efficiency improvements of around 1–2 percent are far less than the forecasted traffic growth of ~5 percent annually.[127] VCM credits can help the aviation sector bridge this 3–4 percent annual emission gap by providing a way to compensate for the additional emissions growth.

[126] ICAO environmental protection, "What is CORSIA and how does it work?"
[127] ICAO environmental protection, "Why ICAO decided to develop a global MBM scheme for international aviation?"

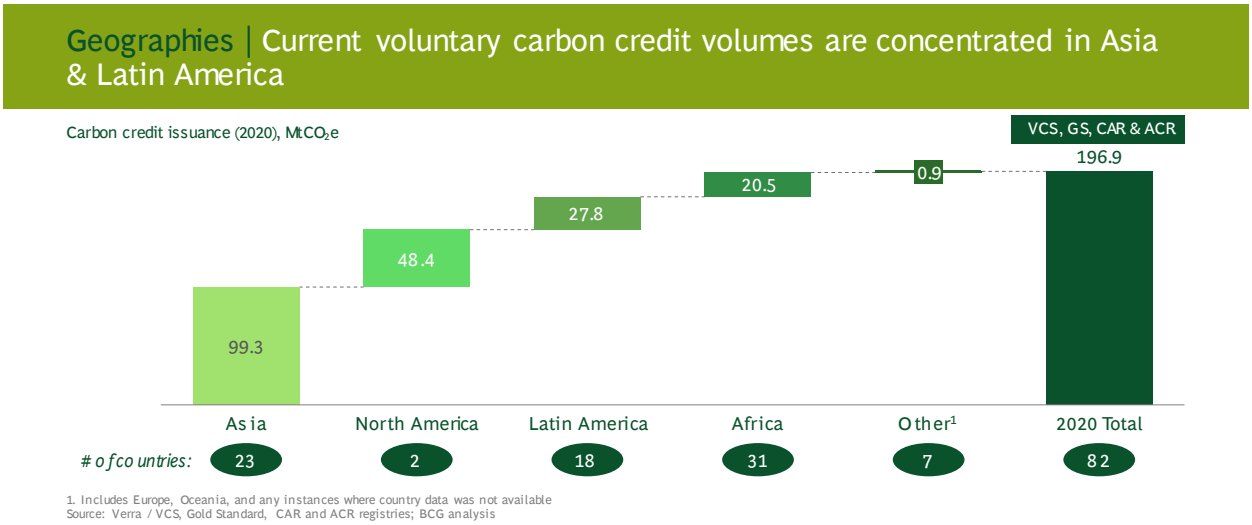


Figure 39: Geographic split of voluntary carbon credit projects

From a geographic perspective, most carbon credits are issued to projects in Asia, North America, and Latin America. Volumes in Asia and Latin America are largely driven by a handful of countries such as India and Peru, while volumes in North America are largely driven by the United States.

Overview of market structures & characteristics

The size of the VCM has fluctuated over time. The highest estimated annual trading volume was in 2008 ($790M).[128] That was mainly driven by transactions made through the Chicago Climate Exchange (CCX), which represents transactions involving U.S.-based projects with U.S. buyers speculating on regulatory changes ("pre-compliance"). However, in 2009, when Congress failed to pass an energy and climate bill that would have created a national scheme for trading emissions, trading volume on the CCX dropped precipitously. Currently, there are very few derivatives available on the market for VCM credits. For example, the CME launched emission offset futures contracts trading in 2021. It is a physically settled contract that allows for CORSIA-eligible VCM credits from the VCS, ACR standard, and CAR protocols.[129]

Market structure

[128] Ecosystem Marketplace, "State of Voluntary Carbon Markets 2020: Voluntary Carbon and the Post-Pandemic Recover," September 2020.
[129] CME group, Global Emissions Offset Futures FAQ.

Credit generation

Projects generate VCM credits based on avoiding emissions versus a baseline level (e.g., through using renewable energy to replace fossil fuels) or removing/sequestering emissions from the atmosphere (e.g., through afforestation or direct air capture). A wide range of projects can generate carbon credits, including AFOLU, renewable energy, household devices (such as high-efficiency and advanced refrigerants and refrigeration systems), chemical/industrial processes, waste (such as landfill gas destruction and beneficial use), transport (such as efficient fleets), etc.

Certification and registration of credits

As mentioned previously, carbon credits should satisfy four key characteristics: additionality, permanence, absence of leakage, and verification. Several third-party carbon offset programs develop and approve standards that define these credit quality criteria as well as review voluntary projects against these standards.[130] Some of the largest and most widely recognized offset program standards are the VCS, Gold Standard, ACR standard, CAR Protocols, and California Air Resources Board (CARB) Standards. Third-party verifiers support these offset programs by verifying that projects and activities meet the standards. For each tonne of verified avoided or removed GHG emissions, offset programs issue a VCM credit to the project developer.

Registries track VCM-credit-generating projects and issue carbon credits. Additionally, they provide records of ownership, trades, and retirement of VCM credits. Offset programs also provide registry services for the carbon credits they issue. For example, ACR oversees the verification of projects that meet the ACR standard as well as a registry of issued carbon credits.

Currently, there is no global meta-registry that tracks VCM credits from all individual registries, but some organizations are starting to launch aggregated registries, such as IHS, which announced plans to launch a meta-registry with the Global Carbon Council, Gold Standard, U.K. Woodland Carbon Code, U.K. Peatland Code, and Verra.[131]

Primary market origination and secondary markets

After carbon credits are generated, verified, and issued, they enter the primary market. There, they are purchased from the project developer by credit retailers, brokers that intend to sell in secondary

[130] http://www.offsetguide.org/understanding-carbon-offsets/carbon-offset-programs/.
[131] IHS news release: IHS Markit to launch Meta-Registry for global carbon credits, March 2021.

market, or end buyers who purchase credits for retirement to meet their own needs—or, where allowed, to meet compliance market requirements.

VCM credits can also be traded in secondary markets between market participants and other market intermediaries. These trades can occur OTC, on an exchange, or through structured solutions with bundles of VCM credits.

Enabling activities (legal, trade settling, accounting, disclosure)

In the VCM, there is no single standardized accounting framework, disclosure criteria, legal contracts, or universal trade settling. Bigger players in the field sometimes play multiple roles including standard setting, verification, registry, and accounting and disclosure services. For example, VCS, the largest registry of the VCM, provides standards that lay out the rules and requirements projects must follow in order to be certified, accounting methodologies used to assess projects and quantify GHG emissions reduction, and a registry system. They also intermediate independent auditing services. CAR also offers standards for developers to abide by, accounting principles, and registry services.

Governing framework

In September 2021, the TSVCM announced the establishment of a new governance body for the VCM, comprised of independent members, with a mandate to ensure a sufficient supply of high-integrity VCM credits through the development and curation of CCPs and to provide oversight over standard-setting organizations.

3 Key lessons from the EU ETS

The development of the EU ETS since 2005 provides **insights on challenges and learnings associated with developing a successful ETS**:

