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Role of Derivatives in Carbon Markets

Derivatives play an essential role in carbon markets. Companies subject to carbon compliance programs use carbon derivatives to meet their obligations and manage risk in the most cost-effective way. Derivatives can also be used by a variety of businesses that have financial positions indirectly tied to carbon prices. Investors can use the price signals from carbon derivatives to assess climate transition risk in their portfolios and can then access liquidity pools to manage risk and allocate capital to benefit from energy transition opportunities.

Derivatives markets also play a major role in enhancing transparency by providing forward information on carbon, which contributes to long-term sustainability objectives and provides helpful signals to policy-makers on the regulation of carbon prices.

This paper describes the role of derivatives in carbon markets and reviews exchange-traded and over-the-counter (OTC) carbon derivatives. It also provides some insights on compliance and voluntary carbon markets and explains how firms use these markets and carbon derivatives to meet their compliance obligations, achieve corporate social responsibility goals and manage risks. In addition, the paper summarizes global climate change mitigation efforts and international carbon markets.

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EXECUTIVE SUMMARY

This paper describes the role of derivatives in carbon markets and reviews exchange-traded and OTC carbon derivatives. It also provides insights on compliance and voluntary carbon markets and explains how firms use these markets and carbon derivatives to meet their compliance obligations, achieve corporate social responsibility goals and manage risks. In addition, the paper outlines global climate change mitigation efforts and international carbon markets.

Carbon markets exist as mandatory (compliance) schemes and as voluntary programs. Mandatory carbon markets, which are also referred to as cap-and-trade programs, emissions trading systems (ETSs) or allowance trading, represent a market-based approach to reducing carbon emissions. While emissions trading involves other greenhouse gases (GHGs), such as methane (CH4) and nitrous oxide (N2O), the predominant form of emissions trading encompasses carbon dioxide (CO2).

The voluntary carbon markets function outside of compliance schemes and enable companies, governments, non-profit organizations, universities, municipalities and individuals to purchase carbon credits (offsets) on a voluntary basis. The majority of voluntary credits are purchased by the private sector, where corporate social responsibility goals are typically the key drivers of credit purchases.

Derivatives play a central role in carbon markets. Companies subject to carbon compliance programs use carbon derivatives to meet their obligations and manage risk in the most cost-effective way. If emitters have concerns about volatility in the cost of allowances, they can either bank allowances or use derivatives to hedge emissions costs linked to production several years out.

Derivatives can also be used by a variety of businesses that have financial positions indirectly tied to carbon prices. For example, firms that produce emissions reduction technologies have no compliance obligations but face financial exposure from carbon price changes. Buying allowances and simultaneously selling forward, futures or options contracts allows firms to avoid exposure to carbon price risk.

In addition, derivatives markets play a major role in enhancing transparency through the provision of forward information on the underlying assets and on carbon, which contributes to long-term sustainability objectives and provides helpful signals to policy-makers on the regulation of carbon prices[1].

Investors can use price signals from carbon derivatives to assess climate transition risk in their portfolios and can then access liquidity pools to manage risk and allocate capital to benefit from energy transition opportunities.

[1] Emissions Trading and the Role of a Long-run Carbon Price Signal https://icapcarbonaction.com/en/?option=com_attach&task=download&id=491

OVERVIEW OF CARBON MARKETS

Carbon markets exist as mandatory (compliance) schemes and as voluntary programs.

ETSs, sometimes referred to as cap-and-trade programs, are market-based mechanisms intended to reduce GHG emissions. Under an ETS structure, an upper limit is set on allowable emissions and participants are given certain emissions allowances. Participants that are more effective at reducing their emissions can sell their allowances to those that have exceeded the maximum emission limit.

Compliance carbon markets are created and regulated by mandatory national, regional or international carbon reduction schemes. While most ETSs are set on a national or regional level, some programs involve international cooperation.

The voluntary carbon markets function outside of compliance schemes and enable individuals, companies or governments to purchase carbon offsets on a voluntary basis. Most voluntary credits are purchased by the private sector, where corporate social responsibility goals are typically the key drivers.

While there has been much recent scrutiny of voluntary carbon offsets, voluntary carbon markets can play an important role in global climate change mitigation efforts. As these markets function outside of compliance markets, proper monitoring and vetting is key to ensuring credibility.

It is important to distinguish between primary and secondary carbon markets. Primary markets involve the distribution of allowances to: (i) parties in compliance carbon schemes that must comply with an ETS; (ii) entities in compliance and voluntary markets that purchase carbon credits generated by emissions reduction projects. Depending on the structure of an ETS, allowances can either be allocated to polluters for free or purchased at an auction.

Secondary markets include all subsequent trading of emission allowances and offset credits. Market participants can trade both spot and derivatives contracts based on emissions allowances and offsets (in the case of derivatives, primarily through standardized contracts like futures and options).

A carbon allowance (or carbon credit) is a tradable permit or certificate that is issued by a government under an ETS. It provides the holder with the right to emit one ton of CO2 or an equivalent amount of another GHG.

A carbon offset is a certificate awarded for a proactive initiative that reduces or removes emissions. Carbon offsets can be used for voluntary carbon reduction commitments and for compliance within certain cap-and-trade programs up to a certain level.

Certified emissions reductions (CERs) are carbon offsets generated under the Clean Development Mechanism (CDM). CERs can be traded by market participants in mandatory compliance schemes to meet their emissions targets.

Verified emissions reductions are carbon offsets that are certified through a voluntary certification process and can be used in voluntary carbon markets.

Firms can buy or sell allowances and offsets for a variety of reasons, including to meet compliance needs, take positions based on expected price movements or provide liquidity. Secondary trading can be executed on exchanges or in OTC markets as spot, forward, futures and options contracts.

Exchanges provide standardized contracts, price transparency and act as a financial intermediary for the trade. An exchange also reduces counterparty risk through its clearing mechanism as it serves as the buyer for every seller and the seller for every buyer. Furthermore, contracts on an exchange provide another avenue for market makers to hedge their positions.

OTC transactions, which are executed directly between counterparties, provide greater flexibility as transactions can be customized more precisely to a company's particular risk management needs.

Key Market Players

Key players in carbon markets are compliance entities, non-compliance participants and service providers. Compliance entities have an obligation to surrender allowances, while non-compliance participants, such as banks, investment firms, energy trading firms and hedge funds, buy and sell allowances as part of their trading and investment strategies.

While most activity in compliance markets is driven by compliance buyers, non-compliance financial market players have been taking a bigger interest in the market.

Power companies represent the largest group participating in compliance carbon markets. Power generators sell a significant share of power one to four years ahead of delivery. To manage the price risk, they sign contracts for fuel and the associated allowances required for generating the power[2].

As power companies need to reduce future exposure to carbon prices, they can either hold allowances that were not used for their compliance needs or use financial contracts as part of their hedging strategies.

Energy-intensive firms, domestic airlines and hard-to-abate industrial operators that purchase allowances for future compliance also participate in this market. Along with managing their own carbon exposure, some energy producers have built significant emissions trading businesses and offer consulting services to other market participants.

Under EU rules, compliance buyers plus investment firms, credit institutions and other intermediaries (such as energy traders) authorized by the home member state are eligible to participate in EU ETS auctions[3]. Similarly, investment firms and credit institutions are eligible to bid in UK ETS auctions[4].

Non-compliance entities in compliance markets (eg, brokers) can act as intermediaries between regulated entities seeking to trade allowances. They can also provide liquidity to regulated entities (eg, as market makers or dealers). Additionally, non-compliance entities can trade on their own account, with the goal of either profiting from their trades or using those transactions to offset other financial exposures[5].

Banks play an important role in facilitating effective compliance markets. Typically, they are counterparties to utilities or industrial companies in selling forward carbon certificates. Banks then dynamically hedge their exposure with spot EU allowances (EUAs) and through auctions.

Banks alleviate any mismatch between spot supply (eg, in auctions) and forward demand (from power hedging or strategic purchases), which helps to minimize the transaction costs of ETS compliance for utilities and industrial installations[6].

[2] Banking of Surplus Emissions Allowances https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.835.7115&rep=rep1&type=pdf

[3] Commission Delegated Regulation (EU) 2019/1868 of August 28, 2019 amending Regulation (EU) No 1031/2010 to align the auctioning of allowances with the EU ETS rules for the period 2021 to 2030 and with the classification of allowances as financial instruments pursuant to Directive 2014/65/EU of the European Parliament and of the Council https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R1868&from=EN

[4] Participating in the UK ETS https://www.gov.uk/government/publications/participating-in-the-uk-ets/participating-in-the-uk-ets#auctioning-and-market-operation

[5] Commodity Futures Trading Commission (CFTC) Report on the Oversight of Existing and Prospective Carbon Markets www.cftc.gov/sites/default/files/idc/groups/public/@swaps/documents/file/dfstudy_carbon_011811.pdf

[6] ISDA Implication of the FRTB for Carbon Certificates www.isda.org/a/i6MgE/Implications-of-the-FRTB-for-Carbon-Certificates.pdf

Institutional investors, insurers and pension funds invest in carbon markets alongside other assets that are negatively correlated with carbon, or by pursuing investments in allowances as part of a larger portfolio[7].

In anticipation of the growth of carbon markets and higher carbon prices, energy trading firms and hedge funds have also been more active in carbon markets to complement their commodity trading portfolios[8,9].

Voluntary carbon markets encompass organizations and individuals that purchase and voluntarily retire allowances. Service providers (such as project developers and standard setters) do not buy or sell allowances or credits but facilitate trades between market participants. Most voluntary credits are purchased by the private sector, where corporate social responsibility goals are typically the key drivers of credit purchases.

In September 2020, a private sector-led initiative was launched to scale voluntary carbon markets in support of the Paris Agreement. The Taskforce on Scaling Voluntary Carbon Markets (TSVCM) includes more than 250 member institutions representing buyers and sellers of carbon credits, standard setters, the financial sector, market infrastructure providers, civil society, international organizations and academics[10].

Meanwhile, Singapore's sovereign wealth fund Temasek, DBS, Standard Chartered and the Singapore Exchange established Climate Impact X (CIX) in May 2021 to help scale the global voluntary carbon markets. CIX has an emphasis on developing quality, integrity and transparency in the voluntary carbon market[11].

In July 2021, four global banks – the Canadian Imperial Bank of Commerce, Itaú Unibanco, National Australia Bank and NatWest Group – announced Project Carbon, a pilot platform for trading voluntary carbon offsets. The project will facilitate increased delivery of high-quality carbon offset projects, a liquid carbon credit market with price certainty and transparency, creation of a strong ecosystem to support the offset market, and development of tools to help clients manage climate risk[12].

In addition, the Voluntary Carbon Markets Integrity Initiative (VCMI) was launched by the UK government and Children's Investment Fund Foundation in July 2021. VCMI's goal is to support private-sector climate action by developing guidance on the use of carbon credits and transparent claims and promoting multi-stakeholder engagement and partnerships[13].

