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THE EVOLUTION OF CARBON MARKETS AND THEIR ROLE IN CLIMATE MITIGATION AND SUSTAINABLE DEVELOPMENT

INTRODUCTION

Climate science confirms the imperative to maintain global temperatures under 2°C and undertake efforts to limit the rise to 1.5°C above pre-industrial levels in order to avert extreme climate hazards. This requires that global annual greenhouse gas (GHG) emissions are halved by 2030 and reduced to net zero by 2050. Against this background, policymakers have launched initiatives at global and country levels to align socio-economic incentives towards the goals of the Paris Agreement. Among those, carbon markets represent an important element in achieving climate targets by attributing a price to carbon emissions, thus internalizing the climate externality into production and consumption decisions. They also play an important role in enhancing climate ambitions by increasing efficiency gains and lowering the marginal cost of abatement.

The importance of these markets has been highlighted recently in the G7 Climate, Energy and Environment Ministers' Communiqué (27 May 2022), which emphasizes 'the crucial potential of carbon markets and carbon pricing for incentivising investments in technologies, infrastructure and Nature-based Solutions that promote a transformation to net zero, accelerate cost-efficient emission reductions, and enhance the alignment of financial flows with the long-term goals of the Paris Agreement', highlighting 'that the revenues generated through carbon markets and carbon pricing can enable countries to finance further climate action, and to support vulnerable and low-income households in the transformation to net zero'[1]. The G7 ministers of climate, energy, and the environment pledged 'to expand the ambitious use of carbon markets and carbon pricing around the world'[2]. Indeed, carbon markets have been expanding rapidly in recent years. According to the *Economist*[3], by the end of 2021 more than 21 per cent of the world's emissions were covered by some form of carbon pricing, with trading on these markets growing by 164 per cent in 2021 to $897 billion. This issue of the *Oxford Energy Forum* focuses on the role of and recent developments in carbon markets.

Developments in global carbon markets

The *Forum* opens with a review of recent developments in global carbon markets. In his article, James Henderson notes that as countries increasingly set net-zero targets for carbon emissions, there is an emerging realization among governments that the imposition of policies and regulations can be enhanced by the creation of economic incentives to reduce emissions. These include carbon taxes which put a price on CO_2 emissions while not specifically constraining the total volume of carbon emissions. In contrast, carbon markets set a cap on total carbon emission volumes and allow the market to set a price for carbon determined by the supply and demand of emission allowances. Henderson focuses on the markets for carbon allowances, often known as emissions trading systems (ETSs), though recognizing that there is a strong trend towards increased trading of carbon offsets and often these credits fall outside the scope of regulated or compliance carbon markets. Based on data from the International Carbon Action Partnership, he notes that 25 ETS systems are currently operating around the world and 22 further ETSs are under development or under consideration. In terms of regions, Europe has tended to lead the way, and the EU ETS remains one of the largest carbon markets in the world. In the US, emissions trading initiatives are being led by various states, of which the most prominent is California. Another important cross-state trading bloc in the US is the Regional Greenhouse Gas Initiative, which covers emissions from the power sector in 10 states in the north and east of the country. In Latin America, developments have been slower, though in Mexico, a pilot ETS started in 2020, covering direct emissions from the energy and industry sectors; while in Colombia, its Climate Action Law has for the first time obliged the reporting of GHG emissions by registered entities with a view to starting an ETS pilot project over the next few years, and ultimately to have a fully operational ETS by 2030. But perhaps the most important development in carbon markets since their inception occurred in Asia in 2021 with first trading on China's national market. Henderson notes that the increase in ambition to cut emissions and the resultant rise in activity on carbon allowance markets have led to an increase in carbon prices across the world, reflecting the setting of more aggressive emissions caps and the expectation of further tightening to come.

The EU Emissions Trading System

The *Forum* then looks at some of these markets in greater detail. Alex Barnes notes that the EU ETS is one of the key pillars of the EU's decarbonization efforts. It has been in place since 2005 and has evolved since then as the EU's climate change

[1] G7 Climate, Energy and Environment Ministers' Communiqué, 27 May 2022
[2] G7 Climate, Energy and Environment Ministers' Communiqué, 27 May 2022
[3] 'Carbon markets are going global. But will they make a difference?'. 26 May 2022. https://www.economist.com/finance-and-economics/2022/05/26/carbon-markets-are-going-global

policies have become more ambitious. The most recent iteration of this is the EU's 'Fit for 55' package, published in 2021, which aims to reduce the EU's emissions by 55 per cent by 2030. In addition, the Commission proposes extending the ETS to sectors not previously covered. Whereas the original ETS covers large stationary industries, the new ETS will directly affect final consumers. The author notes that a key area of recent debate has been the level of ETS allowance prices. These have increased significantly from a level of around €20 per tonne of CO_2 (tCO_2) in 2020 to nearly €100/tCO_2 in early 2022. There are concerns from industry and some member states that the rapid and large price increases are a sign that the ETS is not working properly. Barnes, however, argues that it is important to distinguish between symptoms and causes. Calls to remove financial institutions from carbon markets will limit the ability of companies to hedge their future compliance costs, thus depriving companies of the very thing which they are trying to ensure, namely price stability. Measures which aim at managing the ETS price—for example by amending the Market Stability Reserve (MSR) so that it is driven by price signals rather than the quantity of allowances in circulation—also fundamentally contradict the aim of an ETS, which is for the market to determine the cost of carbon consistent with a given emissions reduction target. The author concludes that a move towards greater intervention in the ETS based on price levels creates the risk of more policy uncertainty, and hence greater volatility in terms of carbon prices. This is not to say that the current ETS is perfect. Better monitoring and supervision of carbon markets are welcome developments, but efforts to target price levels seem misplaced.

In response to Russia's invasion of Ukraine, the European Commission and national leaders have called for an acceleration of the EU's planned shift from fossil fuels to renewables. Elisabetta Cornago discusses how this context is affecting ongoing discussions around the reform of the EU ETS. The Commission estimates that implementing the REPowerEU plan would require investments of around €300 billion by 2030. The bulk of these funds would be reoriented from unused loans from the Recovery and Resilience Facility. But financing REPowerEU investments is bound to have a direct impact on the EU ETS as the Commission has proposed to raise €20 billion by auctioning emission allowances currently held in the MSR, which currently functions based on predefined rules and thresholds. The author argues that reaching for allowances to finance part of the REPowerEU investments is a dubious approach that poses several risks for the EU ETS. Cornago argues that it is unclear how this auction could be organized without disrupting the carbon market, as releasing more allowances risks reducing the carbon price at a time when its stability and direction of travel are ever more critical to drive investments in decarbonization. Higher carbon prices are needed to strengthen incentives to cut emissions. This may also undermine the no-discretion principle on which the MSR is founded, hurting the attractiveness of the carbon market in the longer term. The Commission has also proposed to create a new emissions trading system (ETS2) to cover road transport and building heating as of 2026. Critiques of extending emissions trading to consumer-oriented sectors complain about the distributional impacts of higher energy prices. The author argues that that is a valid critique but it fails to recognize that making good use of revenues from ETS2 would make the scheme progressive.

Katherine Connolly, Nicolas Lockhart, and Stella Perantakou follow on the ETS theme and explain how the EU is seeking to internalize the environmental costs of aircraft emissions. This is occurring through various means. The EU is gradually phasing out so-called free allowances currently granted to the aviation sector. In parallel, the EU is also proposing new sustainable aviation fuel requirements for aircraft leaving an EU airport. At the same time, substantive obligations under the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) are also coming into effect. The interaction between the EU ETS and CORSIA creates a somewhat complex web of obligations. The authors identify some key areas to watch out for. The first is that the recent agreement on the so-called Paris rulebook will shortly also be added to the mix. The adoption of the Paris rulebook may prompt increased demand across the board for high-quality carbon credits—both in compliance markets (where offsetting is legally required) and in voluntary markets (to support voluntary net-zero pledges). This may make CORSIA-eligible carbon credits more expensive over time. Second, the authors argue that the importance of these developments is unlikely to be limited to the aviation sector, as the ETS/CORSIA combination may provide a blueprint for addressing the emissions of other industries. Top of the list is shipping. The EU has already proposed to expand the ETS to cover maritime emissions generated during berth at EU ports, from voyages within the EU, and even from the EU to third countries (counting half of those international emissions). The EU's plans to apply ETS not only to domestic shipping but also to international shipping may encourage states within the International Maritime Organization to follow the International Civil Aviation Organization in adopting a CORSIA-like offsetting framework for emissions resulting from international shipping.

Elin Akinci explores further the issue of free allocation. On 17 May 2022, lawmakers in the European Parliament´s Committee on Environment voted and agreed on a compromise deal to phase out free allocation over the period 2026 to 2030. The timing of the phase-out of free allocation is one of the most controversial issues in the Carbon Border Adjustment Mechanism (CBAM) file, as it will transfer huge EU allowance volumes from free allocation to auctioning and force a large number of manufacturing industries, in particular, to trade, hedge, and buy more actively, and thus certainly raise costs for those industries significantly. Industries concerned are not in favour of a policy that does not see CBAM as a supplement to free allocation. The European steel industry is, for instance, arguing that the industry alone risks losing up to 20 million tonnes of exports worth €45 billion and at least 30,000 jobs as a result of the reform on phasing out free allocation by 2030. Also, European products that are manufactured from those industries that are currently receiving free allocation will be significantly more expensive. In order to reach the Union's ambitious renewable energy targets, demand for products, such as steel and cement, as well as raw material such as copper, is essential. According to the EU Commission's REPowerEU plan, meeting a large part of this increasing demand should be done within the Union. However, phasing out free allocations could result in conflicting objectives and could challenge the union's ability to meet ambitious renewable targets, as essential materials for the renewable buildout produced in Europe, like steel, copper, and cement, risk increasing in price even further. A good example of where conflicts can arise is Europe's growing steel import dependency related to EU's wind energy buildout target. The importance of material like steel, copper, and cement in the capex calculations of wind producers risks raising break-even costs for future projects.

The Carbon Border Adjustment Mechanism and free allowances

One of the European Commission's most controversial proposals is that of the CBAM. Sanna Markkanen notes that the idea behind the EU CBAM is to 'equivalize' the impact of the EU carbon price on certain European energy-intensive sectors by imposing a comparable fee on imported materials. By doing so, the CBAM is expected to reduce the risk of so-called carbon leakage. Carbon leakage would result in an increase in global emissions because more production of carbon-intensive materials would take place in countries where emissions are less regulated. However, Markkanen notes that the justification for the CBAM can be, and has been, questioned extensively. So far, there is no evidence that the EU's carbon price has caused carbon leakage since its introduction in 2005. The question of free allocation is also highly relevant to implementation, yet the removal of free allocation is also the root cause of some of the most vehement opposition to it. Markkanen argues that on a purely theoretical level, an aim to incentivize more ambitious climate action could be regarded as a relatively sound justification for calling the CBAM a climate policy measure as opposed to a protectionist trade measure. However, it is not clear how, or whether, the CBAM alone will present a sufficient incentive for carbon pricing in countries outside the EU instead of simply reducing demand for foreign-produced materials in the EU. The author notes that the EU's trade partners have a set of response options open to them. They may wish to negotiate with the EU to acquire an exemption; however, for a total exemption a country must link its carbon pricing mechanisms with the ETS, which is a challenging task. Other alternatives open to trade partners include legislative action against the EU, retaliation, and compliance, but all these options have their limitations. Markkanen concludes by arguing that the CBAM could be considered a great idea, but it is not yet clear whether its practical application can be successful. A lot depends on the details of the EU's CBAM Act, which currently remain undecided, and on trade partners' reactions. However, there are two things for sure, according to the author: the EU will almost certainly implement some type of a CBAM, and the success of this policy measure will be determined by how quickly it becomes obsolete.

Dongmei Chen and Bertrand Rioux also look at the CBAM and its potential implications for a group of countries (the US, China, and Saudi Arabia). The US has pledged to achieve net zero emissions by 2050. This could present an opportunity for the EU to develop joint CBAM measures under a new EU–US agenda. However, this depends on the design of the CBAM framework and the progress of carbon pricing schemes in the US. As to China, it is taking two different approaches. On international platforms, China has been resistant to the EU CBAM, arguing that it is contrary to the spirit of the United Nations Framework Convention on Climate Change (UNFCCC) and that the whole design of CBAM is for protectionism rather than climate preservation. However, domestically China has been very active and ambitious in dealing with carbon emissions. Expanding the scope of China's ETS from the power sector to the commodities covered by the EU's CBAM and building linkage between the two ETSs could be an ideal option for both China and the EU. As to oil and gas producers, CBAM could push them to align their development plans with CBAM as some producers such as Saudi Arabia can develop advantages from shifting the oil and gas assets to clean hydrogen provision. However, this would require broader international cooperation to harmonize standards and improve the robustness of carbon accounting and verification for global hydrogen trade. It will also be critical to create

innovative financial incentives for a larger-scale deployment of carbon capture and storage to reduce the carbon intensity of hard-to-abate sectors.

Developments outside the EU

The *Forum* then shifts its focus to carbon markets outside the EU. Yan Qin looks at China's national ETS, which was launched in 2021, obliging more than 2,000 power generators to surrender allowance units to account for their 2019–2020 emissions. This was built upon experiences from seven pilot ETSs in operation since 2013, and the national carbon trading finally started on 16 July 2021 at the Shanghai Environment and Energy Exchange. Only power generators have a compliance obligation for now, but the scope will expand in the coming years with all the industrial sectors likely to be added. Power generation is such a large contributor to China's overall GHG output that in its current scope the ETS covers annual emissions close to 4.5 billion tonnes of CO_2 per year or around 40 per cent of China's total emissions. Qin argues that the carbon market is expected to be an important instrument in achieving the country's climate targets. However, the low allowance prices and muted trading liquidity have raised doubts over its role, in addition to concerns over emissions data fraud unveiled among some compliance entities. Lack of clarity over the second compliance period and progress in carbon market legislation are creating uncertainties too. Nevertheless, the launch of this nationwide carbon market has finally established the concept of national carbon price in China. It could support establishing a robust CO_2 emissions reporting and monitoring system which lays an essential foundation for China's achievement of its carbon peak and neutrality goals.

Mari Luomi explores carbon markets and opportunities for the Gulf Cooperation Council (GCC) countries. She notes that as of today, none of the GCC countries has in place a carbon tax or a regulated carbon market mechanism. All six countries have, however, expressed interest in participating in international carbon markets in their most recent Paris Agreement Nationally Determined Contributions. GCC countries have not been keen to implement economy-wide carbon or GHG pricing as this has been perceived as potentially harmful for economic development and, most critically, the competitiveness of the region's energy-intensive export industries. For a long time, carbon pricing instruments were therefore not seen as an attractive policy instrument at the national level. However, like many other developing countries, GCC countries engaged in international carbon markets through the Kyoto Protocol's Clean Development Mechanism. It will be on this basis that much of the region's participation under Article 6 will initially build. In addition, Saudi Arabia has also participated in international carbon markets through the Joint Crediting Mechanism. Luomi argues that as the region gears up to participate in international carbon markets, it will be important to bring together actors that worked on these projects and participated in these early market exchanges. This will help save time and resources and can guide decision makers towards options that have already been tested and worked and away from ones that did not work. Luomi argues that carbon markets could make an important contribution to raising ambition and lowering costs of emissions reductions in the GCC. But well before considering the regional dimension of carbon markets, the GCC countries have a significant amount of work ahead in building institutional and human capacity across government and the private sector to enable the development of the required measurement, reporting, and verification (MRV) frameworks, governance arrangements, and carbon credit-generating activities themselves, among other things. On the positive side, there appears to be a good amount of momentum in many of the GCC countries around voluntary carbon markets, which bodes well for their active engagement in both domestic and international carbon markets in the Paris era.

Carbon market linkages

Carbon markets globally remain segmented and largely asynchronized. Given the emergence of different markets with different designs, the issue of carbon market linkages becomes paramount. Mengfei Jiang, Xi Liang, Shihan Xiong, and Xiaoqing Wang argue that a harmonized international carbon market could facilitate coordination between carbon markets, ensure environmental integrity, and ultimately ensure ecological integrity to stimulate greater ambition for climate action. However, a single global carbon market is an unlikely outcome in the near future due to the heterogeneity of currently existing and emerging carbon markets as well as the growing range of implicit and explicit carbon pricing mechanisms. It is more likely that any international trading system will grow out of bilateral and multilateral agreements authorized and entered voluntarily by participating parties, and here lies the importance of carbon market linkages. Links can take different forms in three main ways. The first is bilateral/multilateral. The second is direct/indirect (a direct linkage means that one ETS accepts units issued by another ETS, while an indirect linkage is a situation where both ETSs recognize units from a third system). The last one is full/regional linkage. Although linking ETSs would generate multiple benefits, such as lower overall abatement costs, increased market liquidity, reduced price volatility, and potential reduction in the risk of carbon leakage, such linkage faces many

challenges. ETSs differ from country to country in terms of fundamental design. Moreover, there will be a considerable dispute regarding the distribution of emission allowances. Another significant concern is the potential unfairness and inequity in linked systems. The actual effort taken to reduce one tonne of emissions in one jurisdiction might be different from that taken in others due to the differences in the marginal costs of abatement. The authors argue that to tackle the above potential unfairness and inequity issue, all allowances must be of comparable value to achieve economic efficiency and environmental efficacy. Only when marginal abatement costs are comparable can efficiency gains be realized, and thus the authors recommend that mitigation outcomes should be valued based on assessing their mitigation impact.

Voluntary carbon markets

The *Forum* then shifts its focus to voluntary carbon markets (VCMs). Bassam Fattouh and Andrea Maino argue that the completion of the rulebook for Article 6 of the Paris Agreement is a necessary step towards building a robust framework in which participants can use collaborative approaches and a market-based mechanism to promote climate and sustainable-development goals. There is widespread expectation that the Article 6 rulebook will create the conditions for effective and robust international carbon markets to thrive, including continued, significant growth in private sector investments through voluntary carbon offset projects. However, there are still some uncertainties surrounding the wider implications of Article 6 for carbon markets. The authors highlight the issue of the diversity of carbon credits available for investors and the uncertainty faced by investors when investing and trading on projects and their underlying credits as well what corporations can claim by purchasing these different carbon offsets. Participants in VCMs will be closely examining the implications for investors in terms of balancing investments in corresponding adjusted versus non-corresponding adjusted credits and accessing high quality projects including carbon removal credits. They will also be considering options to manage some of the risks associated with governments' authorization processes, how corresponding adjustments are applied, and the governance frameworks in place, and assessing the financial and reputational risks of some countries not being able to meet their Nationally Determined Contributions while engaging in large transfers of internationally transferred mitigation outcomes (ITMOs). Various supervisory efforts are already underway to help reduce uncertainty and provide more clarity for users of these markets. These include the UNFCCC Article 6 Supervisory Body (scheduled to meet twice in 2022), the Taskforce for Scaling Voluntary Carbon Markets, the Integrity Council for Voluntary Carbon Markets, the Voluntary Carbon Market Integrity Initiative, and the various accreditor organizations such as Gold Standard and Verra. Also, the UN Secretary General has recently launched a high-level expert group with the task of assessing current standards and definitions for setting net-zero targets by nonstate actors. There is hope that as rules, guidance, and frameworks from regulated and market-led initiatives consolidate, this would create the regulatory certainty to ensure the environmental integrity that investors seek.

On the same theme, Dominic Coppens and Nicolas Lockhart discuss the recent finalization of the Article 6 rulebook and its implications for carbon markets. Building on the growing number of net-zero commitments in the private sector, Dominic and Nicolas note that carbon credits will be a key element of the net-zero toolbox, allowing companies to offset emissions they cannot yet cut. The carbon credit market is expected to grow significantly in the coming years, with the VCM potentially growing from the current $1 billion per year to $50–100 billion by 2030. After discussing the main elements of the Article 6 rulebook, Dominic and Nicolas focus on the impact on the supply and demand for carbon credits going forward. On the supply side, they note that two main types of credits will emerge, adjusted and unadjusted, depending on the authorization status granted by the host country. In particular, the authorization status of a credit is expected to affect its pricing. On the demand side, they note, the Article 6 rulebook does not directly regulate either compliance markets or VCMs or the use of those by companies, but it is still expected to foster integrity and uptake of these instruments. Another important element in assessing the functioning, credibility, and transparency in the VCM is assessing the quality of credit. Quality in the context of VCM credits is multifaced and can be linked to the issue of sustainable development goals benefits and permanency of credits.

Ana Haurie notes that achieving net zero requires not only urgent action but also a vast investment of up to $100 trillion between now and 2050. It is therefore crucial that we harness private sector capital and realize the huge funding and mitigation potential of the VCM. Because of the VCM, in the past 10 years almost 850 million tonnes of GHG emissions have already been removed or avoided by climate projects that would not otherwise have been funded. Haurie notes that the VCM rests on two fundamental principles: high-integrity demand and high-quality, impactful supply. On the supply side, carbon mitigation projects fall into two distinct categories: removal, either via nature-based solutions (NBS) such as reforestation or by technological solutions such as geological storage of direct air carbon capture, and reduction/avoidance, such as the protection and

conservation of existing forests and wetlands, or via technology such as renewable energy or carbon capture and storage in fossil fuel power stations. In both categories, project quality is paramount to counteract accusations of 'greenwashing'. She also notes that until recently NBS enterprises have been underfunded and undervalued. The VCM, however, puts a monetary value on nature and the benefits it provides. Currently, NBS credits aren't allowed in most compliance markets, so it is up to the VCM to unlock the capital flows essential for such projects. Alongside emissions mitigation, nature-based VCM projects often have significant co-benefit impacts including maintaining biodiversity, encouraging sustainable development, and supporting local communities. The fact that the VCM puts a value on nature and pays local people to protect and develop its ecoservices creates a powerful sense of ownership and responsibility. On the demand side, the author argues that it is absolutely essential that, before using carbon credits, companies first avoid and reduce their own and supply-chain emissions as much as possible, set future targets, and then deliver on them. Nevertheless, in the short term, mitigation strategies may take time to produce results, and in the longer term, some remaining emissions may still be inevitable. High-quality carbon credits can address these problems by creating impact immediately and by compensating for unavoidable residual footprint. This means acknowledging the difference between a company's near-term transition and its longer-term destination of net zero.

Hannah Hauman and Malihah Shah argue that while there has been significant growth in carbon finance and in the VCM to date, projects have primarily focused on avoided emissions instead of the development of negative emissions in the form of carbon removals. This is not due to lack of demand. Over 130 countries and 700 companies have committed to net zero by 2050, many of which adhere to UN Science Based Targets that require carbon removals for offsetting residual emissions. Hauman and Shah argue that the market infrastructure to enable meaningful scale goes far beyond traditional facilitators such as registries, regulators, and exchanges and extends to the market participants. They note that just as an exchange facilitates transactions for clearing risk, supply chain experts and commodity risk managers are uniquely well suited to manage the inherent physical risks underlying the carbon removals market to deliver solutions at scale and support the backbone of the global carbon removals market. While the most important of these is the demand signal from net-zero ambitions, there is an equal challenge on the supply side of the equation which requires expertise in operational risks associated with physical assets, understanding of and appetite for policy and country risk, credit and counterparty risk, and finally price risk management. This requires an increased level of commitment from traditional commodity participants who are uniquely equipped to manage physical, legislative, and financial risks, such as supply chain managers, banks, and the insurance community, to adapt best practices from some of the most sophisticated markets in the world into what needs to urgently become one of the largest.

Following on the same theme, Sahar Shamsi and Carlotta von Bebenburg propose a framework for issuance, trading, and ETS integration of technology for permanent greenhouse gas removal (GGR). In light of high costs of abatement for certain economic sectors, solutions which may permanently remove carbon emissions, via either NBS or technological solutions, will become increasingly important to compensate for residual emissions. To promote the uptake of these solutions, Shamsi and von Bebenburg propose different options for the integration with ETS systems. These include separate markets with government as a broker, separate markets with a price cap, integrated markets, and carbon removal obligations. To achieve any of these options, there are two key and immediate practical steps that need to be taken: establishing an MRV and discounting process and deciding on how to ensure the uptake of GGRs in the ETS by either adding more funding schemes to ensure competitiveness or mandating the use of removals. The authors argue that finding routes to market for carbon removals is vital given the importance of these technologies in meeting the Paris Agreement in the coming decades.

In his article, Hasan Muslemani highlights the rise in the interest in carbon dioxide removal (CDR), which can be explained by a number of factors. First, CDR methods have the potential to instantly pull CO_2 out of the atmosphere. Second, they have an element of permanence or durability. Third, some engineered CDR, such as direct air capture technology, has the potential for high scalability. Muslemani argues that traditionally, entities interested in the VCM are likely to view carbon credits and their associated projects in two different dimensions: the monetary and the physical. Solely looking at these factors, avoidance solutions would be implicitly favoured over removals, as options to avoid emissions are much more diverse and are generally at more mature stages (e.g. renewables) and there are not as many limits to scaling up some avoidance projects (e.g. energy efficiency enhancement, avoiding deforestation, and transport electrification). Also, avoidance credits boast significantly cheaper prices, ranging from \$1–20/tCO_2e up to \$4–75/tCO_2e for NBS removals and \$200–1,000/tCO_2e for engineered removals. Muslemani, however, emphasizes that the introduction of CDR methods into the VCM brings about a new dimension: the temporal. CDR solutions have the capacity to lock CO_2 out of the atmosphere for specific periods of time—up to decades or

millennia—which renders them fundamentally different from avoidance projects. More critically, CDR options differ amongst themselves, with different solutions having different permanence (i.e. durability) levels. Failing to distinguish between their durability risks creating similar quality–cost discrepancy, market distortion, and even investor distrust to those seen in the current version of the VCM. From this perspective, purchasing removal credits which only offer a temporary storage option becomes more akin to renting an asset than buying it, where the benefit accrued (climate mitigation in this case) may not be long-lived as it may be subject to reversal if continuation beyond the commitment period is not guaranteed or long-term liabilities are not properly allocated. Hence, ideally, the cost of different CDR solutions should be correlated with their longevity, and carbon markets should reflect this.

Derivatives and carbon markets

The Forum then shifts its focus to the role that derivatives play in carbon markets. Derivatives markets have historically played an important role in commodity markets. They provide market participants with hedging instruments, risk sharing, enhanced liquidity, and term expectations on the underlying commodities. In the context of net-zero commodities, such as traded allowances and credit offsets, derivatives markets are expected to play an important role.

Olga Roman argues that reducing emissions and adapting to climate change will require significant public and private investments. 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 channelled towards sustainable investments and net-zero-emissions activities. Derivatives also play a critical 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. Also, 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. 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. 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. In terms of key players in carbon markets, the author notes that 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. Roman also notes that several derivatives exchanges offer standardized futures and options derivatives contracts on GHG emissions allowances and offsets. But while trading on exchanges provides more liquidity, over-the-counter markets allow participants to customize their transactions to meet particular risk management needs. The ability to trade over the counter 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.

Following on the same theme, Owain Johnson argues that there is a well-worn path for market development in the commodities sector. The initial market structure is typically a long-term sales agreement between a buyer and a seller. This is often followed by a trend towards shorter-term ‘spot’ sales, sometimes linked to a published floating price, which then often leads in time to the development of more sophisticated risk management tools such as futures and options. The author notes that the VCM has been closely following this very standard model of market development. The key difference is that the structures that took decades and even centuries to develop in the traditional commodity markets are developing in voluntary carbon at a significantly faster pace, with major changes and new mechanisms emerging almost on a monthly basis. Many contracts have now been developed including the CBL Global Emissions Offsets (GEO) and CBL Nature-Based Global Emissions Offsets (N-GEO). In 2022, the CME exchange added a third product, the CBL Core Global Emissions Offsets (C-GEO). Johnson argues that this was a very significant development in a market where price transparency has been a challenge in the past. Previously, market participants were able to track the historical evolution of the spot price of voluntary carbon, but there was no market for the transfer of credits at future dates. The transparent publication of a forward curve has proved to be a critical step forward for market development in that it provides an objective valuation of expectations of the current price for delivery of offsets in the months and years to come.

Carbon markets and justice

In the broader context of the potential for climate change to also promote the achievement of the Sustainable Development Goals, carbon markets could represent a just solution to the climate emergency. In the final article, Raphael Heffron examines how justice could be achieved by the development of carbon markets. Heffron identifies five key forms of justice that carbon market policy should and can aim to achieve: distributive justice (concerned with the distribution of benefits from the energy sector and also the negatives, for example, whether energy revenues are shared sufficiently), procedural justice (concerned with the legal process and questions around market structures), restorative justice (concerned with any injustice caused by the energy sector which should be rectified, for example, impacts from the environmental effects of CO_2 emissions such as on health), recognition justice (concerned with the recognition of rights of different groups and in particular local and/or indigenous communities, or vulnerable energy groups) and cosmopolitan justice (concerned with the view that in energy we are all citizens of the same world and therefore the cross-border effects from energy activities need to be considered, such as the effects from cross-border CO_2 emissions). Heffron argues that carbon markets can contribute to these five key forms of justice and ensure that society advances in its mission to have a low-carbon economy. One of the positives of a carbon market is that it can raise revenues and ensure that these are redistributed more equitably. Heffron highlights an example of the redistributive benefits from the Canadian carbon market in Quebec.

A REVIEW OF GLOBAL CARBON MARKETS

James Henderson

As countries increasingly set net-zero targets for carbon emissions by some fixed date in the future (most often 2050, but occasionally later), there is an emerging realization among governments that the imposition of policies and regulations can be enhanced by the creation of economic incentives to reduce emissions. Carbon taxes can be used to put a price on CO_2 emissions (referred to as 'carbon' hereafter) while not specifically constraining the total volume of carbon emissions. In contrast, carbon markets set a cap on total carbon emission volumes and allow the market to set a price for carbon determined by the supply of and demand for emission allowances. Both mechanisms create a price signal for consumers, and are increasingly being seen as a necessary, albeit not sufficient, tool in the battle to keep the rise in global temperatures to less than 1.5°C, or perhaps more realistically 2°C, above pre-industrial levels.

This article will focus on the market for carbon allowances, often known as emissions trading systems (ETSs), within which large emitters are regulated to retire allowances to offset their carbon output in excess of a specified cap, while smaller emitters can sell any excess allowances which they possess.[4] An emerging trend is the increased trading of carbon offsets, whereby carbon credits created by projects that reduce carbon emissions (for example the planting of trees) can also be traded to offset emissions, although often these credits fall outside the scope of regulated (or 'compliance') carbon markets and are instead restricted to uses within voluntary carbon markets. This short paper focuses mainly on global initiatives concerning the compliance carbon market in the form of ETS mechanisms for allowances, but will also highlight countries and regions that are now trying to combine the two into consolidated markets.

There are two main types of ETS—'cap and trade' and 'baseline and credit.' A prime example of the former is the EU ETS, within which the European Commission has determined a limit in emissions (the cap) during a specific period and allowances that make up the cap either are allocated to specific industries and companies or are auctioned, with the market then setting the price. As the cap is reduced over time, the price is likely to rise and a greater incentive to invest in emissions reduction is created.

Under the baseline and credit system, regulated emitters are allocated a baseline and either must surrender credits if their emissions go above the limit or can receive credits if they reduce emissions below the limit. These credits can then be sold to other emitters. An example of this type of system is the new China ETS, within which companies are allocated allowances according to their verified emissions and can sell them if they can reduce their carbon intensity.

[4] It is worth noting that Emissions Trading Systems across the world cover a range of emissions. All include the trading of CO_2, but many (including the EU's) do not include other emissions such as methane or other gases which cause global warming.

It is also important to mention that the sector coverage of global carbon markets varies, with some countries prioritizing the power sector (the Regional Greenhouse Gas Initiative in North America being an example) while others also include some industrial, buildings, and transport sectors (New Zealand, for example, covers its entire energy economy).

In terms of overall numbers, the International Carbon Action Partnership (ICAP) notes that 25 ETS systems are currently operating around the world.[5] The World Bank, in its Carbon Pricing Dashboard,[6] records a larger 30 carbon pricing initiatives, but the discrepancy would appear to be in the definition of those ETSs that are currently scheduled for implementation. ICAP actually sees 22 further ETSs under development or under consideration, and in terms of emissions coverage it notes that 17 per cent of global greenhouse gas (GHG) emissions are now covered by an ETS. Indeed, it goes further and assesses that 37 per cent of emissions in countries or regions with net-zero targets are covered by an ETS, while the figure falls to 17 per cent in areas without a net-zero target.

A regional review of carbon markets

Europe

Europe has tended to lead the way in terms of the energy transition, and this is currently the case with carbon markets. The EU ETS remains the largest carbon market in the world (although it may soon be challenged by China) with $36.7 billion of auction revenues generated in 2021, compared with for example under $4 billion in California. The EU ETS covers the power, industrial, and domestic aviation sectors, but in 2021 significant changes were announced to align the market with the EU's new 2030 targets under the 'Fit for 55' programme. The new proposals include adjustments to the emissions cap, the inclusion of the maritime sector within the existing scheme, a Carbon Border Adjustment Mechanism (carbon border tax) for a limited list of sectors, and a separate fuel ETS for buildings and road transport. These will be discussed in more detail in other articles, but from a global perspective these moves keep the EU ETS on the cutting edge of global carbon market developments.

Other important developments in Europe have included the launch of a national ETS in Germany covering fuels from the transport and building sectors, with regulated entities buying their first allowances in 2021. The UK ETS also completed its inaugural year in 2021, with the new market largely mirroring the structure of its EU counterpart, covering the industry, power, and domestic aviation sectors. Auctioning and trading of allowances started in May 2021, and prices rose so rapidly during the year that the cost containment measure, put in place to allow the government to restrict excessive price movements, was triggered at the end of the year. However, the authorities did not issue new allowances in line with the UK government's increasingly ambitious net-zero targets.