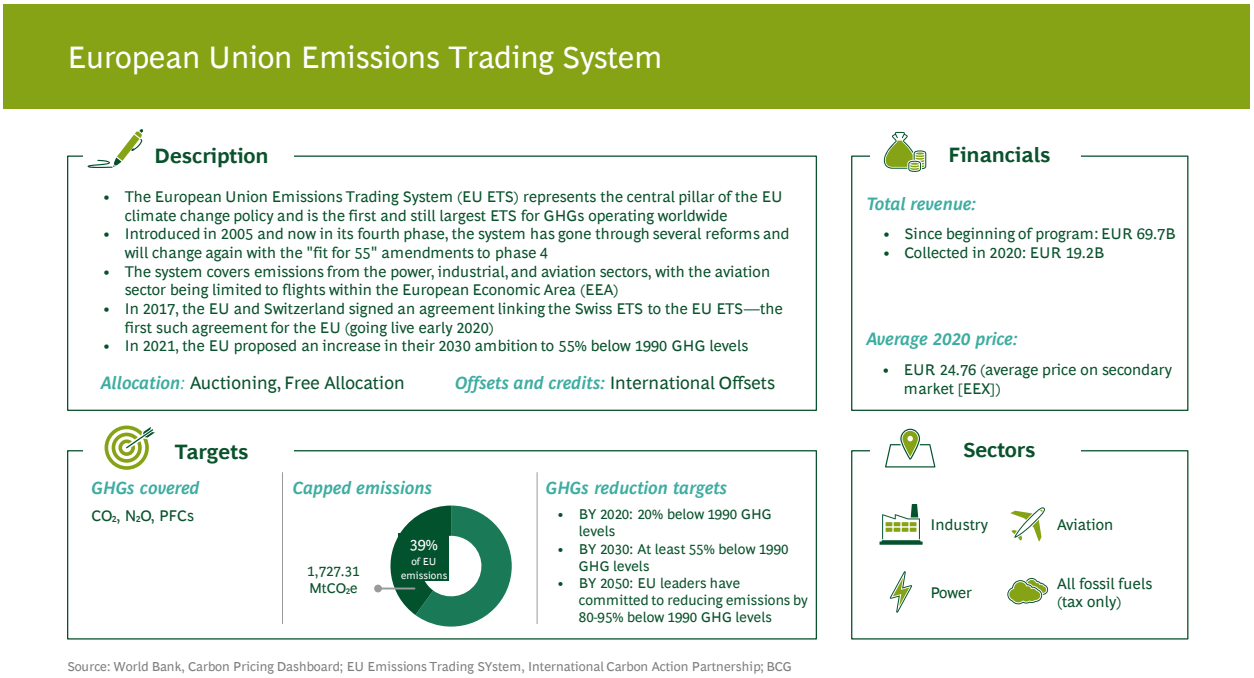


Figure 40: Details on the EU ETS

- **PHASE I (2005–2007):** In 2005, the EU launched the pilot phase of its ETS market. For the most part, allowances, which were based on market participants' current emissions estimates, were allocated for free. The market cap was fixed at 2,096 $MtCO_2e$ in 2005. During this phase, the EU ETS had a surplus of free allowances and, as a result, allowance prices dropped from \$22/tCO_2e in 2005 to \$0 by 2007.[132]

Baselining is key at the outset of an ETS initiative. **Collecting verified annual emissions data from market participants (as close to the next compliance period as possible) to help calculate an appropriate future market cap on allowances** can help ensure appropriate allowance levels.

[132] https://ec.europa.eu/clima/eu-action/eu-emissions-trading-system-eu-ets/development-eu-ets-2005-2020_en.

Since ETSs are market mechanisms, government entities with markets experience should be involved in the design and oversight of compliance markets. As the demand for allowances is artificially constructed by the compliance obligation, and the supply is set by regulators, it is important for the design and supervision of the scheme to rest with entities that have such experience in markets.

- **PHASE II (2008–2012):** In the second phase, the EU ETS matched the Kyoto Protocol commitment. Allowances were still mostly allocated for free (~90 percent), but the cap on allowances was reduced to 2,049 $MtCO_2e$ to prevent another surplus. Despite the cap adjustment, the 2008 economic crisis led to a larger reduction in emissions than anticipated, resulting in a surplus of allowances and a corresponding drop in allowance prices ($\$30/tCO_2e$ in 2008 to $\$8/tCO_2e$ in 2012).

The economic environment can change from when an ETS cap for a compliance period is set to the actual compliance period. **An ETS can adopt mechanisms to adjust the supply of allowances during a compliance period without altering the predetermined cap**. Otherwise, a surplus of allowances can drive down prices and disincentivize emissions reduction.

A similar lesson can be gleaned from other ETS initiatives. For example, due to the economic downturn in 2008, the RGGI ETS also experienced a misalignment between the cap set for the first compliance period and actual emissions. Both the RGGI and California ETS implemented a price collar (i.e., a price floor and ceiling) to protect against unanticipated price volatility.

An additional learning from the experience of the EU ETS is the importance of cybersecurity provisions in the ETS infrastructure. In the first phases of the ETS, the different member countries of the EU established individual registries, resulting in non-harmonized registries across the EU. Consequently, cybersecurity and account creation processes were weaker in some registries as a result. This enabled cybercriminals to steal EU allowances from some entities' accounts and resell them to others in early 2011.[59] An additional issue stemmed from the lack of a comprehensive legal framework underpinning the market, as regulators were unable to establish certainty of ownership between the entities involved in the

allowance theft. For example, the lack of a legal framework made it difficult to determine whether the stolen allowances should be returned to the entities from which they were originally stolen, or the entities which had unknowingly purchased them from the cybercriminals. Since then, the EU ETS has moved toward a common Union Registry with more robust cybersecurity features.

For cross-border or cross-state systems, **a common registry built on a single technology platform with consistent data and rigorous cybersecurity is important**.

A comprehensive legal framework that underpins the compliance system can support confidence and participation in the market.

- **PHASE III (2013–2020):** The EU launched phase III with several policy changes to further strengthen the market.
    - The allowance cap for stationary installations was set at 2,084 $MtCO_2e$ in 2013, with a plan to decrease annually by a linear reduction factor (LRF) of 1.74 percent (of 2008–2012 baseline emissions, or ~38.3 $MtCO_2e$ annual decrease).
    - The share of auctioned allowances (versus free allocation) was increased to 57 percent (incl. full auctioning for power; free allocation for heating and industry).
    - In October 2014, the European Commission adopted a legislative proposal, MiFID II,[133] that expanded the scope to cover EUAs, which this inclusion classified as financial instruments.[134]
    - As of January 2018, emissions allowances were classified as financial instruments, whereas previously only derivative contracts of allowances were in the scope of financial market rules.
    - In 2015, as a short-term measure to address the allowance surplus, the auctioning of 900 million allowances was postponed (back-loaded) to 2019–2020.
    - In 2019, the MSR began operating as a longer-term solution to balance allowance supply and demand. The allowances postponed from auction in 2015 were transferred to the reserve.

[133] The MiFID II is a legislative framework that regulates financial markets and increases security for investors.
[134] https://www.edf.org/sites/default/files/eu-case-study-may2015.pdf.

- As a result of these adjustments, allowance prices on the EU ETS increased (from ~\$5/tCO_2e in 2013 to ~\$28/tCO_2e in 2020) and emissions dropped from over 2 billion tCO_2e to below 1.5 billion tCO_2e (see Figure 41).