[7] Banking of Surplus Emissions Allowances https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.835.7115&rep=rep1&type=pdf

[8] Energy Traders See Big Money in Carbon-Emissions Markets www.wsj.com/articles/energy-traders-see-big-money-in-carbon-emissions-markets-11630488780

[9] Carbon Trading: The 'One-way' Bet for Hedge Funds www.ft.com/content/a5ff89ec-323c-4fb8-85a1-9d0225ae3cdb

[10] Taskforce on Scaling Voluntary Carbon Markets www.iif.com/tsvcm

[11] Climate Impact X www.climateimpactx.com/

[12] CIBC, Itaú, NAB and NatWest Group launch carbon offset platform to drive transparency in Voluntary Carbon Market https://cibc.mediaroom.com/2021-07-07-CIBC,-Itau,-NAB-and-NatWest-Group-launch-carbon-offset-platform-to-drive-transparency-in-Voluntary-Carbon-Market

[13] Voluntary Carbon Markets Integrity Initiative https://vcmintegrity.org/

DERIVATIVES IN CARBON MARKETS

As noted in a recent research report by the Centre for European Policy Studies and the European Capital Markets Institute, derivatives facilitate the raising and allocation of capital towards sustainable investments, help market participants hedge risk related to environmental, social and governance (ESG) factors, facilitate transparency, price discovery and market efficiency, and contribute to long-termism (as financial market participants are more likely to make longer-term investments if they are able to efficiently hedge investment risks)[14].

Reducing emissions and adapting to climate change will require significant public and private investments. Key objectives include deploying low or zero carbon technologies, accelerating innovation in carbon capture, utilization and storage technologies, sequestering emissions through natural climate solutions, and developing infrastructure and technologies needed to adapt to physical risks[15].

Physical risk arises from the material, operational or programmatic impairment of economic activity and the corresponding effect on asset performance from the shocks and stresses attributable to climate change. Transition risk is associated with the uncertain financial impact that could result from the regulatory transition to a net-zero emissions economy.

As an effective tool to manage exposure and hedge risk, derivatives support investment activity in emissions-reduction projects. Firms can use derivatives to enable external capital to be channeled towards sustainable investments and net-zero-emissions activities.

Derivatives also play an essential role in helping firms to manage climate-related and transition risks. By facilitating the transfer of risks from counterparties that do not wish to have risk exposures to those that are willing to do so, derivatives offer an effective tool to hedge physical and transition risks by reducing uncertainty over future prices. Derivatives can transform otherwise erratic cashflows into predictable costs or sources of return.

Companies subject to carbon compliance programs can use carbon derivatives to meet their obligations and manage their risk in a cost-effective way. If emitters have concerns about volatility in the cost of allowances, they can either bank allowances or use derivatives to hedge emissions costs linked to production several years out.

Banks and other financial players buy allowances at auctions and sell forwards or futures to compliance entities that use allowance derivatives to hedge power forward sales. These compliance entities acquire derivatives rather than allowances in auctions or via the spot market due to higher capital costs and financial liquidity restrictions associated with allowances[16].

Derivatives markets also play a major role in enhancing transparency through the provision of forward information on the underlying assets, which contributes to long-term sustainability objectives. A functioning forward market provides certainty about the future costs of emissions, allowing companies to plan their strategic investments in carbon emissions reduction technologies.

Policy-makers rely on price signals from carbon derivatives to gauge the effectiveness of their programs and ensure desired outcomes, such as driving investment in renewables and use of less carbon-intensive fuels[17].

[14] Derivatives in Sustainable Finance, Centre for European Policy Studies (CEPS) and the European Capital Markets Institute (ECMI): www.isda.org/a/KOmTE/Derivatives-in-Sustainable-Finance.pdf. ISDA provided sponsorship for this report

[15] Managing Climate Risk in the US Financial System www.cftc.gov/sites/default/files/2020-09/9-9-20%20Report%20of%20the%20Subcommittee%20on%20Climate-Related%20Market%20Risk%20-%20Managing%20Climate%20Risk%20in%20the%20U.S.%20Financial%20System%20for%20posting.pdf

[16] Is a Market Stability Reserve Likely to Improve the Functioning of the EU ETS? https://climatestrategies.org/wp-content/uploads/2015/02/Climate-Strategies-MSR-Report-Final1.pdf

[17] Environmental Markets & Indices www.theice.com/energy/environmental

Investors can use the price signals from carbon derivatives to assess climate transition risk in their portfolios and can then access liquidity pools to manage risk and allocate capital to benefit from energy transition opportunities. Asset managers can use carbon derivatives to develop portfolios that meet the growing interest to invest in companies that are actively decarbonizing and avoid those that are carbon intensive.

Commonly traded types of carbon derivatives include futures, options and swaps. Futures and options are standardized products that are traded on exchanges and centrally cleared. Exchanges promote more liquidity, provide price transparency and act as financial intermediaries for a trade. An exchange also reduces counterparty risk through its clearing mechanism, as it serves as the buyer for every seller and the seller for every buyer. Furthermore, contracts on an exchange provide another avenue for market makers to hedge their positions.

In a futures contract, counterparties agree to trade allowances/offsets at a certain price on a certain date in the future (the contract's expiration date). The price is locked in on the date at which the futures contract is traded, but the change in ownership of the actual allowance only occurs after the contract expiration date. A futures contract does not necessarily result in physical delivery. It could also be satisfied by a payment based on the current market price at the agreed time of maturity.

In an allowance/offset option, the holder of an options contract has an option to either buy (a call option) or sell (a put option) allowances/offsets at the price agreed in the contract. The contract holder pays a premium for this right. The exchange may take place on the expiration date, but there is no obligation for it to happen. That's the main difference from a futures contact, which does require the exchange to happen on the expiration date.

OTC derivatives allow market participants to customize their contracts more precisely to meet their particular risk management needs.

For example, an allowance/offset forward contract has the same structure as a futures contract but is not standardized. A forward is an agreement to buy allowances or offsets in the future for a certain amount. A forward contract usually results in physical delivery or settlement of the underlying asset. Forward contracts may include some details that fit the exact needs of a buyer or seller.

Swaps are another example of a popular OTC derivative. These are non-standardized exchanges or a series of exchanges of allowances, offsets or cashflows at a given time or for a set period. Offset-allowance swaps allow companies that have not yet reached their quota of allowed offsets to sell their allowances and buy offsets, therefore taking advantage of the price difference versus companies that may have more offsets than allowances and are already over their quota. Swaps are usually settled by payment rather than physical delivery[18].

Exchange-traded Carbon Derivatives

Several derivatives exchanges offer standardized futures and options derivatives contracts on GHG emissions allowances and offsets.

The Intercontinental Exchange (ICE) offers futures and options on EUAs, UK allowances, California carbon allowances (CCAs), California carbon offsets and Regional Greenhouse Gas Initiative (RGGI) allowances[19].

[18] Carbon Market Oversight Primer https://icapcarbonaction.com/en/?option=com_attach&task=download&id=257

[19] ICE Environmental Markets www.theice.com/energy/environmental

The ICE global carbon futures index represents pricing from the three most actively traded carbon markets in the world, including the EU ETS, the California Cap and Trade Program and the RGGI. The secondary futures market for these programs makes up the majority of volume in carbon-based futures contracts[20].

EUA futures are futures contracts for allowances issued by the EU ETS. It's a physically delivered product, with contracts held to expiry resulting in physical delivery of EUAs within the Union Registry[21].

CCA futures are futures contracts for allowances issued by the California Cap and Trade Program. It is a physically delivered product, with contracts held to expiry resulting in physical delivery of CCAs within the Compliance Instrument Tracking System Service (CITSS) registry.

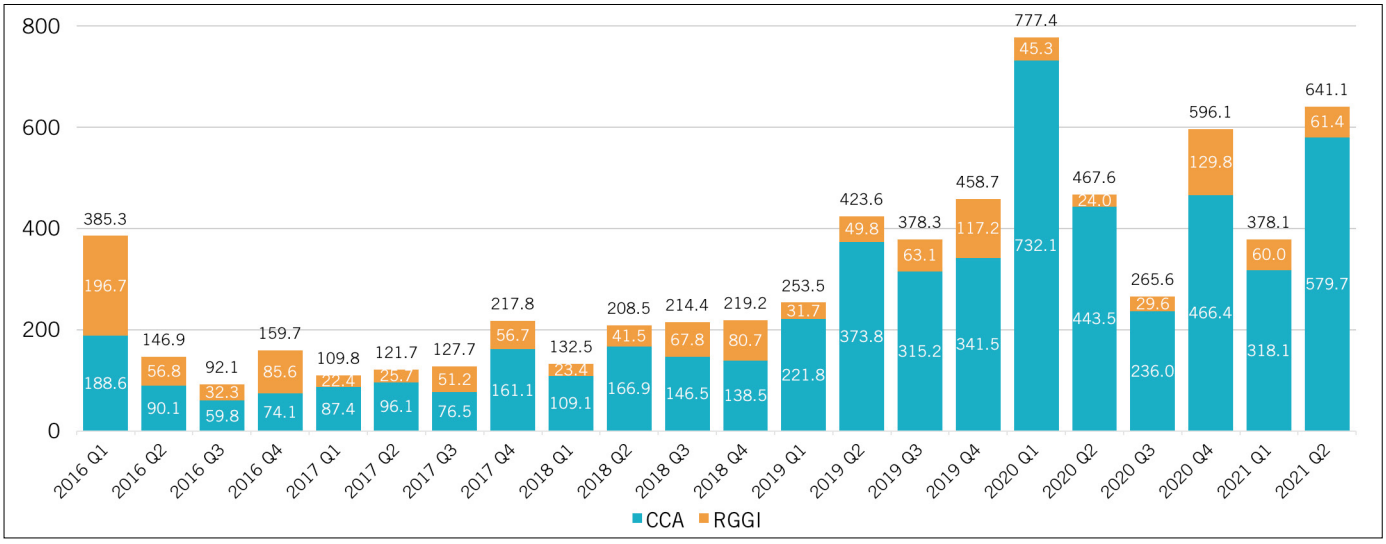
CCO futures are futures contracts for offset credits issued by the California Air Resources Board that can be used to a certain extent for compliance obligations under the California Cap and Trade Program. It is a physically delivered product, with contracts held to expiry resulting in physical delivery of California carbon offsets within the CITSS registry.

RGGI futures are futures contracts for allowances issued by the RGGI cap-and-trade program. It is a physically delivered contract, with contracts held to expiry resulting in physical delivery of RGGI allowances within the RGGI Carbon Dioxide Allowance Tracking System registry.

ICE's quoted carbon markets account for about 95% of global exchange-traded volumes[22].

In North America, trading volume of futures and options, including CCA and RGGI contracts, totaled 641.1 thousand lots in the second quarter of 2021[23]. CCA futures and options volume was 579.7 thousand lots combined, while RGGI futures and options trading volume totaled 61.4 thousand lots[24, 25] (see Chart 1).