Elsewhere in Europe Finland set up a working group to assess and prepare for a national ETS to cover the road transport sector, Montenegro initiated plans to align with the EU's carbon market structure by 2024, the Swiss ETS is now in its third trading period (and is the only ETS with a formal linkage to the EU ETS), and Turkey also accelerated plans to introduce an ETS, having finally ratified the Paris Agreement. Ukraine started the process of introducing measurement, reporting, and verification procedures ahead of plans for an ETS, while in Russia the island of Sakhalin in the far east of the country has launched a pilot ETS, introducing mandatory requirements for carbon reporting and allocating emissions allowances for the first time.

North America

In the USA emissions trading initiatives are being led by various states, of which the most prominent is California. Its cap-and-trade programme began in 2012, with the first compliance period in 2013–2014. Since then the extent of the system has expanded to cover around three-quarters of the state's emissions, and changes in 2021 have seen the addition of a price ceiling and a plan to introduce a steeper allowance cap decline through the rest of this decade. As a result, the price reached record highs in May 2021 and the price ceiling has been set at over US$72/t in 2022.

Since 2014 the California ETS has also been linked with the system in Quebec, where the power, buildings, industry, and transport sectors are included in a cap-and-trade system that covers 80 per cent of the state's emissions. Quebec's fourth compliance period began in 2021, during the year the free allocation rules were adjusted to allow further alignment with California, and at COP26 the state announced plans for further collaboration with the markets in New Zealand and Chile.

[5] International Carbon Action Partnership (2022), *Emissions Trading Worldwide, Status Report 2022*, Berlin: ICAP.
[6] World Bank (n.d.), *Carbon Pricing Dashboard*, https://carbonpricingdashboard.worldbank.org/map_data.

Another important cross-state trading bloc in the USA is the Regional Greenhouse Gas Initiative (RGGI), which covers emissions from the power sector in 10 states in the north and east of the country.[7] Each state has established an individual CO_2 trading program, which then interacts with the other states, and there is an automatic mechanism which adjusts the emissions cap down over time if prices are lower than expected. In 2021, Pennsylvania's state legislature passed a regulation that allows the state to participate in the RGGI from 2022, and North Carolina's environmental authorities have also initiated a process to establish an ETS that is aligned with the RGGI in order to allow it to join in the future.

Elsewhere, Oregon has adopted a new climate programme that involves an ETS that will have its first compliance period in 2022–2024, and in Washington a cap-and-invest programme covering all entities that emit more than 25,000 tonnes of CO_2 equivalent (tCO_2e) per year is due to start in 2023.

In Canada, the federal government has encouraged carbon pricing across all its provinces and territories, but each has been left to adopt its own system. A number have opted for a specific carbon levy, which has to have a minimum level of CAD50 (US$39) in 2022, while others (such as Quebec) have chosen a cap-and-trade market system. These must include an emissions reduction programme at least equal to Canada's national target, and the results must be shown to be at least equal to the implementation of a carbon tax. Aside from Quebec, Nova Scotia has also made plans for an ETS, but the necessary federal approval expires in 2022 and so the province is currently in consultation on its future plans.

Latin America

There is less immediate activity in the southern part of the Americas, although two countries have started work and another two are actively considering their options. In Mexico a pilot ETS started in 2020, covering direct emissions from the energy and industry sectors, which generate at least 100,000 tCO_2e per annum. A total of 282 entities are included, covering around 40 per cent of the country's total emissions, and they participated in the first two allowance allocations in 2021. The results of trading are currently being reviewed, with a view to running the pilot for one more year (2022) before going into full implementation in 2023.

Colombia's Climate Action Law has for the first time obliged the reporting of GHG emissions by registered entities, with a view to starting an ETS pilot project over the next few years and ultimately having a fully operational ETS by 2030. Chile is at an even earlier stage, as its new Climate Law aims to establish emissions limits and a price for carbon but has not yet settled on the system to be used to determine the carbon price. An ETS is one option being considered, but the current focus is on plans to gradually increase the carbon tax that has been in place since 2017.

Finally in the region, Brazil is engaged in a consultative process on the options for implementing an ETS. One proposal from the Ministry of Energy and Mines could see an ETS for the power sector, while the Brazilian National Congress is debating a broader system based on a national program for emissions reductions which is ultimately aimed at reducing GHG emissions by 50 per cent by 2030 compared to 2005 levels. A number of companies are currently involved in an ETS simulation experiment, with the result expected to be seen in the next year, and this could be a key determinant of the system for carbon pricing which the country ultimately adopts.

Asia-Pacific

Perhaps the most important development in carbon markets since their inception occurred in Asia in 2021 with first trading on China's national market. Previously eight regional pilot carbon markets had been operating, and although these are expected to continue trading in parallel with the national market in the short term, the ultimate goal is for them to be merged into the national market as sectoral coverage increases. In the first compliance period, the national market only covered the power sector, but more than 2,000 entities accounting for 40 per cent of total Chinese emissions took part in auctions and trading.

As described elsewhere in this Forum, the system is intensity-based, with ex-post adjustments to the overall cap being made based on actual production levels. It is anticipated that the market will expand to cover other sectors over time, as carbon emissions trading was confirmed as part of the Chinese government's 1+N policy framework in October 2021, and ultimately there is little doubt that China will soon have the largest carbon market in the world.

[7] The states are Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont.

However, the most established carbon market in the Asia-Pacific region is located in New Zealand, where an ETS has been in operation since 2008. It has very wide sectoral scope across almost all of the energy economy, and the system has recently been updated to introduce important new features such as a new cap on the supply of allowances, an auction process (which began in March 2021), and the replacement of an effective price ceiling with a cost containment reserve that can be triggered by a price above US$50/t. As a result, prices are expected to increase significantly over the next few years, with a new price floor set to rise to just under US$30/t by 2026.

South Korea also has an established ETS, which was launched in 2015. It covers 684 of the country's largest emitters and accounts for around three-quarters of the country's total emissions. Recent initiatives have seen the introduction of a price floor after allowance prices fell in 2020 due to the slowing of economic activity during the COVID-19 pandemic, and interestingly, financial intermediaries are also now being encouraged to take part in the secondary market in order to increase liquidity.

Elsewhere in Asia, a pilot ETS for the power sector was established in Indonesia in 2021, and a hybrid cap-and-trade system is due to start in 2022 following a presidential decree regulating the value of carbon emissions. Malaysia has also published a policy document on plans for a domestic ETS, while the Vietnamese government has issued regulations that include provisions for a national carbon market.

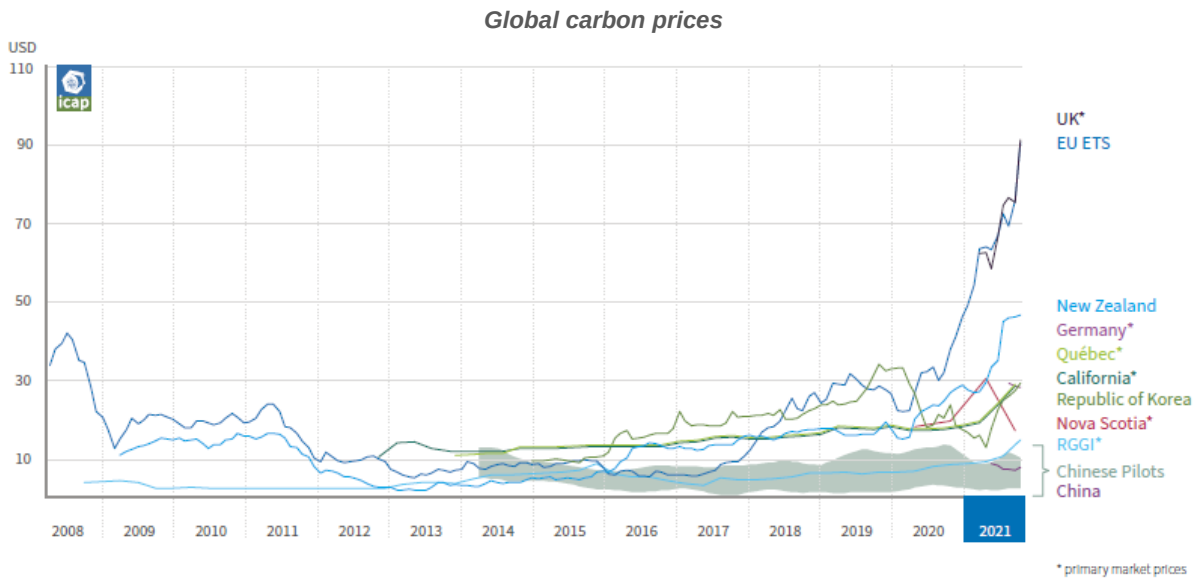
In Japan plans have also been developed to enhance the country's carbon pricing regime beyond the current carbon tax, with the Ministry of Energy proposing an ETS that could scale up an auction process in the early 2030s. Other ideas for the shorter term include a voluntary cap-and-trade programme, with companies setting emissions reduction targets based on technological innovation and then purchasing credits if they fail to achieve the required reductions. This national scheme will build on the existing cap-and-trade programme that has been operating in Tokyo since 2010 covering the industrial and commercial buildings sectors.

Pakistan is also working to create the framework for an ETS, starting with the implementation of a robust emissions measurement, reporting, and verification system over the next few years. Meanwhile the Philippines has introduced a Low Carbon Economy Act which is set to include a cap-and-trade system, although implementation has been delayed by the impact of Typhoon Rai and the COVID-19 pandemic. Finally, Taiwan and Thailand have introduced environmental legislation that provides for the formation of domestic carbon markets, with the former expected to set a timeline for the creation of an ETS in tandem with a specific carbon fee during 2022, while the latter plans a pilot ETS scheme and the publication of more detailed guidelines for carbon trading over the next 12 months.

Global carbon prices

The increase in ambition to cut emissions and the resultant rise in activity on carbon allowance markets has led to an increase in carbon prices across the world, reflecting the setting of more aggressive emissions caps and the expectation of further tightening to come. The price on the EU ETS reached a record level of over $100/t of CO_2 in 2021, and the graph below shows that significant price rises were also seen in other regions, with 2020 and 2021 marking a significant turning point in the pricing of carbon emissions across the world. In North America the allowance price in California rose from US$18 to US$29/t, while it increased from US$8 to US$14/t in the RGGI in the northeast USA. Significant increases were also seen in the Asia-Pacific region, with the price in South Korea rising by over 40 per cent to US$30/t and the level in New Zealand rising by an even larger 70 per cent to reach US$46/t.

These price rises mean that the revenues raised from auctions and other activities have also jumped sharply, with the total auction revenues to governments having reached more than $160 billion by the end of 2020, and with the EU ETS generating revenue of almost $37 billion in 2021 alone, a 63 per cent rise over the previous year.



Source: International Carbon Action Partnership (2022).

Trading of carbon offsets on domestic carbon markets

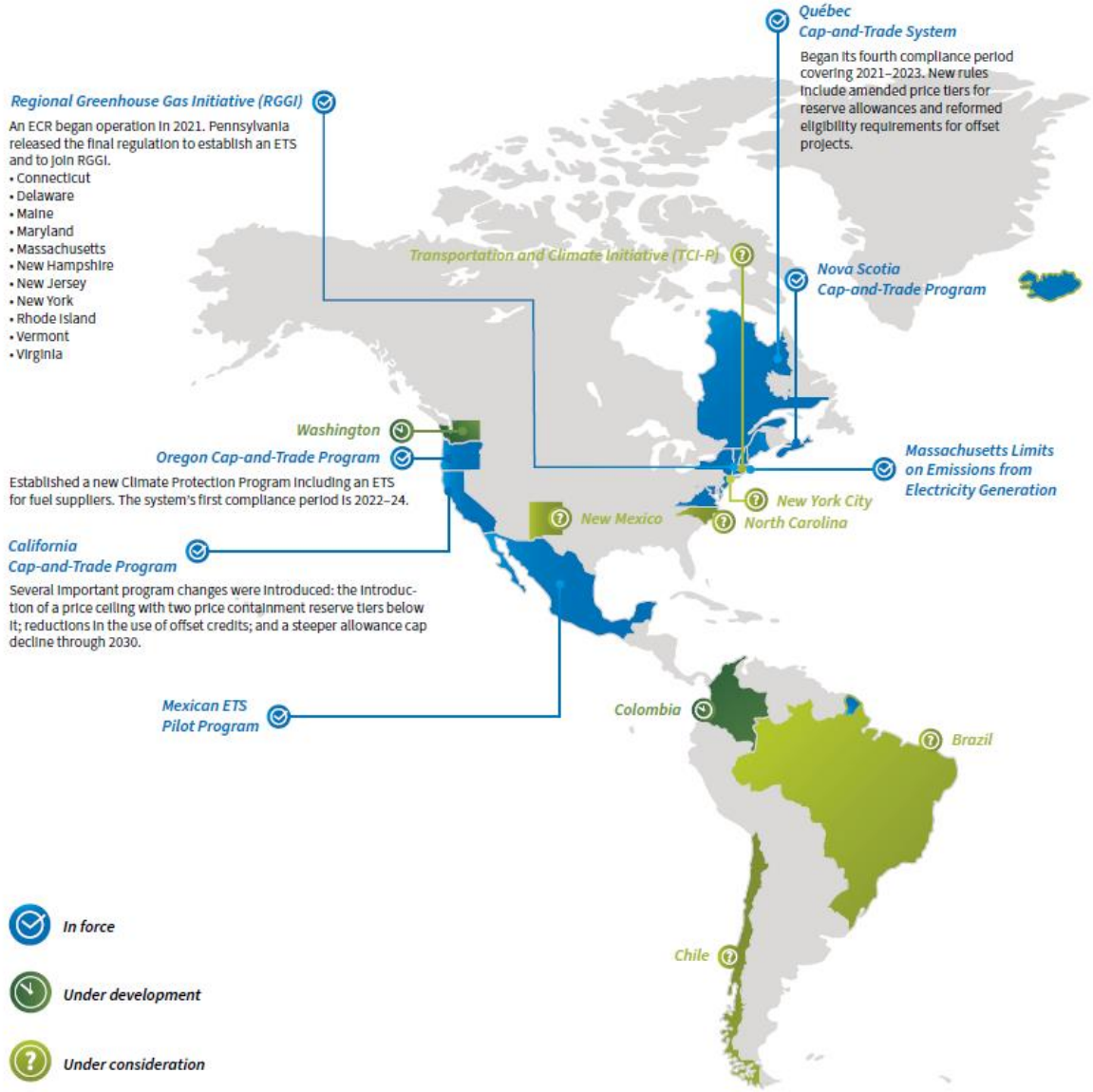
This short review of global carbon markets has focused on the trading of allowances, mainly using ETS systems. However, it is worth noting that in some jurisdictions carbon offsets can also be traded alongside allowances and can be used as credits in the event that companies exceed their emissions cap. Some regimes, such as the EU, the UK, Switzerland, Germany, and New Zealand, do not allow offsets to be used within their trading systems, although interestingly New Zealand does include the forestry sector within its ETS, which has a similar effect. However, in other markets, particularly in North America and Asia, offsets are starting to be allowed as a means to meet compliance obligations, with for example Quebec allowing up to 8 per cent of obligations to be offset, South Korea 5 per cent, and the RGGI 3.3 per cent.

Meanwhile, China and California allow forest-based offsets under strict rules to be used to offset 5 per cent and 4 per cent of obligations, respectively. However, the inclusion of carbon offsets in domestic carbon markets remains largely untested and faces significant economic, legal, and policy challenges as countries continue to debate the validity of some carbon removal strategies. Having said that, the direct removal of carbon from the atmosphere would appear to be becoming increasingly relevant as the world is set to exceed its carbon budget, and if ETS caps ultimately have to turn negative to meet environmental targets, then the inclusion of carbon offsets into carbon markets may become a necessity.

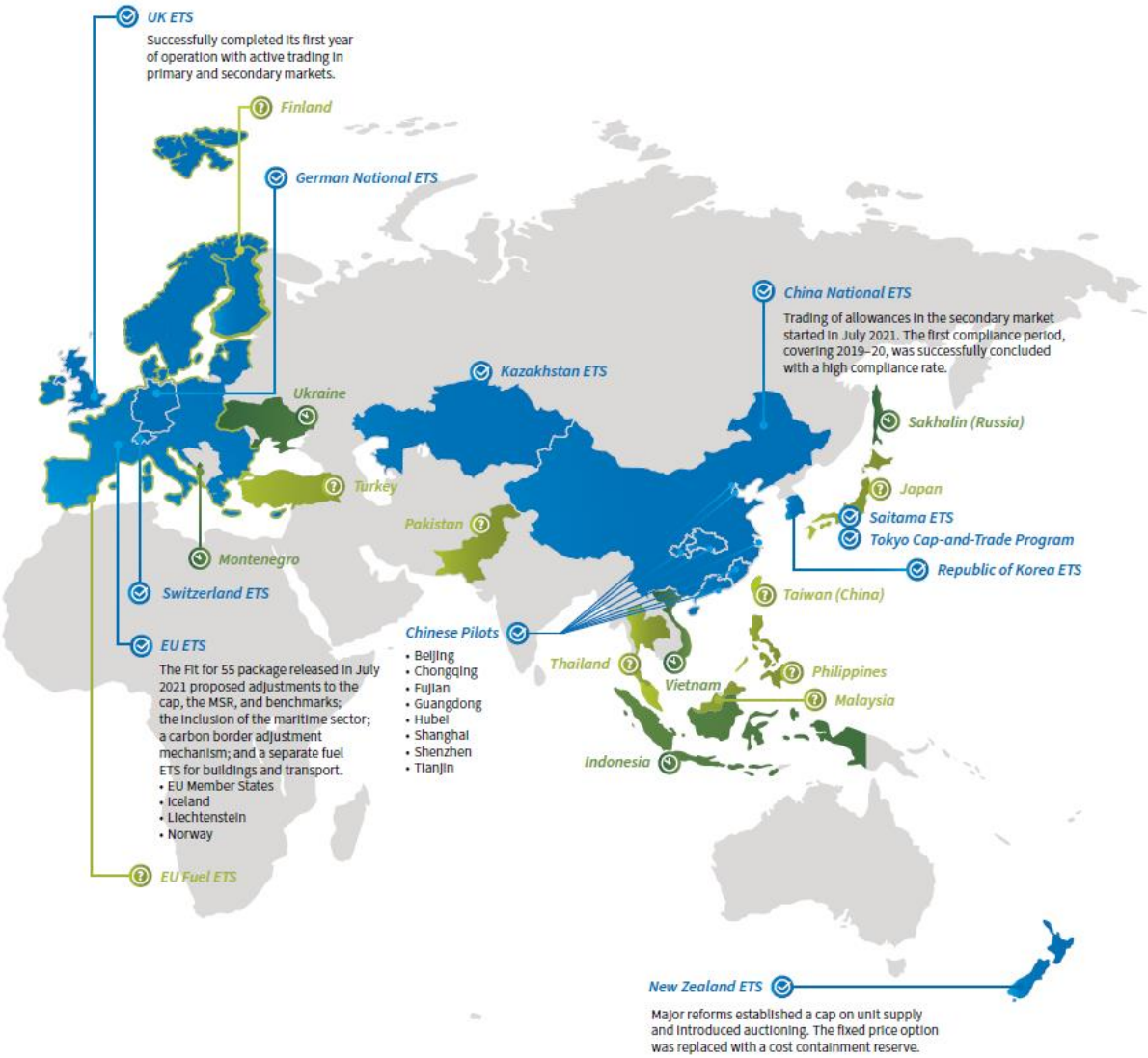
Conclusions

The EU ETS remains the most significant carbon allowance market in the world in terms of volumes traded, but it is clear that a number of other countries are now advancing their activities in this area. North America and Asia are rapidly expanding their carbon trading platforms, with the development of a national ETS in China perhaps the most significant development. Many US states are also progressing their regulations for carbon trading, with California in the lead and also pioneering cross-border trading in its cooperation with Quebec. Meanwhile in Asia many countries are putting plans in place to introduce environmental legislation that could include the development of ETSs as a core objective. Finally, the trading of carbon offsets in tandem with carbon allowances remains controversial but is being considered and allowed in some countries. As the necessity for carbon removal increases, it may be that the need for both broader interaction between domestic carbon markets and further development of combined trading of offsets and allowances will become a necessity if the world is to achieve its environmental targets.

Carbon markets in the Americas



Carbon markets in Europe, Asia, Africa, and the Middle East



WHITHER THE EU EMISSIONS TRADING SYSTEM?

Alex Barnes

The EU Emissions Trading System (ETS) is one of the key pillars of the EU's decarbonization efforts. It has been in place since 2005 and has evolved since then as the EU's climate change policies have become more ambitious. The most recent iteration of this is the EU's 'Fit for 55' package,[8] published in 2021, which aims to reduce the EU's emissions by 55 per cent by 2030, in order that the EU be on track to reach its net-zero target by 2050. Since then energy markets in the EU have been placed under considerable strain due to the increase in gas and electricity prices. This has led to further proposals for reform of the EU ETS, and a faster roll-out of renewable energy as part of the EU's REPowerEU package.[9] This article will look at how the EU ETS is expected to evolve, and in particular at concerns about the functioning of the ETS and the level of carbon prices.

The principle of the ETS is simple: policymakers set a cap on the emissions that entities subject to the ETS can emit in aggregate. Entities must redeem allowances for each tonne of CO_2 (tCO_2) emitted or pay a punitive fine. Allowances are bought at auction or allocated for free. Those entities which have more allowances than they need, for example because they have reduced their emissions more than expected, can sell their excess allowances to those which do not have enough allowances.

This trading sets a price for allowances, and in theory those entities which can reduce emissions at a price lower than the allowance price will do so in order to earn revenue from selling their excess allowances. For those companies which emit more than they expect, or for which the cost of decarbonization is more than the price of the allowances, there is the option of buying additional allowances. Over time the cap, and hence the quantity of allowances made available, reduces, which increases the carbon price. This ensures that entities reduce their emissions—an increased carbon price makes decarbonizing options more economic.

The key differentiator between an ETS approach and a carbon tax approach is that an ETS sets the target level of emissions, and lets the market decide what carbon price is consistent with that level, while a carbon tax sets the price of carbon and then the market decides what level of emissions results. Policymakers control either the quantity (ETS) or the price (carbon tax) but they cannot control both.

An ETS allows the market to decide which sectors can decarbonize at the lowest cost by the trading of allowances. However, if emissions are lower than expected, for example due to a recession, then the resulting surplus of allowances will lead to a low carbon price, which disincentivizes decarbonization. This is what happened to the EU ETS in the wake of the 2008 financial crisis. Conversely, if the price of allowances rises more quickly than expected, as has happened in the past year, companies may find themselves in difficulties.

Under a carbon tax all emitters pay the same carbon price irrespective of their decarbonization costs. It has the advantage that companies know what their carbon costs will be. However, there is a risk that the carbon tax may be set too low, in which case the emissions reduction target will be missed. If the tax is set too high it may cause too high a burden on companies and overshoot the target.

Both approaches are heavily dependent on the credibility of policymakers, namely that policymakers will set emissions caps or carbon taxes at a sensible level to meet targets and that policy will be predictable over time to allow companies to make investment decisions. It is difficult for policymakers to achieve a 'Goldilocks' scenario of emissions caps or carbon taxes which are neither too high nor too low to achieve the target.

The EU ETS is only one part of a broader suite of policies aimed at decarbonizing the EU economy. The ETS affects and is affected by other policies which aim to decarbonize the EU, such as targets for renewable energy, energy efficiency, and energy taxation.[10] All of these are being updated as part of Fit for 55. The Commission uses modelling to ensure that proposed policies meet the agreed decarbonization targets and are consistent with each other.[11]

[8] European Commission (2021, 14 July), 'European Green Deal: Commission proposes transformation of EU economy and society to meet climate ambitions', press release, https://ec.europa.eu/commission/presscorner/detail/en/IP_21_3541.
[9] European Commission (2022 18 May), 'REPowerEU: A plan to rapidly reduce dependence on Russian fossil fuels and fast forward the green transition', press release https://ec.europa.eu/commission/presscorner/detail/en/IP_22_3131
[10] For an overview of carbon pricing in the EU and details on how the EU ETS works, see Barnes, A. (2021), *The Challenges and Prospects for Carbon Pricing in Europe*, Oxford Institute for Energy Studies, https://www.oxfordenergy.org/publications/the-challenges-and-prospects-for-carbon-pricing-in-europe/.
[11] European Commission (n.d.), *Modelling Tools for EU Analysis*, https://ec.europa.eu/clima/eu-action/climate-strategies-targets/economic-analysis/modelling-tools-eu-analysis_en.

However, this process has its weaknesses. First, like any modelling, it is based on assumptions which may not prove to be correct. Second, any legislation requires the agreement of the Parliament and the Council (member states), who can and do propose amendments to the detailed targets. Negotiations are likely to be difficult as the Parliament only recently agreed its starting position, which is different from the Commission's proposals, after considerable acrimony. This indicates that there are not only differences between the three main negotiating parties (Commission, Parliament and Council) but also within those parties. Thus, what the Commission models in its initial proposals is not always the same as the final legislation. This too can mean that outcomes, which take place over many years, can be different from what was originally envisaged.

The 55 per cent emissions reduction target is a considerable increase over the previous 32.5 per cent reduction by 2030. Consequently, Fit for 55 envisages a 61 per cent reduction of emissions currently covered by the EU ETS (about 41 per cent of total emissions) by 2030, compared to the previous target of 43 per cent reduction. In addition, the Commission proposes extending the ETS to sectors not previously covered.

The Commission's proposals include the following:

- Reducing the quantity of allowances available a via a one-off reduction of the cap by 117 million allowances.
- Reducing the quantity available by 4.2 per cent a year instead of the current 2.2 per cent a year. Hence the cap tightens more quickly than previously envisaged.
- Moving to full auctioning of allowances by 2027. At the moment only 57 per cent of allowances are auctioned, whilst the remainder are allocated for free. Whilst those companies which receive free allowances have an incentive to reduce their emissions and thereby monetize their spare allowances, this incentive will be strengthened if they bear the full cost of the allowances.
- Amending how the Market Stability Reserve (MSR) works to ensure stability in the carbon market. The MSR is designed to absorb excess allowances if emissions fall more quickly than expected, for example because of recession, and to release allowances into the market if demand is higher than expected. The MSR was introduced in 2019 to deal with the overhang of spare allowances arising from unexpectedly low emissions caused by the recession which followed the financial crisis.
- Extending the ETS to the maritime sector to include ships of more than 5,000 gross tonnage for all voyages within the EU, and 50 per cent of voyages starting or ending in the EU.
- Reducing the quantity of allowances available for aviation within the EU by 4.2 per cent a year and eliminating free allocation so that allowances for aviation will be auctioned from 2027 onwards.
- Creating a second ETS for buildings and transport. Unlike the original ETS, it will require fuel suppliers rather than end users to buy allowances. Emissions from buildings and transport have previously only been covered by other initiatives such as Effort Sharing, whereby member states are required to put in place policies to reduce emissions not covered by the ETS. This will continue to be the case.

A key area of recent debate has been the level of ETS allowance prices. These have increased significantly from a level of around €20/tCO_2 in 2020 to nearly €100/tCO_2 in early 2022. This coincides with the EU's increased ambition of 55 per cent emissions reductions by 2030. However, there are concerns from industry and some member states that the rapid and large price increases are a sign that the ETS is not working properly. There is concern that the increase in ETS prices is being driven by speculators rather than market fundamentals. In a 'non-paper' sent to the Commission on 30 September 2021, the Spanish government urged the adoption of 'measures to prevent financial speculation in EU ETS markets.'[12] [13] It noted that 'There is significant correlation between increasing price levels and the increased presence of non-incumbents in the market, especially after July 2020. . . If financial speculation rather than real factors drives prices up too quickly, it threatens the smooth transition to an industry powered by clean energy.'

[12] Simon, F. Euractiv (2021, 25 November) 'Europe's energy price hike fuelled by speculators, Spain and Poland say' https://www.euractiv.com/section/emissions-trading-scheme/news/europes-energy-price-hike-fuelled-by-speculators-spain-and-poland-say/
[13] *Non-paper on Energy and Electricity Markets* (n.d.), https://www.euractiv.com/wp-content/uploads/sites/2/2021/10/Spanish-Annex-20210920-Non-Paper-on-Energy-markets.pdf.

This message has also been supported by the Polish government and PGE (Polska Grupa Energetyczna), a Polish utility which is a major coal and lignite power generator, and hence buyer of allowances. In February 2022, the Polish government urged the introduction of 'control mechanisms' and the 'withdraw(al) of financial institutions from the ETS market as soon as possible'.[14] PGE has called for the change of the MSR so it is based on target allowance prices rather than the amount of allowances in circulation, and also allowing active intervention by the Commission to release more allowances in the event of high prices.[15] Some French policymakers support the idea of a 'price corridor' as a 'tool to give economic actors more visibility on the evolution of the price of CO_2'.[16] The Commission has also recently proposed amending the MSR to allow auctioning of allowances from the reserve to provide €20 billion to fund REPower objectives.[17]

The European Securities and Markets Authority (ESMA) was asked to investigate the EU carbon market and published its final report in March 2022.[18] Crucially, it observed that 'the data analysis has not unearthed any major abnormality or fundamental issue in the functioning of the EU carbon market. . . . The observed evolution of carbon prices and volatility seem to have followed market fundamentals.' It noted that most of the activity of financial institutions was related to hedging activity which helps compliance entities manage their costs. However, it did make recommendations to improve the transparency and monitoring of carbon markets. In particular, it noted how difficult it was to obtain data, and that it had to use a number of different sources to build up a picture of activity in the carbon market.

The ESMA report was echoed by a study commissioned by PGE which found that 'the increase in EUA (European Union Allowance) prices level and volatility over the past years seem to have been (at least in part) driven by the evolution of market fundamentals. We also highlight the complementary positions of regulated entities and financial actors in the EU ETS market, and the role of financial speculation to notably support liquidity in the market.'[19]

It is not uncommon for politicians and companies to cry foul when market prices rise higher than expected. There is no doubt that high carbon prices, alongside very high energy prices, cause considerable problems for consumers. However, it is important to distinguish between symptoms and causes, and also to remember what the original objectives are. For example, calls to remove financial institutions from carbon markets will limit the ability of companies to hedge their future compliance costs, thus depriving companies of the very thing which they are trying to ensure, namely price stability. Measures which aim at managing the ETS price, for example by amending the MSR so that it is driven by price signals rather than the quantity of allowances in circulation, also fundamentally contradict the aim of an ETS, which is for the market to determine the cost of carbon consistent with a given emissions reduction target.

If companies want carbon price certainty, they have two options—to push for a carbon tax or to hedge their carbon costs. The former approach, however, risks that the carbon tax may be higher than the market carbon price achieved under an ETS approach. The second approach requires a second party—for example a financial institution—to take a view on future carbon prices. Another word for taking a view is 'speculation'—and yet some are calling for the exclusion of both financial players and speculation from the carbon market. When companies call for a 'restriction of the role of financial institutions involved in speculations'[20] they risk shooting themselves in the foot.

Moreover, it is curious that companies have been taken by surprise by the increase in carbon prices. As soon as the EU declared its intentions to aim for net zero, it was obvious that carbon prices would have to rise, as the number of allowances

[14] Euractiv (2022, 16 February), 'Poland calls on EU to remove "speculators" from its carbon market', https://www.euractiv.com/section/emissions-trading-scheme/news/poland-calls-on-eu-to-remove-speculators-from-its-carbon-market/.
[15] Dąbrowski, W. (2022, 17 May), 'Making EU ETS (and Europe) more resilient', *Euractiv,* https://www.euractiv.com/section/energy-environment/opinion/making-eu-ets-and-europe-more-resilient/.
[16] Moussu, N. (2022, 12 May), 'Idea of carbon price "corridor" resurfaces in France', *Euractiv,* https://www.euractiv.com/section/emissions-trading-scheme/news/idea-of-carbon-price-corridor-resurfaces-in-france/.
[17] European Commission (2022, 18 May), *Proposal for a Regulation of the European Parliament and of the Council*, https://ec.europa.eu/info/system/files/com-2022-231_en.pdf, Article 5.
[18] European Securities and Market Authority (2022, 28 March), *Final Report: Emission Allowances and Associated Derivatives*, https://www.esma.europa.eu/sites/default/files/library/esma70-445-38_final_report_on_emission_allowances_and_associated_derivatives.pdf.
[19] Roques, F., Duquesne, G., Bourcier F. (2022), *Impact of Financial Actors on the European Carbon Market and Potential Measures to Stabilise Prices*, Compass Lexecon, https://www.compasslexecon.com/wp-content/uploads/2022/04/Compass-Lexecon-Impact-of-financial-actors-in-the-EU-ETS-market-and-potential-mesures-to-stabilise-carbon-prices-A-policy-report-20220411.pdf.
[20] Polska Grupa Energetyczna (2022, 11 April), 'PGE: How to change EU ETS so that it supports the energy transition?', press release, https://www.gkpge.pl/en/pge-group/press-center/press-releases/corporate/pge-how-to-change-eu-ets-so-that-it-supports-the-energy-transition.

issued would need to reduce over time, and more than previously expected, to meet the new target. (The previous EU target had been a reduction in emissions of 85 per cent by 2050. Whilst this may not seem very different from a 100 per cent reduction i.e. net zero, in practice decarbonizing the final 15 per cent is much more challenging.) As the ESMA noted, the price increase was driven by such fundamentals. Just as an airline has a good idea of how much fuel it is going to use, and therefore how much to hedge, emitters know how much CO_2 they are going to emit. However, carbon emitters have the added advantage that they know the date by which emissions must be eliminated, and hence the long-term trajectory of the supply of allowances. Carbon emitters only have to think about future demand for allowances, whereas airlines have to think about both potential demand and supply of fuel.