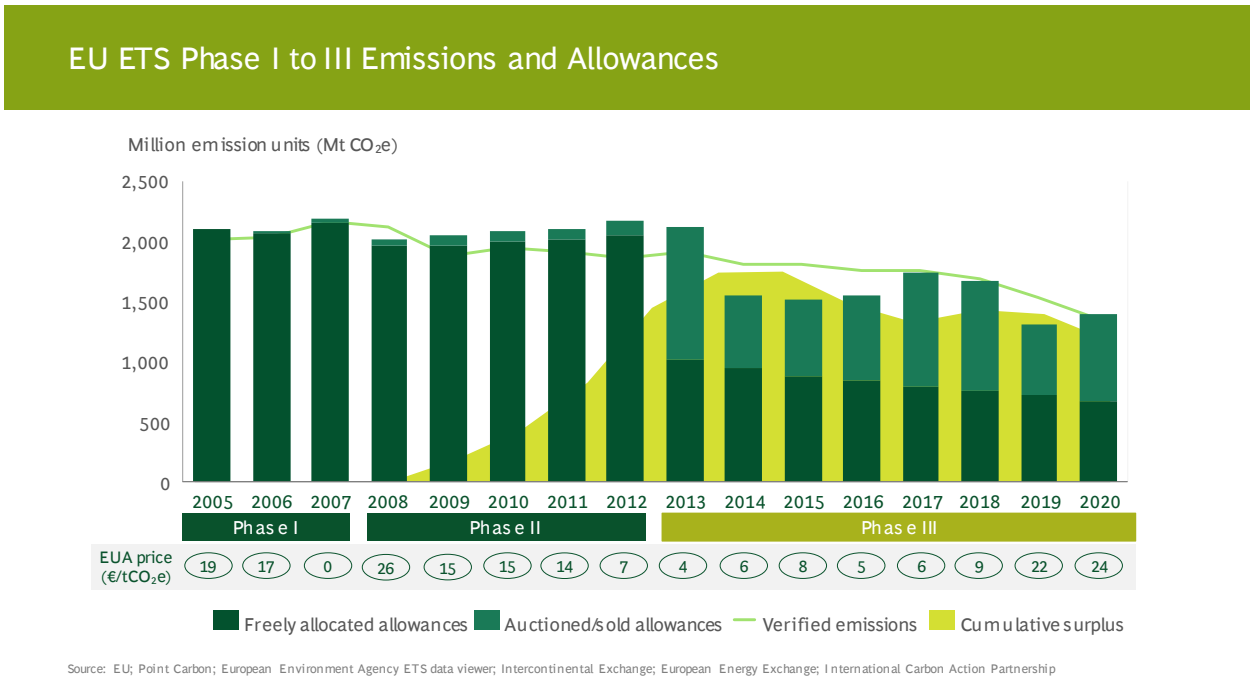


Figure 41: EU ETS Phase I to III emissions and allowance levels

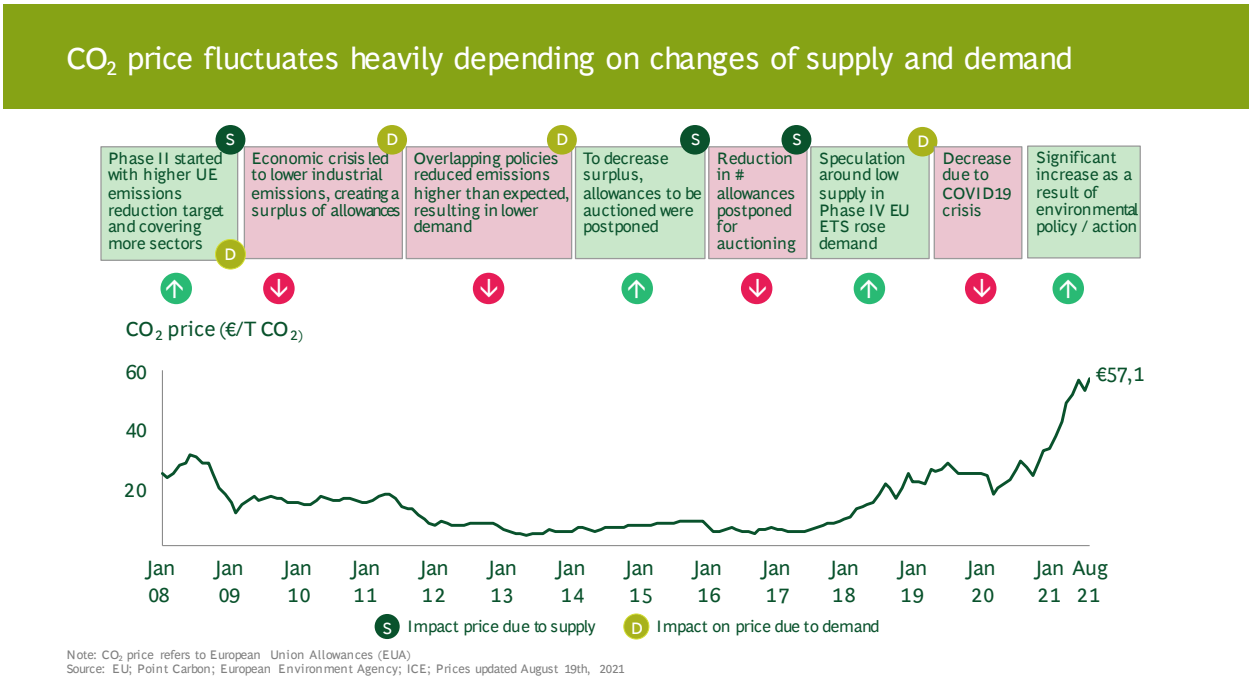


Figure 42: EU ETS price on carbon, 2008–2021

Classifying allowances as financial instruments can help safeguard carbon markets from market abuse and other types of market misconduct. Extending the scope of the MiFID to include EUAs introduces greater security for traders of EUAs and improves the integrity of the market without interfering with the market purpose of reducing emissions.[135]

Transitioning allowance allocation to an auction system (versus being freely allocated) is critical to financially incentivize increased emissions reduction and raise revenue for the government that can be channeled into green investments. The share of allowances allocated via this auction system should increase to 100 percent as quickly as possible in order to maximize this incentive and drive emissions reduction in line with the Paris Agreement ambitions.

[135] https://ec.europa.eu/commission/presscorner/detail/en/MEMO_14_305.

A similar lesson can be gleaned from auctioning that took place in the California and RGGI ETSs; since the programs started, they have generated revenue of over $14 billion and $3.8 billion, respectively.

Implementing an MSR can help proactively address surpluses (and shortages) of auctioned allowances and maintain a strong/stable allowance price while mitigating volatility. In 2019, the MSR helped ensure a year-on-year total emissions reduction of 9 percent under the EU ETS. The establishment of an MSR also prevented the market from flooding in 2019–2020 with the 900 million back-loaded allowances.

- In 2020, Switzerland and the EU linked their markets, which resulted in the mutual recognition of EU and Swiss emission allowances when surrendering allowances.

Where feasible with similar ambition levels, ETS initiatives can consider interoperability with other compatible systems to realize several benefits, including increased market liquidity and carbon price stability.[136]

In 2014, the California and Québec systems linked (and have remained successfully linked) to reduce compliance costs and increase the size of the market for compliance instruments.

- **PHASE IV (2021–2030):** Phase IV is set to run from 2021 to 2030 and will implement several additional changes to ensure market stability and achieve climate objectives.
    - As of September 2021, the EUA is trading above EUR 60.
    - A more ambitious cap for stationary installations is set for 2021 at 1,572 $MtCO_2e$. Emissions for intra-EEA (European Economic Area) aviation are capped at 38 $MtCO_2$ for 2021.
    - To increase the pace of emissions reduction, the LRF for allowance cap will rise to 2.2 percent per year (~43 $MtCO_2$ for both stationary sources and the aviation sector).
    - From 2019 to 2023, the number of allowances transferred to the MSR will be doubled (to 24 percent of the allowances in circulation) to sufficiently reduce surpluses and improve the system's resilience to shocks.

[136] https://ec.europa.eu/clima/policies/ets/markets_en.

- Auctioning will be the default method for allocating emission allowances. Free allocation for less-exposed sectors will be phased out after 2026 from a maximum of 30 percent to 0 by 2030.[137]
- The stringency of carbon leakage regulations will be increased by cutting down the list of sectors that receive free allowances. Only sectors at the highest risk of relocating their products outside of the EU will receive free allocation of allowances.
- Dedicated funding mechanisms—the Innovation Fund and Modernization Fund—will help alleviate the innovation and investment challenges of the low-carbon transition for industry and power sectors.[138]

- PHASE IV ("Fit for 55" addendum): In July 2021, the European Commission updated its 2030 GHG emissions reduction target to at least 55 percent below 1990 levels, hoping to ensure carbon neutrality is achieved by 2050. A series of legislative proposals ("Fit for 55") was adopted to revise several EU climate combat initiatives, including the EU ETS. As a result of this advanced ambition level, the EU plans to adjust the projected Phase IV ETS caps. For example, the proposals suggest implementing a one-off reduction to the cap as well as an increased LRF of 4.2 percent. The EU also plans to expand the ETS scope to cover the maritime sector from 2023 onwards as well as develop a new ETS for buildings and transport. The package is still under negotiations and will likely go into effect around the end of 2022.

The ambition level of an ETS should be assessed periodically and adjusted, when necessary, to ensure alignment with Paris Agreement goals. To increase the ambition of an ETS, the pace of cap reductions can be increased, the number of freely allocated allowances can be decreased, and the market scope can be expanded to cover new sectors/regions in addition to other methods.