Chart 1: North America Futures and Options Trading Volume (thousands of lots)



Source: ICE

[20] ICE Carbon Futures Index Family www.theice.com/publicdocs/ICE_Carbon_Futures_Index_Family_Primer.pdf

[21] ICE FAQs Carbon Markets and Indices www.theice.com/carbon-terminology-and-product-faq

[22] ICE Carbon Futures Index Family www.theice.com/publicdocs/ICE_Carbon_Futures_Index_Family_Primer.pdf

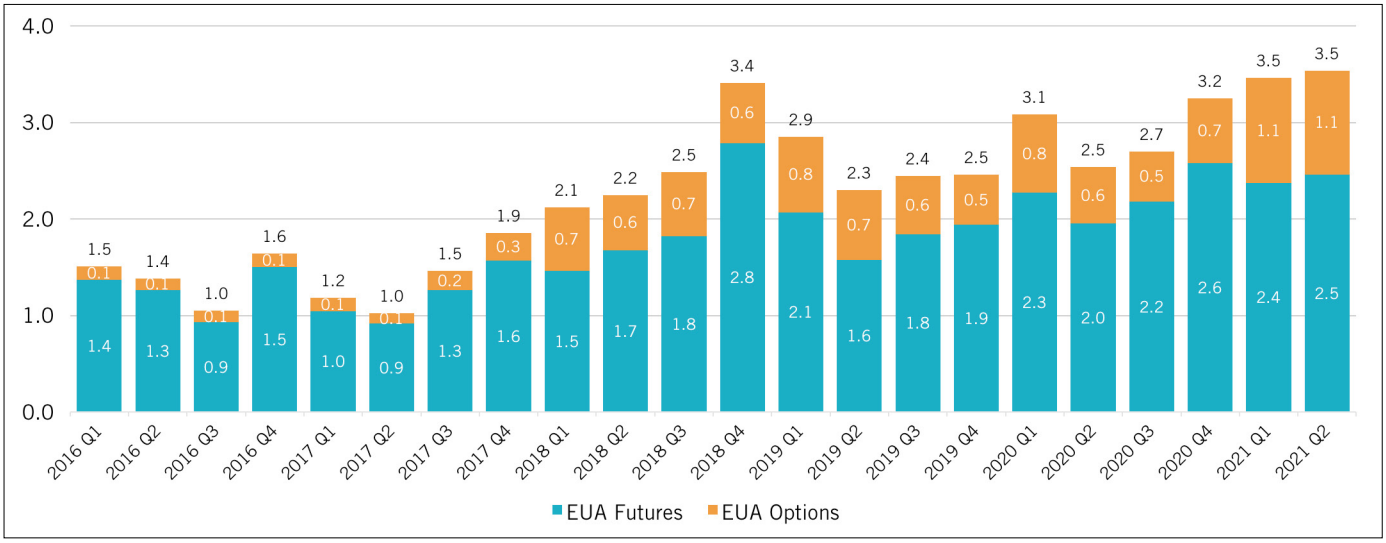
[23] This includes only cleared volumes. Data on non-cleared bilateral transactions is not available

[24] ICE Global Environmental Markets Report www.theice.com/microsite/usenvironmentalmonthlymarketreport

[25] One lot equals 1,000 carbon allowances. One allowance equals one metric ton of carbon dioxide or carbon dioxide equivalent for non-carbon dioxide greenhouse gases

In Europe, EUA futures and options trading volume totaled 3.5 million lots in the second quarter of 2021. EUA futures volumes totaled 2.5 million lots, while EUA options totaled 1.1 million lots (see Chart 2).

Chart 2: Europe Futures and Options Trading Volume (millions of lots)



Source: ICE

The European Energy Exchange (EEX) offers spot, futures and options trading of EU ETS allowances, including EU aviation allowances and EUAs, as well as related spreads[26].

Nodal Exchange, which is part of EEX Group, offers physically delivered futures and options for CCAs, RGGI carbon allowances and sulfur dioxide (SO2)/nitrogen oxide (NOx) emission allowances, among other environmental products[27].

Nasdaq offers a suite of EUA futures, including daily futures contracts, quarterly futures contracts for six rolling years and a pre-delivery option for EUA net sellers to fulfill collateral requirements[28].

CME offers RGGI CO2 allowance futures and options, in-delivery month EUA futures and options, California low-carbon fuel standard futures and CCA vintage-specific futures[29].

Additionally, CME has recently launched nature-based global emissions offset (N-GEO) futures and global emissions offset (GEO) futures. These futures are physically settled contracts that allow for delivery of eligible offset credits. Each contract represents 1,000 offset credits.

N-GEO futures are based on eligible voluntary offsets from agriculture, forestry and other land use projects with additional climate, community and biodiversity accreditation[30]. GEO futures are based on the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) eligible voluntary carbon offset credits from three registries, including the Verified Carbon Standard (VCS), the American Carbon Registry (ACR) and the Climate Action Reserve (CAR)[31].

[26] EEX EU ETS Spot Futures and Options www.eex.com/en/markets/environmental-markets/eu-ets-spot-futures-options

[27] Nodal Environmental Products and Services www.nodalexchange.com/products-services/environmental/

[28] Nasdaq EUA Futures www.nasdaq.com/solutions/eua-carbon-emission-futures-options

[29] CME Emissions Products www.cmegroup.com/trading/energy/emissions/?redirect=/trading/energy/emissions/index.html

[30] CBL Nature-Based Global Emissions Offset (N-GEO) Futures www.cmegroup.com/trading/energy/nature-based-global-emissions-offset-futures.html

[31] CBL Global Emissions Offset Futures www.cmegroup.com/trading/energy/cbl-global-emissions-offset-futures.html

N-GEO and GEO futures are designed to bring more price transparency to the voluntary carbon offset market and make it easier for companies to meet their carbon reduction targets and mitigate climate pricing risk. These contracts offer standardization and price convergence across different carbon registries and project types and contribute to the development of voluntary carbon markets.

While exchanges provide standardized contracts, liquidity and price transparency, they don't always allow market participants to customize the terms of their contracts to align more precisely with their specific hedging needs.

All exchange-traded products are limited in their variety. For example, almost all EUA futures across different exchanges share the same characteristics, including contract size (one lot of 1,000 EUAs), underlying currency (euros and euro cents), tick value (€0.01 per ton /€10.00 per contract), contract months and expiration date (last Monday of the contract month). Most of these contracts have short-term maturities.

In addition to futures and options, investors can also gain exposure to carbon markets and hedge their risk using the IHS Market global carbon index, which is designed to reflect the performance of the most liquid segments of the global carbon credit markets. The index offers broad coverage of cap-and-trade carbon allowances by tracking the most traded carbon credit futures contracts, including EUA, CCA and RGGI futures[32].

The KraneShares Global Carbon Exchange-traded Fund (ETF) tracks most globally traded carbon futures contracts and uses the IHS Markit's global carbon index as a pricing benchmark. The ETF may be beneficial for investors that are concerned about increases in the cost of carbon emissions in their portfolios[33].

OTC Carbon Derivatives

While trading on exchanges provides more liquidity, OTC markets allow participants to customize their transactions to meet particular risk management needs. The ability to trade OTC can be particularly important in the early years of a market, as it enables new products and transaction types to emerge that, over time, can become standardized and move to exchanges[34].

OTC carbon derivatives can be customized based on specific duration and notional amounts. For example, where project financing in the carbon markets and development of energy generation technologies might involve emission patterns and time horizons that are hard to predict, OTC derivatives can be structured to provide flexible and long-term hedging of risk.

OTC derivatives can also provide more specifically tailored hedges for projects with uneven lot sizes or lots that are smaller than in the standard exchange-traded contracts. Small- and medium- size emitters can benefit from having flexibility to enter into smaller OTC hedges that better suit their business needs.

Power plants may find it challenging to assess their long-term emission levels, which vary significantly. In addition to the price of emission allowances, their hedging needs depend on fuel (input) and energy (output) prices. As OTC emissions derivatives have terms and notional amounts that can be tailored based on actual emissions levels and duration needs, they can therefore better match the power plants' actual activity levels than exchange-traded derivatives[35].

[32] IHS Markit Global Carbon Index https://cdn.ihsmarkit.com/www/pdf/1020/Factsheet-GlobalCarbonIndex-hires.pdf

[33] KraneShares Global Carbon ETF https://kraneshares.com/krbn/

[34] CFTC Report on the Oversight of Existing and Prospective Carbon Markets www.cftc.gov/sites/default/files/idc/groups/public/@swaps/documents/file/dfstudy_carbon_011811.pdf

[35] OTC Emissions Derivatives as Facilitators of Market-Based Climatic Regimes in the Wake of the Financial Meltdown https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1933289)

OTC transactions will be instrumental in scaling up voluntary carbon markets. As carbon offset projects can be complex, must be actively managed and involve long durations and changing amounts of offsets, their exposure to swings in offsets prices can only be efficiently hedged via OTC derivatives.

For example, under a forward contract, the offset provider commits to deliver emission reductions to the buyer at a predefined time and price. The provider may have access to future emission reductions from a certain project or portfolio of projects or may have existing emission reductions available.

For both the provider and the buyer, a forward contract helps eliminate market price risk and secure a desired transaction price, even though delivery may not occur for months or years. Such an arrangement protects the provider from falling market prices and the buyer from rising prices or a shortage of available volume in the spot market at that future date. Forward contracts may specify a fixed or proportional number of offsets to be delivered[36].

By enabling predictability and reliability of future cashflows, OTC derivatives on offsets are becoming essential to secure financing for GHG mitigating projects.

Exchange-traded spot and futures contracts and OTC markets are both necessary to ensure a mature, fully functioning market and maintain the efficacy of carbon contracts as a hedging tool[37].

ISDA's Initiatives

ISDA believes the development of liquid carbon trading markets is crucial in meeting sustainability targets and is focusing on ensuring the safety and efficiency of derivatives markets in the transition to a more sustainable economy[38].

As an example, ISDA is involved in the TSVCM. As the voluntary market grows, a sound governance framework, solid legal principles and robust documentation will be vital, and this will be a focus of ISDA's efforts.

ISDA has published a variety of templates to support the trading of emissions and certain types of environmental derivatives. Market participants use ISDA templates for emission allowances (ie, the ISDA US Emissions Annex and the ISDA EU Emissions Annex) to trade swaps, options and forwards.

ISDA also offers EU emissions forms for the trading of CO2 allowances. The ISDA US Emissions Annex covers SO2 and NOx emissions (under the federal scheme) and CO2 emissions (under the RGGI scheme).

ISDA recently published a new US Renewable Energy Certificate (REC) Annex that allows firms to buy and sell US RECs based on standardized product definitions and terms under the umbrella of the ISDA Master Agreement, enabling more efficient trading of these instruments[39].

In addition, ISDA has published several papers that provide detailed analysis of issues in carbon markets and cover other ESG-related topics, including:

- *Overview of ESG-related Derivatives Products and Transactions:* This paper is intended to help market participants further understand the potential role of derivatives in sustainable finance. The paper outlines the range of product structures and transaction types that comprise the universe of ESG-related derivatives[40].

[36] Carbon Offset Guide Contract Terms www.offsetguide.org/understanding-carbon-offsets/how-to-acquire-carbon-offset-credits/buying-offsets/contract-terms/

[37] ISDA's Response to the Institute of International Finance's Taskforce on Scaling Voluntary Carbon Markets consultation http://assets.isda.org/media/9a674bfd/b0ffbc11-pdf/

[38] Developing Standards for ESG www.isda.org/2021/09/08/developing-standards-for-esg/

[39] ISDA Publishes US Renewable Energy Certificate Annex www.isda.org/2021/05/06/isda-publishes-us-renewable-energy-certificate-annex/

[40] Overview of ESG-related Derivatives Products and Transactions www.isda.org/2021/01/11/overview-of-esg-related-derivatives-products-and-transactions/

- *Implications of the FRTB for Carbon Certificates:* This explores the impact of the Fundamental Review of the Trading Book (FRTB) on the trading of carbon certificates. The analysis shows that the FRTB would result in higher capital charges for carbon trading under the standardized approach to market risk, which could impair the ability of banks to act as intermediaries in the ETS market globally, hampering a key tool for policy-makers to ensure a cost-effective transition to a carbon-neutral economy[41].