A move towards greater intervention in the ETS based on price levels creates the risk of more, not less, policy uncertainty, and hence greater volatility in terms of carbon prices. In a system where the volume and trajectory of the allowances cap is known, the fundamental driver of carbon prices will be likely demand for allowances. In turn this will be determined by likely emissions levels driven by economic activity, and the availability and cost of abatement technologies which will lower demand for allowances. If the supply of allowances changes according to what is deemed to be an acceptable price level, a further driver will be speculation about policymakers' intentions. Last year the author noted that there was a temptation for policymakers to tinker with the level of allowances and drew a parallel with the challenges facing central banks when establishing credibility on inflation targets.[21] It is interesting to see not only that the current situation has led to calls for more intervention in carbon markets, but also that central banks' credibility on inflation targets is now being tested.

The situation is not helped by the Commission's proposals to see the ETS as a revenue-raising mechanism for its REPower objectives. This further increases the risk of policy uncertainty if allowances are going to be auctioned for revenue raising purposes rather than as part of the fundamental functioning of the ETS itself. Just as governments can be tempted to print money to meet their fiscal objectives and thereby undermine the value of their currency, there is a risk that auctioning of additional ETS allowances will lower carbon prices and thus undermine efforts to decarbonize. A better way to help companies might be to give assistance to tackle the cause, i.e. carbon emissions, via support for decarbonization efforts, rather than the symptom, namely carbon prices.

None of this is to say that the current ETS is perfect, or that the proposed revisions will solve all its problems. The issue of how to deal with carbon leakage in a world where most jurisdictions have no or more limited carbon pricing remains problematic. The many interactions between the ETS and other EU decarbonization policies make it hard to gauge the short- and medium-term trajectories of carbon prices. Current high fossil fuel prices make the costs of decarbonization even less palatable—although ironically, they make the use of renewable energy more attractive. Better monitoring and market supervision of carbon markets is a no-brainer. But efforts to target price levels seem misplaced.

[21] Barnes, A. (2021, May), *The Challenges and Prospects for Carbon Pricing in Europe,* Oxford Institute for Energy Studies, https://a9w7k6q9.stackpathcdn.com/wpcms/wp-content/uploads/2021/05/The-Challenges-and-Prospects-for-Carbon-Pricing-in-Europe-NG-168.pdf, page 23 and following pages.

RUSSIA'S WAR ON UKRAINE AND POTENTIAL IMPACTS ON THE EU EMISSIONS TRADING SYSTEM

Elisabetta Cornago

Russia's invasion of Ukraine in February 2022 has massively raised energy prices that were already under pressure as the global economy recovered from the pandemic shock. The price of natural gas in Europe has increased over three-fold in the past year, peaking in early March. The price of crude oil is up 60 per cent from a year ago. Carbon prices within the EU Emissions Trading System (ETS) are hovering around €90 per tonne of CO_2, getting close to pre-invasion levels after a momentary dip.[22]

The European Commission and national leaders have called for an acceleration of the EU's planned shift from fossil fuels to renewables, to cut both emissions and the Kremlin's revenues from energy exports to the EU. This has resulted in sanctions on imports of coal and seaborne oil from Russia. However, there are disagreements on the longer-term policies needed to accelerate decarbonization and energy independence: some members of the European Parliament and member states are calling for the European Commission's plans to expand carbon pricing to be watered down or outright shelved. This article discusses how this context is affecting ongoing discussions around the reform of the EU ETS.

Energy policy after Russia's invasion of Ukraine

The energy price spike and Russia's invasion of Ukraine have prompted a range of policy responses in Europe, to address concerns of energy affordability and energy security and to accelerate energy decarbonization.

First, national governments have rushed to support households and businesses facing the drastic increase in energy prices with cuts to VAT and energy taxes, lump-sum transfers, caps on electricity retail prices, and exceptional taxes on windfall profits of energy companies. More recently, governments have extended price-mitigating measures to automotive fuel at the pump.

Second, Europe has come to face its dependency on Russian energy imports. In 2019, 41, 27, and 47 per cent of EU imports of gas, oil, and coal came from Russia. In some countries this dependency is even higher: about half of natural gas imports to Germany and Italy come from Russia, while this is above 75 per cent for member states such as Bulgaria, Hungary, and Austria.[23]

While such asymmetric dependencies have slowed and complicated negotiations on energy sanctions against Russia, EU member states eventually agreed on an embargo of Russian coal and of Russian shipped oil (which exempts piped oil at the request of landlocked Eastern European countries). While replacing coal and oil supplies is somewhat easier than replacing Russian natural gas supplies, this situation will likely maintain energy prices high for the foreseeable future. This makes it difficult to remove the price-mitigating measures that were introduced in haste over the past few months to shield consumers, which amount to fossil fuel subsidies.

Third, Russia's invasion of Ukraine has given greater impulse to the clean energy transition agenda. In its REPowerEU plan, the European Commission insisted that a faster transition from fossil fuels to renewables would be the only structural solution to high energy prices, and a way to ensure energy security. The plan aims for the EU to advance towards a full phase-out of all energy imports from Russia (including gas, oil, and coal) as soon as possible and before 2030, continuing a process started with the recent embargoes. To do so, it combines various strategies: differentiating supply of fossil fuels, accelerating the deployment of renewable energy, and reducing energy demand through immediate behaviour change and mid-term structural improvements in energy efficiency.

The Commission estimates that implementing the REPowerEU plan would require investments of around €300 billion by 2030. The bulk of these funds would be reoriented from unused loans from the Recovery and Resilience Facility. However, financing REPowerEU investments is bound to have a direct impact on the EU ETS as the Commission has proposed to raise €20 billion

[22] Oil price data: *Markets Insider,* https://markets.businessinsider.com/commodities/oil-price?type=brent; natural gas price data: *Trading Economics,* https://tradingeconomics.com/commodity/eu-natural-gas; EU ETS data: *Sandbag,* https://sandbag.be/index.php/carbon-price-viewer/; cutoff date: 5 June 2022.

[23] Eurostat, 'Energy trade visualisation tool', https://ec.europa.eu/eurostat/cache/infographs/energy_trade/entrade.html; 'EU imports of energy products—recent developments' https://ec.europa.eu/eurostat/statistics-explained/index.php?title=EU_imports_of_energy_products_-_recent_developments.

by auctioning emission allowances currently held in the Market Stability Reserve (MSR). At current carbon prices, this may take around 250 million allowances.[24]

The MSR is a storage for excess emission allowances that are withheld from the carbon market when the total number of allowances in circulation exceeds a predetermined threshold of 833 million allowances; conversely, when total allowances in circulation go below 400 million, 100 million can be released from the MSR to increase liquidity on the market. The MSR today functions based on predefined rules and thresholds: reaching for allowances to finance part of the REPowerEU investments is a dubious approach that poses several risks for the EU ETS.

First, it is unclear how this auction could be organized without disrupting the carbon market: releasing more allowances risks reducing the carbon price at a time when its stability and direction of travel are ever more critical to drive investments in decarbonization. Second, this may undermine the no-discretion principle on which the MSR is founded, hurting the attractiveness of the carbon market in the longer term.

The EU ETS today, and reforms under discussion

It is in this context that reforms to the EU ETS are being discussed in Brussels. Currently, the ETS only applies to heavy industry, electricity generation, and intra-EU aviation. However, in July 2021, the European Commission presented its climate policy package, 'Fit for 55', which calls for, among other things, tightening the emissions cap for the existing EU ETS and expanding the coverage of carbon pricing in two ways.

First, free emission allowances would be gradually removed between 2025 and 2036, exposing European heavy industry to the full carbon price. Protection against carbon leakage would be guaranteed through a Carbon Border Adjustment Mechanism, which would be phased in over the same timeline; this way, foreign producers exporting their goods to Europe would be exposed to the same carbon price that European producers face under the EU ETS.

Second, the Commission has proposed to create a new emissions trading system (ETS2) to cover road transport and building heating as of 2026. This would generate a new carbon price that would directly affect households as well as businesses, raising heating bills and fuel prices at the pump. Part of the revenues from the proposed ETS2 would be devoted to a new EU fund, the Social Climate Fund (SCF). These funds would be distributed among member states to help vulnerable consumers with higher energy bills, and to finance subsidies for green investment by households and businesses—such as building renovations, installation of heat pumps, and replacement of combustion engine cars with electric vehicles and bikes.

Given current and projected energy prices, reform proposals that would increase the exposure of industry and consumers to carbon prices are politically difficult.

Early votes in the environment committee of the European Parliament in May signalled a small majority in favour of increasing the ambition of EU ETS reforms: committee members voted in favour of anticipating the full phase-out of free allowances by 2030 (as opposed to 2036 in the original proposal) and further reducing the cap on emissions. At the same time, the committee also suggested that ETS2 be first only applied to commercial entities, focusing on heating in commercial buildings and freight road transport. Households would be exposed to the ETS2 carbon price only starting in 2029.[25]

But it's the plenary vote that counts: on 8 June, a majority of MEPs rejected the reform proposal in the plenary, over clashes on the timelines for phasing out free allowances and for tightening the emissions cap. Negotiations will restart within committees: at the time of writing it is unclear what a new compromise agreement on these issues could look like, and how much this will delay the approval of the cornerstone of the EU's climate policy, together with linked proposals on CBAM and on the Social Climate Fund.[26]

Why is carbon pricing still a good idea?

Finding substitutes for all energy imports from Russia will be expensive and take time. Meanwhile, prices of fossil energy may remain substantially higher than pre-2021 levels for the foreseeable future. But this is not a reason to freeze plans to make EU carbon prices bite harder and to expand emissions trading to more sectors of the economy.

[24] Simon, F. (2022, 19 May), 'Trust in carbon market "undermined" by EU's Russia plans, analysts warn', *Euractiv*.
[25] Abnett, K. (2022, 17 May), 'EU lawmakers vote for more ambitious carbon market overhaul', *Reuters*.
[26] Weise, Z. (2022, 8 June), 'EU Parliament clash delays key climate legislation', *Politico*.

Higher carbon prices are needed to strengthen incentives to cut emissions—for example, by reducing energy consumption, shifting from fossil fuels to renewables for electricity generation, and electrifying processes that would otherwise require fossil fuels. Additionally, auctioning more ETS emissions permits would bring in additional revenues that governments can reinvest in the energy transition and redistribute across households as climate dividends.

Quitting Russian fossil fuels will entail moving to more carbon-intensive alternatives such as coal in the short term—and carbon prices are particularly important because they will help to ensure this shift is only temporary, not the new normal. Swift approval of reforms of the ETS and implementation of ETS2 would provide the necessary certainty for investors to plan ahead and increase investment in renewables and energy efficiency.

EU member states need to act on two fronts—both demand and supply of energy—and on two time scales. They must reduce fossil fuel imports from Russia as rapidly as possible, even if that means procuring more polluting fossil fuels in the short term. At the same time, they must keep their eyes firmly anchored on 2030 and 2050 climate goals.

On the supply side, governments should immediately facilitate accelerated investments in renewable energy, but also in waste-based biogas and in green hydrogen. On the demand side, they should encourage energy efficiency improvements and the use of low-carbon solutions such as electric vehicles and heat pumps, to cut consumption of oil and gas. Both supply and demand measures are critical to reducing dependence on Russia. Carbon prices are the most efficient way to incentivize both types of measures—but they are also politically difficult.

As seen in the past few months, governments might be tempted to shield consumers from high energy prices. But artificially limiting energy prices amounts to providing fossil fuel subsidies and would dim the incentive to reduce energy consumption that high prices provide. Europe needs to adjust to a period of higher and more volatile energy prices; fossil fuel subsidies are neither helpful for decarbonization nor tenable for public budgets. Instead, governments should give unconditional transfers to consumers, making them more generous for the most vulnerable. That way, high energy prices will encourage households and businesses to reduce energy consumption and invest in energy efficiency, while cash transfers will allow those who can't afford to do so to pay their bills. Support for energy efficiency investment, already a priority of the Recovery and Resilience Facility, should first and foremost address the poorest households, who otherwise would find it difficult to renovate or heat their homes, and the least efficient buildings, where the potential for energy savings is highest.

Pausing efforts to expand the coverage of European carbon prices is the wrong way to deal with this energy crisis. The EU should keep its carbon pricing plans, reforming the existing ETS by swiftly removing free allowances while a Carbon Border Adjustment Mechanism is introduced, and creating a new ETS covering road transport and heating, backed up with a strong SCF.

Anticipating the operations of the SCF, as supported by the European Parliament environment committee, would make it possible to front-load energy efficiency investment by households and businesses. Given the urgency of redistributing the cost impacts of the energy crunch, made more acute by the war in Ukraine, it would make sense for the SCF to start as soon as possible, financed with EU joint borrowing and, later, revenues from auctions of emissions permits.

Limiting the ETS2 to commercial actors and excluding households from its remit would shield the latter from carbon prices until 2029, but it would also limit the ETS2's revenue-raising potential. Consequently, the SCF would necessarily be smaller, and less ambitious in its promise to support the poorest in investing to reduce their consumption of fossil fuels.

Critiques of extending emissions trading to consumer-oriented sectors such as heating and road transport complain about the distributional impacts of higher energy prices. That is a valid critique, but fails to recognize that making good use of revenues from ETS2 would make the scheme progressive.[27] Leaving carbon emissions unpriced is not just: carbon pricing is a tool to make climate action equitable, by making polluters pay and using revenues to help the most vulnerable reduce their dependence on fossil fuels.

[27] See Gore, T. (2022), Can Polluter Pays Policies in the Buildings and Transport Sectors Be Progressive? Assessing the Distributional Impacts on Households of the Proposed Reform of the Energy Taxation Directive and Extension of the Emissions Trading Scheme, Institute for European Environmental Policy.

A TALE OF TWO CARBON PRICING SCHEMES FOR AVIATION: THE INTERPLAY BETWEEN THE EU/UK ETS AND CORSIA

Katherine Connolly, Nicolas Lockhart, and Stella Perantakou

As part of a sweeping package of regulatory reforms under the Green Deal, the EU is in the process of revamping its cap-and-trade scheme or emissions trading scheme (ETS)—including gradually phasing out the so-called free allowances currently granted to the aviation sector. This means aircraft operators on flights covered by the ETS will have to purchase allowances covering their total emissions—or risk substantial fines. In parallel, the EU is also proposing new sustainable aviation fuel (SAF) requirements for aircraft leaving an EU airport. The UK—which has its own ETS—has tabled similar proposals.

At the same time, substantive obligations under the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) are also coming into effect. CORSIA requires aircraft operators on certain international flights to offset any increase in their emissions above a baseline level by purchasing carbon credits. CORSIA also allows operators to reduce their CORSIA offsetting requirements by using eligible SAF.

These are important developments that seek to internalize the environmental costs of aircraft emissions. A cap-and-trade scheme, on the one hand, and a mandatory offsetting scheme, on the other, are two quite different ways of imposing a carbon price and, in this case, they will apply simultaneously to the same industry (and even to the same individual operators and the same emissions). Each is complex on its own and the interaction between the two even more so.

The importance of these developments is unlikely to be limited to the aviation sector. The ETS/CORSIA combination may provide a blueprint for how the emissions of other industries—such as maritime—may be regulated in the future.

This article unpacks the details of both schemes, explaining how they will operate in tandem and setting out key takeaways.

The ETS in a nutshell

The ETS is a key component of the EU's efforts to implement its obligations under the Paris Agreement (whereas CORSIA sits outside the Paris framework). The ETS is a cap-and-trade system, which sets an annual cap on the amount of greenhouse gases that companies in covered sectors may emit. To ensure emission reductions, the cap is gradually reduced over time. Within the cap, companies either receive emission allowances for free or buy them. Free allowances are especially provided to sectors considered at risk of carbon leakage (i.e. the risk of EU consumption shifting to goods produced in third countries with less stringent emissions regulation). Unused allowances can be sold or used the following year. If a company fails to secure allowances covering its total emissions, it will be subject to substantial fines.

The ETS operates in the European Economic Area (EEA), which includes the 27 EU Member states plus Iceland, Lichtenstein, and Norway. In 2020, Switzerland linked its ETS to the EU's. Since Brexit, the UK operates its own ETS, which it has not linked to the EU's, though the EU and UK agreed to apply the EU ETS to flights from the EEA to the UK.

In sum, right now the ETS covers emissions generated on intra-EEA flights and flights to Switzerland and the UK. Flights from Switzerland and the UK to the EU are covered by those countries' respective schemes (although the Swiss ETS is linked to the EU's).

In July 2021, as part of its Fit-for-55 package, the EU Commission proposed to strengthen the ETS by phasing out free allowances for the aviation sector (among others) by the end of 2026. This means aircraft operators will gradually have to purchase allowances for emissions generated on routes covered by the ETS. Right now, these are intra-EEA routes, and routes to Switzerland and the UK. However, as explained further below, international routes may also soon be covered under the amended ETS.

CORSIA in a nutshell

CORSIA was agreed in 2016, under the framework of the International Civil Aviation Organization (ICAO)—a UN agency to which virtually all countries are party. CORSIA seeks to address emissions generated by international aviation—which are otherwise not covered under the Paris Agreement. In short, under CORSIA, ICAO member states must require their aircraft operators to offset any growth in their CO_2 emissions, compared to a baseline year, by purchasing carbon credits generated by emissions-reducing projects in other sectors. In practice, things are somewhat more complicated.

What is the scope of offsetting obligations?

CORSIA is set to be rolled out across several stages: a pilot phase (2021–2023), a first phase (2024–2026), and a second phase (2027).

The pilot and first phase are voluntary, meaning only a subset of ICAO member states participate (112 states from 1 January 2023). CORSIA takes a route-based approach, so during the pilot and first phase, the obligations apply to all operators generating emissions on flights between volunteering states—regardless of whether the operator itself is registered in a volunteering state. Emissions generated by any operator on flights to or from a non-volunteering state are not covered during the pilot and first phase. As a result, all operators are treated the same, regardless of country of registration. This means that non-volunteering states must, nonetheless, require their aircraft operators to offset their emissions on covered flights.

The second phase is in principle mandatory for all ICAO member states, so the obligations will effectively extend to emissions generated on any international flight (albeit with some exceptions for States with low levels of aviation activity, least developed countries, small island developing states, and landlocked developing countries).

Phases of CORSIA

Phase	When?	What emissions must be offset?	Who is subject?
Pilot	2021–2023	Emissions generated on international flights between volunteering states	All operators
First	2024–2026		
Second	2027–2035	Emissions generated on international flights between ICAO member states	All operators

How are offsetting obligations calculated?

Calculating an individual operator's offsetting requirements for a given year is a complex technical exercise. CORSIA sets out a formula: the operator's annual emissions (on covered flights only) multiplied by a growth factor, which represents the percentage increase in emissions in the year of assessment compared to the baseline year (also on covered flights only). This gives the formula as *operator's total annual emissions × growth factor = annual offsetting requirements*. All calculations are based on data reported by ICAO member states, under harmonised monitoring and reporting obligations.

The baseline year—against which emissions growth to be offset is calculated—was originally proposed as an average of 2019 and 2020 values. However, industry expressed concern that 2020 should not be included in the baseline, since passenger flight emissions were unusually low due to the COVID-19 pandemic—inflating emissions growth since 2020 and thus significantly increasing offsetting obligations. ICAO agreed to exclude 2020 emissions from the baseline calculations. The baseline will be discussed further (and potentially revised) at the 41st ICAO Assembly in September 2022.

Calculation of the growth factor is designed to take into account both sectoral emissions growth writ large and an individual operator's own emissions growth. However, the two variables are weighted differently across the three phases. Until 2030 (three years into the second phase), only sectoral emissions growth will be included in the formula. After 2030, the weighting of the individual emissions growth factor variable will be gradually increased, until it reaches minimum 70 per cent in 2035. Thus, over time, offsetting obligations become more closely linked to each individual operator's own emissions and, hence, efforts to reduce its own emissions—sharpening an operator's incentive to find emissions reductions in its own operations.

An operator can also reduce its offsetting requirements by using eligible SAF—discussed further below.

How are emissions offset?

Operators must offset growth in their emissions by purchasing carbon credits—generated by emissions-reducing projects in other sectors (like replacing cook stoves with solar cookers, or forestry projects). One carbon credit typically represents a tonne of CO_2 emissions removed or avoided from the atmosphere. The operator must purchase—and cancel—an amount of carbon credits equivalent to its offsetting obligations. Credits are available for purchase on the international carbon market, which is likely to grow significantly in the coming years.

Many types of carbon credits are available on the market, but not all are eligible to satisfy CORSIA offsetting obligations. CORSIA imposes relatively strict eligibility requirements, to ensure the integrity of credits used and avoid justifiable concerns about greenwashing. Core requirements include the following:

- **No double counting**—The credit cannot be counted against another emissions reduction obligation. Importantly, this includes the host country's own emissions-reducing obligations under international law. So, if a project is to generate a CORSIA-eligible carbon credit, the host country must commit to not counting those emissions reductions towards its own Nationally Determined Contribution under the Paris Agreement. This commitment is typically referred to as a corresponding adjustment.
- **Additionality**—This means the credit represents emissions reductions that would not otherwise have occurred in the absence of the projected income stream from the sale of the credits generated by the project. A credit is not additional if, for example, the emissions reductions were legally required under the regulatory regime of the host country where the project took place, or if they would have occurred anyway in a business-as-usual scenario.

Some of the implications of CORSIA for the carbon credit market are discussed below, including in relation to new rules agreed at COP26 on the international regulation of carbon credits under Article 6 of the Paris Agreement.

What about sustainable aviation fuel?

SAF is considered a key plank of the aviation industry's long-term emissions reduction strategy. SAF includes a broad range of products, and involves emissions reductions in the upstream production process, namely where SAF production emits less than conventional fuel production. SAF features under both the EU (and UK) regulatory regime and CORSIA. The uptake of SAF is incentivized in two ways.

First, under both CORSIA and ETS, use of SAF can reduce an operator's offsetting obligations (CORSIA) or obligations to surrender allowances (ETS). Under CORSIA, the emissions reductions corresponding to the amount of SAF used will be deducted from the operator's total offsetting requirements. SAF used on domestic flights (which are otherwise outside CORSIA) can also be claimed to reduce offsetting obligations on international flights.

Under the ETS, use of SAF is deducted from an operator's total emissions, i.e. operators do not need to surrender allowances when reporting the use of SAF. However, the SAF eligibility criteria under the ETS are stricter than under CORSIA. In fact, CORSIA accepts a broader spectrum of fuels eligible for claiming emissions reductions, including fuels which are lower-carbon but still fossil-based, whereas the EU does not (on grounds that fossil-based fuels do not have long-term sustainability potential). On the other hand, the method of accounting SAF under CORSIA is stricter than under the ETS. While under the ETS the total amount of SAF used is rated as zero when calculating total emissions, under CORSIA an amount proportional to the emissions benefits from the SAF production process is reduced from the offsetting requirements.

Second, in parallel to the ETS, the EU has proposed a SAF blending mandate on all commercial flights leaving the EU, regardless of their destination. The mandate thus has a broader scope of application than the ETS, which only covers intra-EEU/Switzerland/UK flights. The mandate applies to fuel suppliers, who must ensure that all aviation fuel supplied to aircraft operators contains a minimum SAF share (2 per cent in 2025, with incremental increases to 63 per cent in 2050). To incentivize uptake of SAF with the highest decarbonization potential, the EU also proposes to require, from 2030, a gradual increase in the share of synthetic SAF relative to biofuel-based SAF. The UK has also proposed an SAF blending mandate (10 per cent by 2030), with details under further consultation.

So, how does this all fit together?

The interaction between the EU ETS and CORSIA creates a somewhat complex web of obligations, and the potential scope of coverage continues to shift as the proposal works its way through the EU legislative process.

The EU ETS was originally planned to apply to all international flights to and from the EEA, which obviously would have meant significant CORSIA overlap. However, the EU modified the application of the ETS to cover only intra-EEA flights ('partial scope'), in part to support the development of CORSIA. The modification was temporary—unless legislators decide otherwise, the ETS is set to revert back to 'full scope' application in 2024. Most recently, the EU Parliament adopted its own amended text confirming a 2024 return to 'full scope'.

In any event, even under the 'partial scope' option which currently applies, there is still some degree of overlap between the EU ETS and CORSIA, and many operators will be subject to both regimes simultaneously. For some operators—e.g. those flying both intra-EEA routes and routes from the EEA to another CORSIA-volunteering country—the two regimes will apply separately to different routes. In other words, emissions generated on intra-EEA routes must be paid for with an allowance under the EU ETS, whereas those generated on EEA–third country routes must be offset under CORSIA (to the extent they exceed the baseline year's emissions).

For some operators, the two regimes may also apply to the same emissions, generated on the same routes. For example, some routes subject to the EU ETS are also international (Paris to London or Oslo, Brussels to Geneva), so are in principle also subject to CORSIA. The same is true for all UK flights to EEA countries and Switzerland—they are in principle subject to both the UK ETS and CORSIA.

Evidently, there will be considerably more overlap if the ETS returns to 'full scope' in 2024 (i.e., if it applies to all international flights to and from the EEA). There remains some uncertainty as to how application of the two regimes to the same route will work. The EU has been considering various policy options, with some difference in the Commission and Parliament's respective positions. For example, among the Commission's preferred approaches was to maintain the ETS its current partial scope (intra-EEA flights only), and to exempt the international flights also covered by the ETS from CORSIA. By contrast, as noted above, the Parliament has proposed returning the EU ETS to full scope, and adopting a hybrid mix on routes covered by both schemes (i.e., requiring ETS allowances for emissions up to the CORSIA baseline and requiring CORSIA offsets beyond the baseline).

The UK is considering its own set of policy options—its current preferred approach is described as a supply-adjusted hybrid mix. Put as simply as possible, this option would (like the EU's hybrid proposal above) require ETS allowances for emissions up to the CORSIA baseline and CORSIA offsets thereafter. However, without adjustment, this approach could reduce demand for ETS allowances (since a portion of what would otherwise have to be paid for under the ETS could instead be offset under CORSIA). So, an adjustment would also be made to reduce the overall ETS cap by an amount equivalent to any emissions offset under CORSIA.

Assuming the EU's and UK's respective preferred options are adopted, the web of route-specific obligations would look something like that shown in the figure below. The obligations on each route would apply to all operators, regardless of their country of registration.

How do the two systems compare in practice?

Together, the ETS and CORSIA present an interesting case study. The two represent different (and much debated) ways of pricing carbon to incentivize reducing emissions—a cap-and-trade system on the one hand, versus mandatory offsetting through carbon credits on the other.

There are two key factors that will affect the respective stringency of the regimes, which could change over time. These are (1) the amount of emissions for which a price must be paid, and (2) the per-unit cost of emissions. The total cost of emissions under each regime will depend on how these factors interact.

On the amount of emissions, under CORSIA, operators are only required to offset emissions above the baseline—above which they can, in principle, emit, provided they pay by purchasing credits. Under the ETS, operators must secure allowances to cover all their emissions; and (compared to carbon credits) there are a limited number of allowances available on the ETS market, which creates a ceiling on the total number of emissions permitted. The amount of emissions subject to a payment will also depend, under both regimes, on the use of (eligible) SAF. In practice, the degree to which SAF is actually available to reduce emissions liability in the near term depends on SAF supply—the resulting demand for SAF is likely to outstrip supply for some time.

On the price of emissions, again, a number of factors could be influential—and price will be subject to change, depending on market and regulatory dynamics. Under CORSIA, price will depend on the carbon credit market, which right now is largely unregulated and fragmented; in 2022, the per-unit carbon price for a CORSIA-eligible credit has ranged between around US$1.20 and US$22. Under the ETS, price will depend on the level of the EU cap—the higher the cap, the greater the number of available allowances, the lower the price per allowance. Currently, the per-unit carbon price under the ETS is approximately US$94 (it has fluctuated in 2022 between US$66 and US$100).

What next?

Developments in this space are moving at pace. Some key areas to watch out for are discussed below.

First, the recent agreement on the so-called Paris rulebook—which seeks to establish a framework for the international regulation of carbon credits—will shortly also be added to the mix. The quality requirements for carbon credits developed in the Paris rulebook were, to some extent, inspired by CORSIA's eligibility requirements. Both regimes, for example, prohibit double counting and require additionality. At the same time, the adoption of the Paris rulebook may prompt further changes to the CORSIA requirements. More generally, the adoption of the Paris rulebook may prompt increased demand across the board for high-quality carbon credits—both in compliance markets (i.e. where offsetting is legally required) or voluntary markets (i.e. to support voluntary net-zero pledges). This may make CORSIA-eligible carbon credits more expensive over time.

The Paris rulebook could also impact the ETS. Previously, the ETS permitted compliance through offsetting, then shifted position, citing concerns over the integrity of credits available on the market. Since the Paris rulebook aims at improving the integrity of carbon credits, the EU may shift again, and permit offsetting—provided it is done through Paris-consistent credits. If so, this would also increase demand for (and therefore the price of) high-quality carbon credits.

Second, the ETS/CORSIA combination may provide a blueprint for other areas, especially where tackling emissions has an international dimension. Top of the list is shipping: the EU has already proposed to expand the ETS to cover maritime emissions generated during berth at EU ports, from voyages within the EU, and even from the EU to third countries (counting half of those international emissions). The EU's plans to apply ETS not only to domestic shipping but also to international shipping may encourage states within the International Maritime Organization to follow ICAO in adopting a CORSIA-like offsetting framework for emissions resulting from international shipping.

THE EU EMISSIONS TRADING SYSTEM: COULD REMOVING FREE ALLOCATION LEAD TO MISSED EU CLIMATE TARGETS?

Elin Akinci

For the ongoing revision of the EU Emissions Trading System (ETS) Directive, the EU Commission has proposed several far-reaching changes such as adjusting the cap trajectory and phasing out free allocation of allowances in exchange for a Carbon Border Adjustment Mechanism (CBAM). The EU Commission in 2021 proposed a gradual phase-out of free allocations over the period 2026–2035 and introduction of the CBAM from January 2023, but with reporting-only obligations for the first years.

In May 2022, lawmakers in the European Parliament´s Committee on Environment (ENVI) agreed on a compromise proposal to phase out free allocation over the period 2026 to 2030. In contrast to the EU Commission´s proposal, a quicker phase-out of free allocation policy is more based on the idea that CBAM is meant to be an alternative to free allocation, not a supplement.

The timing of the phase-out of free allocation is one of the most controversial issues in the CBAM file, as it will transfer huge European Union Allowance (EUA) volumes from free allocation to auctioning and force a large number of manufacturing industries, in particular, to trade, hedge, and buy more actively and thus certainly raise costs for those industries significantly. The industries concerned are of course not in favour of a policy that does not see CBAM as a supplement to free allocation, at least not over time, in line with the Commission´s proposal. When the ENVI proposal was announced, criticism was raised from business associations representing the industries concerned. The European steel industry is, for instance, arguing that industry alone risks losing up to 20 million tonnes of exports worth €45 billion and at least 30,000 jobs as a result of the phase-out of free allocation by 2030. This will ultimately raise prices for European end-consumers.

Following ENVIs presented proposal, the Parliament ended up voting on the ETS file proposals on two occasions, as the first vote resulted in a rejection of the concluded reform. The left of the centre parties in the Parliament considered the reform in its entirety had become too watered-down, while some of the right of the centre parties thought it had become too ambitious. Following this event, the largest parties, however, managed to reach an agreement; to phase out free allowances from 2027 to 2032 (proposed phase-out dates have varied between 2030 and 2035). In the second Parliament vote the agreement was accepted.

Background to free allocation

Under the current EU ETS Directive, manufacturing industries, such as iron/steel, aluminium, cement, and fertilizer, are receiving their emission allowances for free. For phase four (2030), sectors which have been identified as at a high risk of relocating their production outside the EU receive their allocation for free. For less exposed sectors, free allocation is under current regime forecast to be phased out after 2026 from a maximum of 30 per cent to 0 by the end of 2030.

The main driver behind introducing the provision of free allowances in the Directive has been to make up for the competitive disadvantage induced by EU climate policy while at the same time incentivizing abatement within those industries' operation, since those who emit less than the amount covered by their allowances can sell their surplus for profit. Since 2013, the overall annual supply of allowances has been split 57 to 43 between auctioning and free allocation.

The methodology for calculating free allowances is based on greenhouse gas emissions, and installations that meet certain benchmarks will receive all the allowances they need to cover their emissions. Installations that do not will receive fewer allowances than they need and will therefore need to either reduce their emissions, buy additional allowances to cover their emissions, or combine the two. Companies that are not exposed to international competition, such as power generators, are not eligible to receive free allowances and therefore will have to buy all their allowances either at government auctions or in the secondary market.

EU ETS: the EU´s main tool to achieve climate targets

EU ETS is EU's main tool to achieve the Climate Law neutrality target for 2050 and the 55 per cent target for 2030. For EU-ETS sectors that are not eligible to receive free allocations, the compliance buying has resulted in sharp reductions of emissions. However, the fuel switching in those sectors is not enough to reach EU's ambitious climate targets, and the next step will be to target those sectors that still have a long and challenging way ahead to decarbonize with a high abatement cost. Phasing out free allocation is expected to have a strong decarbonization effect on industries that are currently receiving them, as the cost of allowances to cover emissions will stimulate industries to switch from fossil fuel to less polluting alternatives. However, the cost for doing so is very high, which has been the main reason for keeping free allocation, since the risk of carbon leakage has been identified as too high for European industries.