[137] https://ec.europa.eu/clima/policies/ets/revision_en.
[138] The Innovation Fund will provide about EUR 20 billion of support over 2020–2030 for the demonstration of innovative low-carbon technologies to help guide the market toward industrial solutions to decarbonization. The Modernization Fund will support ten lower-income EU member states in their pathway to climate neutrality by aiding in the modernization of their energy systems.

4 Details on carbon border adjustment mechanisms (CBAMs)

As jurisdictions implement ETSs, impose emissions allowances, and establish carbon pricing for their covered entities, **there arises a risk of carbon leakage, or the shifting of high-emission production activities out of the ETS jurisdiction to areas with a lower cost of carbon or less-stringent regulations around emissions.**[139] Until a global carbon price is achieved, current ETSs may consider interim mechanisms to ensure a level playing field, avoid the relocation of industries away from jurisdictions with carbon pricing, and prevent the increase in imports from jurisdictions with less-stringent emissions policies. **This may take the form of a CBAM—a system of tariffs, taxes, and rebates on imports and exports to compensate for differences in carbon pricing across jurisdictions, prevent leakage, and provide for equitable international trade that protects the competitiveness of industries covered by ETSs. CBAMs should have provisions to ensure that developing countries with different carbon transition pathways will not be unduly burdened.**

Leakage may occur via three different channels:

1. Output channel (short term): In the absence of CBAMs, ETS allowances contribute to higher costs for domestic producers, resulting in unconstrained foreign competitors gaining market share by increasing their production volumes at lower costs and offering lower market prices.
2. Investment channel (long term): Investment shifts from domestic to offshore due to lower expected returns in areas with ETSs.
3. Energy market channel: Reduced demand for fossil fuels within ETSs depresses global energy prices, leading to greater use of fossil fuels in regions with lower or no carbon constraints.

This risk stems from the regional nature of ETSs currently, which results in an uneven application of carbon pricing. Extensive ex ante studies have been conducted to estimate and quantify the risk of leakage, as well as several ex post studies to identify the actual amounts of leakage occurring because of different carbon pricing across ETSs and regions without carbon policies. Across various ex ante studies for different sectors, regions, and time periods, **leakage rates from carbon price differentials are predicted to range between 0 and 33 percent.**[140] For example, a 2015 study from the National Technical University of Athens estimated annual leakage rates from 2015 to 2050 of up to 28 percent from the EU, U.S., and China based on estimated carbon prices in those regions.[141] A

[139] IEA, "Implementing Effective Emissions Trading Schemes: Lessons from International Experiences."
[140] ICAP, "Future-proofing Carbon Leakage Protection."
[141] Partnership for Market Readiness, "Carbon Leakage: Theory, Evidence and Policy Design," 2015.

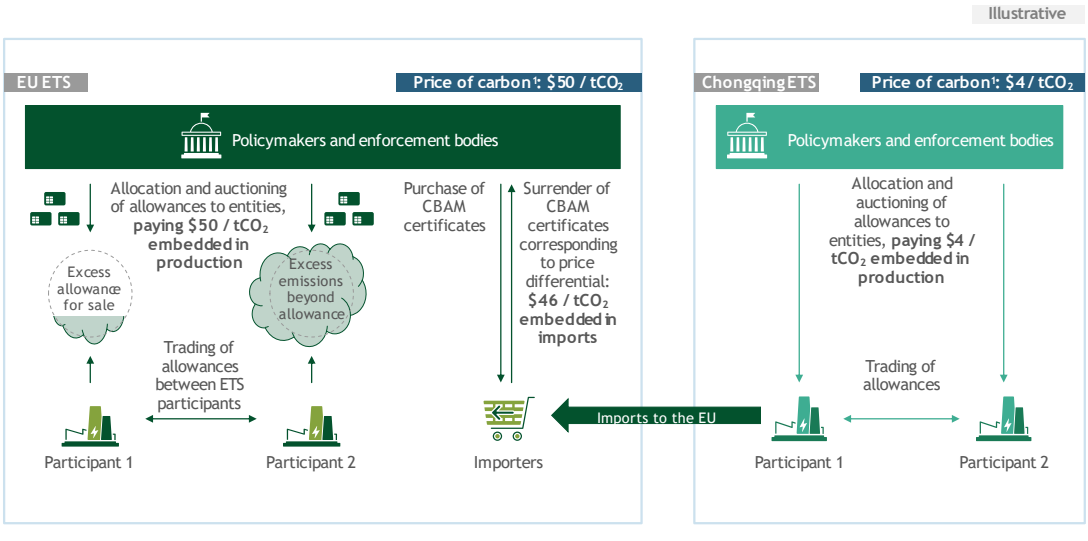
similar study from 2009 projected leakage rates between 2013 to 2020 of up to 39 percent from the EU to the rest of the world in high-emissions industries such as cement, steel, and aluminum.[74] Ex post studies have yet to find specific empirical evidence of leakage, which is likely due to the long lead times for industry relocations versus the short-term time scope of the studies, the existing protections against leakage provided by systems in the form of free allocation or exemptions, and the impact of non-carbon-price factors such as tax rates, wages, and labor supply.

Several organizations such as ICAP are **advocates of mechanisms that reduce the risk of carbon leakage**. For example, recommends CBAMs and consumption charges for carbon-intensive goods. But, **the ideal mechanism to prevent leakage of emissions is a globally consistent price for carbon,** according to ICAP. The equitable application of global carbon pricing across all jurisdictions would eliminate the risk of leakage and prevent opportunities for price arbitrage between ETS jurisdictions.

Current state of CBAMs

Several ETSs have begun implementing CBAMs—or expressing serious interest in doing so.

Illustrative EU CBAM mechanism



Source: World Bank carbon compliance markets price data, as of April 2021

In July 2021, as part of the European Green Deal and the EU's "Fit for 55" legislation package, the European Commission announced a CBAM to prevent leakage and reduce the risk of the EU's own climate objectives being undermined by relocation of production and industry to other countries.[142] In practice, the CBAM will function through the purchasing of certificates by importers that will correspond to embedded emissions within the goods being imported into the EU. The price of CBAM certificates will mirror the price of carbon within the EU ETS. For goods imported from jurisdictions with a lower carbon price or jurisdictions without an ETS, the importers will surrender a portion of their purchased CBAM certificates to ensure the price of the carbon embedded in the imported goods equals the total carbon fee that would have been paid had those goods been produced under the jurisdiction of the EU ETS. In its initial stages, the EU CBAM will apply to five select categories of imports—cement, iron and steel, aluminum, fertilizers, and electricity—due to the high risk of carbon leakage and high emissions from those sectors. All goods in those categories imported from non-EU countries will fall under the scope of the CBAM, with the exception of countries with an ETS linked to the EU ETS, such as Switzerland.

The California Cap-and-Trade Program is the other large ETS with a CBAM, although the California mechanism is less extensive in scope than the new EU CBAM. Under California's CBAM, first deliverers of electricity into California are subject to a border adjustment to compensate for the emissions stemming from the generation of the imported electricity. This adjustment applies to all first deliverers of electricity in states outside California, unless they are in a jurisdiction with an ETS linked to California's ETS.[143]

In addition to the EU and California, several other systems, including those in Canada and Japan, are considering similar border adjustment mechanisms for implementation.[144] The United States is also exploring imposing border adjustment taxes on imports from countries that do not meet its climate objectives.[35] In parallel, the introduction of a CBAM in the EU has spurred announcements from other countries, such as Ukraine and Turkey, that they intend to align the policies of their forthcoming ETSs to the EU ETS's new requirements, thus creating a positive influence on the carbon policies of other countries.

---

[142] European Commission, "Carbon Border Adjustment Mechanism: Questions and Answers."
[143] California Resources Board, "Article 5: California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms."
[144] European Commission, "Carbon Border Adjustment Mechanism: Questions and Answers."