- *Sustainability-linked Derivatives: KPI Guidelines:* This paper sets out proposed guidance for drafting key performance indicators (KPIs) for sustainability-linked derivatives to ensure those KPIs are specific, measurable, verifiable, transparent and suitable[42].

- *Accounting Analysis for ESG-related Transactions and the Impact on Derivatives:* This describes issues associated with the current accounting treatment of ESG transactions and proposes alternative approaches that will improve the value of the information reported[43].

[41] Implications of the FRTB for Carbon Certificates www.isda.org/2021/07/23/implications-of-the-frtb-for-carbon-certificates/

[42] Sustainability-linked Derivatives: KPI Guidelines www.isda.org/2021/09/07/sustainability-linked-derivatives-kpi-guidelines?_zs=XomJM1&_zl=ApOQ6

[43] Accounting Analysis for ESG-related Transactions and the Impact on Derivatives www.isda.org/2021/09/07/accounting-analysis-for-esg-related-transactions-and-the-impact-on-derivatives?_zs=XomJM1&_zl=BpOQ6

COMPLIANCE CARBON MARKETS

Emissions trading (also referred to as cap and trade, ETS or allowance trading) is a market-based approach to reducing CO2 emissions. While emissions trading involves other GHGs, such as CH4 and N2O, the predominant form of emissions trading involves CO2.

Emission trading includes two key components: a limit (or cap) on pollution and tradable allowances (permits) that authorize allowance holders to emit a specific quantity of the pollutant[44]. One allowance is equal to one metric ton of CO2 (or CO2 equivalent for non-CO2 GHGs)[45].

ETSs are set on a national or regional level[46]. Under these schemes, a regulator sets a limit of GHG emissions and issues allowances and the limit declines on an annual basis, with the intention of reducing the overall amount of emissions. Depending on the program, allowances can be either allocated to regulated polluters for free or bought at an auction.

In limited cases, carbon credits that are treated equally as allowances for the purposes of compliance can be purchased directly from project developers (eg, CERs under the CDM that could be previously surrendered under the EU ETS).

Two major methods for free allocation are grandparenting and benchmarking[47]. A higher share of free allowances is usually allocated to companies within sectors that are viewed as having a significant risk of carbon leakage, such as energy-intensive industries. Carbon leakage may occur if businesses transfer production to other countries with laxer emission constraints due to costs related to climate policies. This could lead to an increase in their total emissions[48].

Different ETSs have various scopes and coverage that define which GHGs and sectors should be included, as well as the minimum size for emitters.

To comply with a specific cap-and-trade program, each covered entity must surrender a number of allowances by the end of a defined period corresponding to its emissions during that period.

If a company reduces its emissions below the limit, it can keep the spare allowances to cover its future needs or sell them to another firm that is short of allowances. Entities with low abatement costs therefore have an incentive to reduce their emissions, while those facing higher costs can comply by purchasing allowances.

Although cap-and-trade systems apply to a specific set of GHG emitters, other producers of GHGs have an opportunity to participate in the system through offsets.

Carbon offsets are additional CO2-equivalent reductions that are produced by those outside the cap. Generators of GHG emissions that produce offsets can sell them to GHG producers covered by the cap. However, there are some specific rules that determine quantity and types of offsets that be used for compliance with ETS.

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[44] What Is Emissions Trading? www.epa.gov/emissions-trading-resources/what-emissions-trading

[45] Carbon dioxide (CO_2) is the most common greenhouse gas and is therefore usually the first gas covered in an ETS. When other gases like methane (CH_4), nitrous oxide (N_2O) or fluorinated gases (SF6, HFC, PFC, etc.) are included in a system, carbon dioxide still serves as the point of reference and is the gas against which others are measured, expressed in terms of tons of carbon dioxide equivalents (CO_2e)

[46] International emissions trading is covered later in the report

[47] Under the grandparenting method, companies receive a free allowance based on their historical emissions from a specified period. Benchmarking means the companies receive free allowances depending on a set of performance standards, based on the emissions intensity of a product across a sector

[48] Carbon Leakage https://ec.europa.eu/clima/policies/ets/allowances/leakage_en

Key ETSs

As of April 2021, there were 29 ETSs implemented around the world[49]. While some of these ETSs have been in place for a relatively long time, others have been established very recently. For example, the EU ETS started in 2005, while China's national ETS started operating in 2021.

The EU ETS is the largest cap-and-trade program in the world and covers around 40% of GHG emissions from the EU. This program was established in 2005, and covers emissions from power and heat generations, energy-intensive sectors and commercial aviation within the EU. The program includes all EU member countries, as well as Iceland, Lichtenstein and Norway[50]. In January 2020, the linking agreement between the EU ETS and Switzerland ETS entered into force[51].

The UK ETS replaced the UK's participation in the EU ETS in January 2021. The scheme applies to energy-intensive industries, the power generation sector and aviation. It covers activities involving combustion of fuels in installations with a total rated thermal input exceeding 20MW[52].

The Western Climate Initiative is the largest carbon market in North America, based on collaboration between California, Québec and Nova Scotia. California and Québec independently established ETSs and linked their systems in 2014, creating the first international cap-and-trade system. Each participating jurisdiction has an independent ETS that issues emissions allowances and set an economy-wide emission cap consistent with its jurisdiction-specific GHG emission reduction target. Emission allowances can be traded between and among covered entities and third parties[53].

The California Cap and Trade Program is the first multi-sector cap-and-trade program in North America. This program began in 2013 with the state of California and has since expanded by linking with the province of Québec to cover emissions from both jurisdictions. The program covers about 85% of the combined emissions from California and Québec's economies, including large electric power plants, large industrial plants and fuel distributors (natural gas and petroleum), among other areas[54].

The RGGI is a US multi-state cap-and-trade program that includes Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island and Vermont. Each participating state has its own emissions cap, which limits emissions from electric power plants[55].

The New Zealand Emissions Trading Scheme (NZ ETS) was launched in 2008 and was originally designed to cover the whole New Zealand economy. The NZ ETS creates a financial incentive for businesses to reduce their emissions and for landowners to earn money by planting forests that absorb CO2 as the trees grow. All sectors of the New Zealand economy, including forestry, agriculture, waste, synthetic gases, industrial processes, liquid fossil fuels and stationary energy, must report their annual GHG emissions to the government. All sectors apart from agriculture have surrender and reporting obligations. Just over 50% of New Zealand's GHG emissions are covered by surrender obligations[56].

[49] State and Trends of Carbon Pricing 2021 https://openknowledge.worldbank.org/handle/10986/35620

[50] EU Emissions Trading System https://ec.europa.eu/clima/policies/ets_en

[51] Linking the Swiss and EU Emissions Trading Systems www.bafu.admin.ch/bafu/en/home/topics/climate/info-specialists/reduction-measures/ets/linking-swiss-eu.html

[52] Participating in the UK ETS www.gov.uk/government/publications/participating-in-the-uk-ets/participating-in-the-uk-ets#who-the-uk-ets-applies-to

[53] Western Climate Initiative, Inc https://wci-inc.org/our-work/approach

[54] California Cap and Trade Program https://ww2.arb.ca.gov/our-work/programs/cap-and-trade-program/about

[55] The Regional Greenhouse Gas Initiative https://www.rggi.org/program-overview-and-design/elements

[56] About the New Zealand Emissions Trading Scheme https://www.mfe.govt.nz/climate-change/new-zealand-emissions-trading-scheme/about-nz-ets

South Korea's Emissions Trading System (KETS) is east Asia's first nationwide mandatory ETS and the second largest carbon market after the EU ETS. KETS covers 610 of the country's largest emitters, which account for about 70% of national GHG emissions. It covers direct emissions of six Kyoto gases, as well as indirect emissions from electricity consumption[57].

China's National ETS was launched in 2017 and started operating in 2021. The ETS regulates more than 2,200 companies from the power sector (including combined heat and power, as well as captive power plants of other sectors), which emit more than 26,000 tons of CO2 per year. The Chinese national ETS is estimated to cover more than four billion tons of CO2, accounting for about 40% of national carbon emissions[58].

Tokyo Cap and Trade is Japan's first mandatory ETS and was launched in 2010. The program covers large buildings, factories, heat suppliers and other facilities that consume large quantities of fossil fuels. Entries covered under the program are required to reduce emissions below a facility-specific benchmark. This scheme is linked to the Saitama ETS[59].

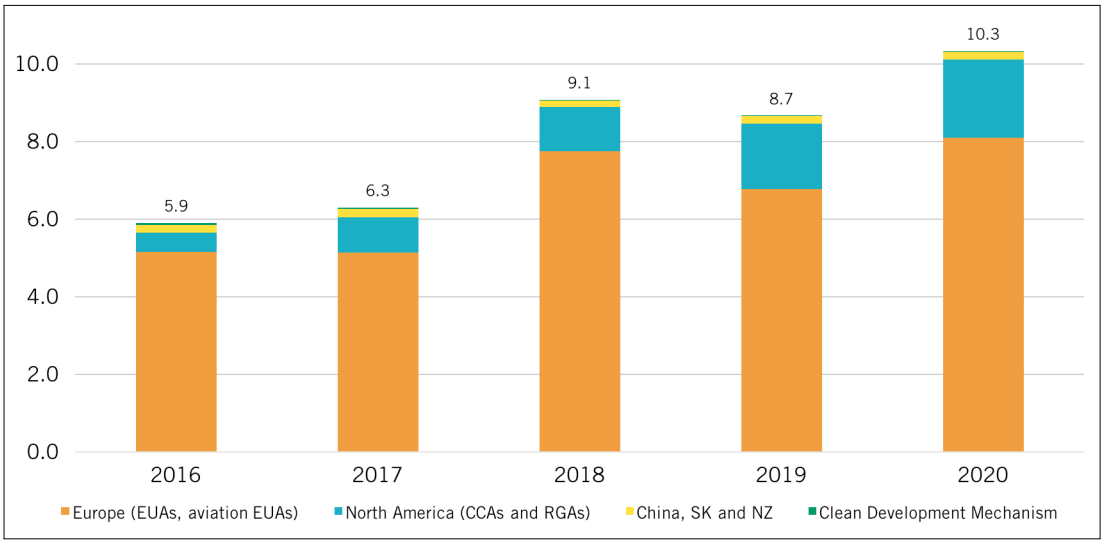
ETSs not only refer to cap-and-trade systems but also include baseline-and-credit systems, such as the one in British Columbia. However, systems operating like a baseline-and-offsets program, such as the Australia Safeguard Mechanism, fall outside the scope of the definition of an ETS[60].

Under a baseline-and-credit system, baselines are set for regulated emitters. Firms with emissions above their designated baseline need to surrender credits to make up for these emissions. Emitters that have reduced their emissions below their baseline receive credits for these reductions, which they can sell to other emitters.