There is evidence that the competitiveness of European industries has been preserved because of free allocation, and little currently indicates that European manufactures are losing market shares, or moving their production, to countries outside Europe based on the carbon price. However, there is certainly evidence of them doing so for other reasons. There has been a significant rationalization in most industry sectors in Europe due to higher taxes and employment costs but also rising energy and commodity prices compared to markets outside Europe. With the additional financial risk for industries posed by decarbonization, exposing them to higher carbon costs in the near future, a premium for green products is emerging. Thus, European steelmakers, for instance, have started to introduce a carbon surcharge in their long-term contracts with automotive customers to make up for their increasing carbon cost.

Steel producers are also arguing that switching from current fossil-based technology to hydrogen-based alternatives will cost around €1 billion per million tonnes of steel. This will require huge investments that their competitors will not have to make within the same time frame. However, different industries have different views on how this higher cost environment should be handled by the EU. Whereas European steel producers are advocating a CBAM solution as a complement to free allocation, aluminium producers do not want to be covered by a CBAM, chiefly because they worry about potential retaliation from countries to which they currently export.

The main conclusion is, however, that European products that are manufactured in those industries that are currently receiving free allocation will be significantly more expensive in the future. The CBAM will only assist in making European industries less exposed to international competition, as it will be just as expensive to export the same products to Europe, but it will not prevent higher costs for industries and therefore rising product prices for European consumers and end-users.

Timing is more important than ever

Aligning the climate and energy policy framework to EU's climate targets for 2030 and 2050 will require significant and far-reaching changes to all relevant policy instruments. This includes amendments and revisions of the EU ETS Directive, but also to other relevant legislation under the Fit for 55 package, such as the Effort Sharing Regulation, Renewable Energy Directive,

and Energy Efficiency Directive. The whole Fit for 55 package certainly aims to decarbonize sectors by making it costly to emit, but reaching EU's climate targets and especially its renewable energy targets, the legislative package also requires access to raw materials, commodities, and affordable energy.

The issue surrounding access to supply has also broadened lately, in the wake of Russia's invasion of Ukraine, when Europe's import dependency proved to be far wider than just energy. The EU Commission is emphasizing the need for the Union to scale up production and procurement for supply chains that are necessary to decrease the EU's import dependency and realize the transition. However, the EU Commission's priorities—on decarbonizing industries through the EU ETS reform; reducing import dependency on energy, commodities, and raw materials; as well as reaching the Union´s ambitious renewable energy targets—do not always go hand in hand. In some cases, it can be argued that they could even oppose each other, and this is where the discussion on when and how free allocation will be phased out becomes relevant.

Renewable energy targets and the need for industry growth in Europe

In order to reach the Union's ambitious renewable energy targets, demand for products such as steel and cement, as well as raw material such as copper, is essential. According to the EU Commission's REPowerEU plan, meeting a large part of this increasing demand should be done within the Union. However, if industry associations are correct in their assessments that stricter obligations within the EU ETS Directive for those relevant industries will lead to further decline of production in the EU, the Union risks not meeting its target of reducing import dependency and/or its renewable energy target.

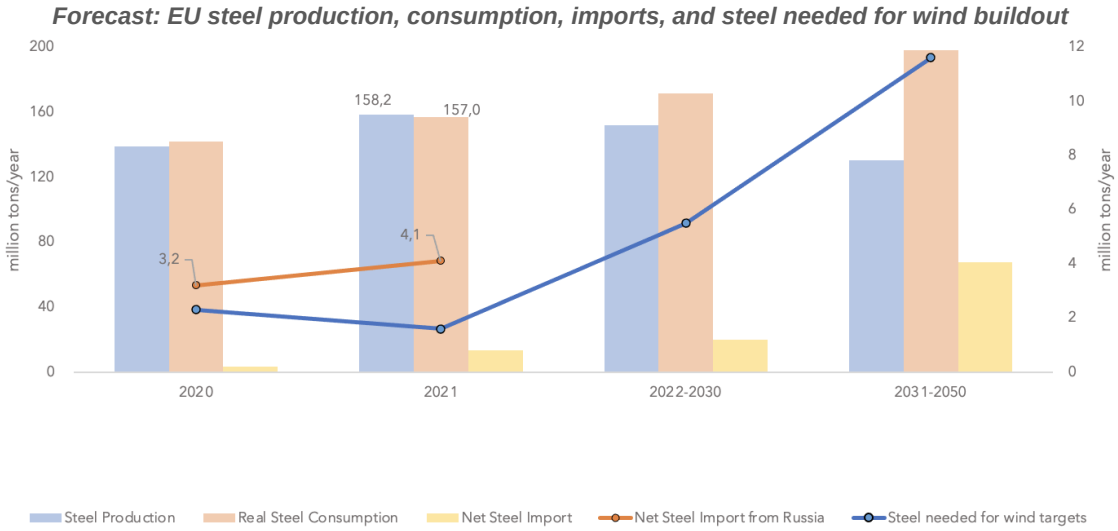
A good example of where conflicts can arise between the above objectives is Europe's growing steel import dependency related to its wind buildout target. Materials like steel are required for offshore as well as onshore wind turbines in comparatively large quantities. Thus, rising prices for these materials lead to noticeable increases in overall capex costs for wind producers. With Europe's steel production falling every year, and given more ambitious climate targets to 2050, the annual demand for steel by the wind industry alone is forecast to rise to 10 per cent of European production, tightening European steel supply significantly.

Steel prices have doubled since early 2021 owing to supply shocks. Russia's invasion of Ukraine saw them shoot up 40 per cent in Europe. If adding the fact that European steel makers will, in the near future due to the phase out of free allocation, have to specialize their production and offer the market premium products, the price forecast for steel in Europe is looking very bullish. If EU-wide and/or national government support will not aid in bridging the cost gap between high-cost European-produced materials and the effect they could have on future renewable production costs, the renewable energy targets risk not being met. This is simply because it risks becoming too expensive to build solar and wind in Europe, unless the Union accepts continued reliance on cheaper products produced outside Europe.

Conclusion

The EU Commission's effort to increase European self-reliance and decrease dependencies on key materials is understandable, even laudable, given the current geopolitical context. However, it could challenge the Union's ability to meet ambitious renewable targets, as essential materials for the renewable buildout produced in Europe, like steel, copper, and cement, risk increasing in price even further. Their importance in the capex calculations of wind producers in particular risks raising break-even costs for future projects. The weak societal acceptance of high energy prices during winter 2021/2022 indicates that there could be a political backlash if the transition proves to be significantly more expensive, over a relatively short time period. The amount of energy and climate policies and targets to be enacted and fulfilled at roughly the same time, with the same level of priority, is what really creates the challenge.

The initial events unfolded during the processes of voting trough the ETS proposals in the Parliament suggests that there are concerns about the secondary effects of a too rapid phasing-out of free allocations, such as renewed cost escalations down the line, setting off even more emergency management of end-consumer costs and market intervention, along the lines seen this past winter and spring. Although the phase out date that was accepted by the Parliament is a compromise it is still an earlier phase out date than what the Commission proposed (which was 2035), however the phase out process will not start until 2027, which is later than what the left of the centre backed and later than what the Commission proposed. Whether the voted trough phase out period will be the actual outcome when the law enters into force remains to be seen. There are still a few steps left before the ETS reform becomes law, including negotiations with EU member states.



Source: ELS Analysis.

CARBON BORDER ADJUSTMENT MECHANISM AND ITS IMPLICATIONS FOR INTERNATIONAL TRADE

Sanna Markkanen

The publication of the European Commission proposal for a Carbon Border Adjustment Mechanism (CBAM) on 14 July 2021 was notable for three main reasons. First, the proposal itself was unprecedented: although the idea of CBAM-type mechanisms had been floated since the 1990s, never before had a jurisdiction published a unilateral legislative proposal for such a measure. Second, it evoked exceptionally strong responses from various types of organizations and businesses, both within the European Union (EU) and abroad. Third, it raised questions about how trade policy could (and possibly should) be used to support decarbonization efforts in global markets where countries have increasingly diverse levels of climate ambition.

One thing that is particularly interesting about the EU's CBAM proposal is the almost complete lack of unconditional support for it. While companies, industry associations, non-governmental organizations, and various other stakeholders have publicly endorsed the policy measure—and the broader objectives of the Fit for 55 package it is a part of—most of these have been subject to considerable caveats. The diverse views regarding the CBAM were particularly well reflected in the proposed amendments to it by the Council of the European Union and the various European Parliament committees.

After the Parliament finalizes its position on the CBAM in the plenary session in June, the Commission, the Council, and the Parliament will engage in a *trialogue* (ie interinstitutional negotiation involving the aforementioned three EU institutions) to reach a consensus on the CBAM Act. This is expected to be a lengthy and difficult process that will require all parties to make considerable compromises. The final Act will likely look very different from the Commission's original proposal; however, it will almost certainly attract a similar or greater amount of criticism.

The exact impact(s) of the CBAM depend on the specific details of the final CBAM Act, revisions to the EU Emissions Trading System (ETS) (which is subject to the same trialogue process as the CBAM), and the trade partners' reactions. This short article draws on, and builds upon, an earlier assessment of the Commission's original CBAM proposal[28] to explore how the CBAM could affect global emissions and international trade.

[28] Markkanen, S., Viñuales, J., Pollitt, H., Lee-Makiyama, H., Kiss-Dobronyi, B., Vaishnav, A., et al. (2021), *On the Borderline: the EU CBAM and Its Place in the World of Trade*. Cambridge, UK: Cambridge Institute for Sustainability Leadership, University of Cambridge, https://www.cisl.cam.ac.uk/files/cbam_report.pdf (last accessed 27 May 2022).

The EU CBAM and the logic behind it

The idea behind the EU CBAM is simple: to 'equivalize' the impact of the EU carbon price on certain European energy-intensive sectors by imposing a comparable fee on imported materials. The purpose of the CBAM is to 'level the playing field', i.e. to ensure that EU-based producers are not disadvantaged because of the higher production costs caused by the EU carbon price, compared to producers in jurisdictions without a carbon price.

By equivalizing the impact of the carbon price, the CBAM is expected to reduce the risk of so-called 'carbon leakage', a process whereby producers relocate their operations (or redirect future investments) from highly regulated jurisdictions to less stringently regulated ones. The underlying assumption is that carbon leakage would result in an increase in global emissions because more production of carbon-intensive materials would take place in countries where emissions are less regulated. Carbon leakage could also increase the EU's dependency on imports.

However, the justification for the CBAM can, and has been, questioned extensively. So far, there is no evidence that the EU's carbon price has caused carbon leakage since its introduction in 2005. Of course, this may change as the EU phases out the allocation of free ETS allowances—a plan that many consider crucial for the EU's ability meet its 2050 climate neutrality target, but which has been vocally opposed by companies and trade associations in industries covered by the ETS.

The question of free allocation is highly relevant to the implementation and feasibility of the CBAM: unless the free allocation is removed, the CBAM is not legally or politically justifiable. Yet the removal of free allocation is also the root cause of some of the most vehement opposition to it. The challenge here lies in the CBAM's ability to 'level the playing field' only within the EU's domestic markets, a fact that may compromise the competitiveness of European export-oriented producers in the global markets. Many industrial operators also lack confidence in the CBAM and argue that free allocation should be maintained until the CBAM is known to work effectively.

The removal (or retention) of free allocation and the treatment of exports are among the issues that remain mostly hotly debated, alongside questions regarding the scope of emissions and sectors that the CBAM should cover, the recycling of the revenue, and the possibility of regulation being regarded as a justification for a lower CBAM rate. How these are addressed in the final CBAM Act will have a major impact on how the policy will be received and its impacts. For example, the extension of the CBAM to Scope 2 (indirect) emissions could potentially penalize some of the cleanest production facilities in the EU. Solutions such as export credits to mitigate the impact of the removal of free allowances on exports from the EU, on the other hand, would be difficult to reconcile with the EU's plans to adopt a set of anti-circumvention strategies to ensure that trade partners do not simply send their cleanest products to the EU without adopting measures to cut their industrial emissions more generally.

How could the CBAM impact global emissions?

Under the Commissions' draft proposal, the CBAM alone would have a very minor impact of approximately 10 million tonnes of CO_2 per annum (or 0.023 percent) on global emissions, by 2050. However, the CBAM is not actually intended to cut emissions directly but rather by creating an incentive for countries that rely heavily on the EU market for their exports to implement carbon pricing policies.

On a purely theoretical level, an aim to incentivize more ambitious climate action could be regarded as a reasonably good idea, and a relatively sound justification for calling the CBAM a climate policy measure (as opposed to a protectionist trade measure). The problem is, it is not clear how, or whether, the CBAM alone will present a sufficient incentive for carbon pricing instead of simply reducing demand for foreign-produced materials in the EU. Moreover, by focusing exclusively on carbon pricing, the EU may be pushing countries to adopt a climate policy tool that the EU endorses, instead of policies that might be more effective in driving decarbonization in local contexts, or policies that would have greater co-benefits (such as air quality improvements).

How may the EU's trade partners react?

The EU's trade partners have a set of response options open to them. They may wish to negotiate with the EU, either to acquire an exemption or to reach an agreement that their existing policies will earn them a CBAM rate reduction. However, for a total exemption, a country must link its carbon pricing mechanisms with the ETS—an interesting aspect of the proposal that has been exceptionally widely supported within the EU but subject to much criticism from certain very large trade partners, such as the US. The highly restricted grounds for a total exemption also mean that even countries with a comparably high carbon price, such as the UK, would be subject to the administrative costs associated with the CBAM, even if no actual CBAM rate was

payable. Subsequently, it could be argued that the CBAM is not seeking to encourage countries to implement their own carbon pricing mechanisms, but rather to expand the EU ETS.

The other alternatives open to trade partners include legislative action against the EU, retaliation, and compliance. Out of these options, the legislative avenue is most accessible for countries with the considerable resources necessary to instigate a dispute at the World Trade Organization (WTO). However, such a challenge may not be successful and, even if it is, the EU would not be required to pay any retrospective penalties.

Retaliation, which may not require the same level of resources, is only effective when applied either by a group of countries, or by a single country that constitutes a sufficiently large market for certain EU export(s) to 'hit where it hurts'. Many of the markets that are most reliant on the EU as an export destination for basic materials covered by the CBAM (such as Mozambique) are not actually in a position to 'hurt' the EU by placing restrictions on their imports from the region. However, some large trade partners, such as the US or China, may retaliate by placing restrictions on specific EU exports, including ones that are not covered by the CBAM, such as certain foods or beverages. Alternatively, they may adopt their own carbon border adjustment measures (such as what the UK is considering), or similar measures that are targeted specifically at the EU (such as the US proposal for a Carbon Polluter Import Fee).

Alternatively, groups of countries may join together to form so-called climate clubs. These could be sector-specific or broader in scope, with a membership eligibility based on levels of ambition rather than the presence of any specific measures to achieve them. While the idea of such clubs is raised frequently in trade and climate conversations, it is not entirely clear what they would look like, how they would operate, and what membership criteria could or would be applied. However, it is likely that a multilateral climate club that actively welcomes new members would be politically more palatable than a unilateral CBAM, and thus less likely to upset trade partners.

Small countries with limited resources and markets that are of relatively low importance to EU exporters, such as the least developed countries (LDCs), will most likely have to comply with the EU CBAM, even if this means additional administrative costs and reduced demand for their exports within the EU. Even if they were interested in applying a carbon pricing policy (and this would generate some domestic revenue to be used for climate action), many of these countries lack the financial resources and capacity to design and implement such policies. They may also fear carbon leakage, especially in countries where one or two energy-intensive basic materials industries are hugely important for the national economy. Moreover, considering that having a carbon pricing policy in place will only earn a minor reduction in the CBAM rate payable—rather than a full exemption—the risks are likely to outweigh the benefits, especially in the short term.

In this context, the plan put forward in the Commission's original proposal not to exempt LDCs and to recycle the CBAM revenue to the EU's internal budget could be regarded as unfair and conflicting with the spirit of the Paris Agreement. However, this could be addressed by directing the CBAM revenue, or an equivalent amount, to support decarbonization efforts in the LDCs. Although a minor gesture considering the size of the expected revenue, this would be a symbolically meaningful act to indicate that the CBAM is not intended to raise revenue for the EU budgets.

How might the CBAM impact international trade?

The impacts that the CBAM will have on international trade depend largely on the reactions of the EU's trade partners. These, in turn, will be influenced by the details of the final CBAM Act, as mentioned above.

If the EU simply applies the CBAM on imports, as outlined in the Commission's original proposal, but trade partners do not implement carbon pricing in response, there will likely be a slight increase in the production of the materials covered by the CBAM in the EU to compensate for a small decline in imports. This impact would be constrained to the basic materials covered by the CBAM, while manufactured goods (which will face higher material input costs in the EU but not be protected in any way against cheaper imports) could witness a shift in the opposite direction, with domestic producers losing market share to imports which have lower production costs (both labour and materials).

If the scope of the CBAM is extended, the potential impacts could be different. For example, extension of the CBAM to Scope 2 emissions could worsen the economic viability of some of the EU production of aluminium and recycled steel (produced using electric arc furnaces) because the CBAM rate would not sufficiently compensate the impact of the higher electricity costs that European producers incur. Without appropriate flanking measures, such as revisions to indirect cost-compensation mechanisms

and strong demand-side measures to create lead markets for low-carbon materials, these industries may relocate to other countries (or simply close their EU operations), increasing the EU's import dependence for some of the key materials that are needed for the transition to a climate-neutral economy.

There is also a possibility that the CBAM will have no impact at all on the emissions intensity of basic materials production, or on where this production takes place. For example, countries could simply direct their cleanest products to the EU markets, without reducing the overall carbon intensity of their production. There is a strong consensus within the EU over the need for strong 'anti-circumvention' measures to prevent this type of activity, but it remains unclear how, and how well, these measures would work in practice. Moreover, the anti-circumvention measures would most likely be incompatible with any export credit measures to ease the impact of the removal or phrasing out of free allocation on EU producers (which may also be incompatible with World Trade Organization regulations).

Even if the anti-circumvention measures were effective, the level of imports into the EU may decline only slightly, or not at all. This is because production cost and the price of materials and products is influenced by various factors, including the cost of labour, feedstocks, and taxes. The CBAM would not address any of the sources of cost difference beyond carbon price, meaning that imports could continue to be cheaper than comparable products from the EU.

From a just transition perspective, the CBAM would be extremely damaging if it resulted in LDCs losing market share in Europe, as this would further exacerbate the economic crisis in countries that have been severely affected by the Covid-19 pandemic and the Russian invasion of Ukraine. Moreover, the strict criteria to qualify for a total exemption may incentivize developing countries to concentrate their efforts on carbon pricing and overlook a host of other climate policies that are also needed, and which could generate faster results and more extensive co-benefits. If this happens, the CBAM may actively harm some of the most vulnerable people and poorest communities on the planet.

On the other hand, if the CBAM incentivizes the development of more open carbon clubs, it could instigate large-scale change in a positive direction, leading to considerable emissions cuts globally.

Concluding comments

The CBAM could be called a great idea, but it is not yet clear whether its practical application can be successful. A lot depends on the details of the EU's CBAM Act, which currently remain undecided, and on trade partners' reactions. At this point, there are only two things we know for sure: the EU will almost certainly implement some type of a CBAM, and the success of this policy measure will be determined by how quickly it becomes obsolete.

POTENTIAL IMPLICATIONS OF THE EU CARBON BORDER ADJUSTMENT MECHANISM

Dongmei Chen and Bertrand Rioux

On 22 June 2022, the European Parliament voted in favor of the legislation of the Carbon Border Adjustment Mechanism (CBAM). This is a significant progress following the relase of initial proposal on CBAM on 14 July 2021 by European Commission and the adoption of general approach by the European Council on 15 March 2022. As an integral part of the European Commission's 'Fit for 55' package, the CBAM is designed to be progressively phased in while free carbon allowances in sectors covered by the EU Emission Trading System (ETS) are phased out. It is clarified that the transitional phase will last from 1 January 2023 till 31 December 2026, when importers will be required to report embedded emissions on a quarterly basis. A price will be applied to CBAM credits in line with domestic carbon prices when all articles of the CBAM come into effect in 2027. At the same time, the ending of free EU ETS allowances is to be phased out from 2027 and to end by 2032.

The CBAM represents a measure to prevent a shift in the production of energy-intense commodities to countries with no, or less severe, carbon pricing and emission constraints—also known as carbon leakage. The initial list of commodities covered by CBAM contains selected products in the electricity, cement, fertilizers, iron and steel, and aluminium sectors. This scope is extended to also include polymers, organic basic chemicals, hydrogen, and ammonia, according to the amendment adopted by the European Parliament. It urges the Commission to develop a fair methodology to calculate embedded emissions from refinery products before the end of the transition phase.

In its initial proposal, the EU's CBAM will only cover direct Scope 1 emissions of carbon dioxide and other potent greenhouse gases during the production of commodities imported by the EU. Indirect Scope 2 emissions from electricity, heating, or cooling consumed during the production process is now included in the latest adopted legislation.[29] It may also be extended to account for the other value chain Scope 3 emissions at later stage, including the carbon emissions from the production of material inputs used by the producer—for example, emissions associated with the production of metallurgical coal or hydrogen feedstocks used by the steel industry.

The objective of CBAM is to create a level playing field in the cost of carbon abatement internationally. However, existing agreements complicate the path forward and will require striking a balance in the international community between the interconnected issues of trade and climate. The CBAM is expected to face challenges in its design and implementation. The legal enforcement of the accounting and verification of embedded emissions in imported commodities is a major concern.

How will accounting for indirect, or embedded, emissions be enforced? How will the verification and disclosure of data be achieved by countries that lack financial and technical support to build measurement, reporting, and verification (MRV) systems? How can linkage be created across national carbon markets, and how can pricing be set to ensure that the CBAM is fair and balanced across international suppliers and EU producers?

It is critical for the EU to promote ambitious climate policies and pave the way for global carbon pricing through a collaborative approach with the international community. International positions and responses to the EU CBAM are divided, largely depending on their trade connection with the EU and carbon intensity in the global supply chain. Countries—including Canada, Chile, Japan, South Korea, New Zealand, and the UK—that already have carbon pricing schemes and have trade agreements with the EU are more likely to accept the CBAM. For least developed countries, the implementation of the CBAM is perceived as a barrier to industrialization when their exports to the EU constitute a significant portion of national income. Major trading partners of the EU, especially developing countries whose exports are mostly low-value and carbon-intensive goods, have already raised concerns on the potential impact of CBAM on their exports and competitiveness.

The EU CBAM may have systemic implications, despite its relatively small effects on emission levels and on most trade flows. Through a quick analysis of three countries (the US, China, and Saudi Arabia), this article explores the implications of CBAM to countries with a comparable context to that of the European Union, countries with a large share of energy-intensive product exports, and countries heavily reliant on fossil fuel exports. How these countries could internalize carbon costs would provide perspectives for similar countries.

Implications for the US

The US has been the largest annual trading partner of the EU for the last decade, except in 2020 when it was overtaken by China. US exports of goods reached 11 per cent of the EU's total imports in 2020, primarily in the chemicals, machinery, and transport equipment categories. Compared to the rest of the world, the US has a decisive carbon advantage throughout the economy, which is on average three times more carbon efficient than China's and nearly four times as efficient as India's.[30] This advantage is reflected not only in high-value sectors such as computers, electronics, and optical products, but also in energy-intensive sectors such as steel. A domestic carbon fee and US carbon border adjustment policy, applied in the context of the 2019 steel market, could have increased the US steel industry margin by 32–41 per cent and value-add by 45–52 per cent,[31] given its advantage of short production processes and abundant domestic natural gas supplies.

Since the late 2000s, the idea of carbon border adjustments has been embedded in a series of proposals for federal emissions trading and carbon tax systems in the US as a policy instrument for protecting domestic industry from foreign competition. Carbon pricing in the US has so far only been introduced at the state level. Examples include California's Cap and Trade System and the Regional Greenhouse Gas Initiative covering 11 north-eastern states. Policymakers in the US continue to debate a national carbon price across the political spectrum. A legally sound national carbon border adjustment is difficult to

[29] European Parliament (2022, 22 June), Amendments adopted by the European Parliament on 22 June 2022 on the proposal for a regulation of the European Parliament and of the Council establishing a carbon border adjustment mechanism, https://www.europarl.europa.eu/plenary/en/texts-adopted.html.
[30] Rorke, Catrina, and Greg Bertelsen (2020), *America's Carbon Advantage*, Climate Leadership Council.
[31] CRU International (2021), *Leveraging a Carbon Advantage: Impacts of a Border Carbon Adjustment and Carbon Fee on the US Steel Industry*, Climate Leadership Council, https://clcouncil.org/reports/leveraging-a-carbon-advantage.pdf?v1.

implement without an economy-wide carbon pricing mechanism. During the Biden presidency, regulations to introduce a cost on carbon for the industries that a US CBAM would generally cover is also unlikely.[32]

The US has pledged to achieve net zero emissions by 2050. This presents opportunities for the EU to develop joint CBAM measures under a new EU–US agenda for global change. However, the final response of the US would still depend on the design of the CBAM framework and progress of its national carbon pricing scheme.

Implications for China

China's exports to the EU (€383 billion) in 2020 nearly double its imports from the EU (€202 billion). However, greenhouse gas emissions embedded in China's exports to the EU, estimated at around 270 million tonnes, are almost 10 times those estimated for the EU's exports to China.[33] At the initial stage of the EU CBAM implementation, China's export of ferrous and nonferrous metals to the EU would be impacted the most. They could drop by as much as 14 per cent and 25 per cent, respectively. But the impact of this on China's national economy would be limited, as its exports to the EU covered by CBAM account for only 0.4 per cent of its total exports. However, if the EU extends to all products and includes indirect emissions, China's overall exports to the EU would drop 20 per cent. This could drag down China's GDP growth by 0.15 per cent.[34]

China is taking two different approaches to deal with the EU CBAM. On international platforms, China has been resistant to the EU CBAM, arguing that it is contrary to the spirit of the United Nations Framework Convention on Climate Change and the whole design of CBAM is for protectionism rather than climate preservation. However, domestically, China has been very active and ambitious in dealing with carbon emissions. Following President Xi's pledge to achieve peak carbon emissions by 2030 and carbon neutrality by 2060, China has created a new wave of change with carbon reduction prioritized in every aspect of their economic development plans. Two days after the EU released its CBAM proposal on 14 July 2021, China officially launched its national ETS and commenced trading on the platform operated by the Shanghai Environment and Energy Exchange. Measured by the volume of emissions, China's national ETS is the world's largest carbon trading market, covering 2,162 companies in the power sector with a total estimated emissions of 4.5 billion tonnes of CO_2 annually.

Expanding the scope of China's ETS from the power sector to the commodities covered by the EU's CBAM, and building linkages between the two ETSs, could be an ideal option for both China and the EU. This can address the EU's concerns about carbon leakage and loss of competitiveness and reduce the additional costs and policy risks faced by China's exporters. However, China's ETS is still in its infancy if measured by the trading volume and transactions. The two countries would have to rectify significant differences in carbon pricing for the linkages to address the carbon leakage problem the CBAM is meant to solve. It would become critical for China to improve its MRV system and build the robustness of its ETS to manage the risks of being exposed to CBAM.

There are also discussions regarding possible choices for China in pursuing export policy adjustments and resource shuffling. China could prioritize the production of low-carbon-intensity commodities for export to the EU and retain high-carbon-intensity goods for domestic and other international trading partners. This approach, however, offers no benefit in achieving China's long-term climate commitments. Once the CBAM covers both direct and indirect emissions, the high carbon intensity in power generation arising from heavy reliance on coal power would impose great challenges to industrial production in most regions in China.

Implications for Saudi Arabia

Although Saudi Arabia is not one of the EU's major trading partners, they have strong economic ties. The EU is its second largest trading partner, with Saudi imports and exports valued at €25 and €17 billion in 2020, respectively. The EU's trade surplus with Saudi Arabia comes mainly from chemical products, machinery, and transport equipment. Saudi Arabia's exports to the EU are dominated by petroleum products—at around 80 per cent of the total—and the rest are mainly chemicals and plastics.

[32] Tu, Kevin, Oliver Sartor, and Run Zhang (2021), *EU-China Roundtable on Carbon Border Adjustment Mechanism*, Agora Energiewende Briefing.
[33] Wang, Hailin, Xiaodan Huang, Xiaofan Zhao, and Jianjun He (2020), 'Key problems in global climate governance and China's countermeasures', *China Population Resources and Environment*, 11, 26–33.
[34] He, Xiaobei, Fan Zhai, and Jun Ma (2022), *The Global Impact of a Carbon Border Adjustment Mechanism: A Quantitative Assessment*, March, https://www.bu.edu/gdp/files/2022/03/TF-WP-001-FIN.pdf.

The initial coverage of ammonia-based fertilizers by CBAM creates an opportunity for Saudi Arabia. Ammonia plays an increasingly important role in next-generation systems for energy storage, transportation, and power generation. This has changed its conventional function in the fertilizers industry. Benchmarking information from the United Nations Industrial Development Organization shows that ammonia production in the Middle East and North Africa region, including Saudi Arabia, is more efficient than that in China, Central Europe, and India if measured by specific energy consumption per tonne of ammonia produced.[35] The development of blue hydrogen and green hydrogen in Saudi Arabia can strengthen its carbon advantage in ammonia production. Applying carbon capture and storage (CCS) to the natural-gas-based steam reforming process can reduce up to 90–95 per cent of carbon emissions from hydrogen production. Saudi Arabia's abundant wind and solar resources and ambition for renewable energy development can support the development of green hydrogen, which may further decrease the CO_2 penalty. Saudi Arabia can establish national MRV standards in support of blue and green hydrogen certification so as to comply with reporting of embedded carbon emissions for export to the EU by 2023.

While oil and gas products are not covered directly by the CBAM, they provide primary inputs for complex products covered by it, including ammonia. This will impact major fuel suppliers, like Saudi Arabia. The European Parliament's resolution stresses that the CBAM should cover both direct and indirect emissions and extend the product scope to include polymers, organic chemicals, hydrogen, and petroleum products. This extension may have limited impact in the short term for Saudi Arabia due to its lower cost and lower carbon intensity in the hydrocarbon production process compared with international averages. But with increasing stringency and rapid transition towards net-zero carbon emissions, a medium- to long-term decarbonization strategy would be critical for Saudi Arabia to maintain its economic advantage. Such efforts could also improve the demand for Saudi commodity exports, and even seek a premium in the EU market by avoiding import tariffs introduced by the CBAM policy, as planned to start in 2026.

Saudi Arabia voiced its concerns about the EU CBAM policy at a World Trade Organization meeting, criticizing it as an attempt to stop investments from leaving the EU.[36] However, in 2019, Saudi Arabia announced the Circular Carbon Economy (CCE) initiative, targeting four balanced emission management pathways: reduce, recycle, reuse, and remove. This CCE framework adopted by the G20 provides guidelines for many oil producing and exporting countries to drive changes in policy, investment, and technology development.

The Oil and Gas Climate Initiative, of which Saudi Arabia's national oil company, Saudi Aramco, is a member, identifies options to reuse carbon emissions as feedstock in synthetic fuel production or remove them through storage in depleted reservoirs.

Clean hydrogen offers another attractive transition pathway for oil- and gas-exporting countries. They can leverage established energy export infrastructure (ports, pipelines, and storage facilities); a skilled workforce familiar with producing, converting, and handling energy fuels and gases; and existing energy trade relations.[37] Among others, Saudi Arabia has the potential to become a major producer and low-cost supplier of low-carbon hydrogen. These resources can be used for energy exports or as an input to domestic energy-intensive sectors, for example reducing carbon emissions for steel production. Saudi Arabia completed a pilot shipment of blue ammonia to Japan in 2020, and in the same year announced the Helios Green Fuel Project with investment of $5 billion for green hydrogen and green ammonia production powered entirely by solar and wind in the megacity of Neom.

To align the CCE and clean hydrogen development plans with the EU CBAM, Saudi Arabia is expected to strengthen its capacity in building a national MRV system. This could help harmonize standards and improve the robustness of carbon accounting and verification methods for global hydrogen trade. Exploring and promoting the use of carbon storage units in a broader carbon trading system can help create additional incentives to commercialize and deploy CCS at a larger scale.

Furthermore, Saudi Arabia could consider establishing a national carbon fund as a responsive tool to the CBAM. This would collect carbon taxes nationally, to avoid importers of products originating from Saudi Arabia from buying CBAM credits from the EU. The fund should define the scope of the industries and sectors where it is applied, such as taxing all domestic production

[35] United Nations Industrial Development Organization (2010), *Global Industrial Energy Efficiency Benchmarking*.
[36] Leeuwen, Hans van (2021, 2 May), 'EU cops international fire over carbon border tax plan', *Financial Review*, https://www.afr.com/world/europe/eu-hit-by-international-fire-over-carbon-border-tax-plan-20210501-p57nzp.
[37] International Renewable Energy Agency (2022), *Geopolitics of the Energy Transformation: The Hydrogen Factor*, https://www.irena.org/publications/2022/Jan/Geopolitics-of-the-Energy-Transformation-Hydrogen.

versus exports. It is also important to provide transparency and accountability on revenue allocation. In this way, revenues that would otherwise be collected by the EU on hydrocarbons and derived commodity imports from Saudi Arabia could be used to catalyse investment in CCS, green hydrogen, and renewable energy for the Kingdom.

Conclusion

The economic implications of an EU CBAM will depend on how broad and deep the MRV coverage is for the embedded carbon emissions of the products covered. The CBAM will require solutions to the technical challenges of MRV. This involves minimizing administrative costs and addressing carbon leakage from strategic reallocation of resources and shifting trade patterns.