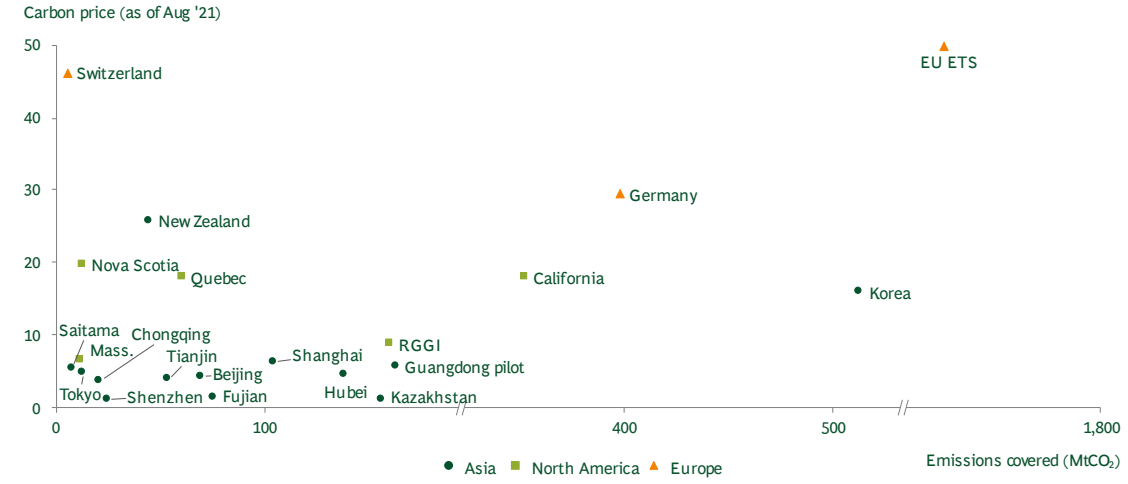
Taxes or fee adjustments on imports are the primary form of existing CBAMs. However, some jurisdictions are also considering introducing rebates on exports of products to regions with less-stringent carbon pricing in order to protect domestic producers. For example, the United States' proposed Energy Innovation and Carbon Dividend Act (H.R.2307) includes a provision for credits or refunds to exporters for the "total carbon fees accumulated upon the greenhouse gas content of the exported carbon-intensive product" for goods produced within the U.S. and exported to regions with less-stringent carbon policies. The Act also specifies the adjustment as including a harmonization of the "border carbon fee adjustment with the domestic carbon fee" to enable the adjustment to work in conjunction with domestic carbon pricing policies.[145] Such adjustments to the CBAM are meant to level the playing field and protect the competitiveness of corporates subject to carbon pricing within their jurisdiction, compared with corporates not subject to such systems in other regions. In incorporating these adjustments, however, policymakers should monitor for unintended consequences—such as significant increases in the exports of carbon-intensive products to less-developed countries with lower carbon pricing—and make adjustments as necessary to avoid those outcomes.

Relevance of CBAMs to carbon markets

The absence of a CBAM poses a risk to the scaling of compliance markets due to the uneven application of carbon prices among the various ETSs today. Without a border adjustment mechanism to compensate for price differences based on different transition pathways, the integrity of ETS markets will be challenged. Covered entities will have the opportunity to engage in price arbitration for different products and services by shifting their production to jurisdictions with less-stringent compliance policies, thus rendering the intended decarbonization effects of ETS allowances moot. The integrity of ETS markets depends on their allowances resulting in decarbonization, which will not occur if entities are able to shift production without financial consequence.

[145] H.R.2307—Energy Innovation and Carbon Dividend Act of 2021.

Price dispersion across ETS systems



Source: World Bank carbon compliance markets price data, as of August 2021

Sidebar: illustration of potential carbon leakage between compliance markets

Opportunities for carbon leakage occur when compliance markets have different pricing and sectoral coverage. For example, if one ETS imposes a price of $50 per tCO_2 on glass producers as opposed to another which imposes a price of $6/tCO_2$, the effective price differential provides a potential opportunity for glass producers to shift their production and associated emissions to the region where they would not be subject to carbon pricing. For buyers of glass products, there is also an opportunity to source materials from glass producers in this region, which may be able to offer lower pricing due a lower carbon price level. A CBAM is meant to prevent cases of carbon leakage and loss of competitiveness for industries covered by the adjustment mechanism. Although glass is not one of the five sectors that will be covered by the first version of the EU CBAM, Glass Alliance Europe—a group of 13 European glass associations—has commented that "it is positive that the European Union is considering options to encourage global efforts [in the fight against climate change]."[146]

Declining competitiveness of domestic corporates and industries in the global economy as a result of ETSs is another risk CBAMs may protect against. As a result of the jurisdictional nature of ETSs

[146] Glass Alliance Europe position paper, "The European glass sector's views on a Carbon Border Adjustment Mechanism (CBAM)."

and the uneven price of carbon across ETSs and regions without carbon pricing, the competitiveness of covered entities within an ETS may decline relative to corporates in regions with less-stringent carbon policies, or a lack of pricing altogether.[140] Loss of competitiveness may also be associated with leakage, as covered entities relocate to regions where they will be more competitive due to lower carbon pricing. The European Commission's impact assessment of the EU CBAM predicts that the CBAM will have a positive impact on the competitiveness of the EU sectors covered by the CBAM. More generally, CBAMs are a method to protect the competitiveness of industries in compliance markets and compensate for differences in carbon prices that factor into domestic producers' costs and pricing and thereby affect their competitiveness in the global economy.

Additionally, the lack of a CBAM and the associated risk of leakage may place downward pressure on allowance pricing within the ETSs. If covered entities are able to shift production and emissions outside their ETS jurisdiction, demand for allowances within the ETS jurisdiction will decline and the price of allowances may decrease. Although this effect may be balanced by the use of adjustment mechanisms such as the MSR in the EU ETS, the risk of price movements will be difficult to fully eliminate. This would effectively prevent the full cost of the externality from being captured, and thus further underscores the importance of a mechanism to prevent leakage outside of ETS jurisdictions.

Details on specific mechanisms at play—EU case study

When designing the EU CBAM, the European Commission conducted an impact assessment to model the anticipated carbon leakage in sectors covered by the CBAM across different policy options under consideration. The Commission evaluated six different CBAM policy options (bolded portions reflect changes from one option to the next):

1. An import tax on specific basic materials based on the average carbon intensity in the EU for various products, in conjunction with full auctioning of allowances in the EU ETS for the sectors covered under the CBAM
2. Import certificates for specific basic materials, with importers purchasing and surrendering CBAM certificates based on the average carbon intensity of the imported products in the EU, in conjunction with full auctioning of allowances in the EU ETS for the sectors covered under the CBAM
3. Import certificates for specific basic materials, with importers purchasing and surrendering CBAM certificates based on the actual carbon intensity of the imported products, in

conjunction with full auctioning of allowances in the EU ETS for the sectors covered under the CBAM

4. Import certificates for specific basic materials, with importers purchasing and surrendering CBAM certificates based on the actual carbon intensity of the imported products, **in conjunction with a phase-out of free allocation of ETS allowances from 2025–2035** for the sectors covered under the CBAM
5. Import certificates for specific basic materials **and finished products**, with importers purchasing and surrendering CBAM certificates based on the actual carbon intensity of the imported products, **in conjunction with full auctioning of allowances in the EU ETS** for the sectors covered under the CBAM
6. Import certificates for specific basic materials and finished products, with importers purchasing and surrendering CBAM certificates based on the actual carbon intensity of the imported products, **in conjunction with free allocation of allowances in the EU ETS** for the sectors covered under the CBAM

In the Commission's impact assessment, **all six policy options were predicted to result in lower levels of emissions in the EU in 2030** ranging from 13 to 16 percent of the projected 2030 baseline level of emissions. However, there were marked differences in the impact each policy option had on leakage levels, which depended on the change in emissions in both the EU and the rest of the world. Options 1, 2, and 6 were associated with leakage, **while options 3, 4, and 5 were estimated to not only prevent leakage of emissions from the EU, but to also result in ceteris paribus reductions in emissions in the rest of the world**. The emissions reductions outside the EU in options 3, 4, and 5 were driven by the use of actual carbon intensity for imports (vs. average carbon intensity in the EU in options 1 and 2), as actual emissions tend to be higher than the EU average, resulting in significantly greater adjustments for imports in those scenarios. The **recommendation of the impact assessment was to implement option 4** "for its positive impacts [on reducing emissions and leakage] and its coherence with the rest of the Fit for 55 package."[147]