Emission Allowances Trading

The total traded volume of emission allowances increased to 10.3 billion tons in 2020, compared to 6.3 billion tons in 2017. EU ETS traded volume was 8.1 billion tons, while traded volume in North America totaled $2.0 billion tons (see Chart 3).

Chart 3: Total Emission Allowances Traded Volume of Major ETS (billions of tons)



Source: Refinitiv

[57] Korea Emissions Trading Scheme https://icapcarbonaction.com/en/?option=com_etsmap&task=export&format=pdf&layout=list&systems%5B%5D=47

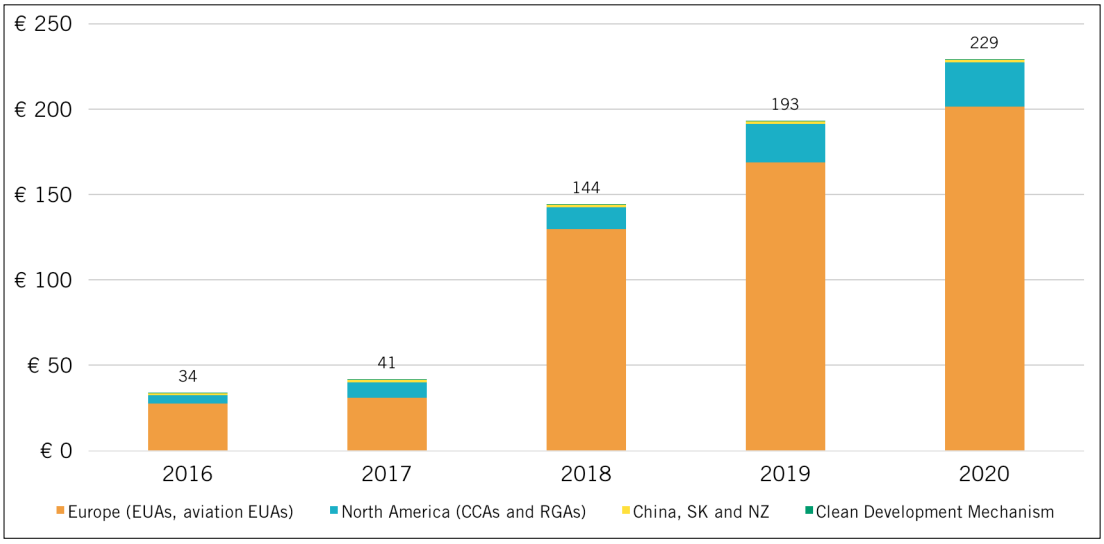
[58] ETS in China https://ets-china.org/

[59] Tokyo Cap-and-Trade Program https://www.kankyo.metro.tokyo.lg.jp/en/climate/cap_and_trade/index.html

[60] Carbon Pricing Dashboard https://carbonpricingdashboard.worldbank.org/map_data

The total value of major carbon markets has been growing rapidly since 2017. It reached €229.1 billion in 2020 compared to €41 billion in 2017. The EU ETS equaled €201.4 billion and represented about 88% of total value in 2020 (see Chart 4).

Chart 4: Total Value of Major ETS (€ billions)



Source: Refinitiv

Emission Allowances Prices

In an ETS, supply and demand factors and issues related to market structure, regulation and intervention all influence allowance prices[61].

Supply factors include the total allocation of allowances to ETS participants, the extent of converting carbon credits from the CDM and joint implementation projects under the Kyoto Protocol, and the possibility of banking or borrowing allowances.

Higher amounts of free allocations would result in lower prices as fewer allowances need to be purchased. Changes in the rules on quantity and types of offsets that can used for ETS compliance, as well as the price of offsets, can also impact the allowance price.

Demand for allowances is influenced by economic conditions, energy prices and weather conditions. A stronger economy would usually result in higher allowances prices – as industrial production increases, associated carbon emissions rise, meaning more carbon allowances are needed by operators to cover their emissions[62].

Changes in energy prices can impact the carbon emissions allowance price too. For example, higher coal prices incentivize a switch to gas, which reduces carbon emissions and causes allowance prices to fall. However, the relationship between carbon prices and other energy prices varies over different periods[63].

Carbon prices are also affected by unexpected weather conditions. For example, extreme temperature events have a significant effect on carbon price changes as cold winters increase the need for heating by using electricity or fuels. Rainfall, wind speed and hours of sunshine directly affect the share of carbon-free heat generation from hydropower, wind and solar energy.

[61] Sijm, J., S. Bakker, Y. Chen, H. Harmesen, and W. Lise (2005). CO2 price dynamics: The implications of EU emissions trading on the price of electricity

[62] Alberola, E., Chevallier, J., & Chèze, B. (2008). The EU Emissions Trading Scheme: The Effects of Industrial Production and CO2 Emissions on European Carbon Prices

[63] Alberola, E., Chevallier, J., & Chèze, B. (2008). Price Drivers and Structural Breaks in European Carbon Prices

Market structure, regulations and interventions affect carbon prices as well. For example, new rules setting higher GHG targets, lowering caps or including new sectors under an ETS could result in higher demand for allowances and therefore higher prices.

Most ETSs have some form of price control mechanism that provides flexibility to respond to imbalances in allowance supply and demand and helps keep allowance prices in a desirable range.

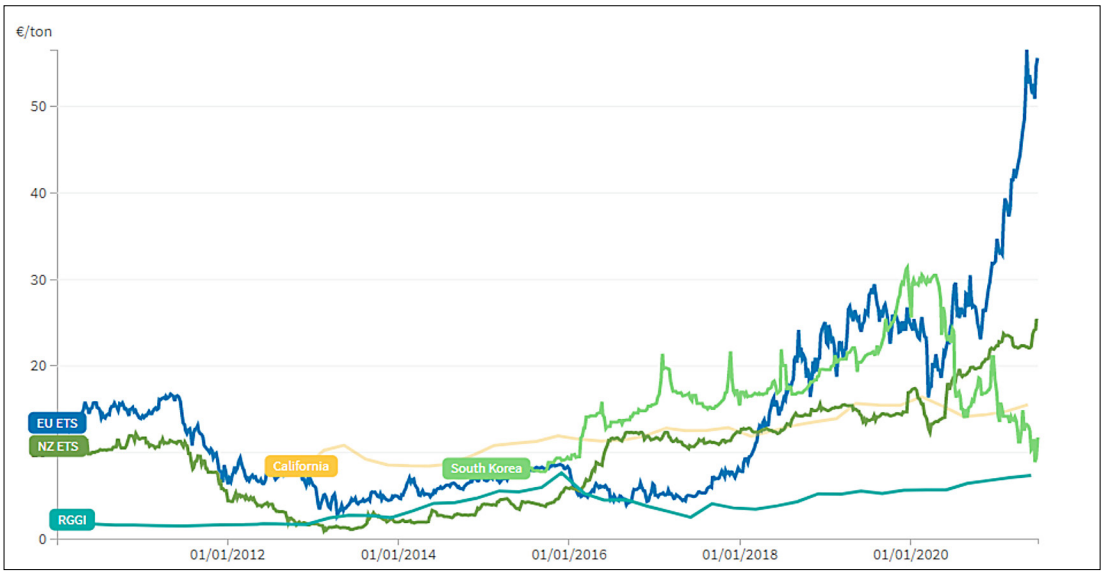
During periods of low demand and excessive supply that leads to low allowance prices, the goal is to maintain incentives for abatement and reduce risks for low-carbon investments. In cases of excessive demand resulting in high allowance prices, mechanisms are in place to contain costs for market participants and the economy and ensure continued support for the system – for example, by increasing short-term allowance supply or providing additional compliance units[64].

For example, the EU ETS market stability reserve (MSR) started operating in 2019 to address the surplus of allowances and improve the system's resilience to major shocks by adjusting the supply of allowances that are auctioned. The MSR alters auction volumes when the total number of allowances in circulation is above or below predefined triggers[65].

Given different designs of ETSs around the world, allowance prices are not a single commodity and cannot be directly compared. Chart 3 shows historical allowance prices for several large ETSs, including those in the EU, New Zealand, South Korea, California and the RGGI from January 2010 to June 2021.

Prices for EU ETS allowances have been growing rapidly over the past two years and exceeded €55 in June 2021. The main drivers of the increase were an expected tightening of the EU ETS rules, fewer free allowances, higher energy demand due to cold weather and interest from financial investors. In comparison to the high increase in EU ETS allowance prices, prices for the RGGI and California ETSs were relatively flat at around €7 and €15, respectively, in June 2021 (see Chart 5).

Chart 5: Historical ETS Allowance Prices



Source: ICAP Allowance Price Explorer

Some critics point out that if an allowance price is too low, it can't offset climate damage. Companies have less economic incentive to decrease emissions and may choose to buy allowances instead of reducing their emissions. However, if the price is too high, it can have negative economic consequences.

[64] Market Stability Mechanisms in Emissions Trading Systems https://icapcarbonaction.com/en/?option=com_attach&task=download&id=669

[65] Market Stability Reserve https://ec.europa.eu/clima/policies/ets/reform_en

VOLUNTARY CARBON MARKETS

Voluntary carbon markets function outside of compliance schemes and enable companies, governments, non-profit organizations, universities, municipalities and individuals to purchase carbon credits (offsets) on a voluntary basis. The majority of voluntary credits are acquired by the private sector, where corporate social responsibility goals are typically the key drivers of credit purchases.

While there has been some scrutiny and criticism of voluntary carbon offsets, these markets could play a significant role in the global effort to mitigate climate change.

More than 100 companies committed to The Climate Pledge as of April 2021[66], which involves measuring and reporting GHG emissions on a regular basis, implementing decarbonization strategies in line with the Paris Agreement and neutralizing any remaining emissions with offsets. The Climate Pledge calls on signatories to reach net-zero carbon emissions by 2040, 10 years ahead of the Paris Agreement's goal of 2050[67].

While some companies can achieve their GHG emissions reduction goals through new technologies, efficiency improvements, renewable energy and other strategies, others need to use carbon credits to supplement their own efforts.

The Platform on Sustainable Finance, the European Commission's (EC) expert group, defines offsetting as "the process or practice of compensating for an impact incurred by a particular activity, by implementing another activity that helps to mitigate that same impact. It is not the process of substitution with a cleaner activity. It is an add-on as compensation to an activity that is not providing a direct substantial contribution to an environmental objective"[68].

Voluntary carbon credits are generated by specific projects that avoid, reduce or remove GHG emissions from the atmosphere, and are verified and validated according to a set of independent standards.

Voluntary carbon credits enable organizations to compensate for emissions that have not yet been eliminated by financing projects that reduce or avoid emissions from other sources or remove GHGs from the atmosphere. These credits are traded on a voluntary basis.

For a carbon-reduction project to generate carbon credits, it needs to demonstrate that the achieved emission reductions or carbon dioxide removals are real, measurable, permanent, additional, independently verified and unique.

Credit holders must retire carbon credits in order to use them and claim their associated GHG reductions. Retirement occurs according to a process specified by each carbon offset program's registry. Once an offset credit is retired, it cannot be transferred or used.