Other political and legal challenges may also complicate CBAM implementation, and progress towards embedded emissions reporting, including efforts to derail the CBAM under World Trade Organization rules. Bilateral and multilateral agreements on international standards for the verification and transfer of carbon emissions data could help address barriers around fairness of CBAM implementation.

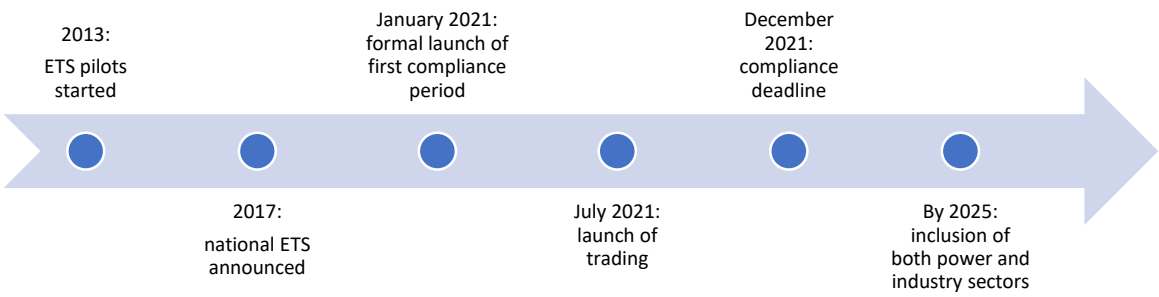
To reduce exposure to EU CBAM payments relative to the default penalties, countries that have a strong trade connection with the EU could consider introducing carbon management strategies to lower emission intensities, and setting up national carbon pricing mechanisms to offset carbon taxes that might be imposed by the EU. Oil and gas producers may develop advantages from shifting the oil and gas assets to clean hydrogen provision. The knowledge, skill sets, and infrastructure they have accumulated from fossil fuel industries could be turned into inputs for new economic growth. However, this would require broader international cooperation to harmonize standards and improve the robustness of carbon accounting and verification for global hydrogen trade. It will also be critical to create innovative financial incentives for a larger-scale deployment of CCS, so as to reduce the carbon intensity of hard-to-abate sectors.

CHINA'S ETS: PERFORMANCE, IMPACT, AND EVOLUTION

Yan Qin

China's national emission trading system (ETS) finally launched in 2021, obliging more than 2,000 power generators to surrender allowance units to account for their 2019–2020 emissions. This was built upon experiences from seven pilot ETSs in operation since 2013, and the national carbon trading finally started on 16 July 2021 at the Shanghai Environment and Energy Exchange. Only power generators have a compliance obligation for now, but the scope will expand in the coming years with all the industrial sectors likely to be added. However, power generation is such a large contributor to China's overall greenhouse gas output that in its current scope the ETS covers annual emissions close to 4.5 billion tonnes of CO_2 per year or around 40 per cent of China's total emissions.

Timeline of China's national ETS



How has China's national ETS performed in its first year of operation?

In its first year, China's new national ETS delivered mixed messages. On the positive side, the market was finally able to take off after over 10 years in the making. The first compliance cycle went smoothly in terms of allocating allowances to covered

enterprises and surrendering allowances for compliance by the end of 2021. The compliance rate was very high at 99.5 per cent, as announced by the Ministry of Ecology and Environment.[38]

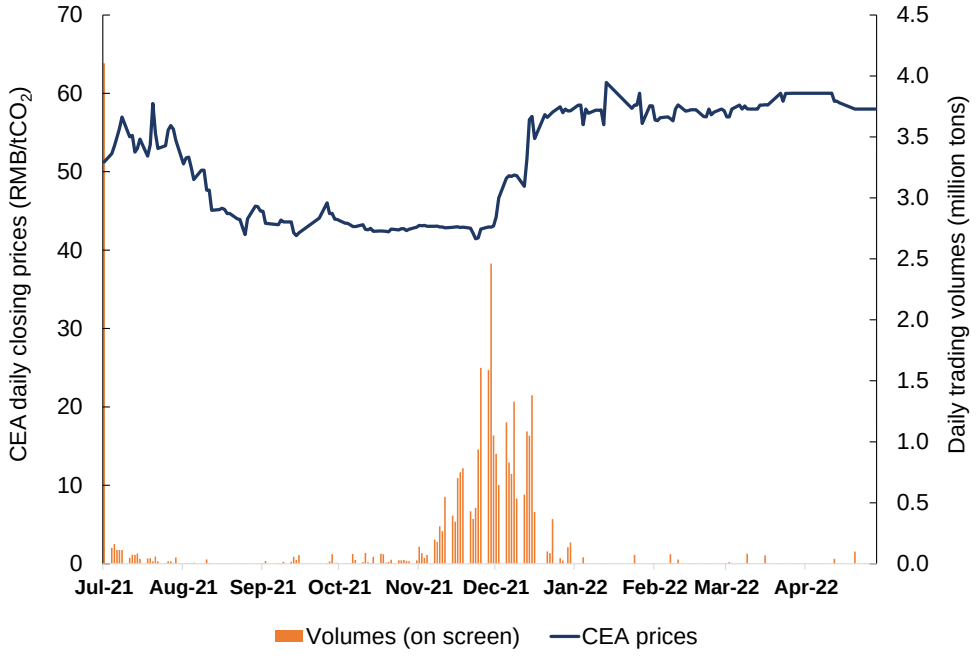
However, the low level of allowance prices and muted trading liquidity are less encouraging. The China Emission Allowance (CEA) traded at between 40 and 60 RMB per tonne of CO_2 (tCO_2) during most sessions and remained near 60 RMB in May 2022. This price level is just a fraction of the EU ETS price of €80/tCO_2, and raised doubts about the ETS's effect in driving emission reduction.

Trading volumes of CEAs were very thin compared to the vast size of covered emissions of 4.5 billion tCO_2 per year, and compared to other ETSs. Volumes picked up somewhat in late November 2021 when the end-of-year deadline for surrendering allowances for compliance drew near. Daily trading volumes were below 100,000 tonnes in most sessions. Entering 2022, trading activities almost dried up with lots of sessions only seeing a trivial 10 tonnes changing hands.

Why the low prices and poor liquidity?

The main reasons behind the poor liquidity are rather generous allocation and handing out of all allowances for free, which dented market participants' buying interests. In China's national ETS, coal- and gas-fired power plants are allocated allowances based on benchmarks. The regulator was wary of resistance by enterprises to the new ETS and opted for a soft start of the system to encourage participants to cooperate. Hence, the benchmarks for the first compliance period were set at quite generous levels, and indeed were higher than the average CO_2 emission factor of the coal fleet. As a result, the majority of the power plants have sufficient allowances to cover their compliance needs and do not need to purchase allowances.

China national ETS—daily closing prices of CEA and trading volumes since July 2021



There are additional rules, such as offset usage and an allowance shortage cap, which further loosened the supply–demand balance in the ETS. The Refinitiv Carbon Research team estimated the final verified emissions for the two-year period of 2020–2021 to have been 8.68 billion tonnes, against a known total allocation of 9.01 billion allowances and around 30 million offset usages. This left a surplus of 360 million allowances going forward into the new compliance period.[39]

[38] China Ministry of Ecology and Environment (2021, December), 'Completion of first compliance cycle of national ETS', http://www.ncsc.org.cn/xwdt/gnxw/202201/t20220101_965915.shtml

[39] Tan, L. (2022, February), 'The first year of China's national carbon market, reviewed', *China Dialogue*,

Moreover, the low allowance price partly reflects the low abatement costs in China's power sector at present. Unlike in European countries, gas-fired power plants only account for less than 5 per cent of China's power fleet, in contrast to coal's dominating share of 60 percent. Thus, in China there is almost no potential for coal-to-gas switching as in the European power sector; rather, the greatest potential is for switching from least efficient to more efficient coal plants. The costs of these incremental improvements are quite low.

Currently only compliance entities are allowed to trade in China's national ETS. Only spot trading is allowed, and there are currently no financial derivatives available. Consequently, covered enterprises only have the incentive to start procurement of allowances near the compliance deadline, creating a 'tidal pattern' in trading volumes. Since the annual compliance was completed after 31 December 2021, the enterprises have had little incentive to trade allowances, since the next compliance deadline is distant. This has resulted in a near standstill in trading activities in the ETS in 2022. The Environment Ministry has not announced the new allocation plan for the second compliance period. Draft version for consultation in March 2022 has proposed to set the new period at two years, 2021 and 2022, with the compliance deadline at the end of 2023. If this is adopted, then it will be one and a half years until the next true-up. This will severely limit the buying interests of compliance enterprises and keep trading activities muted.

The impacts of the Chinese ETS focus on efficiency improvement in its current stage

Despite the current low price level, the role of China's national ETS goes beyond the carbon price signal. The establishment of the ETS has also helped the authority to collect emissions data, build up an effective greenhouse gas monitoring system, and enhance awareness of carbon pricing among energy-intensive enterprises. This capacity building will lay a solid foundation for the country's overall emissions reduction efforts. Through the national ETS, China has now set a national carbon price. It can prompt the enterprises to consider internal carbon pricing, as other international enterprises have already been doing, and can be used as a reference carbon price for financial institutions in climate risk stress testing of assets.

Nevertheless, it needs to be pointed out that the Chinese ETS's current design with intensity-based targets limits its effectiveness. The big difference between China's ETS and other carbon trading programs is that the former is intensity-based, with the cap being adjusted according to actual production levels. While the EU ETS and other programs hold covered entities accountable for their absolute emissions measured in tonnes and decide the overall cap years into the future (2030), Chinese firms' compliance obligation relates to their carbon intensity, measured in emissions per unit of production (in the power sector, this is per unit of electricity generated), and is thus not pre-set to a fixed declining trajectory over time.

This approach was chosen for the purpose of being consistent with China's climate target in the 14th Five-Year Plan (2021–2025), i.e. the GDP intensity goal. Thus, aging and inefficient thermal plants will be punished if their emission intensity is above the benchmark, since they need to buy allowances for compliance. In contrast, more efficient thermal plants will have surplus allowances as subsidies since they can sell in the carbon market and get revenue.

With the intensity-based target, the choice of benchmarks will represent the reduction ambition of the ETS. But it can mainly serve the purpose of improving overall efficiency and bringing down the CO_2 emission intensity of the thermal power fleet (mainly coal). Moreover, the ETS emissions will rise as long as total output (thermal power generation) does. Another limitation of this design is that it provides incentives for building new and more efficient plants whose emission intensity will be below the benchmark. Meanwhile, the energy regulators have also released a plan to upgrade the coal fleet and shut down inefficient plants.40 This could further restrict the impacts of the ETS with its intensity-based target, which may only have limited impacts in parallel to these regulatory measures of improving coal sector efficiency.

The use of offsets in the ETS has provided further leeway for compliance enterprises. The domestic offsets are China Certified Emissions Reductions (CCERs), which refer to activities by companies to reduce emissions on a voluntary basis that have been certified by the government. Example activities include renewable power generation, forestry projects, and waste-to-energy projects. Power enterprises are allowed to use CCER for compliance, up to 5 per cent of their yearly emissions. And the CCER price has been lower than the ETS allowance, only 20 RMB to 30 RMB/tCO_2. Hence the offsets become cheaper substitutes,

https://chinadialogue.net/en/climate/the-first-year-of-chinas-national-carbon-market-reviewed/.

[40] China National Development and Reform Commission (2022, May), 'Clean and efficient utilization of coal in key sectors advanced and baseline levels (2022 version)', https://www.ndrc.gov.cn/xxgk/zcfb/tz/202205/t20220510_1324482.html?code=&state=123.

reducing the net allowance demand of entities and resulting in allowance surplus. Going forward, the regulator indicated that it aims to tighten the CCER issuance rules, limit project types, and potentially restrict the offset allowed in the ETS.

Evolution: China ETS eyes expansion and further revision in design

China's newly launched ETS will, nonetheless, play an important role in China's emission peaking and carbon neutrality targets. The sheer size of emissions covered in the ETS underpins its significance; it is expected to cover 60 per cent to 70 per cent of China's total emissions when both power and industry sectors are included. Even if the current ETS price level is not enough to significantly impact investment decisions, the benchmarking exercise and emissions reporting and verification are already good steps forward. Also, the ETS, despite its design flaws, is a tool for China to use as leverage in discussions with the EU around the Carbon Border Adjustment Mechanism currently under discussion by lawmakers.

There is already a lot to expect in 2022 as China's national ETS enters its second compliance period. The Ministry of Ecology and Environment will likely release the new and stricter benchmarks for the new period in June or during the third quarter. The State Council is expected to finally approve the ETS regulation which will lift the ETS policy framework higher in the regulatory hierarchy. There will also be further progress in expanding carbon trading to financial investors and the introduction of carbon derivatives trading, in either late 2022 or in 2023. The expansion of the ETS to more industry sectors is also ongoing, with data collection and benchmark setting being carried out.

It is reported, though, that the inclusion of industrial sectors such as aluminium and cement may be postponed to 2023 due to data quality issues,[41] so one year later than previously expected by market observers. Complex industrial processes could be a main obstacle in the scope expansion, and it also involves thorough collaboration between the Environment Ministry and other ministries. In addition, the complicated macroeconomic and energy security situation in 2022 is creating headwinds. Economic slowdown worries could prompt the government to delay putting any additional pressure on the industries that will support recovery. On 8 June, the Ministry of Ecology and Environment released a notice postponing the deadline for 2021 ETS data reporting by three months to September, citing covid restrictions and overall consideration for socio-economic development[42].

Looking ahead, the impacts of China's ETS largely hinge on the system design. The current intensity-based target needs to move to an absolute emissions reduction target in order to drive down emissions in the ETS-covered sectors, fulfilling the 2030 carbon peak goal. Government could include the contribution of the ETS into the overall climate target. Domestic studies have projected that China's power sector will likely peak emissions in 2028, slightly later than industrial sectors.[43] This is mainly due to electrification needs such as coal-to-electricity switching in the industry and transport sectors. Hence, it is likely that such an absolute emissions target for the ETS will only be ready to be implemented starting in the 2025–2030 period.

In addition, the national ETS should also gradually introduce auctioning of allowances, and reduce the free allocation of allowances. The revenues from auctioned allowances could be used as funding for investments and innovation in low-carbon technology. If free allowances will continue in the future, all types of power producers, including wind and solar power producers, should have allowances based on the power production from the plants.

Despite the issues mentioned above, it should be noted that it takes some time for an ETS to move from trial stage to maturity. The EU ETS has also experienced significant downturns, starting with a three-year pilot period in 2005–2007, then getting hit by the 2008–2009 financial crisis with prices remaining in single digits for several years due to heavy oversupply. It finally took off in 2017 when the market reform debate began. This pathway tells us that sturdy long-term climate goals and tighter rules for handing out allowances in the ETS will help the carbon price to discover its true intrinsic value and reflect abatement costs. Experiences from the EU ETS's success will guide the China ETS to be more quickly on track and incentivize decarbonization in the power and industry sectors.

[41] 'China national ETS delays sector expansion, how to solve carbon data issues?' (2022, May), *Caijing Magazine*, https://mp.weixin.qq.com/s/bhuiTIWB40AiCZR1m_UX2w.
[42] China Ministry of Ecology and Environment (2022, June), 'Notice on adjusting 2022 enterprise greenhouse gas emissions reporting work and key tasks', http://www.ncsc.org.cn/xwdt/gnxw/202206/t20220610_985083.shtml
[43] China Electricity Council (2021, December), 'China power sector carbon peak and neutrality pathway study', https://cec.org.cn/detail/index.html?3-305486.

CARBON MARKETS AND RELATED OPPORTUNITIES FOR THE GULF

Mari Luomi

With a growing number of countries and corporations adopting net-zero emissions targets and increasingly ambitious medium-term emission reduction targets, interest in carbon markets has been rising rapidly. In November 2021, following six years of negotiations, governments reached agreement on the major building blocks of implementation guidance for international carbon market cooperation under Article 6 of the Paris Agreement. This guidance gives long-awaited clarity that will allow countries and companies to start planning their future engagements in this space in more detail.

The full operationalization of the market mechanism under Article 6.4, along with the various other bilateral and multilateral cooperative arrangements that will emerge under Article 6.2, will still take years. At the same time, however, indicating high expectations by the private sector regarding the potential of carbon markets to support their climate goals, demand for carbon credits has risen to record-high levels. In the first 11 months of 2021, the voluntary market reached more than US$1 billion, according to the monitoring service Ecosystem Marketplace.[44] The same year, McKinsey estimated that global demand for offsets could increase to US$5–50 billion by 2030.[45]

Carbon markets globally remain highly fragmented, and in many countries related expertise and experience lies on a narrow basis, among a limited number of organizations and individuals. Until the early 2010s, only developed countries deployed carbon pricing instruments, such as carbon taxes or emissions trading schemes (ETSs). Among the first developing countries to do so, China launched its first ETS pilots in 2013 and Mexico introduced a carbon tax in 2014. As of 2021, based on the World Bank's Carbon Pricing Dashboard, 37 developed and eight developing countries had in place either a carbon tax or an ETS at a national or subnational level, with a further four and 12 countries, respectively, either scheduled to or considering launching one soon.[46] In addition, there are 13 countries with subnational- or national-level baseline and crediting schemes, which generate offsets for various purposes, including for compliance use under ETSs or voluntary offsetting.

Today, none of the Gulf Cooperation Council (GCC) countries (or Arab countries by extension) has in place a carbon tax or a regulated carbon market mechanism—an ETS or crediting scheme. All six countries have, however, expressed interest in participating in international carbon markets in their most recent Paris Agreement Nationally Determined Contributions (NDCs).

Kuwait, for example, mentions Article 6 as a means to achieving greater ambition in reducing greenhouse gases (GHGs). Bahrain outlines that its approach will be 'multi-metric', meaning it might wish to trade not only in carbon dioxide equivalent units but also in renewable-energy- and energy-efficiency-related units. While this is allowed under Article 6.2, tangible examples remain to be articulated and implemented. Oman's second NDC mentions cost-efficient emission reductions, transfer of mitigation technologies, and sustainable development co-benefits as its Article 6-related goals. Saudi Arabia refers to enhanced private sector engagement (in mitigation action) and unlocking investment flows, among others, in its updated first NDC.

Past engagement with international carbon markets: the Clean Development Mechanism

To date, GCC countries have not been keen to implement economy-wide carbon or GHG pricing, as this has been perceived as potentially harmful for economic development and, most critically, the competitiveness of the region's energy-intensive export industries. For a long time, carbon pricing instruments were therefore not seen as an attractive policy instrument for the national level. However, like many other developing countries, GCC countries engaged in international carbon markets through the Kyoto Protocol's Clean Development Mechanism (CDM).

An international crediting scheme, the CDM allowed developed countries to finance projects that reduce or remove GHG emissions in developing countries and use the achieved emissions reductions towards meeting their emission reduction targets. In many cases, developing countries developed CDM projects unilaterally, with the same aim of selling them to buyers with emission reduction commitments under the Kyoto Protocol or, later on, to voluntary carbon markets. All CDM projects were required to contribute to sustainable development in the developing country—as defined by the host country government—and

[44] Ecosystem Marketplace (2022), 'Transacted voluntary carbon credit volume, weighted average price, and value 2021 year-to-date', https://data.ecosystemmarketplace.com/, accessed 4 May 2022.
[45] Blaufelder, Christopher, et al. (2021, 29 January), 'A blueprint for scaling voluntary carbon markets to meet the climate challenge', *McKinsey Sustainability*, https://www.mckinsey.com/business-functions/sustainability/our-insights/a-blueprint-for-scaling-voluntary-carbon-markets-to-meet-the-climate-challenge, accessed 25 April 2022.
[46] World Bank, *Carbon Pricing Dashboard*, https://carbonpricingdashboard.worldbank.org/, accessed 4 May 2022.

result in measurable and long-term benefits in terms of reducing emissions. A key principle was additionality: CDM project developers were required to prove that the reductions would not have occurred without the project.

The idea behind the CDM was to provide flexibility for developed countries with emission reduction targets under the Kyoto Protocol's two commitment periods (2008–2012 and 2013–2020) to offset some of their emissions by paying for reductions achieved elsewhere at a lower cost. Since developing countries did not have caps on their emissions, the primary incentive for participating came through the financial benefits achieved via the sale of Certified Emission Reductions (CERs) and the clean technologies transferred as part of the projects.

The literature remains divided over whether CDM projects supported sustainable development in the host countries, and over whether the emission reductions were additional or would have taken place in any case. What is generally agreed, however, is that the CDM, along with other carbon market mechanisms and standards that have been developed over the past decades, built a significant amount of knowledge and capacity on assessing, measuring, reporting, and verifying emission reductions; laid the foundations for a market infrastructure; and developed an understanding of how these markets work and how they can be further improved.

Until today, as in most other developing countries, the CDM has been almost the only carbon market mechanism that GCC countries and their private sectors have interacted with. It will be this basis that much of the region's participation under Article 6 will initially build on.

Data on the GCC's carbon market participation

In terms of statistics, the GCC countries host amongst them 28 registered CDM projects, which collectively are estimated to result in a cumulative GHG emissions avoidance of 52.3 million tonnes of carbon dioxide equivalent ($MtCO_2e$) through 2025.[47] In addition, Saudi Arabia hosts two programmes of activities (PoAs), with a total cumulative avoidance potential of 0.2 $MtCO_2e$ through 2025. For a comparison, Climate Watch estimates the GCC countries' total GHG emissions in 2018 (latest available year) as 1,245 $MtCO_2e$.[48]

The registered CDM projects in the GCC are located in five countries (all except Bahrain), with the majority in the United Arab Emirates (UAE) (15) and Saudi Arabia (6). Most of these projects were initiated unilaterally by the GCC countries, and many have yet to issue credits. As of April 2022, 15.9 million CERs had been issued from 13 of the projects; the rest had not issued credits. After issuance, CERs still need to be sold in order to generate monetary benefits for the project developers. There is no centralized database for sold CER volumes.

Reflecting the falling interest in developing new projects due to lower CER prices post-2012, only eight of the GCC's CDM projects were registered after 2012. As agreed in Glasgow, all CDM projects and PoAs can request to transition to the Article 6.4 mechanism. Transitioned projects and PoAs must shift from CDM methodologies to Article 6.4 methodologies by 2026 at the latest. Furthermore, CERs only qualify for use towards first or first updated NDCs, and they must originate from projects or PoAs registered from 2013 onwards. The expected accumulated reductions (CERs) from the eight qualifying GCC projects through 2025 total 6.0 $MtCO_2e$ (out of which 0.5 MtCO2e has been issued in CERs to date), which means the GCC countries will be stepping into the Paris era with a small carryover and will need to focus efforts on incentivizing a pipeline of new projects from early on, should they wish to generate a domestic credit supply either for domestic uses or for international transfers under Article 6.

One GCC country, Saudi Arabia, has also participated in international carbon markets through another crediting scheme, called the Joint Crediting Mechanism (JCM). The JCM is a bilateral mechanism under which Japan has to date engaged with 17 developing countries. It differs from the CDM in that the details of the cooperation are agreed bilaterally and credits are shared between Japan and the project host country. The JCM was designed with the Paris Agreement's Article 6.2 in mind and is now transitioning into this era. Saudi Arabia currently has one registered JCM project, in the area of industrial energy efficiency, which will deliver 16 kilotonnes of CO_2 equivalent ($ktCO_2e$) in reductions through 2022. Another project is in the process of being registered.

[47] Fenhann, Jorge (2022, 1 April), *CDM Pipeline*, UNEP Copenhagen Climate Centre. https://www.cdmpipeline.org/
[48] Climate Watch (n.d.), 'Historical GHG emissions: CAIT', https://www.climatewatchdata.org/ghg-emissions?end_year=2018&regions=BHR%2CKWT%2COMN%2CQAT%2CSAU%2CARE&start_year=1990, accessed 3 May 2022.

The Verified Carbon Standard, a major independent crediting standard catering for voluntary carbon markets, lists two approved projects from the GCC, located in Bahrain and the UAE. The former, which is a 123 MW solar energy project, has a crediting period that runs through 2031. The crediting period of the latter, a waste heat recovery project, expired in 2019.

On the demand side of voluntary carbon markets, the registry of voluntary CER cancellations maintained by the United Nations Framework Convention on Climate Change lists two Saudi companies—Saudi Basic Industries Corporation (SABIC) and Al Taiseer Aluminium Company—which have together cancelled a total of 95.4 ktCO_2e. Three smaller cancellations—including a literature festival—were also made in the UAE, totalling 0.5 ktCO_2e.[49]

As the region gears up to participate in international carbon markets, it will be important to bring together actors that worked on these projects and participated in these early market exchanges. This will help save time and resources, and can guide decision makers towards options that have already been tested and worked and away from ones that did not work

Recent domestic developments

Already more than a decade ago, Nasser Saidi, then the chief economist of the Dubai International Financial Centre, promoted the idea of Dubai becoming a carbon exchange hub.[50] The Dubai Multi Commodities Centre free zone also held similar aspirations, as reported by Reuters, to 'become a centre for trading greenhouse gas emissions permits, diving into a fast-growing market and the potential to turn the region's sizeable carbon footprint into cash'.[51]

With the rapid fall in CDM credit prices in 2011–2012 due to limited demand from the primary CER market, the EU ETS, accompanied by a significant oversupply and concerns over the quality of credits, CDM projects quickly became less attractive. In the GCC, as noted above, only eight CDM projects were registered in the past decade.

With the overall urgency around climate action rising rapidly, recent years, however, have seen carbon markets re-emerging in policy discussions in some GCC countries. Under the Paris Agreement, all countries have set emission targets, which means that Gulf countries now not only may potentially be suppliers of carbon credits but also might be on the demand side of the equation. Airlines in Qatar, Saudi Arabia, and the UAE are prime examples of this, as their host countries have joined the pilot phase of the International Civil Aviation Organization's Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), and therefore face offsetting obligations starting from 2021 onwards, once their CO_2 emissions exceed 2019 levels.

Alongside three GCC governments—Bahrain, Saudi Arabia, and the UAE—several major GCC corporations announced net-zero GHG or CO_2 targets in the run-up to the UN Glasgow Climate Change Conference (COP 26). In Saudi Arabia alone, this included the national oil company Saudi Aramco, which has set a net-zero GHG emissions target for its Scope 1 and 2 emissions for 2050, the chemicals giant SABIC, which has pledged carbon neutrality by 2050, and the megaproject Neom, which aims to reach a 100 per cent renewable power supply. Among GCC corporates, there are expected to be both major buyers and sellers of credits. For example, Neom can be expected to have offsetting needs during its construction phase, but later on could potentially become a source of carbon credits.

Prompted by these corporate pledges and the rising interest in international carbon markets worldwide, recent months have seen two major announcements in the GCC relating to voluntary carbon markets. In September 2021, Saudi Arabia's sovereign wealth fund, the Public Investment Fund, along with the stock exchange Tadawul, announced plans to establish a voluntary exchange platform for carbon credits for the Middle East and North Africa region.[52] In March 2022, five major Saudi companies signed memoranda of understanding with the two entities indicating an intent to join the platform once it becomes operational, possibly in 2022. In Abu Dhabi, the financial centre Abu Dhabi Global Market announced the same month it would be the 'first fully regulated carbon trading exchange and carbon clearinghouse' with the aim of becoming the 'first jurisdiction globally to

[49] United Nations Framework Convention on Climate Change, 'CERs cancelled through the CDM registry regular process: from 16 November 2018 onwards', https://cdm.unfccc.int/Registry/vc_attest/index.html, accessed 2 May 2022.
[50] Neuhof, Florian (2011, 15 November), 'DIFC wants to become clean, green finance hub', *The National*. https://www.thenationalnews.com/business/difc-wants-to-become-clean-green-finance-hub-1.427344
[51] Reuters (2008, 15 January), 'Dubai's DMCC launches new clean energy partnership'. https://www.reuters.com/article/carbon-credits-mideast-idINL1516062720080115
[52] Saudi Press Agency (2021, 3 September), 'PIF in collaboration with the Saudi Tadawul Group announces an intent to establish a voluntary exchange platform for carbon credits within the Middle East and North Africa Region', press release. https://www.spa.gov.sa/viewfullstory.php?lang=en&newsid=2280535

regulate carbon credits and offsets as emission instruments, and to issue licenses for exchanges to operate both spot and derivative markets'.[53]

Alongside these two, Qatar has since 2016 hosted the Global Carbon Council, which is a voluntary carbon market program that caters for the global south. The platform, which has been operational since 2019, has created its own crediting standards and has been accredited under CORSIA. As of March 2022, 216 projects had been submitted to the Council. Two projects had been approved, with 134 ktCO_2e Approved Carbon Credits issued.[54] A similar trend of aspiring voluntary carbon market trading platforms has also been observable in other regions, including in Singapore and Hong Kong in Asia.

It remains to be seen which markets the GCC platforms end up catering for. In the past, competition has often trumped cooperation in many economic sectors in which individual GCC countries have sought to become regional hubs for collaboration or trade. In the case of carbon markets, experts generally agree that the GCC stands to gain significantly more from a regionally integrated carbon market than from individual domestic markets. This issue will become increasingly pressing if GCC countries decide to pursue regulated carbon markets alongside purely voluntary ones going forward.

Opportunities and work ahead

If properly regulated, and if high quality of credits is assured, carbon markets could make an important contribution to raising ambition and lowering costs of emissions reductions in the GCC. They continue to offer opportunities for technology transfer and, if well designed, other sustainable development co-benefits, such as employment and environmental health. Well before considering the regional dimension of carbon markets, the GCC countries—similarly to most developing countries and emerging economies—have a significant amount of work ahead in building institutional and human capacity, across government and the private sector, to enable the development of the required measuring, reporting, and verifying frameworks; governance arrangements; and carbon credit-generating activities, among other things.

Early and proactive engagement by governments towards corporates to encourage participation will be a crucial first step. Companies will need support on aspects ranging from understanding what their role would be in the market (a buyer or a seller), reporting their emissions, calculating their potential offsetting needs or credit generation potential, understanding project development, and connecting to relevant market actors. Governments have a key enabling role to play in all this.

At the same time, governments themselves will need capacity building in a new environment in which their role in international carbon markets has gained increased weight through their role in authorizing internationally transferred mitigation outcomes (ITMOs) under Article 6.2. In other words, governments will need to understand the potential implications of ITMOs for their NDC achievement, as all ITMOs sold internationally must be 'un-counted' from the country's emissions inventory. On the positive side, there appears to be a good amount of momentum in many of the GCC countries around voluntary carbon markets in particular, which bodes well for their active engagement in both domestic and international carbon markets in the Paris era.

[53] Abu Dhabi Global Market (2022, 29 March), 'Abu Dhabi to launch the first regulated carbon credit trading exchange and clearing house in the world', press release. https://www.adgm.com/media/announcements/abu-dhabi-to-launch-first-regulated-carbon-credit-trading-exchange-and-clearing-house-in-the-world

[54] Global Carbon Council (2022, 30 March), 'Catalyzing climate actions through first and only voluntary carbon market based in MENA region', side event at the MENA Climate Week. https://unfccc.int/MENA-CW2022/daily-programme

LINKING CARBON MARKETS BASED ON ACTUAL EFFORT

Mengfei Jiang, Xi Liang, Shihan Xiong, and Xiaoqing Wang

The Paris Agreement reached in December 2015 demonstrates the global commitment to restrict global warming to well below 2°C above pre-industrial levels in the long term and pursue the best efforts to limit increased warming to 1.5°C.[55] But nationally determined policies to reduce emissions are now far from sufficient to achieve these goals.[56] Therefore, to achieve the agreed global warming limits, mitigation strategies must be strengthened to accelerate the rate of fossil fuel emission reductions in all sectors.[57] Carbon pricing plays a central role in encouraging long-term emission abatement investment across sectors. The broader the base for a given carbon price, the more efficiently it operates, and the lower the overall cost of reducing emissions to the economies within its scope.[58]

A harmonized international carbon market could facilitate coordination between carbon markets, ensure environmental integrity, and ultimately, ensure ecological integrity to stimulate greater ambition for climate action.[59] However, a single global carbon market is an unlikely outcome in the near future due to the heterogeneity of currently existing and emerging carbon markets as well as the growing range of implicit and explicit carbon pricing mechanisms. It is more likely that any international trading system will grow out of bilateral and multilateral agreements authorized and entered voluntarily by participating parties. Therefore, carbon pricing requires the development of common standards or guidelines to ensure the integrity of international emissions trading.