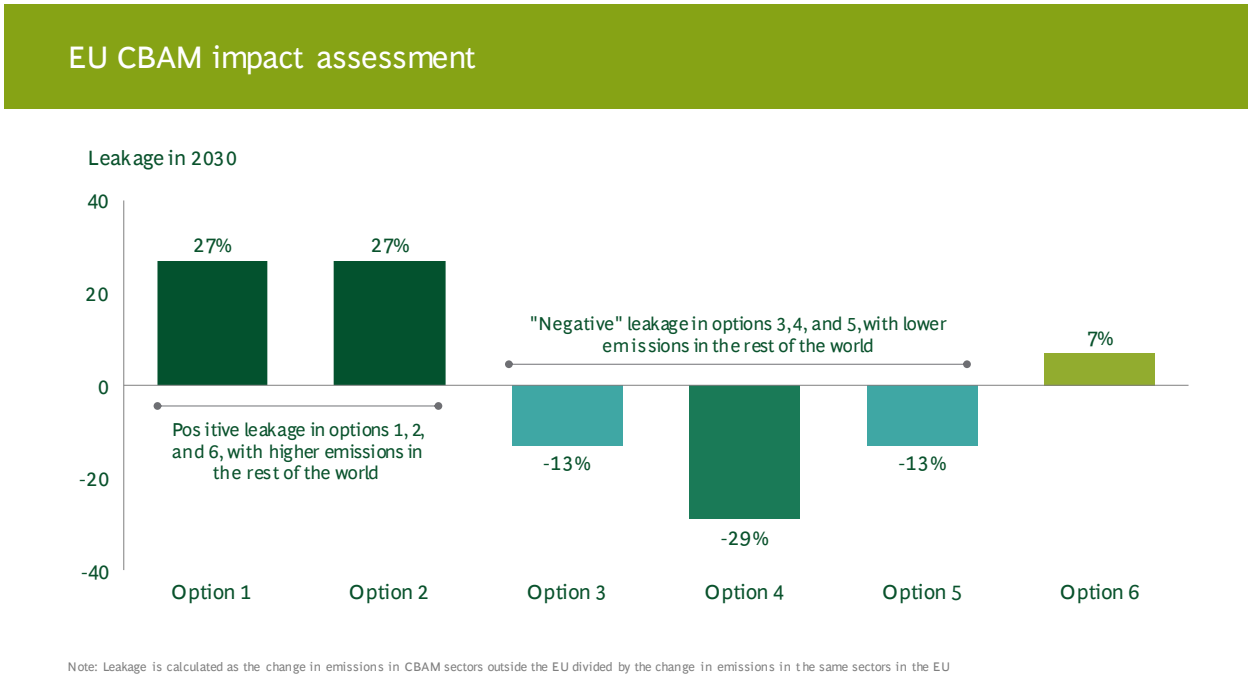


Figure 45: EU CBAM impact assessment

The ongoing debate on CBAMs

[147] European Commission, "Proposal for a regulation of the European Parliament and of the Council establishing a carbon border adjustment mechanism."

CBAMs are gaining more acceptance among organizations and bodies relevant to carbon markets. The World Bank has recognized the spillover effects CBAMs can have on trading partners of jurisdictions with such mechanisms, acknowledging that CBAMs "could also speed-up or strengthen the introduction of carbon pricing and other climate policies in their countries in particular if other major players, such as the United States, move ahead with carbon border adjustments."[35] The Climate Leadership Council has also included a CBAM with both import taxes and export rebates as one of its Carbon Dividend Plan's Four Pillars.[148] ICAP acknowledges the additional political and administrative challenges that would likely accompany implementing a CBAM, but also recognizes the additional abatement opportunities that may arise ICAP provides a short list of guiding principles for jurisdictions considering implementing a CBAM.[140]

At the same time, opponents of CBAMs continue to point out the drawbacks and risks that must be considered when designing and implementing a CBAM. CBAMs are complex to implement, particularly when considering the breadth of sectors and regions that may have differing transition pathways. Transition pathways are based on inherent differences across regions and account for factors such as geography, industrial mix, level of technological maturity, and, potentially, industry-specific solutions. In the same manner, CBAM implementation plans can account for these differences, and incorporate adjustments for specific sectors or regions in order to avoid international trade issues.

Another consideration for jurisdictions is the potential misuse of the mechanism to enable trade conflicts. ICAP recognizes the risk of trade distortions throughout the value chain as a result of CBAMs, and points to the trade conflict between the U.S. and China as a result of the steel and aluminum tariffs as an outcome to be avoided in implementing adjustment mechanisms. Methods to prevent trade distortions include setting no quantitative limit on CBAM instruments and ensuring CBAM prices reflect ETS prices so that the size of price adjustments is accurate.

Additionally, several groups, including the European Commission, ICAP, and the UN, have recognized the potential negative impact CBAMs may have on developing countries relative to more developed countries. As part of an assessment on the EU's CBAM, the United Nations Conference

[148] https://clcouncil.org/our-plan/.

on Trade and Development modeled that the EU CBAM would result in declines in exports from developing countries in favor of exports from developed countries, as the latter's production processes tend to be less carbon-intensive, and so potential CBAMs would impose less of a burden on imports from developed countries.[149] ICAP cites the risk of accusations of "green protectionism" from CBAM opponents, or the attempt to limit imports from developing economies under the guise of environmental concern.[140] Policymakers considering CBAMs may wish to consider region-specific transition pathways in their designs.

[149] United Nations Conference on Trade and Development, "A European Union's Carbon Border Adjustment Mechanism: Implications for developing countries."

5 Use of Market Stability Mechanisms in ETSs

An ETS sets a fixed cap on market supply, which can increase the potential of price volatility in the face of unanticipated changes in supply or demand. Price fluctuations are typical under an ETS, but unexpected external shocks can greatly impact demand and generate large price fluctuations that disrupt the market. For example, the COVID-19 pandemic led to a decrease in economic activity and a resulting drop in emissions, thereby lessening the demand for ETS allowances. Low prices can disincentivize emissions reduction while excessively high prices or volatility could create challenges for market participants.[150]

To promote a well-functioning market, policymakers can adopt market stability mechanisms (MSMs)[151] also known as price and supply adjustment mechanisms (PSAMs).[152] These mechanisms can help stabilize and provide greater transparency on the ETS market price.

MSMs can be either price-based or quantity-based. The rules for an MSM (e.g., the number of allowances to be withheld from the market or the price level that will trigger the MSM) are typically defined before the start of a compliance period. These adjust the number of allowances to be allocated via auction at the beginning of the upcoming compliance period. In some cases, the number of allowances may also be adjusted during a compliance period (outside of an auction).

Price-based mechanisms

Price floors prevent allowances from being available below a defined price level. There can be soft price floors (number of allowances allocated is adjusted at auction) and hard price floors (number of allowances allocated is adjusted throughout a compliance period).

A soft price floor (auction reserve price, ARP) sets a minimum price that allowances can be sold at during auctions. Bids lower than the defined reserve price are not accepted and unsold allowances may be withheld from the market. However, prices in the secondary market can still fall below this minimum price. Any withheld allowances may be transferred to future auctions, placed in a reserve,

[150] ICAP, Market Stability Mechanisms in Emissions Trading Systems, February 2020.
[151] As termed by the International Carbon Action Partnership.
[152] As termed by World Bank.

or retired, which can ultimately lead to a greater reduction of emissions compared with the initial cap. Soft price floors are the most common mechanism mainly because they are easy to implement through auctioning. However, if only a small portion of allowances is allocated via auctioning, implementing a reserve price may have less of an impact.[153] Soft price floors have been adopted by several ETSs, including RGGI, California, Québec, Nova Scotia, Massachusetts, and Korea.[150] For example, in 2012, California set an ARP wherein bids below $10 (increasing at 5 percent per annum plus inflation) are not accepted, and unsold allowances are reoffered via auction if two consecutive auctions lead to settlement prices above the ARP.