Carbon offset projects can be produced by various activities that reduce GHG emissions or increase carbon sequestration, such as renewable energy development, energy efficiency improvements, the capture and destruction of high-potency GHGs, restored forestry and regenerative agriculture, and carbon capture and storage.

[66] The Climate Pledge is a cross- sector community of companies, organizations, individuals and partners that collaborate on tackling the climate crisis. It was co-founded by Amazon and Global Optimism in 2019 www.theclimatepledge.com/us/en/about/frequently-asked-questions

[67] The Climate Pledge Celebrates Surpassing 100 Signatories www.aboutamazon.com/news/sustainability/the-climate-pledge-celebrates-surpassing-100-signatories

[68] Platform on Sustainable Finance: Technical Working Group https://ec.europa.eu/info/sites/default/files/business_economy_euro/banking_and_finance/documents/210803-sustainable-finance-platform-report-technical-screening-criteria-taxonomy_en.pdf

In addition to GHG reduction, some carbon offset projects also cover social and environmental benefits, such as improvements to community employment opportunities, enhanced air or water quality, biodiversity and habitat conservation, improved energy access, and better access to community health and education services[69].

The voluntary carbon market includes a wide range of programs, protocols and standards that differ significantly. Some of the leading carbon offset programs include the ARC, the CAR, Gold Standard, Plan Vivo and Verra (which operate the VCS program)[70]. While there are common components of the project approval process, the programs use different approaches for project validation and verification.

Offset programs must use carbon offset registries to keep track of project and credit ownership and to minimize the risk of double counting. A registry assigns a serial number to each verified offset credit. Once the credit is used, the serial number is retired, preventing the credit from being resold. There are several registries in the voluntary offset market, developed by governments, non-profits and the private sector. Currently, no universal meta-registry exists[71], although the World Bank has taken steps to promote a climate warehouse or meta registry[72].

Table 1: Compliance Carbon Markets vs. Voluntary Carbon Markets

	Compliance Carbon Markets	Voluntary Carbon Markets
Market Function	Allow regulated entities to buy and sell carbon credits to comply with limits on the amount of greenhouse gases (GHGs they are allowed to emit. The number of available credits is gradually reduced, ensuring decarbonization.	Allow participants to purchase carbon offsets to mitigate their GHG emissions resulting from manufacturing processes, electricity use and transportation. The number of available offsets is not limited and has been growing.
Market Participants	Regulated entities that have to comply with emissions trading schemes and financial players (banks, energy trading firms, institutional investors and hedge funds).	Businesses, investors, governments, non-governmental organizations, non-profit organizations, universities, municipalities and individuals.
Market Regulation	Created and regulated by mandatory national, regional or international carbon reduction schemes.	Function outside of compliance markets. Markets are largely unregulated.
Credit Types	Permits to pollute and project-based emission reduction credits.	Project-based emission reduction credits.
Issuer of credits	National governments and agencies. Certification bodies recognized by the compliance schemes.	Independent certification bodies.

Carbon credits can be purchased directly from project developers. Some developers sell offsets through a broker or an exchange[73] or sell to retailers that resell them to an end buyer.

While some exchanges like ICE facilitate offset credit transactions, most voluntary carbon credits are traded OTC, resulting in limited liquidity and transparency in the market. Other exchanges function as peer-to-peer platforms and match buyers and sellers of offsets.

The risks of transacting an offset may differ depending on the category of project that generates them. Projects that result in offsets by storing carbon that otherwise would have been emitted are not necessarily permanent by their nature and can suffer reversals of the avoided emissions. Examples include offsets from forestry projects and carbon capture and sequestration.

When there is a reversal – for instance, due to wildfires – voluntary standards will retire offsets from their buffers to account for the reversals. Offsets purchased from projects that suffered reversals therefore continue to be valid because the retirement of buffer offsets will support the validity of the offsets purchased from those projects.

[69] Carbon Offset Projects www.offsetguide.org/understanding-carbon-offsets/carbon-offset-projects/

[70] Voluntary Offset Programs www.offsetguide.org/understanding-carbon-offsets/carbon-offset-programs/voluntary-offset-programs/

[71] Registries and Enforcement www.offsetguide.org/understanding-carbon-offsets/carbon-offset-programs/registries-enforcement/

[72] Climate Warehouse www.worldbank.org/en/programs/climate-warehouse

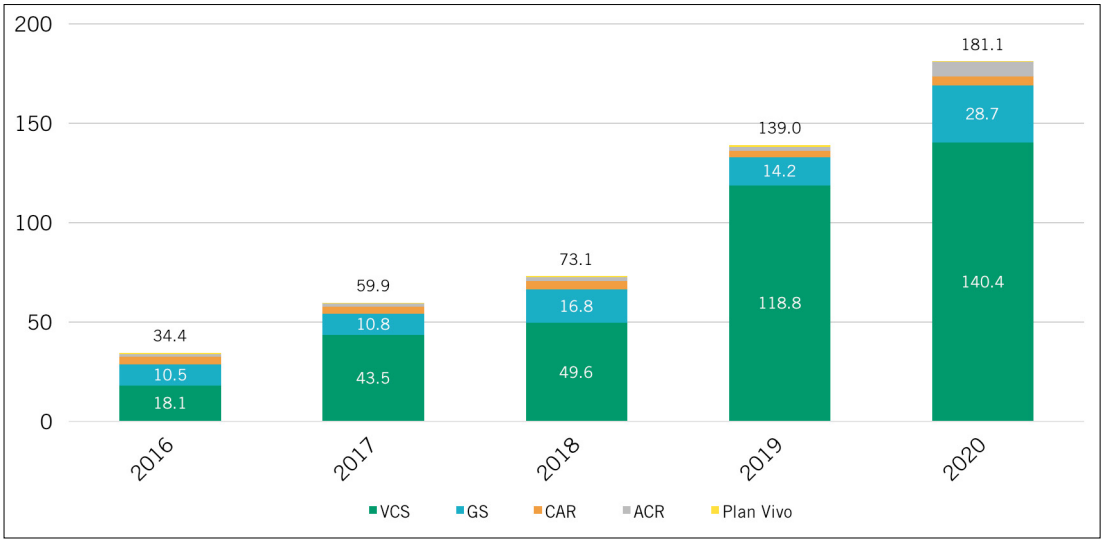
[73] For example, Carbon Trade Exchange https://ctxglobal.com/carbon-offset/

However, a project that has suffered a reversal (or an intermediary that has purchased offsets sourced from this project) may encounter challenges in selling offsets to end users because of reputational risk (ie, a company may be wary of the potential stigma of purchasing existing offsets from a project that has been destroyed by wildfire).

The price of carbon credits varies significantly and depends on the type of carbon offset project, the carbon standard under which it was certified, the size and location of the project, the co-benefits associated with the project and the vintage year of carbon sequestration or removal[74].

While the voluntary carbon credit market has been growing rapidly, it remains relatively small compared to compliance schemes. Issuance reached 181.1 million tons of CO2 equivalent in 2020[75] (see Chart 6). In comparison, total traded volume of emission allowances totaled 10.3 billion tons in 2020.

Chart 6: Issuances in Voluntary Carbon Markets (millions of metric tons of CO2 equivalent)



Source: VCS, GS, CAR, ACR and Plan Vivo registries

Given the growing number of companies with net-zero commitments, the size of voluntary carbon markets is expected to grow. The TSVCM estimates that demand for carbon credits could increase by a factor of 15 or more by 2030 and by a factor of up to 100 by 2050. Depending on different price scenarios, the market size in 2030 could be between $5 billion and $30 billion at the low end and more than $50 billion at the high end[76].

Despite its growth, the voluntary carbon market remains highly fragmented and faces ongoing criticism over the quality of credits, which could make it challenging to scale up this market.

Some of the common criticisms of carbon offsets focus on offset quality and how offset credits are used. For example, some argue that offset credits may not represent valid GHG reductions, as many derive from energy sector projects that would have occurred anyway and do not represent additional mitigation.

Continued on next page >

[74] Carbon Pricing: Why do Prices Vary by Project Type? www.goldstandard.org/blog-item/carbon-pricing-why-do-prices-vary-project-type

[75] This data is collected from five major registries, including VCS, GS, CAR, ARC and Plan Vivo. Data excludes voluntary credits used for meeting compliance targets

[76] A Blueprint for Scaling Voluntary Carbon Markets to Meet the Climate Challenge www.mckinsey.com/business-functions/sustainability/our-insights/a-blueprint-for-scaling-voluntary-carbon-markets-to-meet-the-climate-challenge

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Other issues include concerns about overestimation of emission reductions – for example, for industrial gas destruction and other project types. Some carbon offset projects could also harm local communities or result in broader environmental damage[77].

Other criticisms focus on whether carbon offsets allow companies to continue polluting. Instead of making investments to significantly reduce their carbon footprint, companies might use carbon offset credits to achieve their GHG reduction goals. Carbon offsets could also be perceived as a way of firms avoiding regulation of certain sectors and industries.

Taskforce on Scaling Voluntary Carbon Markets

The TSVCM is a private-sector-led initiative to scale voluntary carbon markets and includes over 250 member institutions representing buyers and sellers of carbon credits, standard setters, the financial sector, market infrastructure providers, civil society, international organizations and academics[78].

The TSVCM has identified six areas that are essential to support the scaling up of voluntary carbon markets, including the development of core carbon principles and a taxonomy, core carbon reference contracts and the necessary infrastructure, and ensuring offset legitimacy, market integrity and demand signals[79].

To create a voluntary carbon market, the TSVCM recommends creating carbon spot and futures contracts with the aim of matching suppliers' products and buyers' preferences more efficiently, as well as providing a daily reference carbon price for a standardized product.

These contracts would be physically settled, traded on exchanges and cleared via clearing houses. Futures contracts should be fungible to allow for trading across all markets and multiple platforms and could potentially be cash settled. These future contracts would also act as a price reference for OTC contracts. When negotiating OTC contracts, parties could use the price of the liquid carbon futures and the price signal for standardized additional attributes as a starting point.

Establishing an active secondary market would allow market participants to manage and hedge risks from carbon projects. It would also support longer-term financing for project developers, increase access to carbon markets for participants that would not traditionally be present in the financial markets and attract more investors.

In July 2021, the TSVCM published a new report that outlines next steps for the creation of voluntary markets. The taskforce plans to form an independent governance body for the voluntary carbon market to ensure it serves its primary purpose of reducing GHG emissions and accelerating the transition to net zero[80].

[77] Carbon Offset Guide www.offsetguide.org/concerns-about-carbon-offset-quality/

[78] Taskforce on Scaling Voluntary Carbon Markets www.iif.com/tsvcm

[79] Taskforce on Scaling Voluntary Carbon Markets Final Report www.iif.com/Portals/1/Files/TSVCM_Report.pdf

[80] Taskforce on Scaling Voluntary Carbon Markets Publishes Roadmap for Strengthening Market Integrity www.iif.com/tsvcm/Main-Page/Publications/ID/4496/Taskforce-on-Scaling-Voluntary-Carbon-Markets-Publishes-Roadmap-for-Strengthening-Market-Integrity

ADDITIONAL CARBON PRICING APPROACHES

Carbon Tax

A carbon tax is set by a government and is defined as a per-ton tax rate on GHG emissions[81]. It is designed to provide incentives for producers and consumers to reduce their consumption of fossil fuels and shift to lower-carbon alternatives or renewable energy sources.