Carbon market linkage types

Carbon market linkage usually means that one emission trading scheme (ETS) accepts a unit which is also used as a compliance instrument by another ETS. Links can take different forms in three main ways. The first is bilateral vs multilateral—bilateral linkages involve two ETSs, while multilateral linkages involve multiple ETSs. The second is direct vs indirect. A direct linkage means that one ETS accepts units issued by another ETS, while an indirect linkage is a situation where both ETSs recognize units from a third system. For example, both the EU ETS and the New Zealand ETS initially allowed the use of Certified Emission Reductions from the Clean Development Mechanism and Emission Reduction Units from Joint Implementation. The third difference is complete vs restricted linkage. A complete linkage involves unconditional mutual recognition of units without any quantitative or qualitative restrictions, while a restricted linkage involves partial, conditional, or limited credit of units from another ETS.[60]

There are two stylized approaches for linking ETSs and other carbon pricing systems: a global top-down approach such as the United Nations Framework Convention on Climate Change, and a bottom-up approach through bilateral and multilateral agreements between jurisdictions.[61] The experiences and lessons of international climate negotiations suggest that reaching a global top-down agreement on the carbon market is extraordinarily difficult, due to the heterogeneity of currently existing and emerging carbon markets as well as the growing range of implicit and explicit carbon pricing mechanisms that are being developed and implemented around the world (e.g. green bond market, green/white certificate markets, ETS).[62]

Efficiency gains

Benefits from linking carbon markets are transparent, i.e. a broader market provides more flexibility for parties to achieve emissions reductions at the lowest marginal cost of abatement across all covered sectors. The linking of two cap-and-trade

[55] United Nations Framework Convention on Climate Change (2015, 12 December), *Paris Agreement under the United Nations Framework Convention on Climate Change*, http://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf.
[56] United Nations Framework Convention on Climate Change (2021), *Glasgow Climate Pact*, https://unfccc.int/documents/310475.
[57] Mackey, B., Moomaw, W., Lindenmayer, D. and Keith, H. (2022). Net carbon accounting and reporting are a barrier to understanding the mitigation value of forest protection in developed countries. *Environmental Research Letters*, 17 (5). https://doi.org/10.1088/1748-9326/ac661b.
[58] International Emissions Trading Association (2016), *A Vision for the Market Provisions of the Paris Agreement*, http://www.ieta.org/resources/Resources/Position_Papers/2016/IETA_Article_6_Implementation_Paper_May2016.pdf.
[59] Keohane, N., Petsonk, A., and Hanaf, A. (2016), 'Building a coalition of carbon markets to spur faster, deeper cuts in climate pollution', in *The Paris Agreement and Beyond: International Climate Change Policy Post-2020*. Cambridge, Mass.: Harvard Project on Climate Agreements, October 2016. https://www.belfercenter.org/publication/paris-agreement-and-beyond-international-climate-change-policy-post-2020.
[60] Mehling, M., and Görlach, B. (2016), *Multilateral Linking of Emissions Trading Systems*, MIT Center for Energy and Environmental Policy Research, https://ceepr.mit.edu/workingpaper/multilateral-linking-of-emissions-trading-systems/.
[61] Green, J. F., et al. (2014), 'A balance of bottom-up and top-down in linking climate policies', *Nature Climate Change,* 4(12), 1064–1067.
[62] Ranson, M., and Stavins, R. N. (2016), 'Linkage of greenhouse gas emissions trading systems: Learning from experience', *Climate Policy*, 16(3), 284–300; Carbon Trust (2009), *Linking Emissions Trading Systems Prospects and Issues for Business*, https://www.carbontrust.com/resources/linking-emission-trading-systems-prospects-and-issues-for-business.

systems in two jurisdictions offers a common approach while also allowing a more flexible regulatory framework tailored to each jurisdiction's political and economic needs.[63] The system with higher marginal cost benefits from purchasing relatively inexpensive allowances from the other system, and achieving its emissions reduction goals at a lower cost of abatement. Conversely, the system with lower marginal cost of abatement benefits from selling its allowances at higher prices, resulting in an inflow of revenue. The free flow of allowances between systems results in an equalization of prices and leads to the cost-effective distribution of abatement efforts across the linked systems.

Overall, linking the two cap-and-trade systems appears to offer a win-win outcome, signalling a common effort to address climate change, while allowing for more flexible arrangements tailored to each jurisdiction's political and economic specificities through complementary regulatory measures. Furthermore, among the benefits derived from linkage, linked markets are likely to be more liquid since the more active the market participants, the weaker the price-setting capability of each one individually. In addition, the potential for carbon leakage emerging may be relieved when competing industries in the linked system face a similar price to polluting. Most importantly, merging two or more systems expands the number of mitigation options, increasing cost-effectiveness and facilitating reductions at the least possible overall cost.

Theoretically, a single global market for emissions trading could produce an economically desirable outcome. Nevertheless, the actual effort taken to reduce one tonne of greenhouse gas emissions in one jurisdiction might be different from the efforts taken to achieve the same result in the others due to differences in the marginal costs of abatement. Also, carbon market linkages can result in the loss of sovereignty, reducing the autonomy of the linked jurisdictions.

In addition, game theory concerns the possibility of linkages inducing parties to set less ambitious national goals so that they can sell cheap surplus units to other carbon markets to which they are linked**.** Therefore, direct linking without considering the heterogeneous value of allowances would be a significant obstacle to formation of a global market. The box below shows two successful cases of carbon market linkage.

Cases of carbon market linkage

The Switzerland ETS and the EU ETS

Switzerland and the EU signed an agreement in 2017 to link their ETS systems. The EU and Switzerland exchanged ratification or approval instruments on 1 January 2020. By the Linking Agreement, the Joint Committee adopted Decision 2/2019 to ensure the compatibility of the two systems for the year 2020. Decision 1/2020 adopted common operational procedures, and Decision 2/2020 amended Annexes I and II to the Agreement and adopted linking technical standards. In both cases, the link is operated under the same rules. They also create legal certainty. When surrendering allowances to cover emissions occurring after January 2020, the EU ETS and Swiss ETS will be linked for mutual recognition. Switzerland maintains a separate system from the EU ETS but applies similar rules.

California's cap-and-trade program and Québec's

California's cap-and-trade program was linked to Québec's as of 1 January 2014 and further connected to Ontario's on 1 January 2018. The programs from California, Québec, and Ontario will all be able to recognize all allowances issued before the finalization of the linkage. In California, every California allowance, Quebec emission unit, and Ontario allowance (referred to as 'allowances' hereafter) represents one metric tonne of carbon dioxide. In California, Québec, or Ontario, the linking of the accounts will not change the allowances in the accounts of those entities. There will be no difference between the amounts paid by California, Québec, and Ontario in the amount they settled in the past and the amount they paid after the linkage. Cap-and-trade includes general requirements regarding linking other trading programs to the Cap-and-Trade Regulation trading programs.

[63] Green, J. F., et al. (2014), 'A balance of bottom-up and top-down in linking climate policies', *Nature Climate Change,* 4(12), 1064–1067; Burtraw, D., Palmer, K. L., Munnings, C., Weber, P., and Woerman, M. (2013), *Linking by Degrees: Incremental Alignment of Cap-and-Trade Markets*, Resources for the Future Discussion Paper 13–04.

Challenges

Although linking ETSs would generate multiple benefits, such as lower overall abatement costs, increased market liquidity, reduced price volatility, and potential reduction in the risk of carbon leakage, such linkage faces many challenges. Due to potential hurdles such as design concerns, political considerations in talks, and economic disparities in operations, most countries are unsure and hesitant to establish the linkage.

There are critical technical issues when linking diverse and heterogeneous carbon markets. ETSs differ from country to country in terms of fundamental design. Specifically, the implementation level of carbon trading also ranges from national to regional or sectoral. Moreover, the traded assets may vary in nature, distribution, and lifespan in different carbon markets. In addition, there could be differences in terms of compliance entities and rules, such as the thresholds for inclusion, compliance rights, and obligations.

Moreover, there will be a considerable dispute regarding the distribution of emission allowances. The international market is likely to build on historical inequities in the structure of global trade between developed and developing countries.[64] Policymakers need to agree on a fair allocation of emission allowances based on adequate consultation and negotiation and avoid favouritism towards certain countries.[65] Deeper cooperation and asymmetric efforts from countries with different economic structures are required for the equitable distribution of emission allowances.

Another significant concern is the potential unfairness and inequity in linked systems. The actual effort taken to reduce one tonne of emissions might be more in one jurisdiction than in another due to differences in the marginal costs of abatement. For instance, developing countries can easily use some energy efficiency measures to effectively reduce the same amount of carbon emissions in production activities. In contrast, developed countries require adopting more advanced technologies and facilities—such as carbon capture, utilization, and storage or direct air capture—which are more expensive and have more extended payback periods. Therefore, excess allowances in developing countries seek to be sold into developed countries after the linkage because the abatement costs in developing countries are lower. Thus, direct linking would be a significant obstacle to forming a global market without considering the different values of allowances.

Linking based on actual effort

In order to tackle the above potential unfairness and inequity issue, all allowances must be of comparable value to achieve economic efficiency and environmental efficacy.[66] Only when marginal abatement costs are comparable can efficiency gains be realized.[67] Due to the different geographical features, economic growth outlooks, emissions profiles, and the ambition of emission reduction targets, the efforts to reduce one unit of carbon dioxide may vary across jurisdictions. As a result, we suggest that mitigation outcomes should be valued based on assessing their mitigation impact.

The World Bank Group has proposed the mitigation value (MV) conceptual framework through its Networked Carbon Market initiative. MV can be defined as a relative value that promotes the interchangeability of units between heterogeneous carbon markets, where it is hard to compare the MVs of different units.[68] It enables comparability and linkage of an extensive range of actions, even if they differ in their design, implementation, and impact—for instance, baseline and crediting schemes, Nationally Appropriate Mitigation Actions, and low-carbon city programs.

As an exchange rate for the abatement costs of different countries, MV is intended to provide a way to assess an action's relative climate mitigation contribution, which can encourage jurisdictions to increase their level of effort to mitigate global warming. As a floating value, MV can be calculated at any time and can change based on different economic and regulatory conditions. For example, the MV of an allowance can be considered declining if the oversupply of allowances persists due to an economic recession rather than mitigation actions. Moreover, MV is derived for all bankable and fungible units, not just the surplus that can be determined at some identified moment.

[64] Davies-Venn, M. (2021), 'The quest for equity, fairness and justice in an international carbon market', *Energy Transition,* https://energytransition.org/2021/11/the-quest-for-equity-fairness-and-justice-in-an-international-carbon-market/.
[65] Pozo, C., Galán-Martín, Á., Reiner, D. M., MacDowell, N., and Guillén-Gosálbez, G. (2020), 'Equity in allocating carbon dioxide removal quotas', *Nature Climate Change*, *10*(7), 640–646.
[66] Green, J. F., et al. (2014), 'A balance of bottom-up and top-down in linking climate policies', *Nature Climate Change,* 4(12), 1064–1067.
[67] Aldy, J. E., et al. (2010), 'Designing climate mitigation policy', *Journal of Economic Literature,* 48(4), 903–934.
[68] Marcu, A. (2015), *Mitigation Value, Networked Carbon Markets and the Paris Climate Change Agreement,* https://www.ceps.eu/wp-content/uploads/2015/10/MitigationValueNetworkedCarbonMarketsandtheParisClimateChangeAgreement.pdf.

As for the determiner of the MV, anyone can set an MV, such as the authority, an agency designated by the regulator, or a non-governmental organization. Many algorithms and factors are available to those who would like to assign an MV to a unit of greenhouse gas emissions reduction.[69] Based on the assessed mitigation impact of these actions, MV can inform how mitigation outcomes are priced. Overall, an assessment of mitigation efforts could provide information to enhance the credibility of pledges being proposed by different jurisdictions, and the equations thus benefit successful international trade negotiations.[70]

In summary, many business leaders and government officials urge the use of carbon pricing as the most effective policy instrument for emission reduction. To limit competitiveness concerns and to facilitate global trade without distortionary influences, these systems should harmonize and eventually converge such that a single prevailing carbon price begins to emerge. Although that process may take many years, it is the expected direction of travel.

As we know, the heterogeneity of carbon markets can adversely affect the negotiation to link carbon pricing systems, as allocated units in different jurisdictions may lead to different amounts of emission abatement and consequently to different mitigation outcome values. Therefore, an internationally recognized baseline methodology is essential to make a fair and accurate assessment of mitigation efforts. Currently, there is no such methodology for setting up the baseline and quantifying mitigation outcomes or for addressing the allowance over-allocation issue. The MV concept has the potential to be used for assessing mitigation outcomes based on actual efforts.

ARTICLE 6 AND VOLUNTARY CARBON MARKETS

Bassam Fattouh and Andrea Maino

In contrast to the top-down approach to setting climate and emissions targets implemented under the Kyoto Protocol, the Paris Agreement adopts a bottom-up approach in which each country sets out the mitigation contributions it pledges to undertake to reduce its emissions. Specifically, each ratifying party must submit and communicate a Nationally Determined Contribution (NDC) describing its mitigation contributions and climate actions. To achieve their NDCs, many countries have included the use of 'cooperative approaches'.

Article 6 of the Paris Agreement recognizes the role of collaboration in countries' efforts to implement their NDCs and to enable them to enhance their climate ambitions by increasing efficiency gains and lowering the marginal cost of abatement while promoting sustainable development and environmental integrity. Particularly, Article 6 establishes cooperative approaches in the form of bottom-up bilateral or multilateral agreements (Article 6.2) and a centralized mechanism (Article 6.4) whereby countries can agree to trade 'emission reductions' or 'mitigation outcomes' (terms explained below) to meet their NDCs as long as a robust accounting framework is applied. By doing so, it formally establishes international carbon markets within the perimeter of the Paris Agreement as essential towards meeting the Agreement goals.

The completion of the Article 6 rulebook and clarifications of related procedures and frameworks are some of the most important outcomes of COP26 in Glasgow. However, despite the important progress, uncertainty remains, especially around the implications of the voluntary carbon markets (VCMs) and what investors could claim by purchasing various types of carbon credits on the VCMs. Various supervisory efforts are already underway to help reduce uncertainty and provide more clarity for users of these markets. Market participants will be monitoring clarifications from a variety of initiatives and bodies. Also, the UN secretary general has recently launched a high-level expert group with the task of assessing current standards and definitions for setting net-zero targets by non-state actors.

It is hoped that these initiatives would provide more clarity about the operation of international carbon markets and enhance their environmental integrity. This, however, is a challenging task as there is an inevitable tension between promoting carbon markets to raise finance on the one hand and regulating and supervising those markets to ensure environmental integrity and sustainable development goals that investors seek on the other. There is also the risk that the proliferation of regulatory and supervisory efforts could add another layer of uncertainty about which regulations will eventually apply.

[69] Marcu, A. (2017), *Views on Mitigation Value and its Application*, Geneva: International Centre for Trade and Sustainable Development.
[70] Aldy, J. E., and Pizer, W. A. (2016), 'Alternative metrics for comparing domestic climate change mitigation efforts and the emerging international climate policy architecture', *Review of Environmental Economics and Policy* 10(1), 3–24.

Another challenge is the nature of the carbon offsets credits to be offered in carbon markets. So far, the dominant form of carbon offsets has been 'avoidance' carbon credits—accounting for around 80 per cent of credits in the VCM, with the remainder made up mostly of 'nature-based solution' credits. But as the Intergovernmental Panel on Climate Change concludes in its latest report, carbon dioxide removal (CDR) technologies that pull carbon out of the atmosphere, such as direct air capture and storage (DACCS), will be essential to meeting the Paris Agreement targets by 2100. Carbon markets will need to continue to evolve to encourage investment not only in reducing emissions to move us towards net zero emissions, but also to support investment in carbon removals.

Corporates and other actors also need to be aware of the risks involved in investing and trading in VCMs. Projects are primarily located in regions such as Asia, Latin America, and Africa where country and governance risks play an important role, particularly given the role that Article 6 gives to host countries in terms of authorization of issued credits. Investors will take these contingencies into account, and several mitigation measures can be used to reduce these risks.

Article 6 and carbon markets

Article 6 consists of a few sub-articles that set the parameters for cooperative approaches and carbon markets[71]. The most relevant are Article 6.1, which emphasizes cooperative approaches in countries' efforts to meet their NDCs; Article 6.2, which emphasizes the transfer of 'mitigation outcomes' as an important element of cooperative approaches subject to robust accounting; and Article 6.4, which establishes a centralized mechanism by the United Nations Framework Convention on Climate Change (UNFCCC) to support sustainable development and generate emission reductions (ERs) that can be used by countries to help meet their NDCs and enhance their climate ambitions. This short article provides an overview of the main relevant aspects of Article 6.2 and Article 6.4. The reader is referred to the lead paper[72] for further details.

Article 6.2

Article 6.2 establishes a framework in which countries can engage in agreements to implement greenhouse gas (GHG) ER projects by issuing and transferring internationally transferred mitigation outcomes (ITMOs). ITMOs can be transferred from the credit-generating country (often referred to as the host country) where the reduction in GHG is achieved and can be used in several ways. They can be

- transferred to credit-buying countries (often referred to as the receiving countries) towards achieving their NDCs;
- transferred and used in market-based schemes such as the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) (referred to as 'other international mitigation purposes'); or
- transferred and used by companies to offset their emissions (referred to as 'other purposes').

To guarantee and enhance the environmental benefits from the trade of ITMOs, corresponding adjustments (CAs) need to be applied to a country's annual emissions balance to avoid double counting of ER benefits. Thus, if the receiving country uses ITMOs towards its NDC, the host country must 'un-count' the mitigation outcome from its emissions budget by adding the amount of respective emissions to the annual emissions balance related to its NDC and declare this in its Biennial Transparency Report. The receiving country counts the mitigation outcome by deducting the respective amount of emissions from its emissions balances. CAs should be applied 'in a manner that ensures transparency, accuracy, completeness, comparability and consistency'[73].

The credit-generating country must authorize the use of ITMOs (for NDC, other international mitigation purposes, or other purposes). According to Article 6.3, the use of ITMOs shall be 'voluntary and authorized by participating Parties'. By authorizing the use of ITMOs for the purpose of achieving NDCs, the host country is committing to undertake CAs against the transfer of the ITMO. However, the credit-generating country is under no obligation to authorize the transfer of all mitigation outcomes, and it

[71] UNFCCC - Conference of the Parties serving as the meeting of the Parties to the Paris Agreement, 'Report of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement on its third session, held in Glasgow from 31 October to 13 November 2021, Decisions adopted by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement', March 2022, https://unfccc.int/sites/default/files/resource/cma2021_10_add1_adv.pdf

[72] Fattouh, B., and Maino, A. (2022, May), *Article 6 and Voluntary Carbon Markets*, OIES Energy Insight.

[73] Guidance on cooperative approaches referred to in Article 6, paragraph 2, of the Paris Agreement, Paragraph III, Section B. https://unfccc.int/sites/default/files/resource/cma2021_10_add1_adv.pdf

can decide whether mitigation outcomes generated from domestic projects can be exported to help other countries meet their NDC (in which case CAs are applied) or used domestically towards its NDC.

This gives nation states more control over how mitigation outcomes can be used and which ones to transfer abroad. This could provide incentive for host countries to transfer mitigation outcomes from projects in hard-to-abate sectors (and thus attract finance into these sectors) and use mitigation outcomes from projects with low abatement costs towards its own NDC. This would push investors and developers interested in the transfer of 'adjusted' carbon credits up the cost curve.

Some governments may not yet have in place the necessary framework and processes for authorization and adjustment of their national inventories. Also, the reporting requirements are extensive. There are some concerns that some developing countries may not have the resources or the incentive to put in place such elaborate frameworks, especially if they expect limited benefits from such markets.

Article 6.4

Unlike the generation of ITMOs, which is governed by cooperative approaches and bilateral agreements, Article 6.4 ERs are generated from a centralized mechanism (referred to as the 'Mechanism'), which is governed directly by the UNFCCC for the authorization and issuance of ERs similar to the CDM (Clean Development Mechanism) credits under the Kyoto Protocol. But ITMOs and Article 6.4 ERs are linked, and as Article 6.2 notes, Article 6.4 ERs, when authorized for use toward NDC achievement or other international mitigation purposes, are ITMOs and are subject to CAs when transferred internationally.

Key for the operation of the Mechanism is the Supervisory Board, which has the responsibility of approving methodologies, setting guidance, and implementing procedures. The preparation work for the Supervisory Board is expected to run till the end of 2023. By providing a centralized crediting mechanism, Article 6.4 is expected to generate ERs with assured quality and environmental benefits. Project developers will have to register their projects with the Supervisory Board to be able to issue Article 6.4 credits. Also, any activity must receive the approval of the host country to qualify for Article 6 transactions[74]. The approval process for projects is yet to be developed.

The Mechanism will include a central accounting framework, a central registry, and an Article 6 database. Similar to ITMOs, Article 6.4 ERs are subject to CAs between the host country and the receiving country. Also, Article 6.4 permits the transfer of authorized ERs for 'international mitigation purposes' and 'other purposes'. However, unlike ITMOs, ERs issued under Article 6.4 are subject to cancellation under Overall Mitigation of Global Emissions (OMGE)(2 per cent of all Article 6.4 ERs are subject to cancellation). Also, unlike ITMOs, the Share of Proceeds for Adaptation (SOPA) applies to Article 6.4 ERs (5 per cent of Article 6.4 ERs are dedicated to a fund to finance adaptation). Also, administrative fees are applied to these ERs, but these are still do be determined.

In COP26, participants agreed to limit the number of legacy credits under the CDM known as Certified Emissions Reductions (CERs) that could be used to achieve a country's NDC, thereby reducing the risk of an oversupply of credits (only CDM activities registered on or after 1 January 2013 would be eligible). The main concern about these credits is that they often lack environmental integrity, and it remains to be seen whether investors would demand such credits. If all or most of the issued CDM credits had been allowed to pass from the Kyoto Protocol to the Paris Agreement, this would have flooded the market and discouraged the development of new offset projects. Trading in earlier iterations of the EU Emissions Trading Scheme (EU ETS) shows that such oversupply can severely impact the orderly functioning of carbon markets and hence the carbon price.

Voluntary carbon markets and diversity of credits

Article 6 does not offer clear guidance as to the use of carbon credits by the corporate sector that are adjusted in a country's carbon budget. For instance, there is no guidance regarding what can be claimed by corporations buying these credits or the quality of these credits compared to non-adjusted credits. More fundamentally, Article 6 does not directly regulate the VCM, and thus in principle carbon credits can be issued and purchased without reference to Article 6. In fact, VCMs rely on their own ecosystem of standards and certification organizations, project developers, and verifiers to recognize ERs that are 'real,

[74] UNFCCC - Conference of the Parties serving as the meeting of the Parties to the Paris Agreement, 'Report of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement on its third session, held in Glasgow from 31 October to 13 November 2021, Decisions adopted by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement', March 2022, https://unfccc.int/sites/default/files/resource/cma2021_10_add1_adv.pdf

measurable, and additional'[75].

However, given the potential fungibility between the VCM and Article 6 carbon credits, some argue that there might be a need to align VCM rules with those of the Article 6 rulebook, in particular towards CAs and claims. Also, carbon offset programs (also referred to as 'registries') such as Gold Standard and Verra may have to align their methodologies (for instance, their approaches to setting baselines and their assessment of additionality) and rules with the Article 6 rulebook.

Until there is more clarity, several types of carbon offsets will emerge as summarized below. Host countries can decide whether to attract finance through Article 6 carbon markets or through the VCM, though to attract finance through the former, CAs must always be applied and therefore this may come at a higher cost for the host country. For the host country, the issue becomes whether the benefits from using Article 6 cooperative approaches and the Mechanism outweigh these costs. While these costs would ultimately be borne by investors, the generated adjusted ERs and ITMOs under Article 6 may still attract more interest from those investors as they may be perceived to be of higher quality.

Investors also have a wide range of choices of carbon credits with different perceived qualities and different crediting mechanisms. These include Article 6 ERs and ITMOs and various types of voluntary credits issued by the different standards (known as Verified Emission Reductions), some of which will apply CAs while others may not.

Type of ER credits which could be originated following the finalization of Article 6 of the Paris Agreement

Type of framework	Type of credits	Target	Governance	Specific procedures	Examples
Article 6.2	ITMOs	Receiving country NDC	Bilateral agreements	CAs at 'first transfer'	Switzerland and Peru agreement
		International compliance carbon market		CAs occur on host country's choice of authorization, issuance, use/cancellation	ITMOs to CORSIA
		Receiving country VCM			ITMOs to VCM
Article 6.4	ITMOs under Article 6.4 (Article 6.4 ERs)	Receiving country NDC	Centralized governance by Article 6.4 supervisory board	CAs at 'first transfer' Subject to haircuts: • 5% for Share of Proceeds for Adaptation • 2% for Overall Mitigation of Global Emissions • Administrative fees (to be determined)	Bilateral exchange by countries governed by Article 6.4
		International compliance carbon market			Article 6.4 ERs to CORSIA
		Receiving country VCM			Article 6.4 ERs to receiving country VCM
VCM	No authorization needed from host country	Private companies voluntary claims	Independent bodies, transparency initiatives such as the Voluntary Carbon Market Integrity Initiative, standards-setting bodies such as Gold Standard and Verra	Subject to standards and transparency agreements	VCM credits under the Verra registry
Compliance carbon markets	Part of country NDC	Economic sectors under coverage	Country, state level or international body	Regulation	EU-ETS, California ETS, other ETS

[75] 'VCMI Proposal to Assist Developing Countries to Develop VCM Access Strategies', July 2021, https://vcmintegrity.org/publications/

Given the diversity of carbon credits, a multiple tier system could emerge with different types of carbon credits available for investors, particularly the following:

- Companies will be to able purchase 'adjusted credits' that eliminate the risk of double counting, possibly with higher perceived value in pursuit of science-based targets and net zero emissions.
- Other 'non-adjusted' credits could be used to support claims for other environmental or social indicators, or for ERs (contribution claims) that have a lower perceived value in terms of science-based targets required to achieve net zero emissions. Although the differentiation in claims based on ER types is widely accepted, this issue has not been resolved and remains an area subject to debate.

The claims issue has received increased attention by various initiatives such as the Voluntary Carbon Markets Integrity Initiative (VCMI). Key issues highlighted include the set of claims that companies can use when they purchase carbon credits and the different types of claims that could be used with the different credits. There is also the issue of who should make the claim in relation to the use of carbon credits. The Science Based Targets initiative proposes that while carbon credits can be used by companies to support global efforts to achieve the Paris climate targets, corporations should not use these credits to claim they have met targets of reducing their internal emissions. In this spirit, the Science Based Targets initiative has a 'mitigation hierarchy' where companies should set short-term and long-term science-based targets to address their value chain emissions.

Companies can invest in mitigation outside their value chain (referred to as 'beyond value chain mitigation'), but priority should be given to implementing measures to reduce emissions within their value chain. This has implications for the use of carbon credits where 'companies are not able to purchase carbon credits as a replacement for reducing value chain emissions in line with their near and long-term science-based targets'[76]. To that extent, carbon credits can be used in two ways: (1) on the road to net zero, companies can purchase credit to 'support society to achieve net-zero emissions'[77], and (2) when they reach net-zero, companies with residual emissions within their value chain 'can neutralize those emissions with an equivalent amount of carbon dioxide removals'[78] that can be sourced from (removal-based) carbon credits.

Risks and mitigation

In an evolving landscape where, multiple frameworks and crediting mechanisms coexist, investors, companies, and project developers operating on the supply and demand sides of the international carbon markets face various uncertainties.

For instance, on the demand side, and in the context of Article 6.2, for ITMOs which have been authorized, there is still the risk of those being called back, and their status could be in question if the host country were to fail to meet its own NDC at some point in the future. This 'buyer liability' has an adverse impact on the predictability and reliability of transfers. In a situation in which many ITMOs have been transferred by a host country, it may also not be clear which ITMOs should be retracted. In addition, buyer liability can put downward pressure on prices in order to compensate for the expected risk of retraction, thus reducing the effectiveness of carbon price signals in abating emissions.

Also, there is a reputation risk, as corporate buyers don't want to be seen as responsible for the host country failing to meet its ER pledges under the Paris Agreement. Also, the lag between the time of purchase and when the CA is applied can create its own risks. An investor can buy credits from projects to which the host country agreed to apply CAs, but until it can be verified that the CA has been properly applied (through the submission of the biennial transparency reports), the investor faces the risk that the country may not deliver on its commitment to adjust its GHG inventory.

On the supply side, countries need to ramp up capacity building with respect to project development. Article 6 assigns an important role to the authorization status of ERs from the host country. It creates risks for developers as there would be uncertainty as to whether a project would be granted a CA and, if the project is not granted authorization, what this would imply for the project. Uncertainty on the exact nature of ERs that could be issued from a project could increase risks for project

[76] Science Based Targets, 'SBTi Criteria and Recommendations', October 2021, https://sciencebasedtargets.org/resources/files/SBTi-criteria.pdf
Science Based Targets, 'The SBTi Net-Zero Manual & Criteria, Version 1.0, for public consultation', September 2021, https://sciencebasedtargets.org/resources/files/Net-Zero-Criteria-Draft-for-Public-Consultation-v1-0.pdf
[77] ibid
[78] ibid

developers and thus could affect investment in these projects. The dependence of credits' quality on their authorization status also exposes investors to risks. Establishing a clear legal framework around authorization and contingencies is important for project developers which depend on external investors' financing.

Conclusions

The completion of the Article 6 rulebook of the Paris Agreement is a necessary step towards building a robust framework in which participants can use collaborative approaches and a market-based mechanism to promote climate and sustainable development goals. There is widespread expectation that the Article 6 rulebook will create the conditions for effective and robust international carbon markets to thrive, including continued, significant growth in private sector investments through voluntary carbon offset projects.

However, there are still some uncertainties surrounding the wider implications of Article 6 for carbon markets. This short article has highlighted the potential impact of Article 6 on the diversity of carbon credits available for investors and the uncertainty faced by investors when investing and trading on projects and their underlying credits, as well as for corporations, particularly in what claims they can make by purchasing these different carbon offsets. Participants in carbon markets will be closely examining the implications for investors in terms of balancing investments in adjusted versus non-adjusted credits and accessing high-quality projects including carbon removal credits. They will also be considering options to manage some of the risks associated with governments' authorization processes, how CAs are applied, the governance frameworks in place, and assessing the financial and reputational risks of some countries not being able to meet their NDCs while engaging in large transfers of ITMOs.

Participants will also be monitoring closely the ERs generated under the Article 6.4 mechanism and whether these will gain the credibility and integrity to be permitted to be used in other compliance markets such as the EU ETS, encouraging convergence across markets. There is hope that as rules, guidance, and frameworks from regulated and market-led initiatives consolidate, this would create the regulatory certainty to ensure the environmental integrity that investors seek.

THE PARIS RULEBOOK AND ITS IMPLICATIONS FOR CARBON CREDIT MARKETS

Dominic Coppens and Nicolas Lockhart

Companies around the globe are increasingly committing to achieving net-zero carbon emissions, sometimes through a regulatory nudge and sometimes voluntarily. Carbon credits will be a key element of the net-zero toolbox, allowing companies to offset emissions they cannot yet cut. The carbon credit market is expected to grow significantly in the coming years, with the voluntary carbon market potentially growing from the current $1 billion per year to $50–100 billion by 2030.[79]

There are opportunities and risks associated with carbon credits. If carbon credit projects are properly run, credits will lower overall global emissions. When carbon credits are generated in developing countries, they may also contribute to other sustainable development goals. Carbon credits can generate these positive outcomes only when the integrity of the credits is ensured. The regulation of carbon credit markets is limited and fragmented, so there are justifiable concerns that some credits may amount to little more than greenwashing.

To address some of these concerns, the international community took significant steps at the Glasgow Climate Change Conference in 2021 to bolster the integrity of credits. Countries adopted the so-called Paris rulebook, which provides new rules on both procedures and benchmarks for credits (e.g. on government approvals; methods for measuring emission reductions; and monitoring, reporting, and verification). The rules aim to ensure that carbon credit projects genuinely lead to a measurable reduction in global emissions, and they add transparency to the process.

Early signs suggest that the new rules will improve the integrity of carbon credits and, over time, may reduce fragmentation. When successfully implemented, the rules will help carbon credits to deliver on their potential to reduce global emissions, encourage companies to invest in these instruments as part of their net-zero pathway, and provide important investment opportunities for investors to finance credit-generating projects.

Given the nature and scale of the challenge and the lack of clarity on some aspects of the Paris rulebook, the rules are complex

[79] See Credit Suisse (2022), Treeprint: Carbon Markets, the Beginning of the Big Carbon Age.

and difficult to navigate in practice. This article introduces carbon credit markets, the Paris rulebook, and the rulebook's impact on the supply of, and demand for, carbon credits.

Carbon credit markets in a nutshell

Carbon credits are issued as a part of a project in a 'host' country to reduce or remove emissions. Each credit confers a right to compensate a certain amount of carbon emissions (usually one tonne per credit) and is tradable. Credits can be purchased by a company or a country, in a compliance market or a voluntary market.

- In a compliance market, entities purchase credits that can be used to meet obligations to account for emissions under (1) international schemes, e.g. by countries to meet their Nationally Determined Contribution (NDC) under the Paris Agreement or by airline operators to offset emissions under the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), or (2) national schemes, e.g. by companies seeking (a) to reduce their liability under an emissions trading scheme (ETS) or a carbon tax or (b) to meet mandatory offset obligations.
- In the voluntary carbon market (VCM), companies purchase carbon credits to support so-called voluntary claims—that is, voluntary net-zero pledges, which are called 'offset claims'—or to show support for emission reduction projects, which are called 'impact claims'.

The Paris rulebook in a nutshell

The Paris rulebook develops two approaches for trading carbon credits internationally.

- The Cooperative Approach (Article 6.2) applies when countries trade carbon credits between them; and, according to most stakeholders, also when the host country allows another country or company to use credits, even if the host country has no agreement with another country. As an example of the Cooperative Approach, Switzerland and Peru signed an agreement for Swiss public or private entities to finance credit-generating projects in Peru.[80] Switzerland entered into this agreement to provide offsets to Swiss sellers of fossil motor fuels, which are obliged, under Swiss law, to offset part of the emissions resulting from the use of those fuels in Switzerland. The credits purchased by these companies, and redeemed to meet their Swiss offset obligations, will ultimately be used by Switzerland to meet its NDC targets.
- The Sustainable Development Mechanism (SDM) (Article 6.4) establishes a supranational scheme for the registration and approval of credit-generating projects. The SDM Approach succeeds the Kyoto Protocol's Clean Development Mechanism, which stopped registering new projects at the end of 2020.