A hard price floor keeps prices in the entire market from above a lower price level. If prices drop below the defined level, triggering the hard price floor, the government can intervene and buy back a portion of allowances (reducing the allowable number of emissions for the period) until the price is restored to a value above the floor price. A hard price floor provides greater certainty that the market will stay above the defined level, but the mechanism is generally avoided because of the fiscal implication for the government when buying back allowances. As a result, there are currently no examples of a true hard price floor in play, yet.[150]

If the aim of the price floor is to ensure a minimum level of emissions reduction and lower risks for low carbon investments, it is best practice to set price floors while considering the low carbon technology costs and desired efficient emissions reduction pathway. Policymakers can consider these areas by (1) assessing the fuel mix and price level that would enable the most carbon intensive fuels to no longer be competitive in wholesale markets, or (2) quantitatively assessing efficient price trajectories for a desired reduction target through intertemporal energy system optimization models.[150]

An emissions containment reserve (ECR) which tightens an ETS market cap by withholding a fixed number of allowances during an auction when prices fall below a defined trigger price, can be adopted along with price floors and can also help counteract low prices in the market. Trigger prices can be set using the same considerations as price floors, while the number of allowances to be withheld can be defined by considering allowance quantity provided by other MSMs (e.g., a separate

[153] Partnership for market readiness, ICAP, and the World Bank, "Emissions trading in practice: A handbook on design and implementation (2nd edition)," 2021.

reserve) as well as previous cap adjustments in the system.[150] In 2021, RGGI implemented the first ECR. Ten percent of the ETS's cap will be withheld and moved to the ECR at the start.

Priced-based mechanisms can also be implemented to address high prices. There are two main types: cost containment reserves and hard price ceilings. When a trigger price is surpassed, a **cost containment reserve** (CCR) (which can act as a soft price ceiling) offers a fixed amount of allowances at tier prices through additional auctions or an increase in auctioned allowances. CCRs are composed of allowances that were withheld from distribution or listed for auction but remained unsold, so eventually releasing them from the reserve during the compliance period does not increase the initial market cap for that period.[153] Similar to ECRs, **CCR tiers do not bound allowance prices, so prices can continue to rise once the fixed number of allowances available in the CCR have been auctioned out.** The California ETS adopted a three-tiered CCR (or allowance price containment reserve, APCR) from 2013 to 2020 wherein a share of allowances from the cap is withheld in the reserve annually. The tiers were set at $40, $45, and $50 in 2013 and increased by 5 percent plus inflation per year to 2020. If the quarterly auction leads to a price above 60 percent of the lowest tier price, allowances will be offered from the reserve.[150]

A **hard price ceiling**, on the other hand, sets an absolute limit on the price paid for an allowance. To achieve this, if the market price rises above the price ceiling, an unlimited number of allowances will be offered to regulated entities at the price ceiling value until the price drops back to below the ceiling value. **Hard price ceilings allow the number of allowances allocated to exceed the ETS market cap and could, therefore, be less desirable for driving emissions reduction.** Amendments to the California's ETS in 2018 established a hard price ceiling at $65 per allowance as a backup mechanism for two APCR tiers at ~$41 and ~$53. Hard price ceilings are set based on political and economic considerations. In general, ceilings are set at a price that balances instilling confidence that the ETS will not cause extreme economic burden without constraining low carbon technology investments.[150]

Quantity-based mechanisms

A quantity-based mechanism does not set triggers based on a desired price range. Instead, the mechanism proactively adjusts the number of auctioned allowances based on the number of allowances circulating in the market, creating a flexible supply of allowances. However, this creates less certainty in future price levels. An MSR adjusts the number of allowances to be released at the next auction if the market supply is outside a predefined range before the auction. The EU MSR is

an example of this mechanism in action. In the EU, 12 percent (24 percent from 2019–2023) of the total number of allowances in circulation (TNAC) are withheld from auction and added to the reserve if the TNAC is greater than 833 million. Alternatively, 100 million allowances are released from the reserve if the TNAC is less than 400 million. The TNAC is calculated as the cumulative supply of allowances since January 2008 subtracted by both the cumulative number of allowances surrendered or cancelled by regulated entities since January 2008 (i.e., demand) and the number of allowances in the MSR. This TNAC is calculated and published in May each year to dictate the number of allowances that will be added or released from the reserve in the following year. As of 2023, allowances in the MSR that exceed the previous year's number of auctioned allowances will be retired.[154]

The trigger quantities (i.e., TNACs) for an MSR will depend on the surplus required for the specific market to function effectively. In the case of the EU ETS, the trigger quantities are based on the hedging requirements of firms operating under the ETS—termed the "hedging corridor"—and the banking demand of non-power entities.[150,155] In terms of the EU withdrawal and release rates, 12 percent was chosen so that monthly auctions were each adjusted by 1 percent, allowing for a gradual adjustment of allowances. Models designed by the European Commission verified that this rate was suitable for guaranteeing quick adjustments to shocks without a risk of overshooting.[156]

The goal of an ETS is to drive cost-effective emissions reduction. When adopting an MSM, it is important to balance the potential need for intervention to stabilize price with the potential that intervention in the market may interfere with the market-driven nature of an ETS and its aim of cost-efficiency. The aim of achieving cost-efficient abatement across the market may be challenged by unexpected impacts from intervention (e.g., creating too narrow or broad of a range, allowing for too low or high price swings). Moreover, intervention can generate uncertainty among market participants regarding any future policy developments. **If adopted effectively (e.g., with transparency about future intervention and a long-term horizon), this uncertainty can be mitigated and ETSs can function efficiently and effectively.**[150]

---

[154] https://ec.europa.eu/clima/sites/clima/files/ets/reform/docs/c_2021_3266_en.pdf.
[155] Salant, S. (2015). What Ails the European Union's Emissions Trading System? Discussion Paper RFF DP 15-30, Resources for the Future, Washington, DC.
[156] European Commission (EC) (2014). Impact Assessment: Commission Staff Working Document. Brussels, Belgium.

6 Details on Agriculture, Forestry, and Other Land Use (AFOLU) coverage

An important use for the VCM could be to contribute to and finance the decarbonization of sectors that have a significant proportion of small businesses such as AFOLU. These sectors are estimated to contribute 12 $GtCO_2e$ annually, or nearly a quarter of global annual GHG emissions, yet are not currently included in carbon pricing schemes in a wide-scale manner.[157]

For the agricultural sector (6.2 $GtCO_2e$, or ~13 percent of global annual emissions), the VCM serves as a potential natural platform for decarbonization. Due to the non-corporate nature of many farmers and farmland-owners, coverage of agriculture under ETSs is difficult. Likewise, in many countries the farming sector has political influence because of its size and output, and control-based mechanisms such as mandates to use certain technologies or processes may be difficult to implement.

Some agricultural activities already generate VCM credits today, such as livestock methane management and rice cultivation projects. **However, this could present an opportunity to expand the scope of voluntary credit-generating projects to a broader range of activities, such as the use of regenerative farming techniques to sequester carbon.** Although regenerative farming techniques can be more costly for farmers and agricultural companies to implement in the short term, they may be able to generate high-quality, additional VCM credits from sequestering carbon. By serving as the exchange for these credits, the VCM can help finance the decarbonization of the agricultural sector. Organizations such as the U.S. Department of Agriculture and the Environmental Defense Fund have recognized the potential for agricultural conservation to be a source of carbon credits for use in the VCM and some compliance markets.[158,159]

For forestry and other land use (5.8 Gt CO_2e, or ~12 percent of global annual emissions), the appropriate action to incentivize decarbonization depends on a range of factors, including the owner of the forest or land. In the United States, for example, the majority (~60–70 percent) of forest land

[157] IPCC, Special Report on Climate Change and Land, January 2020.
[158] https://www.usda.gov/oce/energy-and-environment/markets/carbon.
[159] EDF, Agricultural Soil Carbon Credits: Making sense of protocols for carbon sequestration and net greenhouse gas removals, July 2021.

is held by the private sector. Of this portion, ~10-20 percent is owned by private corporates, and ~50–60 percent is owned by private non-corporates. The balance is in the hands of the government at the federal, state, and local levels.[160]

Imposing a carbon price through an ETS scheme may be feasible for forests owned by private corporates. The New Zealand ETS currently includes owners of pre-1990 forest land as covered entities and imposes a compliance obligation on them for engaging in deforestation activities. The same type of coverage may not be feasible in all ETSs; however, for corporates that own forest land (such as for lumber supply), there is potential to explore expanding ETS coverage to penalize deforestation by those entities. For forests held by the public sector (e.g., national forestland), control-based mandates may be a more viable solution to preventing deforestation and ensuring sustainable growth. Such mechanisms may include designating government-owned forests as national parks and placing them under the oversight of government agencies such as the U.S. Department of the Interior. For forests owned by private non-corporates (e.g., families and trusts), the VCM is potentially a strong mechanism for encouraging preservation and credit-generating activities such as afforestation and reforestation.