Carbon taxes can be levied on different types of GHGs, such as CO2, CH4, N2O and fluorinated gases (SF6, HFC, PFC, etc), and can be set at different points in the energy supply chain. For example, it can be levied at the point of fuel production (upstream), at the point of fuel consumption (downstream) or at different points in between (midstream).

According to the World Bank, 27 national jurisdictions have implemented carbon taxes as of 2021, including various countries in Europe, Canada, Japan and Argentina[82]. The scope of each country's carbon tax differs with varying shares of GHG emissions covered by the tax.

A carbon tax is different from an ETS as it provides a higher level of certainty over cost but less certainty over the emissions reduction outcome. Indeed, one of the challenges is forecasting the resulting level of emissions reduction from a specific tax rate.

In theory, a carbon tax should be set equal to the social cost of carbon, which is the present value of estimated environmental damages over time caused by an additional ton of carbon emitted today. The tax rate should also rise over time to reflect the growing damage expected from climate change. An increasing rate should provide a signal to emitters that they need to act and their investments in emissions-reduction technologies will be economically justified[83].

Carbon tax revenues could be returned to consumers in the form of a dividend. Alternatively, they could be reinvested in low-carbon technologies or building resilience. As a carbon tax is likely to have a greater impact on lower-income households, directing some of it to these households can compensate for increased energy costs.

Carbon Border Adjustment

A carbon border adjustment mechanism is a tariff on imported goods based on their carbon content. It is intended to level the playing field between the costs of producing carbon-intensive goods in countries covered by carbon pricing regimes and countries that don't impose carbon costs.

In July 2021, the EC adopted a proposal for a new carbon border adjustment mechanism (CBAM), which is intended to put a carbon price on imports of a targeted selection of products. It is designed to ensure European emissions reductions contribute to a global emissions decline, instead of pushing carbon-intensive production outside Europe[84].

The main purpose of CBAM is to prevent carbon leakage by creating a level playing field for EU producers in sectors covered by the EU ETS. EU importers will have to buy carbon certificates corresponding to the carbon price that would have been paid had the goods been produced under the EU's carbon pricing rules.

If a non-EU producer can show it has already paid a price for the carbon used in the production of the imported goods in a third country, then the corresponding cost can be fully deducted.

[81] Pricing Carbon www.worldbank.org/en/programs/pricing-carbon#:~:text=A%20carbon%20tax%20directly%20sets,but%20the%20carbon%20price%20is

[82] Carbon Pricing Dashboard https://carbonpricingdashboard.worldbank.org/map_data

[83] Center for Climate and Energy Solutions www.c2es.org/content/carbon-tax-basics/

[84] Carbon Border Adjustment Mechanism https://ec.europa.eu/taxation_customs/green-taxation-0/carbon-border-adjustment-mechanism_en

The CBAM will initially apply to a selected number of goods at high risk of carbon leakage, including electricity, iron, steel, cement, fertilizer and aluminum products. The CBAM is expected to be implemented in 2026, following a three-year transition period[85].

In July 2021, the US introduced a bill to impose tariffs on imports of carbon-intensive goods. The legislation seeks to impose a cost on GHG emissions associated with imported goods "to account for the cost incurred by US businesses to comply with laws and regulations limiting greenhouse gas emissions"[86].

The proposed tariffs would apply to imports of aluminum, iron, steel, cement, natural gas, petroleum and coal. However, imports from less-developed countries and jurisdictions that do not impose their own border carbon adjustment on goods produced or manufactured in the US would be exempt.

Revenue from the tariffs would be used to support the development and commercialization of emissions reduction technologies and provide resources to workers and businesses affected by the transition to a low-carbon economy.

Canada[87] and Japan are also considering the establishment of border carbon adjustments.

[85] Carbon Border Adjustment Mechanism: Questions and Answers https://ec.europa.eu/commission/presscorner/detail/en/qanda_21_3661

[86] Legislation to Impose "Border Carbon Adjustment" Fee on Imported Steel and Other "Carbon-Intensive" Goods Introduced in US Congress www.whitecase.com/publications/alert/legislation-impose-border-carbon-adjustment-fee-imported-steel-and-other-carbon

[87] Exploring Border Carbon Adjustments for Canada www.canada.ca/en/department-finance/programs/consultations/2021/border-carbon-adjustments/exploring-border-carbon-adjustments-canada.html

CONCLUSION

Derivatives play an essential role in carbon markets. Companies subject to carbon compliance programs use carbon derivatives to meet their obligations and manage risk in the most cost-effective way. Derivatives can also be used by a variety of businesses that have financial positions indirectly tied to carbon prices. Investors can use the price signals from carbon derivatives to assess climate transition risk in their portfolios and can then access liquidity pools to manage risk and allocate capital to benefit from energy transition opportunities.

Derivatives markets also play a major role in enhancing transparency by providing forward information on carbon, which contributes to long-term sustainability objectives and provides helpful signals to policy-makers on the regulation of carbon prices.

Exchange-traded contracts and OTC derivatives are both necessary to ensure a mature, fully functioning market and maintain the efficacy of carbon contracts as a hedging tool.

ANNEX I: GLOBAL CLIMATE CHANGE MITIGATION EFFORTS

The Kyoto Protocol

The Kyoto Protocol is an international legally binding climate agreement that committed industrialized countries and economies in transition to limit and reduce greenhouse gas (GHG) emissions in accordance with agreed individual targets. The protocol, which was linked to the United Nations Framework Convention on Climate Change (UNFCCC), was adopted in 1997 and entered into force in 2005[88].

The protocol set binding emission reduction targets for 37 industrialized countries and economies in transition plus the EU. Overall, these targets added up to an average 5% emissions reduction compared to 1990 levels over the five-year period between 2008–2012 (the first commitment period).

The protocol placed emissions limitations on Annex I countries only[89]. Developing nations were asked to comply voluntarily. Most developing countries, including China and India, were not required to restrict their emissions.

Under the Kyoto Protocol, countries had to meet their targets primarily through national measures. However, the protocol also provided three market-based mechanisms that allowed participants to reach their goals, leading to what is now known as the carbon market.

These mechanisms encourage sustainable development and emissions reductions, while giving industrialized countries some flexibility in how they meet their emissions reduction targets.

Table 2: Market-based Mechanisms Under the Kyoto Protocol

Market-based Mechanism	Description
Clean Development Mechanism (CDM)	The CDM allows countries with commitments under the Kyoto Protocol to implement an emissions-reduction project in developing countries. These projects can earn saleable certified emission reduction credits, each equivalent to one ton of carbon dioxide (CO2), which can be traded and counted towards Kyoto targets[90].
Joint Implementation (JI)	Under the JI, countries with commitments under the Kyoto Protocol (Annex I countries) can invest in emissions-reduction projects in any other Annex I counties as an alternative to reducing emissions domestically. Most JI projects are expected to take place in economies in transition[91]. JI emissions reduction projects are awarded emission reduction unit (ERU) credits, which represent an emissions reduction equivalent to one ton of CO2 equivalent. The ERUs come from the host country's pool of assigned emissions credits, known as assigned amount units[92].
Emissions Trading	Emissions trading allows participating countries to buy and sell emissions rights. Countries that have extra emission units (emissions assigned but not used) can sell this excess capacity to countries that are above their targets. As CO2 is the principal greenhouse gas, emissions trading is often referred to as carbon trading[93].

The Kyoto Protocol established monitoring, review, verification and compliance systems to enforce its rules, address any compliance problems and avoid any error in calculating emissions data and accounting for transactions under the three Kyoto mechanisms.

The protocol required countries to submit annual emissions inventories and national reports at regular intervals.

[88] What is the Kyoto Protocol? https://unfccc.int/kyoto_protocol

[89] Annex I parties included the industrialized countries that were members of the Organization for Economic Co-operation and Development in 1992, plus countries with economies in transition, including the Russian Federation, the Baltic States and several Central and Eastern European States https://unfccc.int/parties-observers

[90] Clean Development Mechanism https://cdm.unfccc.int/index.html

[91] Joint Implementation https://ji.unfccc.int/index.html

[92] Assigned Amounts Unit (AAU) is a Kyoto Protocol unit equal to 1 metric ton of carbon dioxide equivalent. Each Annex I party issues a predetermined amount of AAUs up to the level of its allowed emissions (assigned amounts) into its national registry account

[93] Emissions Trading https://unfccc.int/process/the-kyoto-protocol/mechanisms/emissions-trading

Countries with commitments under the Kyoto Protocol had to keep national registries that contain accounts within which units are held in the name of the government or in the name of legal entities authorized by the government to hold and trade units. In addition to recording the assigned amount unit holdings, these registries settle emissions trades by delivering units from the accounts of sellers to those of buyers[94].

Each registry operates through a link established with the International Transaction Log (ITL), which is administered by the UNFCCC secretariat. The ITL verifies registry transactions in real time to ensure they are consistent with rules agreed under the Kyoto Protocol[95].

Critics argue the Kyoto Protocol failed and its costs outweighed its benefits[96]. While countries covered by the protocol met their emissions reduction targets, overall global emissions rose. China and India were exempt due to their status as developing countries[97]. The US ratified the original agreement but dropped out of the protocol in 2001, claiming it was unfair. Canada announced its withdrawal from the protocol in December 2011.

After the first commitment period of the Kyoto Protocol ended in December 2012, parties adopted the so-called Doha Amendment, which established a second emissions reduction commitment period for 37 countries from 2013 to 2020. During this period, participating countries committed to reduce GHG emissions by at least 18% below 1990 levels. The amendment entered into force in December 2020[98].

The Paris Agreement

The Paris Agreement, an international treaty on climate change, was adopted by 196 parties at the Paris Climate Conference in December 2015 and entered into force in November 2016.

The goal of the agreement is to keep the increase in global average temperature to well below 2°C (preferably 1.5°C) compared to pre-industrial levels. To achieve this long-term temperature goal, countries aim to reach a global peak of GHG emissions as soon as possible and subsequently undertake rapid reductions to achieve a balance between emissions and removals (net zero) in the second half of the century[99].

While the Paris Agreement sets a global objective, action to achieve it is driven at the national level and each country is responsible for setting its own policies. The agreement establishes binding commitments on all parties to prepare, communicate and maintain nationally determined contributions (NDCs) and pursue domestic measures to achieve them[100].

Participating countries update and communicate their NDCs every five years. The content of NDCs continues to be nationally determined and non-binding but should reflect what a country intends to achieve. Countries are not required to set a specific emissions target by a specific date, but each target should go beyond the previously set targets.