For each approach, the Paris rulebook sets out core substantive and procedural requirements to ensure the integrity of the credits—credits that contribute meaningfully to reducing overall global emissions.

What are the core requirements under the Paris rulebook?

1. **No double counting:** A carbon credit can be counted only once. The host country may formally agree not to use the credit to meet its own NDC and, instead, allow the credit to be used for other carbon mitigation purposes (e.g. by another country to meet its NDC or by a company in another country). These credits are called 'adjusted' carbon credits. The adjusted credit is not counted by both the host country and the company or other country.
2. **Additionality:** A credit-generating project must result in emission reductions or removals that would not have occurred in the absence of the projected income stream from the sale of the credits generated by the project. This requirement ensures that a project has a real—and additional—impact on lowering emissions in the host country, irrespective of who actually uses the credit. The SDM Approach has more detailed requirements on how to calculate the quantity of emissions reductions.

What are the key differences between the two approaches in the Paris rulebook?

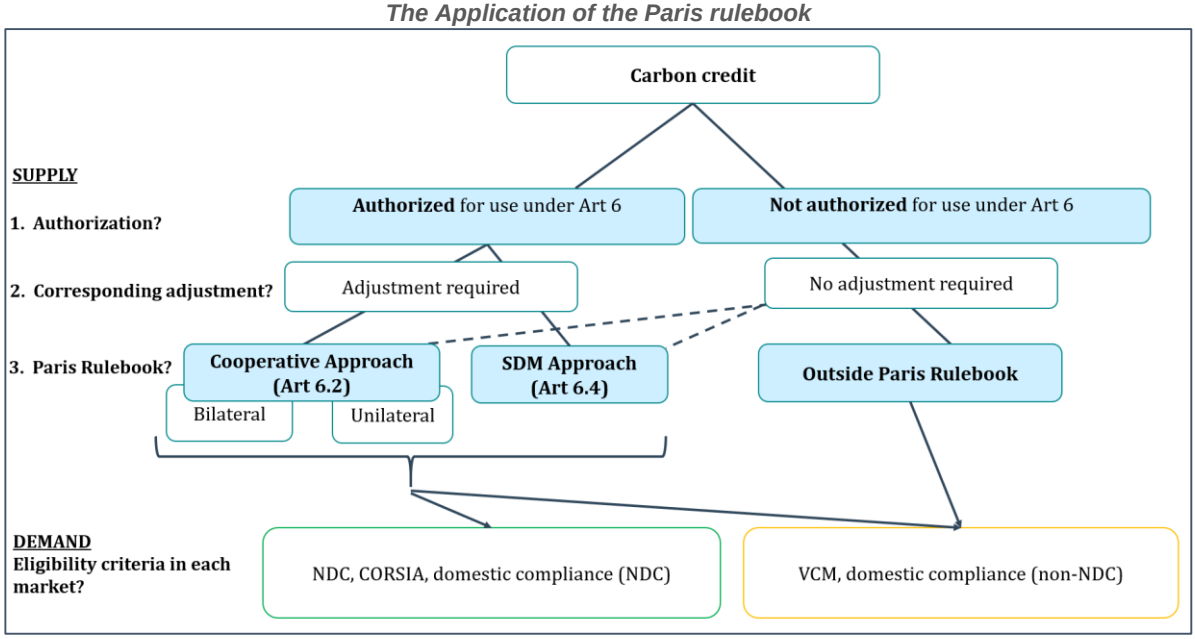
[80] The list of Switzerland's agreements on the implementation of Article 6 of the Paris Agreement is available here: https://www.bafu.admin.ch/bafu/en/home/topics/climate/info-specialists/climate--international-affairs/staatsvertraege-umsetzung-klimauebereinkommen-von-paris-artikel6.html.

1. **International approval:** Under the Cooperative Approach, the credit-generating project is run with the approval of the host country, but without the approval of an international supervisory body. Although there is no international body, parties must meet detailed transparency and reporting requirements, with review by independent technical experts, who can make (nonbinding) public recommendations. In contrast, under the SDM Approach, there are extra layers of supervision: A project needs to be approved by a newly created international supervisory body, which acts on the basis of recommendations made by an independent verification body.
2. **Mandatory levies:** Under the SDM Approach, mandatory levies totalling 7 per cent are charged on carbon credits. The levies are used to support climate adaptation in developing countries (5 per cent contribute to the United Nations Framework Convention on Climate Change Adaptation Fund) and to guarantee additionality (2 per cent are cancelled). Mandatory levies are not imposed under the Cooperative Approach, although they are strongly encouraged.

The impact on the supply of carbon credits

The host country plays a critical role in triggering the Paris rulebook, and thereby in determining the type of carbon credit that will become available on the market. As visualized in the figure below (which depicts one possible reading of the rulebook, endorsed by some key stakeholders), the host country decides whether the rulebook applies, and if so, which approach under the rulebook applies. The host country's decisions will affect the value and possible uses of the resulting carbon credit.

The Application of the Paris rulebook



Adjusted carbon credits

If the host country authorizes the international transfer of carbon credits under Article 6 (so-called internationally transferred mitigation outcomes or ITMOs), the Paris rulebook applies and the host country accepts the obligation *not* to use the credit to meet its own NDC (to avoid double-counting). The host country, instead, allows the credit to be used for carbon mitigation purposes by another country (to meet its NDC) or by another entity (a company to meet CORSIA requirements or domestic compliance requirements, or for voluntary purposes). The host country could specify which types of use are allowed.

Concretely, in a letter of authorization, the host country commits to make a corresponding adjustment (to adjust its emissions and removals in its accounts so that they do not count toward its own NDC), and to specify which types of use are allowed. With the adoption of the rulebook, it is expected that more host countries will put the institutional arrangements in place to deliver a letter of authorization, and to meet the rulebook's requirements.

An adjusted carbon credit could result from the Cooperative Approach or the SDM Approach.

1. An adjusted carbon credit could result from **the Cooperative Approach**, based on a bilateral agreement with another country, or based on a unilateral decision by the host country. Bilateral agreements could require registration by a private carbon crediting registry, or not. The bilateral agreement between Switzerland and Peru does not, for instance, require such registration. Those projects need to fulfil the Article 6.2 requirements, as well as additional substantive and procedural requirements set out under the Switzerland–Peru Agreement (e.g. the project needs to prevent social conflict and respect human rights). If the Cooperative Approach is based on registration under a private carbon-crediting registry, the project must also fulfil any additional substantive and procedural requirements under the program at issue (these requirements, as explained below, differ substantially among programs). A number of programs, like Gold Standard and Verra, are in the process of strengthening their requirements to provide adjusted carbon credits consistent with Article 6.2.
2. Alternatively, the host country could trigger **the SDM Approach**, once it becomes operational. The project must then fulfil the Article 6.4 requirements. It is not yet clear how successful the SDM Approach will become. The procedural and substantive requirements are much more rigorous than those of the Kyoto Protocol's Clean Development Mechanism, which was perceived as lacking sufficient integrity. Some acquiring countries, like Switzerland, may also see value in the SDM Approach, as an alternative to developing further bilateral agreements; and host countries could, individually or collectively, agree to promote the SDM Approach by triggering its application. That said, some host countries, and other stakeholders, may prefer the Cooperative Approach because the requirements might be less burdensome and mandatory levies do not apply, while the carbon credits would still be considered 'Paris proof' when they meet the Article 6.2 requirements. To maximize its appeal, the SDM Approach needs to be implemented in an efficient way, whilst guaranteeing the integrity of the carbon credits.

Unadjusted carbon credits

If the host country does not authorize the international transfer of carbon credits under the Paris rulebook (the host country takes a negative decision, or no decision), there is no requirement to apply the rulebook, and no requirement to make a corresponding adjustment. In these circumstances, the host country could use the emission reduction or removal to meet its own NDC. In addition, the unadjusted carbon credit could still be sold on the market, but could not be used for all purposes. An unadjusted carbon credit could not be used by another country to meet its NDC, or by a company to meet CORSIA requirements, or under a domestic compliance scheme in an acquiring country that uses the carbon credit to meet its NDC. Unadjusted carbon credits could, at present, still be used by companies for any voluntary purposes (in the VCM), and under a domestic compliance scheme, in an acquiring country that does not use the carbon credit to meet its NDC.

Unadjusted carbon credits will usually be registered by a private carbon crediting registry.[81] The procedural and substantive requirements, and the resulting quality of carbon credits, differ substantially among programs.[82] At present, there are no unified global guidelines or regulations mandating the quality of credits provided under these programs. That may change. For instance, the Integrity Council for Scaling Voluntary Carbon Markets (IC-VCM) is developing voluntary guidelines to enhance the integrity of credits. These Core Carbon Principles (CCPs) may reflect elements of the Paris Rulebook, and thereby increase convergence among – and higher quality of – carbon credits. IC-VCM is expected to release draft guidelines in July 2022, and to open public consultations.

The impact on the demand for carbon credits

The Paris rulebook does not directly regulate how carbon credits could be used by companies in compliance and voluntary markets. In compliance markets, each regulator determines to what extent carbon credits can be used to meet regulatory requirements and the eligibility criteria for credits; whereas in the voluntary market, there is no international regulation or guidance on the quality of carbon credits that can be used by companies for voluntary purposes. The rulebook is, however, expected to boost further the demand for, and the integrity of, credits in both compliance and voluntary markets.

[81] The rulebook seems not to exclude the possibility that a host country could trigger the SDM Approach, without authorizing use as an ITMO, and thus without the obligation to make a corresponding adjustment. Under the Cooperative Approach, it also seems possible for a host country to authorize use as an ITMO for some carbon credits resulting from a project, but not for others. In those circumstances, the host country could use the share of unadjusted carbon credits to meet its own NDC.

[82] See e.g. Öko-Institut (2022, 21 March), *Methodology for Assessing the Quality of Carbon Credits* (version 2.0).

1. In **compliance markets**, national regulators sometimes allow a company to use credits to meet some or all of its obligations under a carbon tax or ETS, or impose offset obligations on their companies. Regulators may now make the eligibility criteria more demanding in light of the Paris rulebook, thereby incentivizing the use of carbon credits that comply with the rulebook. If these countries intend to use the carbon credit to meet their own NDC, they are allowed to accept only adjusted carbon credits. With the availability of high-quality credits that meet the Paris rulebook requirements, other countries with or considering a carbon tax or ETS may be more inclined to permit the use of carbon offsets, or to impose carbon offset obligations on certain industries (e.g. following Switzerland's example to impose offset requirements on mineral oil companies). Although the CORSIA scheme for offsetting emissions from international aviation already has relatively demanding rules for the quality of carbon credits, countries may enhance those standards further. Countries could also agree to subject other industries (e.g. maritime shipping) to similar international schemes.
2. In **the VCM**, increased net-zero pledges will further boost the demand for carbon credits. Private initiatives are developing guidance for buyers of carbon credits, including regarding the claims companies can make based on a carbon credit. For example, in June 2022, the Voluntary Carbon Markets Integrity Initiative released the provisional Claims Code of Practice (with public consultations until 12 August 2022; and a final Claims Code expected by late 2022 or early 2023).

   The provisional Claims Code sets out voluntary standards for how carbon credits can be used by companies in making climate claims (such as, we are a "*net zero*" company, or we provide a "*climate neutral*" product). If a company chooses to meet the conditions in the Claims Code, the Code provides a set of VCMI climate claims or "labels" that a company could use to describe its net zero strategy (e.g., "we meet VCMI Corporate Gold"). Under the Claims Code, a company can use the VCMI labels only if it publicly commits to a net zero emission target by 2050 at the latest (covering its Scopes 1, 2, and 3 emissions), with interim targets every five years. The company's progression towards net zero must also be independently monitored. The VCMI labels allow companies that have embarked on a proper net zero pathway to use high quality carbon credits, if they wish, to offset their residual emissions. The VCMI labels will provide transparency and uniformity on climate claims, and signal that a company uses carbon credits in addition to – and not as a substitute for – emission reductions within its own value chain.

   Whilst strongly debated, the draft Claims Code does not currently contain any requirements to avoid double counting of carbon credits by the company and the host country where the offset project is developed. In other words, a company could purchase and retire carbon credits which the host country also uses to meet its NDC. A company, however, needs to publicly communicate whether it retired carbon credits that avoid double- counting or not (adjusted or not).

   Over time, some national regulators may also decide to regulate credits used for voluntary purposes (through, *e.g.*, corporate reporting requirements, consumer protection laws, or marketing rules). Some expect that, with enhanced integrity of carbon credits, the VCM may grow from the current $1 billion per year to $50–100 billion by 2030.[83]

As a result of these market dynamics, the Paris rulebook is expected to also have an effect on pricing. Credits that comply with the rulebook and that are adjusted will have higher integrity and are likely to be eligible for use in more markets. They can, therefore, be expected to earn a price premium.

Opportunities and risks for stakeholders

It is clear that this moment of fast-changing regulatory and market dynamics presents significant opportunities and risks for all stakeholders. Of particular note are the following:

- **Companies** have the opportunity to purchase high-quality carbon credits to meet their net-zero commitments (either voluntary or possibly mandatory). Increased scrutiny of the integrity of carbon credits by both consumers and regulators underpins the need to choose carefully the right carbon credit 'product'.

[83] See Credit Suisse (2022), Treeprint: Carbon Markets, the Beginning of the Big Carbon Age.

- **Investors and project developers** have the opportunity to invest in, and develop, high-quality projects, albeit with some questions as to how the regulatory and market dynamics will play out (including pricing dynamics and the liquidity/stability of the market as it grows).
- **Host countries** may seize on the opportunity to receive additional financing for carbon-reducing projects, carefully considering which carbon credit approach to apply to cut emissions and to foster sustainable development.
- **Regulators** now must further develop and implement the Paris rulebook and decide whether and how to adapt the eligibility criteria under their own domestic ETS or carbon tax schemes. Internationally, regulators must consider how the rules affect schemes like CORSIA and whether to subject other industries (e.g. maritime shipping) to similar schemes.

HOW THE VOLUNTARY CARBON MARKET IS AN ESSENTIAL TOOL FOR REACHING NET ZERO

Ana Haurie

Climate science tells us it is now imperative to keep global warming to well under 2°C and ideally to limit the rise to 1.5°C above pre-industrial temperatures. If we are to avoid catastrophic climate change, we need to reach 'net zero'—where anthropogenic greenhouse gas (GHG) emissions are balanced by removing the same amount out of the atmosphere[84]—by 2050. To get on the pathway to net zero we must cut global emissions in half by 2030.[85] The GHG mitigations promised by each country's Nationally Determined Contribution by themselves would result in 2.1 to 2.4°C of warming this century.[86] Additional emissions pledges by corporates, whilst essential, will not on their own add enough to the reductions needed.

Challenge and potential

Achieving net zero requires not only urgent action but also a vast investment—up to $100 trillion between now and 2050.The current funding deficit is estimated at between 60 and 85 per cent.[87] In order to meet the Paris Agreement targets it is therefore crucial to harness private sector capital and realize the huge funding and mitigation potential of the Voluntary Carbon Market (VCM). The VCM enables businesses—as well as investors, governments, and NGOs—to voluntarily purchase carbon credits, each credit representing one metric tonne of verified emissions mitigation. These purchases finance the implementation or expansion of climate projects. Because of the VCM, in the past 10 years almost 850 million tonnes of GHG emissions have already been removed or avoided by climate projects that would not otherwise have been funded.[88]

The underlying process is different from government-regulated compliance markets such as the EU Emissions Trading Scheme where obligated companies are issued 'cap and trade' permits allowing them to emit up to agreed, but gradually declining, levels. Nevertheless, whilst the compliance and voluntary markets are distinct, there is potential for them to converge. In a significant development at COP26 in November 2021, Article 6 established the basis for a new international carbon market.

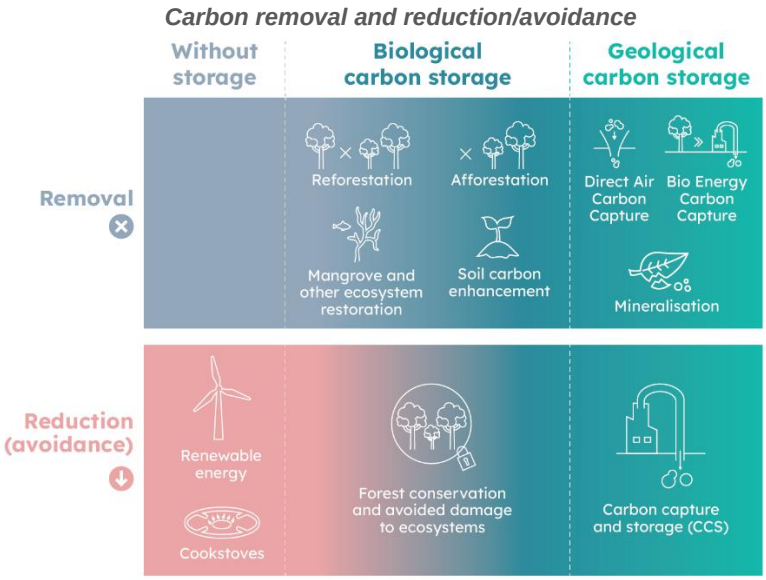
The VCM rests on two fundamental principles: high-integrity demand, and high-quality, impactful supply. Let's look first at the supply side.

[84] Intergovernmental Panel on Climate Change (2018), 'Glossary', in *Global Warming of 1.5°C*, https://www.ipcc.ch/sr15/chapter/glossary/.
[85] UN Environment Programme, Copenhagen Climate Centre (2021), *Emissions Gap Report 2021*, https://www.unep.org/resources/emissions-gap-report-2021.
[86] Climate Action Tracker (2021), 'Glasgow's one degree 2030 credibility gap: net zero's lip service to climate action', news release, https://climateactiontracker.org/press/Glasgows-one-degree-2030-credibility-gap-net-zeros-lip-service-to-climate-action/.
[87] Carney, M., and Topping, N. (2021), 'Getting Finance in shape for COP26', Guest view, *Reuters*, https://www.reuters.com/breakingviews/guest-view-getting-finance-shape-cop26-2021-04-21/.
[88] 'The voluntary carbon market: eight things to know for the year ahead' (2022), *South Pole,* https://www.southpole.com/publications/the-voluntary-carbon-market-eight-things-to-know-for-the-year-ahead.

Types of project supply

Carbon mitigation projects fall into two distinct categories: removal and reduction/avoidance (see figure below). Removal projects sequester carbon dioxide either via nature-based solutions (NBS) such as reforestation or by technological solutions such as geological storage of direct air carbon capture. Reduction/avoidance projects mitigate emissions via NBS such as the protection and conservation of existing forests and wetlands, or via technology such as renewable energy or carbon capture and storage in fossil fuel power stations.

In both categories, project quality is paramount in order to counteract accusations of 'greenwashing'. Projects have to be additional (i.e. they would not have happened without VCM funding); emissions mitigations must be measurable and permanent; and carbon credit issuance should be conservative (secured via a 'buffer' pool, a reserve of credits that serve as insurance for non-permanence or leakage). Over the last decade the standards for assessing these qualities have become much more exacting. Leading certification agencies such as Verra and Gold Standard combine rigorous scientific methodologies, peer review, accurate surveillance, and regular verification to ensure project integrity. In short, credits must be results-based with impacts that are independently and credibly certified. Meanwhile, the Integrity Council for Voluntary Carbon Markets (https://icvcm.org) aims to set and enforce global benchmarks so that carbon credits are high quality and will channel finance effectively towards mitigation and climate-resilient development.



Source: Respira International.

The company led by the author of this article, Respira International, has been focused mainly on facilitating the finance of NBS projects involving the protection and restoration of existing forests, soil, and wetlands. Until recently, NBS enterprises have been underfunded and undervalued. The VCM, however, puts a monetary value on nature and the benefits it provides. Currently, NBS credits aren't allowed in most compliance markets, so it is up to the VCM to unlock the capital flows essential for such projects. The VCM is in fact the first global private market that, at sufficient scale, values ecosystem services, including carbon storage, that can provide fully one-third (up to 10 gigatonnes of CO_2 equivalent per year) of the emissions mitigation needed by 2030.[89]

Globally, forests are home to most of the planet's biodiversity. They regulate rainfall, pump out clean water and oxygen, and provide food, shelter, fuel, and income to over a billion people. Forests are also vital for tackling climate change since they absorb approximately one-quarter of all CO_2 emissions from the atmosphere.[90] Yet currently, between 10 and 15 per cent of annual global emissions are the result of deforestation and forest degradation—more, in fact, than produced by the global

[89] Griscom, B.W., et al. (2017), 'Natural climate solutions', *PNAS* 114 (44), 11645–11650, https://www.pnas.org/doi/10.1073/pnas.1710465114.
[90] Foley, J. (2021), 'We need to "see the whole board" to stop climate change', *GlobalEcoGuy,* https://globalecoguy.org/we-need-to-see-the-whole-board-to-stop-climate-change-98be66412281.

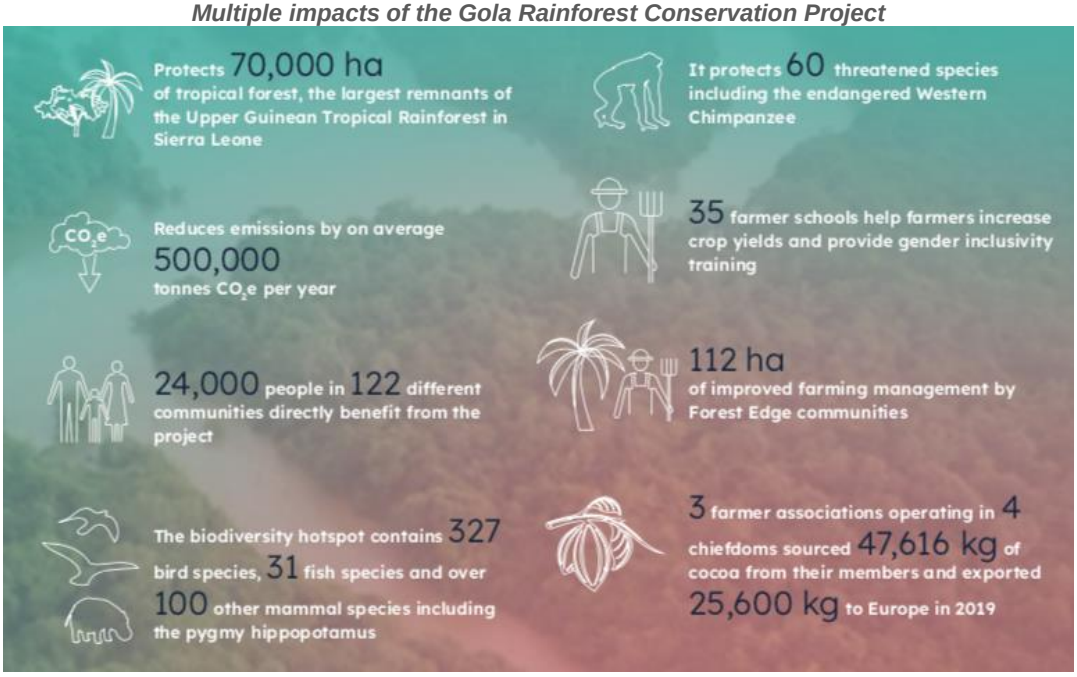
transport sector. In 2020 alone, 12 million hectares of tropical forest were lost and much more were degraded.[91] It takes many decades for a forest to grow to maturity, together with the resulting biodiversity. New planting is more expensive, more risk-prone, and likely to come with fewer co-benefits than conserving existing stock. It makes no sense to lose forests faster than we plant them—that's like to trying to fill a bath with no plug in it. This accords with the latest scientific guidance that the best way to prioritize emissions mitigation from NBS is to protect, manage, and then restore.[92]

Additional impacts

Alongside emissions mitigation, nature-based VCM projects often have significant co-benefit impacts including maintaining biodiversity, encouraging sustainable development, and supporting local communities. The fact that the VCM puts a value on nature and pays local people to protect and develop its ecoservices creates a powerful sense of ownership and responsibility. Profit share in future credit price appreciation is an additional incentive for local project developers, and Respira's operational model was one of the first to include upside sharing.

Sierra Leone's Gola Rainforest Conservation Project is a good example of the multiple impacts that can accrue to a well-designed, well-managed NBS enterprise (see figure below). Developed in partnership with the Royal Society for the Protection of Birds or RSPB, the project protects 70,000 hectares of highly threatened tropical forest and avoids half a million tonnes of CO_2 equivalent in emissions per year.[93] And by encouraging sustainable development and land use planning, the Gola Project enables local communities to become guardians and stewards of the natural resources that underpin their livelihoods.

Multiple impacts of the Gola Rainforest Conservation Project



Source: Respira International.

The demand side

There is now mounting pressure on companies—even when not obligated by policy—to voluntarily cut emissions, target net zero, and make a positive environmental and societal difference whilst doing business. The pressure has multiple sources, upwards and downwards, internal and external: from management and employees; from shareholders and customers, and from meeting Environmental, Social and Governance (ESG) goals and matching competitor commitments.

[91] Weisse, M., and Goldman, L. (2021), 'Primary rainforest destruction increased 12% from 2019 to 2020', https://www.globalforestwatch.org/blog/data-and-research/global-tree-cover-loss-data-2020/.
[92] Cook-Patton, S., et al. (2021), 'Protect, manage and then restore lands for climate mitigation', *Nature Climate Change* 11, 1027–1034, https://www.nature.com/articles/s41558-021-01198-0.
[93] Respira International, (2022), Gola Rainforest Conservation Project.

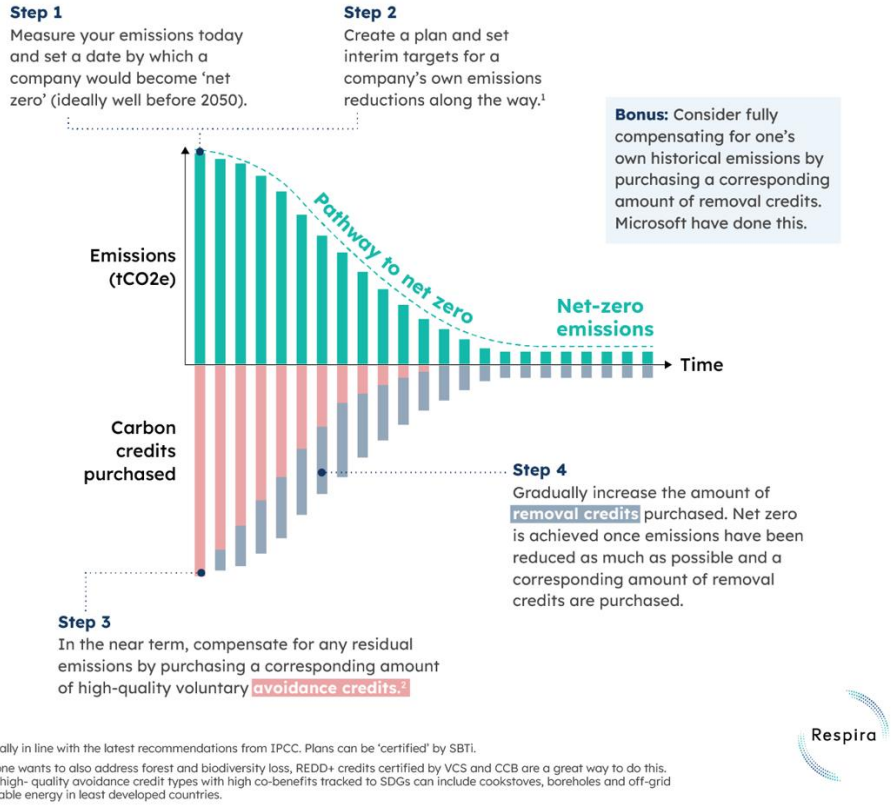
The VCM provides a vital mechanism for businesses to mitigate their unavoidable carbon footprint. In this process, integrity and best practice are key. As in any sector, in the past there have been instances of bad actors. The VCM therefore welcomes initiatives such as the Voluntary Carbon Market Integrity Initiative, which has been established to ensure companies do not greenwash. It is absolutely essential that, before using carbon credits, companies first avoid and reduce their own and supply-chain emissions as much as possible, set future targets, and then deliver on them. Carbon credits must not be a substitute for this.

Nevertheless, in the short term, mitigation strategies may take time to produce results, and in the longer term some remaining emissions may still be inevitable. High-quality carbon credits can address these problems by creating impact immediately and by compensating for unavoidable residual footprint.

However, there are those who argue that only removals credits should count towards a company's pathway to net zero. Thus, new forest planting and reforestation projects (removals) would be acceptable, but protection and conservation (avoidance) would not. It is true that, strictly speaking, avoidance projects do not reduce carbon footprint by actually removing emissions. But, as we have seen on the supply side, we cannot ignore the immediate and urgent need to safeguard what we still have. Respira therefore has two main types of avoidance credits in its portfolio—cookstoves and REDD+ (reducing emissions from deforestation and forest degradation). The latter is not simply justifiable but absolutely essential for stopping catastrophic deforestation.

On the demand side that means acknowledging the difference between a company's near-term transition and its longer-term destination of net zero. Respira argues for a corporate mitigation strategy that is weighted initially towards avoidance credits (see figure below). Over time, with global conservation hopefully becoming the norm, removals credits should play an increasingly important role. Ultimately, a business will achieve net zero once its emissions are reduced to the fullest extent possible *and* any residual emissions are compensated by credits.

The role of high-quality carbon credits on the pathway to net zero



Source: Respira International.

The above figure shows that the VCM also enables companies to take a powerful additional step by also compensating for historical emissions via a corresponding amount of removals credits. Microsoft, for example, has committed to becoming carbon negative by 2030, and to have mitigated all the historic carbon it has emitted by 2050.[94]

Market credibility and momentum

In addition to the integrity initiatives already mentioned, the VCM has become a professional and credible marketplace due to increasing institutionalization in various other forms. There is now more pricing visibility accessible through, for example, S&P Commodity Insights. Exchange traded contracts are available, including one for high-quality nature-based credits. On the supply side, several new project ratings agencies have launched recently that are working with and improving on traditional methodologies. On the demand side, the Science Based Targets Initiative (SBTi) enables organizations to set ambitious but achievable emissions reduction goals on their pathway to net zero.

The VCM is now experiencing a significant increase in momentum as more and more companies recognize the crucial part that carbon credits can play, in both supporting ambitious climate action and achieving valuable ESG and sustainable development co-benefits. Sixty per cent of Fortune 500 companies have now set climate targets,[95] and many of the world's largest businesses, including Amazon and BP, have pledged to achieve net zero by 2050.[96] In a very encouraging development at COP26, the London Stock Exchange (LSE) announced it is working on 'facilitating the public listing of carbon funds through a disciplined, transparent market with a clear price signal'[97]. The Exchange's declared intention is to enhance investor confidence in climate projects worldwide by addressing two challenges: access to a durable supply of high-quality carbon credits for corporates and investors during their pathway to net zero; and access to capital—mainly from investors in the global north—at sufficient scale for new projects based mainly in the global south.[98]

The rise in VCM demand is driving prices higher, with credits from NBS projects seeing one of the biggest increases. In 2021, the value of the VCM grew by 190 per cent to over $1 billion.[99] In 2022 the market is forecast to expand a further 50 to 80 per cent. By 2030, voluntary carbon credit demand is forecast to be 5 to 10 times its current level, and 10 to 30 times by 2050.[100] Former Bank of England governor Mark Carney, who launched the Taskforce on Scaling Voluntary Carbon Markets (precursor to the Integrity Council for Voluntary Carbon Markets (ICVCM)), has estimated that the market could be worth up to $100 billion a year by mid-century.

This growing momentum is positive on several fronts. First, it means more and more private capital is being—and will be—unlocked, channelled, and directed towards where it needs to go, primarily from the developed global north to the less developed global south.

Second, VCM expansion indicates more and more businesses first committing themselves to the avoidance and reduction of emissions before buying carbon credits. A growing number of market participants therefore brings the net-zero horizon that much closer.

Third, buying credits puts a price on a company's carbon footprint, and this becomes a decision-making tool. Rising credit prices represent a cost incentive that will encourage corporate commitments to decarbonize and invest in permanently reducing both their own emissions and those within their value chain.[101]

[94] Smith, B. (2020), 'Microsoft will be carbon negative by 2030', *Microsoft,* https://blogs.microsoft.com/blog/2020/01/16/microsoft-will-be-carbon-negative-by-2030/.
[95] Cervantes, L., et al. (2021), *Power Forward 4.0: A Progress Report of the Fortune 500's Transition to a Net-Zero Economy*, World Wildlife Fund, https://wwfint.awsassets.panda.org/downloads/power_forward_4_0.pdf.
[96] Jacobson, R., and Weinberg, K. (2021), 'Giving carbon credit: Lessons from unchecked financial markets', *GreenBiz,* https://www.greenbiz.com/article/giving-carbon-credit-lessons-unchecked-financial-markets.
[97] https://www.lseg.com/resources/media-centre/press-releases/london-stock-exchange-developing-new-market-solution-voluntary-carbon-markets
[98] London Stock Exchange Group - LSEG (2022), *Voluntary Carbon Markets Rule Drafting Update*.
[99] Trove Research (2022), *Voluntary Carbon Market: 2021 in Review and 2022 Outlook*.
[100] *Future Demand, Supply and Prices for Voluntary Carbon Credits—Keeping the Balance* (2021), Trove Research and University College London, https://trove-research.com/wp-content/uploads/2021/06/Trove-Research-Carbon-Credit-Demand-Supply-and-Prices-1-June-2021.pdf.
[101] 'The voluntary carbon market: eight things to know for the year ahead' (2022), *South Pole,* https://www.southpole.com/publications/the-voluntary-carbon-market-eight-things-to-know-for-the-year-ahead.