Additionally, the use of the VCM to drive decarbonization in the agricultural sector and portions of the forestry and other land use sectors can facilitate a natural linkage between compliance and voluntary markets. Several ETSs already allow the use of certain credits from AFOLU activities. For example, the California ETS allows covered entities to use credits generated by forest and livestock projects. In the Fujian ETS, entities are allowed to use specific Fujian Forestry Certified Emissions Reduction Credits. In enabling this linkage, ETSs naturally facilitate greater demand for VCM credits and contribute to its scaling.

A key dependency for driving decarbonization in AFOLU sectors is the development of a consistent emissions accounting and reporting methodology. For agriculture, the GHG Protocol released its "GHG Protocol Agricultural Guidance" in 2018, which supplements the Corporate Standard and

[160] U.S. Endowment for Forestry and Communities, "Who owns America's forests?," 2017.

outlines emissions accounting methodologies for livestock, crop production, and land use change.[161] However, for the VCM to serve as the driving force of decarbonization for this sector, this methodology will need to be widely accepted and employed by farmers, agricultural companies, and others engaged in agricultural activities.

For forestry and land use, the appropriate carbon accounting is more complicated given the nature of forests as carbon sinks. The effective carbon emissions from deforestation, for example, can either be calculated as the direct emissions from cutting down forests, or as the total lifetime opportunity cost of carbon that will no longer be sequestered. In the 5.8 $GtCO_2e$ annual figure cited by IPCC, **loss of future potential carbon sequestration as a result of land use changes are not included in the calculation of emissions**. Instead, emissions from land use changes are based on changes in the stock of carbon already sequestered in a particular piece of land. Currently, no direct guidance on accounting for this lost carbon sequestration potential from deforestation has been issued by climate science bodies. The closest guidance on this topic is from the GHG Protocol's Land Use, Land Use Change, and Forestry Guidance; however, it only discusses risk of sequestration reversals in afforestation and reforestation projects, and not loss of potential from deforestation.[162]

For forestry and land use changes to be covered under ETSs, there is currently no explicit guidance on the calculation of entities' compliance obligation from deforestation. Likewise, for the VCM to drive decarbonization in this sector, there is little guidance for establishing a verifiable baseline of emissions.

Additionally, for the VCM to serve as the coverage mechanism for such sectors, certain other prerequisites are needed, such as more stringent and harmonized MRV processes that can help establish the credibility of credits. In this respect, there is a potential role for the academic community in helping develop consensus on measurement and verification processes, as well as in introducing new measurement technologies. For example, satellite imagery can be used to measure the impacts of projects by visually monitoring forest cover over time in areas with such projects.

---

[161] GHG Protocol, GHG Protocol Agricultural Guidance: Interpreting the Corporate Accounting and Reporting Standard for the agricultural sector, 2018.
[162] GHG Protocol, The Land Use, Land-Use Change, and Forestry Guidance for GHG Project Accounting, November 2006.

7 Role of carbon markets for corporates

Recently, the number of corporates establishing net-zero commitments and other climate targets has been growing globally. So far, over 1,800 corporates have committed to science-based targets for emission reduction through the SBTi. Of these, more than 900 have already adopted SBTs and over 800 have established targets that align with a 1.5°C future.

Figure 46: Corporations committing to combat climate change by reducing GHG emissions

Corporate action not only benefits global climate efforts but also promotes positive business outcomes throughout the value chain. Incorporating climate considerations, and reimagining business models with a climate perspective, has a strong potential to create both upside advantages—top-line growth, cost optimization, stronger market valuations, and benefits in terms of brand and other intangible assets—as well as downside risk protection through mitigated regulatory/environmental risks and prevention of price/share erosion.

As an example, in several sectors, there is a roughly 10–15 percent valuation premium (price-to-sales ratio) achieved by corporates in the top quintile of emissions intensity performance versus the median.[163]

The role of carbon markets for corporates

One of the important steps, as identified by leading organizations such as the SBTi, is to **develop a transition pathway** that includes the establishment of short-, medium-, and long-term targets on emissions and emissions intensity, and translating them into a set of initiatives to decarbonize within their business and value chain.

Corporates can also benefit from participation **in the carbon markets**. Specifically, existing or future compliance markets in their geographies will have an influence on their own decarbonization pace and costs. In addition, they can leverage the VCM to both compensate for their emissions and neutralize their residual emissions (through removals).

In addition, corporates can also benefit from integrating climate considerations into their enterprise risk management framework. Compliance market and carbon pricing data can help support the quantification of transition and physical risks in their risk analyses. Pricing of derivative instruments such as futures can be helpful in providing forecast views on financial impacts as well.

Corporates that are covered by compliance markets can also leverage carbon instrument derivatives such as futures, options, swaps, and forward agreements to hedge against certain aspects of transition risk and carbon price volatility, improving the quality of their financial forecasts and risk quantification.

[163] BCG analysis.

Moreover, corporates interested in voluntarily compensating for their emissions through VCM credits, or neutralizing residual emissions through removals, they can structure long-term offtake agreements and forward contracts with high-quality project developers. Doing so can allow companies to (1) hedge against future price increases, and (2) establish a long-term supply of credits that may be in short supply given the increasing demand in the market.

Furthermore, corporates that are engaged in activities that are eligible for generation of high-quality VCM credits with additionality can leverage the VCM for capital to support the development and/or implementation of new decarbonization, low-carbon, or carbon removal technologies.

8 Role of carbon markets for investors

Carbon markets can play an important role for investors and can be supported by the banking and capital markets sector.

Compliance markets can provide price signaling and direction for different sectors. This can be leveraged as a tool to prioritize engagement and analyze the expected impact on portfolios, and to help chart a pathway toward low carbon portfolios. Carbon pricing data from compliance markets can further help in analyzing transition risks associated with portfolios. Carbon market products such as futures, forwards, options, swaps, and customized solutions can also be leveraged to hedge certain aspects of transition risk such as carbon price volatility.

The VCM can also provide new sources of investment opportunities. Some of these projects require large investment upfront and can take years before they become financially viable (e.g., direct air capture projects), thereby creating financing challenges. Carbon markets can help investors identify attractive opportunities with greater demand as new investment opportunities. They can also explore innovative financial structures and products in partnership with banking and capital markets firms and other ecosystem participants.

Furthermore, high-quality VCM credits can be leveraged to compensate for (or neutralize through removals) the emission footprint of existing investment strategies and funds. Although this would not address the endogenous carbon footprint, it could be a complementary effort attractive to ESG-focused asset owners and investors.

Carbon markets also offer the opportunity to trade carbon instruments as an asset class. Global ETS markets have reached ~$170B[7] in value, with corresponding trading volume of $275B in EU, North America, China, South Korea, and New Zealand[164] in 2020.[40] There is also expected growth in the VCM with increasing demand from corporates. Both compliance and voluntary markets could provide opportunities to create innovative investment vehicles, such as ETFs that tracks carbon indices, investment funds with embedded carbon market instruments, and the like.

[164] Refinitiv, Jan 2021. Exchange rate used: EUR 1 = USD 1.2. China ETS includes only pilots.