[94] Registry Systems under the Kyoto Protocol https://unfccc.int/process/the-kyoto-protocol/registry-systems

[95] International Transaction Log https://unfccc.int/process/the-kyoto-protocol/registry-systems/international-transaction-log

[96] The Wrong Solution at the Right Time: The Failure of the Kyoto Protocol on Climate Change https://onlinelibrary.wiley.com/doi/pdf/10.1111/polp.12105

[97] China was exempt from the requirements of the Kyoto Protocol because of its status as a developing country

[98] The Doha Amendment https://unfccc.int/process/the-kyoto-protocol/the-doha-amendment

[99] The Paris Agreement https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

[100] Key Aspects of the Paris Agreement https://cop23.unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement/key-aspects-of-the-paris-agreement

Table 3: Differences between the Kyoto Protocol and the Paris Agreement

	The Kyoto Protocol	The Paris Agreement
Participating Countries	192 parties ratified the protocol[101]. Only 37 industrialized countries that were members of the Organization for Economic Co-operation and Development in 1992 plus countries with economies in transition committed to emissions reductions. Developing countries were exempt from the commitments.	The agreement was ratified by 191 parties as of 2021. Both developed and developing countries must submit nationally determined contributions (NDCs) containing non-binding pledges to mitigate greenhouse gas (GHG) emissions.
Objective	To reduce GHG emissions by 5% below their 1990 levels, with different targets for each participating country.	To hold the GHG-induced increase in temperature to well below 2°C and to pursue efforts to limit the temperature increase to 1.5°C compared to the pre-industrial levels.
Party obligation	The protocol set legally binding emissions reduction targets for 37 parties.	The agreement establishes a set of binding procedural commitments on all parties, although not all provisions are mandatory[102]. The achievement by a party of its NDCs is not a legally binding obligation.
What's covered	Six major GHGs: carbon dioxide, methane, sulfur hexafluoride, HFC, PFC and nitrous oxide.	All anthropogenic GHGs.
Timeframe	The protocol was adopted in 1997 and entered into force in 2005. The first commitment period was from 2008 to 2012. The second commitment period was from 2013 to 2020.	The agreement was adopted in 2015 and entered into force in 2016. The agreement works on a five-year cycle.

In February 2021, UN Climate Change published the NDC Synthesis report that covers NDC submissions to the end of December 2020. The report includes new or updated NDCs by 75 parties, which represent approximately 40% of parties to the Paris Agreement and 30% of global GHG emissions[103].

According to the report, total GHG emissions levels resulting from implementation of the targets communicated in the new or updated NDCs are estimated to be 0.5% lower in 2030 compared to 2010.

To be consistent with the goal to keep the increase in global average temperature at about 1.5°C, carbon dioxide emissions need to decline by about 45% from the 2010 level by 2030. For limiting global warming to below 2°C, emissions need to decrease by about 25% by 2030 compared to 2010. The estimated reductions therefore fall far short of what is required, demonstrating the need for counties to further strengthen their mitigation commitments under the Paris Agreement[104].

[101] The Kyoto Protocol - Status of Ratification https://unfccc.int/process/the-kyoto-protocol/status-of-ratification

[102] Some provisions are binding, such as those on reporting and review, while others are recommendations or collective commitments to which it would be difficult to hold an individual party accountable

[103] United Nations Climate Change https://unfccc.int/news/climate-commitments-not-on-track-to-meet-paris-agreement-goals-as-ndc-synthesis-report-is-published

[104] Nationally Determined Contributions Under the Paris Agreement. Synthesis Report by the Secretariat https://unfccc.int/documents/268571

ANNEX II: INTERNATIONAL CARBON MARKETS

International carbon markets allow countries that can't meet their nationally determined contributions (NDCs) or want to use less expensive emissions cuts to purchase emissions reductions from countries that have decreased their emissions beyond their target. This market is meant to be governed by Article 6 of the Paris Agreement but is still being negotiated.

Article 6 of the Paris Agreement

Negotiators haven't been able to finalize the rules for Article 6 as it was intended to be agreed at the Conference of the Parties (COP) in 2019 in Poland (COP24). It is hoped that an agreement can be reached at the COP26 meeting in Glasgow in November 2021.

Article 6 of the Paris Agreement outlines mechanisms for voluntary international cooperation among the parties to implement their NDCs through the use of international carbon markets.

Article 6 allows countries to use bilateral carbon markets to achieve their NDC targets (Article 6.2). A country with a surplus of domestic greenhouse has (GHG) emissions reductions beyond its NDCs can sell its surplus to another country that has a shortfall.

Article 6 also creates a centralized international carbon market, which includes the public and private sectors. This new market is referred to as the Sustainable Development Mechanism (SDM) and is viewed as a successor to the Clean Development Mechanism under the Kyoto Protocol.

Finally, Article 6 develops a framework for cooperation between countries to reduce emissions using non-market approaches, such as aid[105].

International carbon markets could enable countries to achieve higher emissions targets than they can on their own. According to analysis by the Environmental Defense Fund, utilizing global emissions trading to meet Paris Agreement pledges could reduce total mitigation costs by up to 79%. Reinvesting these cost savings into greater emissions reductions would nearly double cumulative emissions reductions from 2020-2035 relative to current NDCs[106].

Some of the contentious issues that require global negotiation include double counting and the corresponding adjustments, environmental integrity and carry over of pre-2020 Kyoto mechanism units.

Double counting might occur if one country sells emissions reductions to another and also claims them towards its own NDC. If there's no corresponding adjustment, the emissions reductions of that project are counted twice.

Environmental integrity ensures the SDM delivers real, additional benefits to GHG mitigation that would not have otherwise occurred and prevents carbon leakage, where business production is relocated to countries with lower emissions and environmental standards. Another issue is whether countries can use existing credits generated under the Kyoto Protocol prior to 2020 (carry-over credits) towards their NDCs.

[105] Paris Agreement https://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf

[106] Environmental Defense Fund The Power of Markets to Increase Ambition www.edf.org/sites/default/files/documents/Power_of_markets_to_increase_ambition.pdf

Bilateral Emission Trading Deals

While negotiations over global carbon market structure remain uncertain, some countries have agreed bilateral deals in which one country pays to reduce emissions in another and applies those reductions to its own emissions inventory. Some countries have also established bilateral partnerships that enable climate change cooperation.

For example, Switzerland signed a carbon offsetting agreement with Peru in October 2020, which allows Peru to fund sustainable development projects and Switzerland to count the resulting emissions cuts against its national targets[107]. Switzerland signed a similar agreement with Ghana in November 2020, which allows it to offset part of its emissions through climate projects in Ghana[108].

The US and India launched the US-India Climate and Clean Energy Agenda 2030 Partnership in April 2021. The countries committed to working together to achieve their climate and clean energy targets and strengthen bilateral collaboration across climate and clean energy. The partnership focuses on two main areas: the Strategic Clean Energy Partnership and the Climate Action and Finance Mobilization Dialogue[109].

Australia has partnerships with the EU, UK, US, China, South Africa, New Zealand and Japan. Australia also signed a memorandum of understanding (MoU) with Singapore in October 2020 to advance cooperation on low-emissions technologies and solutions. Under the MoU, Australia and Singapore will share technical knowledge and experience and collaborate on the development of new technologies that will reduce emissions[110].

In addition to bilateral deals, countries have been taking steps towards multilateral emission reduction initiatives, such as the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) and the global market for maritime emissions.

CORSIA

CORSIA is a market-based mechanism developed by the UN's International Civil Aviation Organization to address emissions from international aviation. It requires airlines and other aircraft operators to offset any growth in carbon emissions above the 2019 base year. The goal is to achieve carbon-neutral growth in international aviation until low-emission technology such as sustainable aviation fuel can be scaled up[111].

The scheme was agreed by 192 countries in 2016 and started operating in January 2021. CORSIA will be implemented in three phases. A pilot phase from 2021 to 2023 and the first phase from 2024 to 2026 are voluntary, while the second phase from 2027 to 2035 will be mandatory.

During the initial phases, CORSIA will only apply to international flights between states that have volunteered to participate. During the mandatory stage, CORSIA will cover all international flights with some small exceptions, representing more than 90% of all international activity.

CORSIA applies only to international flights as emissions from domestic flights are covered by the Paris Agreement.

Participating airlines and other aircraft operators will be required to buy and cancel approved offset credits equivalent to their final carbon offsetting requirements for the compliance period.

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[107] Peru and Switzerland Sign 'World First' Carbon Offset Deal Under Paris Agreement www.eceee.org/all-news/news/peru-and-switzerland-sign-world-first-carbon-offset-deal-under-paris-agreement/

[108] Switzerland and Ghana Sign Climate Protection Agreement www.admin.ch/gov/fr/accueil/documentation/communiques.msg-id-81266.html

[109] US-India Joint Statement on Launching the U.S.-India Climate and Clean Energy Agenda 2030 Partnership www.state.gov/u-s-india-joint-statement-on-launching-the-u-s-india-climate-and-clean-energy-agenda-2030-partnership/

[110] Australia and Singapore to Work Together to Accelerate Low Emissions Technologies www.minister.industry.gov.au/ministers/taylor/media-releases/australia-and-singapore-work-together-accelerate-low-emissions

[111] What is CORSIA and how does it work? www.icao.int/environmental-protection/pages/a39_corsia_faq2.aspx

International Shipping

The International Maritime Organization (IMO) is a specialized agency of the UN that is responsible for improving the safety and security of international shipping and preventing pollution from ships. It is also involved in legal matters, including liability and compensation issues and facilitating international maritime traffic. The IMO was established in 1948 and currently has 174 member states[112].

The IMO has adopted measures to reduce air pollution from ships and improve energy efficiency, including the energy efficiency design index, which is mandatory for new ships, and the requirement for a ship energy efficiency management plan for all ships. The IMO set a goal to reduce overall GHG emissions from maritime shipping by 50% by 2050 from 2008 levels.

To meet its goal, the marine environment protection committee adopted amendments to the international convention for the prevention of pollution from ships Annex VI in June 2021 that will require ships to reduce their GHG emissions. These amendments combine technical and operational approaches to improve the energy efficiency of ships[113].

Among other requirements, all vessels will be required to calculate their energy efficiency existing ship index, take certain technical steps to improve their energy efficiency and establish an annual operational carbon intensity indicator, which compares a vessel's GHG emissions to the transport work performed by such a vessel. The requirements are expected to come into effect in January 2023.

[112] International Maritime Organization www.imo.org/en/About/Pages/FAQs.aspx

[113] IMO Further Shipping GHG Emission Reduction Measures Adopted www.imo.org/en/MediaCentre/PressBriefings/pages/MEPC76.aspx

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ISDA has published a variety of other papers on ESG-related topics, including:

- ***Sustainability-linked Derivatives: KPI Guidelines***
  https://www.isda.org/2021/09/07/sustainability-linked-derivatives-kpi-guidelines
- ***Accounting Analysis for ESG-related Transactions and the Impact on Derivatives***
  https://www.isda.org/2021/09/07/sustainability-linked-derivatives-kpi-guidelines
- ***Implications of the FRTB for Carbon Certificates***
  https://www.isda.org/a/i6MgE/Implications-of-the-FRTB-for-Carbon-Certificates.pdf
- ***Financing a US Transition to a Sustainable Low-Carbon Economy***
  https://www.isda.org/a/qXITE/Financing-a-US-Transition-to-a-Sustainable-Low-carbon-Economy.pdf
- ***Overview of ESG-related Derivatives Products and Transactions***
  https://www.isda.org/a/qRpTE/Overview-of-ESG-related-Derivatives-Products-and-Transactions.pdf
- ***Derivatives in Sustainable Finance: Enabling the Green Transition***
  https://www.isda.org/a/KOmTE/Derivatives-in-Sustainable-Finance.pdf

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