There is effectively a virtuous circle in operation whereby increased demand signifies better business practice and creates rising prices, and those rising prices further incentivize better practice whilst increasing the amount of funding available for new and more ambitious VCM projects. In addition, credit prices are enhanced by a project's co-benefits. A higher price implies greater sustainable development impacts.[102]

Final thoughts

We estimate that for the NBS part of the VCM to realize its full potential requires at least $300 billion of financing annually by 2030. Without private sector capital this will not be easy. It's similar to the amount invested in renewable energy in 2019 ($280 billion), but 100 times what was invested in NBS in that year.[103] The VCM is not the only funding solution, but it is a critical one. Voluntary carbon credit finance represents a scalable way to mobilize private sector investment that's available right now.

The experience of recent years shows that a vibrant VCM makes it much easier to attract large flows of private capital. A significant number of businesses are now reducing emissions, setting targets, and using carbon credits with best practice. But to hit net zero in a rapidly shrinking time frame, still more commitment is required. And it is possible.

Consider this final point: if all the Fortune Global 500 companies committed to spending just 0.1 per cent of their total revenues to compensate their direct and indirect non-value-chain emissions, that alone would create an estimated 5 billion tonnes of carbon credit demand.[104] If half the credits were allocated to NBS avoidance projects, this would unlock almost enough funding, from the VCM alone, to end deforestation.

SEEKING SCALE: THE ROLE OF PHYSICAL COMMODITY MARKETS TO DELIVER ON REMOVALS

Hannah Hauman and Malihah Shah

In the most recent Intergovernmental Panel on Climate Change report[105], carbon removals are identified as a necessary and unavoidable tool to remedy the likely overshoot past annual emissions levels required to meet the goals of the Paris Agreement. The shortfall in country commitments[106] and the many challenges of the energy transition mean that the additional contribution required from carbon removals is material, in both 1.5°C and 2°C scenarios. Notably, the most conservative estimate in the Bloomberg New Energy Finance Gray Scenario requires 21.5 billion tonnes of carbon removals between 2023 and 2050[107].

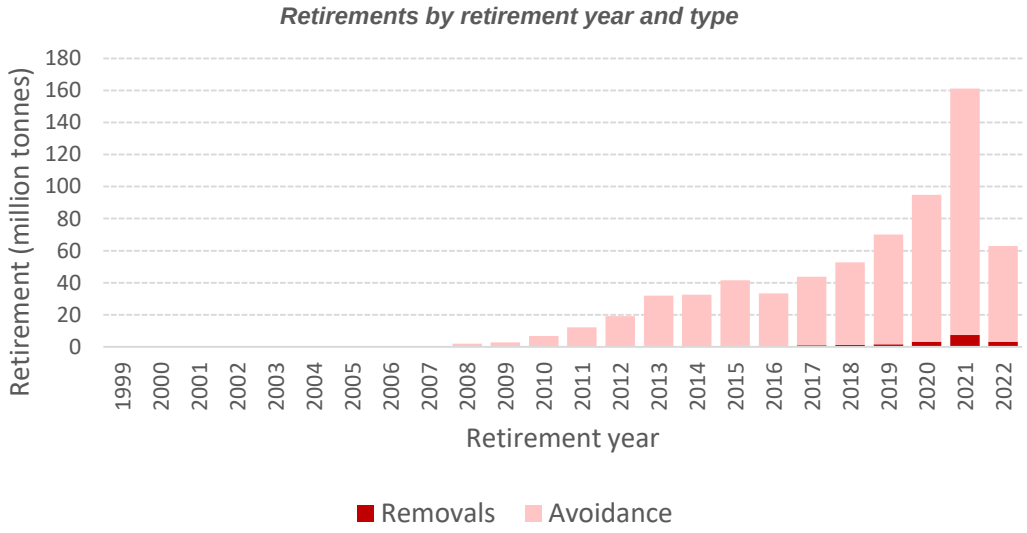
While there has been significant growth in carbon finance to date, and in the voluntary carbon market in particular, projects have primarily focused on 'avoided emissions' instead of the development of negative emissions in the form of carbon removals. This is not because of a lack of demand: over 70 countries and 1,200 companies have committed to net zero by 2050[108], encompassing 80 percent or more of global emissions at time of writing. Many of these countries and companies are committed to the Science Based Targets initiative, which requires carbon removals for offsetting residual emissions. While these are long-term targets, immediate demand needs are just as critical in terms of achieving progress towards net zero. Notably, Microsoft has cited a supply shortage of appropriate solutions in relation to their 2021 Request for Proposals[109] on carbon removals.

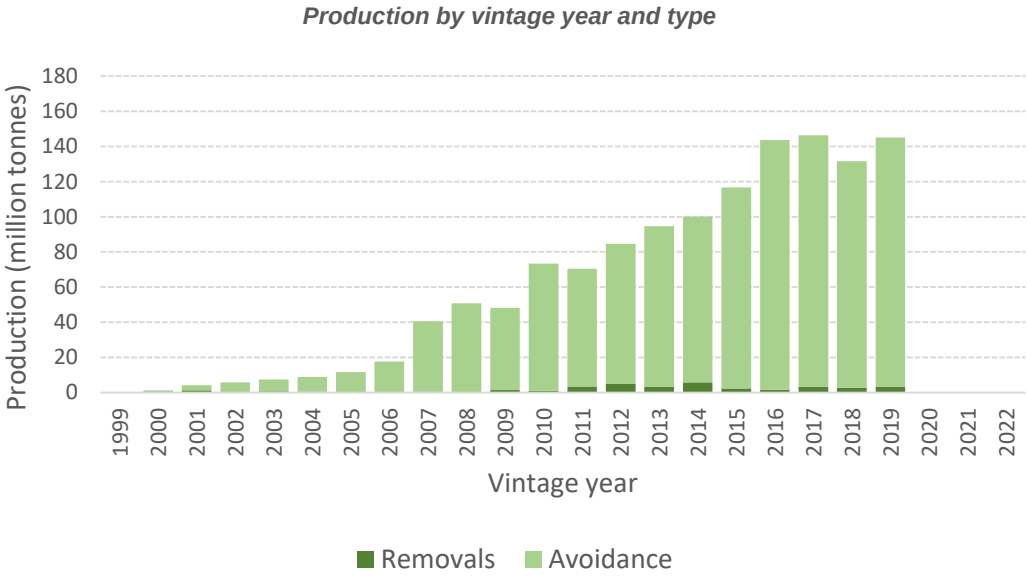
[102] *Future Demand, Supply and Prices for Voluntary Carbon Credits—Keeping the Balance* (2021), Trove Research and University College London, https://trove-research.com/wp-content/uploads/2021/06/Trove-Research-Carbon-Credit-Demand-Supply-and-Prices-1-June-2021.pdf.
[103] 'Executive summary', *Nature for Net-Zero: Consultation Document on the Need to Raise Corporate Ambition towards Nature-Based Net-Zero Emissions* (2020), The Food and Land Use Coalition, https://www.foodandlandusecoalition.org/wp-content/uploads/2020/12/FOLU_Nature-for-Net-Zero_Executive-Summary_.pdf.
[104] 'Executive summary', *Nature for Net-Zero: Consultation Document on the Need to Raise Corporate Ambition towards Nature-Based Net-Zero Emissions* (2020), The Food and Land Use Coalition, https://www.foodandlandusecoalition.org/wp-content/uploads/2020/12/FOLU_Nature-for-Net-Zero_Executive-Summary_.pdf.
[105] IPCC (2022) Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge. Cambridge University Press.
[106] UNFCCC Secretariat (2021) Nationally determined contributions under the Paris Agreement. Revised note by the secretariat. [online] Available from: https://unfccc.int/sites/default/files/resource/cma2021_08r01_E.pdf [accessed 17 June 2022]
[107] Henbest, S. Kimmel, M. Callens, J. Vasdev, A. Berryman, I. Danial, J. Brandily, T. Vickers, B (2021) New Energy Outlook 2021. [online] Available from: https://about.bnef.com/new-energy-outlook/ [accessed 17 June 2022]
[108] United Nations (2022) For a livable climate: Net-zero commitments must be backed by credible action [online] Available from: https://www.un.org/en/climatechange/net-zero-coalition [accessed 17 June 2022]
[109] Microsoft (2022) Microsoft carbon removal: An update with lessons learned in our second year. [online] Available from:

Therefore, the constraint remains supply, a predicament seemingly unique to carbon removals, with all carbon avoidance sectors having experienced an increase in supply in response to growing demand.

Annual growth in voluntary carbon credit retirements and production

Carbon removals, as an electronic certificate recorded in a registry ledger, are often oversimplified in terms of their ease of production. However, behind these virtual tonnes are very real physical assets with complex operations and risks, not dissimilar to those faced in the traditional physical commodities sector. While a tonne of carbon removals from a forestry or carbon capture, storage and utilisation (CCUS) project will never be loaded onto a ship, project investors are still required to manage delivery, timing, policy, credit and customer risk against the backdrop of a rapidly changing regulatory landscape. This is not necessarily unique to carbon removals compared to other classes of carbon credits, however as removals require a higher cost of implementation with an outcome of lower volumes and extended delays to production, this risk is amplified and projects are often foregone altogether.





Sources: Data from Verified Carbon Standard, Gold Standard, Climate Action Reserve, American Carbon Registry, as of 6 June 2022.

https://query.prod.cms.rt.microsoft.com/cms/api/am/binary/RE4QO0D [accessed 17 June 2022]

While a number of corporates have been recognised as pioneers in direct carbon removals investment, the scale required by voluntary net zero demand and Intergovernmental Panel on Climate Change scenarios[110] requires enhanced market architecture in the form of participants as much as frameworks. Just as an exchange facilitates transactions for clearing risk, supply chain experts and commodity risk managers are uniquely suited to managing the inherent physical risks underlying the carbon removals market and to delivering solutions at scale.

Removals taxonomy and associated challenges

Even with a wide range of carbon removals options available within the categories of nature-based and technology-based project solutions, all removals share a heightened barrier to entry compared with avoidance and reduction equivalents because of the lead time from final investment decision to production, ongoing operational challenges and policy risk. However, this presents differently based on the project subcategory.

Nature-based removals contain the widest variety of subcategories, including traditional forestry-based afforestation/reforestation (AR), regenerative agricultural practices (soil carbon), mangrove restoration (blue carbon) and biochar. The concept of carbon sequestered via biomass means that the constraint of time is a given, with projects taking two to four years to deliver the first tonnes and only reaching full-scale production after seven to 10 years. The final growth rates, however, depend on the specific geography, land eligibility and species type, which means that even forestry-based removals production curves can have extraordinary variability in terms of assessing and guaranteeing volume. Soil carbon, while more accurate in terms of delivery timescales, has the distinct challenge of measurement, reporting and verification when it comes to managing landscapes at scale. This is especially difficult given that sequestration rates may only become truly quantifiable following a project's first monitoring period, potentially years after the activity has begun.

Afforestation and restoration with native species is as beneficial for restoring biodiversity as they are for carbon sequestration. Still, from a silvicultural perspective, they have far slower growth rates than exotic (non-native) equivalents and face greater physical risks outside their natural environment. On the other hand, while exotics demonstrate strong rates of growth, there can be risks associated with ensuring the ideal clone selection and the accurate assessment of land eligibility to make sure a project is truly operating on degraded lands that otherwise would not be viable for carbon.

The final variable for nature-based removals, whether natives or exotics, is that developers have to choose between the inclusion of a harvesting component or to seek pure carbon sequestration. Harvesting practices, while producing far fewer carbon removals under the long-term-average methodology, can provide meaningful revenue and diversification of community engagement for the project, arguably ensuring their long-term sustainability and permanence. Restoration through non-harvest exotics or native species, on the other hand, receive top marks for environmental additionality but have far greater risks as stand-alone carbon investments.

Technological removals, while not reliant on seasonal constraints in the same way as nature-based equivalents, experience their own lead-time and production risks on the front end as a result of the human constraints of permitting, engineering studies and final technical viability testing. Once operational, these projects largely forego variability in production figures as they sequester carbon in a linear, predictable fashion. However, as policy evolves, they face a unique risk in the regulatory treatment of their engineering process under the lens of policy, namely the tightening of requirements on energy consumption. The key input for technology-based removals, such as direct air capture and carbon capture, storage and utilisation processes, is power. Therefore, the absence of renewable power supply can change carbon sequestration rates drastically. Leading technologies achieve only 20 per cent of the capture rate if reliant on grid-sourced power and legislators are taking an increasingly rigorous stance on additionality when it comes to renewable power use for green projects. We see this in advancing legislation on hydrogen in the European Union, which requires renewable-power-generating installations to be built alongside electrolysers to ensure that projects are not cannibalising existing resources.

[110] IPCC (2021) Climate Change 2021 The Physical Science Basis Working Group I Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change: Summary for Policymakers. [online] Available from: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_FrontMatter.pdf [accessed 17 June 2022]

Finally, while each type of carbon removal activity faces unique challenges surrounding surety on sequestration rates and timing, common to all projects is the overarching policy risk relating to the UNFCCC Article 6 implementation. There have been an increasing number of instances that highlight how nationalisation risk and changing domestic policy can have an impact on project participants, such as the recent freeze of voluntary carbon issuances for export in Indonesia or the announcement in China that forestry projects in the province of Fujian will only be allowed under domestic schemes. There is also the uncertainty relating to project policy-driven validity, such as in the case of the REDD+ moratorium on all new projects in Papa New Guinea or the ban on methane flaring in Russia, which rendered upstream emission reduction projects obsolete as a result of a lack of additionality.

Physical commodity players as an integral part of market architecture

The categories and associated risks can be dizzying for even the most experienced agronomists and technologists, let alone for corporates otherwise occupied with decarbonising their core industrial businesses. This has resulted in an admirable but relatively limited movement of capital into removals as a result of the aforementioned risks tied to ownership and operation of physical carbon assets. Therefore, traditional physical commodity players bring a unique skillset in managing physical asset risk and connecting markets, enabling solutions at scale by managing three key risk parameters and enablers: delivery, specification and financial tools.

Delivery

At the heart of any traded commodity market is the natural mismatch between global producers and global consumers with regard to requirements relating to timing and quantity. Producers naturally want immediate cash for goods produced, while consumers avoid payment until delivery is required. At the same time, producers seek to avoid any quantity or timing guarantees because of inherent variability and propensity for delays in production processes, while consumers seek security of supply in terms of both quantity and timing. Carbon removal supply chains are no different. Just as an automotive manufacturer is reliant on deliveries from nickel mines, the corporate managing its net-zero commitment is reliant on the carbon removal project to deliver the exact tonnes transacted, at the price agreed and at the timing required. The absorption of delivery risk relating to quantity shortfall and potential for delays occurs every day in the physical commodity world, with supply chain managers providing producers with the flexibility they require while providing consumers with the surety they need.

Additionally, as supply chain managers are focused on meeting a broad view of general market demand as opposed to individual corporate requirements, quality and scale explored are never limited by quantity. Every project development requires a high fixed amount of costs and time related to technical and policy vetting, legal structuring and financial arrangement costs. This translates to size and scale acting as a positive for supply chain managers at the same time that it is a limiting factor for individual corporates with constraints around project diversification, capex or quantity.

Specification

Just as there are specific requirements with regard to quantity and timing, individual corporates seek specific quality baskets, often with priorities for type, registry and geography. While the concept of product specification is not unique to any physical commodity market, it is a natural limitation for individual actors investing for their own consumption to scale for the full suite of carbon removals, each with its own role to play in mitigation and adaption services.

Terrestrial afforestation/reforestation projects to date have served as the largest supplier of carbon removals, offering corporates the opportunity to contribute to bolstering forestry stocks that help to protect biodiversity and shield against the loss of carbon contained in the biomass. However, for organisations with direct exposure to agricultural supply chains, it may be important to interweave carbon removals with the production of cacao, coffee, bananas or cotton, giving rise to agroforestry and soil carbon projects. Similarly, the maritime industry in particular has gravitated towards the category of blue carbon removals or projects that focus on restoration of mangroves to rebuild marine ecosystems. Others have a keen interest in driving carbon finance to communities nearest to their operations, meaning the main qualifier could actually be the project location itself.

While a tonne may equal a tonne in carbon accounting, the social and biodiversity aims that often accompany net-zero targets create a range of carbon removals specifications that require a broad-based markets approach to deliver at scale and to ultimately connect global producers and consumers in what is anything but one-size-fits-all landscape.

Financial tools

While physical assets and delivery risk serve as tremendous barriers to entry and scale in their own right, the largest barriers of all are concentrated in what could be characterised as financial tools: finance, credit and price risk management.

To date, while strong commitments have emerged from individual corporate end users, investments are often limited by capex constraints, especially in carbon removals that have a high upfront cost hurdle for implementation and a long delay to delivery. The physical commodity landscape is inherently tied to the traditional banking community for project finance, but also significantly in terms of the use of working capital as goods move from origin to transformation, storage and end-user stages. Leveraging these relationships and this expertise to increasingly frame carbon removals as a bankable commodity class is a critical requirement to move markets forward and deliver sequestration at scale, allowing for broad-based cooperation across the private sector to unlock sidelined financing into carbon removal asset development.

Credit and counterparty risk management is another critical component for markets to function efficiently. This is largely taken for granted in the major commodity markets, but a mismatch in working capital and the provision of credit is often as critical to scaling markets as any other aspect. Credit requirements exist on both the producer and consumer fronts, with individual corporates often lacking the technical expertise to assess a project for prepayment eligibility and producers requiring credit guarantees from buyers. Given that carbon removal offtakes generally average a minimum of 10 years, transactions are naturally very long term in nature, even compared to traditional commodities, which average one year in duration. This only increases the importance of this capacity within the market.

Finally, price risk management looms as the final hurdle in scaling carbon removals, especially because of their relatively high implementation cost and long lead times to production and payback periods, and with the backdrop of a rapidly changing regulatory landscape. While the derivatives market is swiftly advancing to create a robust underlying market architecture to improve transparency, liquidity and ability to hedge, such as the CME Group CBL Nature-Based Global Emissions Offsets (N-GEO) futures contract and the Intercontinental Exchange Nature-Based Solutions carbon credit futures contract, it is reflective of voluntary avoidance credits only.

A carbon removals derivatives market is likely to develop in the future, but at present the market finds itself stuck in a circular loop, whereby a derivatives market requires liquidity and therefore high volumes to launch, and equally the removals sector looks for hedging mechanisms to invest in new projects. Until the market crosses the threshold of critical mass to create a positive feedback loop in this respect, market participants need to be prepared to underwrite price risk, making physical commodity traders with experience in managing price risk an important lever in introducing solutions at scale and ultimately underpinning liquidity for wider market architecture to be further developed in the name of carbon removals.

Conclusion

Developing market infrastructure to enable meaningful scale and climate impact goes far beyond traditional facilitators such as registries, regulators and exchanges, and extends to market participants. While the most important of these is the demand signal from net-zero ambitions, there is an equal challenge on the supply side of the equation that requires expertise in operational risks associated with physical assets, in understanding policy and country risk, credit and counterparty risk, and in price risk management.

To date, the strong growth in the development of carbon assets has been encouraging. However, it has thus far left one of the most critical climate mitigation levers, carbon removals, out of the equation due to the far greater burden of cost and risk linked to this solution compared with carbon avoidance equivalents. Reframing this landscape requires an increased level of commitment from traditional commodity participants that are uniquely equipped to manage physical, legislative and financial risks, such as supply chain managers, banks and the insurance community, to adapt best practices from some of the most sophisticated markets in the world for use in what urgently needs to become one of the largest.

THE EVOLUTION OF CARBON REMOVAL MARKETS AND NEGATIVE EMISSIONS

Sahar Shamsi and Carlotta von Bebenburg

Greenhouse gas emissions, which have been found to be a major cause of global warming, are a classic case of a negative externality. Economists refer to a negative externality arising where the production or consumption of a good has a negative impact on others (for example, through pollution), which is not reflected in the price of the good, thereby leading to overproduction. The textbook response to an observed negative externality is to impose a cost on the production or consumption activity that causes the harm, such that the harm is 'priced' and the level of the activity correspondingly declines. In the case of carbon markets—notwithstanding that the intention of various carbon taxation schemes, in Europe and around the world, is to address the negative externality—several factors make it difficult to fully internalize or eliminate this externality by correctly pricing it in. Specifically, there is:

- no single price of carbon—prices vary between a few pounds per tonne of CO_2 (tCO_2) for some voluntary markets, for example average prices of \$3.37/tCO_2 (£2.70/tCO_2) on Ecosystem Marketplace, and around £250/tCO_2 according to the values used in UK policy appraisals;[111]
- no single instrument for carbon—numerous providers of varying quality offer verifications of carbon offsets in voluntary markets;
- no single market for carbon—voluntary markets exist alongside national emission trading schemes (ETSs);
- an incomplete understanding of carbon as an asset class and the role of carbon emission reduction projects in facilitating the delivery of wider social benefits that may also be unpriced or only partially priced, such as biodiversity.

While a review of all of the missing markets and market failures in relation to the pricing of carbon would be infeasible here, this article focuses on one possible route to market for greater uptake of greenhouse gas removals (GGRs). [112] These are technologies that can permanently remove emissions from the atmosphere. Specifically, the article puts forward a framework that would allow the creation of a tradable GGR unit, and sets out market design proposals that would allow these GGR units to participate in the UK ETS. The UK ETS has only been operational since 2021 and has evolved as a separate scheme from the EU ETS following the UK's exit from the EU. While the market design options discussed here focus on allowing GGRs in the UK ETS, they allow for integration of the two cap-and-trade schemes; similar market design options are also possible for the EU ETS.

The structure of this article is as follows: First, it briefly sets out the need for incentivizing GGRs. Next, it explains a possible way to create a tradable 'unit' of GGRs. It then sets out a number of criteria for market design options that allow the integration of GGRs within the UK ETS. Finally, the market design options themselves are presented and next steps are discussed.

The need for incentivizing greenhouse gas removals

Reaching the UK's net-zero ambitions and meeting the UK government's obligations under the Paris Agreement requires all sectors to reduce, prevent, or offset their emissions by 2050.[113] Although emissions are increasingly being abated, some emissions—such as those from aviation or hard-to-decarbonize industrial and agricultural processes—are likely to remain too costly or impractical to eliminate fully.[114]

In light of this, negative emission technologies, which can permanently remove greenhouse gases from the atmosphere, will become increasingly important to compensate for any residual emissions from industries that cannot be completely decarbonized. These include nature-based solutions, such as planting trees, and engineering-based technologies that capture and store greenhouse gases.

[111] This follows a 'target-consistent' or 'abatement cost' approach, as outlined in Department for Business, Energy & Industrial Strategy (2021, 2 September), *Valuation of Greenhouse Gas Emissions: for Policy Appraisal and Evaluation*, https://www.gov.uk/government/publications/valuing-greenhouse-gas-emissions-in-policy-appraisal/valuation-of-greenhouse-gas-emissions-for-policy-appraisal-and-evaluation.

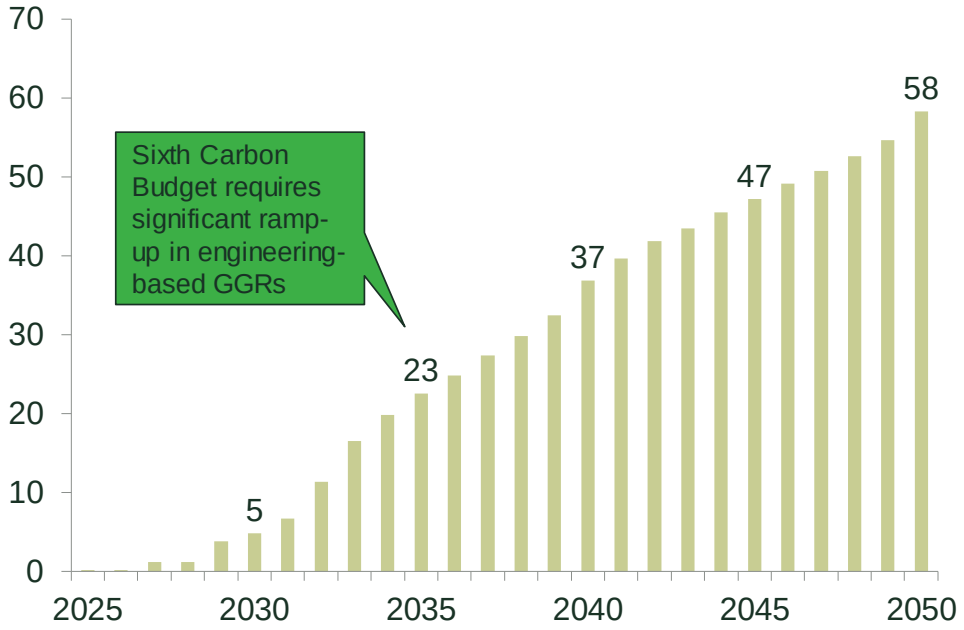
[112] The market design options for integrating negative emissions in the Emissions Trading Scheme, as discussed in this article, are explored in more detail in Oxera (2022, 9 February), *Market Design for Negative Emissions in the UK ETS*, prepared for Drax Group, https://www.oxera.com/wp-content/uploads/2022/03/Market-design-for-negative-emissions-in-the-ETS.pdf .

[113] National Infrastructure Commission (2021, July), *Engineered Greenhouse Gas Removals*, https://nic.org.uk/app/uploads/NIC-July-2021-Engineered-Greenhouse-Gas-Removals-UPDATED.pdf.

[114] Fuss, S., Lamb, W. F., Callaghan, M. W., Hilaire, J., Creutzig, F., Amann, T., and Minx, J. C. (2018, March), 'Negative emissions—Part 2: Costs, potentials and side effects', *Environmental Research Letters,* https://iopscience.iop.org/article/10.1088/1748-9326/aabf9f/pdf.

According to the UK's net-zero projections, GGRs are crucial to reaching the country's climate targets.[115] To ensure that sufficient GGRs are available at scale in the future, it is necessary to send the appropriate market entry signals for the required technologies today. Incentivizing timely uptake is a relevant consideration because these technologies will be needed in the coming years, and there is a significant lead time for development and commercial deployment. Even in 2035, around 15–25 $MtCO_2e$ of engineering-based GGRs will be required, but deployment at scale can take decades. Scaling up is necessary to reduce costs, which tend to decline with commercial deployment, while performance also tends to improve as technologies mature.[116] The following figure shows the necessary scale of engineering-based GGR uptake that is required over the coming decades, according to the UK's latest carbon budget.

Engineering-based GGRs necessary to achieve net zero in the UK ($MtCO_2e$ per year)



Source: Committee on Climate Change (2020), *The Sixth Carbon Budget Greenhouse Gas Removals*, December, Figure A3.11.a.

The uptake of these technologies can be achieved through different funding mechanisms that are not mutually exclusive, such as direct subsidies, voluntary or mandatory markets, and contracts for differences. As mentioned at the outset, the focus in this article is on integration with the ETS as one route to market for the uptake of GGRs.

Creating a unit of greenhouse gas removals

As a prerequisite for integrating GGRs into the ETS it is necessary to create a verified, tradable instrument, for which two steps are required:

1. introducing robust monitoring, reporting, and verification (MRV) standards to ensure that only genuine removals participate in the market;
2. accounting for differences in permanence across different types of GGRs to create a 'unit' of removals.

The second step is essential because technologies differ in terms of how permanent the removal of greenhouse gases is. For instance, the Department for Business, Energy & Industrial Strategy shows that storing greenhouse gases for 100 and 1,000 years has the effect of reducing climate impacts by 39 per cent and 66 per cent, respectively, compared to no removals.[117]

[115] Committee on Climate Change (2020, December), *The Sixth Carbon Budget—The UK's Path to Net Zero*, https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-The-UKs-path-to-Net-Zero.pdf.
[116] National Infrastructure Commissions (2021, July), *Engineered Greenhouse Gas Removals*, https://nic.org.uk/app/uploads/NIC-July-2021-Engineered-Greenhouse-Gas-Removals-UPDATED.pdf.
[117] Department for Business, Energy & Industrial Strategy (2021, 19 October), *Monitoring, Reporting and Verification of Greenhouse Gas Removals—Task and Finish Group Report*, 11, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1026994/mrv-ggrs-task-report.pdf.

Based on this type of analysis, a discounting approach can be developed to create a unit of GGR. Permanently removing one tonne of CO_2 would be awarded one unit of GGR, whereas less permanent removals would be awarded less than one unit.

Criteria for developing a route to market for GGRs via integration in the ETS

Having discussed the important role of GGRs in achieving net-zero targets, as well as the creation of a tradable unit of GGRs, we now turn to the principles for market design before suggesting specific options. From a public policy perspective, the following criteria are of particular relevance when integrating GGRs within the ETS.

- **Long-term effectiveness in reducing overall emissions**: It is important for market participants to retain strong incentives to reduce emissions when GGRs are introduced to the market. Similarly, emissions should not simply be shifted to other areas or countries. Robust MRV processes need to be established in order to ensure high-quality removals.
- **Efficiency of market(s)**: The mechanism should bring together sufficient buyers and sellers for an efficient price discovery and allow for the lowest overall cost per tonne of CO_2 removed (subject to the criteria above).
- **Fairness of cost allocation**: There should be a balance between the amount of costs placed on industry and on tax- and bill-payers.
- **Practicality/ease of implementation**: The options need to be politically acceptable and feasible to implement.
- **Integrability with the EU ETS**: Ideally, the options would not involve changes to the UK ETS that would prevent future compatibility and integration with the EU scheme.

The market design proposals set out in the next section have been developed in line with these criteria.

Market design proposals to include removals in the ETS

The UK ETS is a cap-and-trade system. Firms covered under it must obtain certificates or 'emission allowances' for the emissions they produce. These either are allocated for free or need to be purchased. Over time, the number of available emission allowances in the market declines in line with net-zero targets, forcing companies to reduce their emissions or pay a higher price for residual emissions.

The first three market design proposals set out here involve the concept of units of GGRs being added to the ETS and purchased as an alternative to emission allowances. Similar ideas have been explored in the economic literature.[118] Two key features of this market design are ensuring that (1) incentives to abate emissions are retained and (2) there is an uptake of removal units despite possible price differentials relative to traded ETS, especially in the early stages of GGRs being introduced to the market.

Option 1: separate markets with government as broker

Under this option the government acts as an intermediary. It reduces the supply of emission allowances in the ETS (by reducing the supply of either free or auctioned certificates). The certificates that are taken out of the ETS market are transferred to GGR operators in return for an equivalent amount of GGR units. GGR operators can then sell on the certificates in the secondary market. This means that the overall number of emission allowances in the market remains unchanged, which ensures that abatement incentives remain unchanged—while removals are additional to existing abatement levels. GGR operators can implicitly sell their emission removals at the prevailing carbon price (because they are 'paid' in emission allowances that are tradable on the secondary market). Initially, this amount might not be sufficient to cover the costs of first-of-a-kind negative emission technologies, so additional funding mechanisms may need to be in place to ensure that GGRs enter the market and are rolled out at scale to reach cost reductions.

Option 2: separate markets with price cap

Under option 2, polluters can buy GGR units directly in a separate market from the ETS but they are accepted as alternatives to emission allowances. Again, the primary supply of emission allowances is reduced in line with the number of GGR units

[118] See, for instance, Rickels, W., Proelß, A., Geden, O., Burhenne, J., and Fridahl, M. (2021, June, 3), 'Integrating carbon dioxide removal into European emissions trading', *Frontiers in Climate*, 690023, https://www.frontiersin.org/articles/10.3389/fclim.2021.690023/full#:~:text=Integrating%20Carbon%20Dioxide%20Removal%20Into%20European%20Emissions%20Trading,-Wilfried%20Rickels1&text=In%20one%20of%20the%20central,EU%20ETS)%20becomes%20net%20negative.

entering the market. This ensures that gross emissions do not increase, i.e. that polluters retain the incentive to reduce emissions. Other market participants not covered by the ETS may also purchase GGR units. In order to ensure sufficient uptake of GGRs, the price of GGR units could be capped at the prevailing ETS price. Additional policies are then needed to ensure that GGR operators participate in the market (e.g. ensuring that they receive sufficient remuneration).

Option 3: integrated market

Option 3 is a fully integrated market, where GGR units are auctioned together with emission allowances. Again, it is necessary to reduce the number of emission allowances in line with the supply of GGR units so the overall number of certificates in circulation does not increase. Such a full integration is likely to be more feasible once the market for GGRs is more mature.

These three options could in fact be implemented sequentially as the market matures. With costs for GGRs decreasing—and ETS prices increasing—less intervention would be needed to ensure the uptake of GGRs, and more market-based approaches would be possible.

Option 4: carbon removal obligation

Option 4 offers different mechanisms to ensure continued incentives to decarbonize and sufficient uptake of GGRs. This option introduces an obligation for polluters covered under the ETS.[119] With every emission allowance they purchase, there is an obligation for the future removal of the associated emissions. Firms buying emission allowances therefore need to obtain an equivalent amount of GGR units (or as a transitional measure, fewer than the number of emission allowances). An increase in demand for emission allowances would therefore automatically increase the demand for GGR units. At the same time, polluters would face very sharp decarbonization incentives as the cost of emitting increases. An increase in demand for emission allowances would therefore automatically increase the demand for GGR units. If required, other policies can help mitigate the cost for industry (and reduce the risk of carbon leakage).

The four market design options are summarized in the figure on page 74.

Conclusions and next steps

This article and Oxera's more detailed report for Drax Group set out a number of feasible market design options that integrate removals into the ETS. There are two key and immediate practical steps to take in order to implement any market design option for including GGR units in the UK ETS. These are:

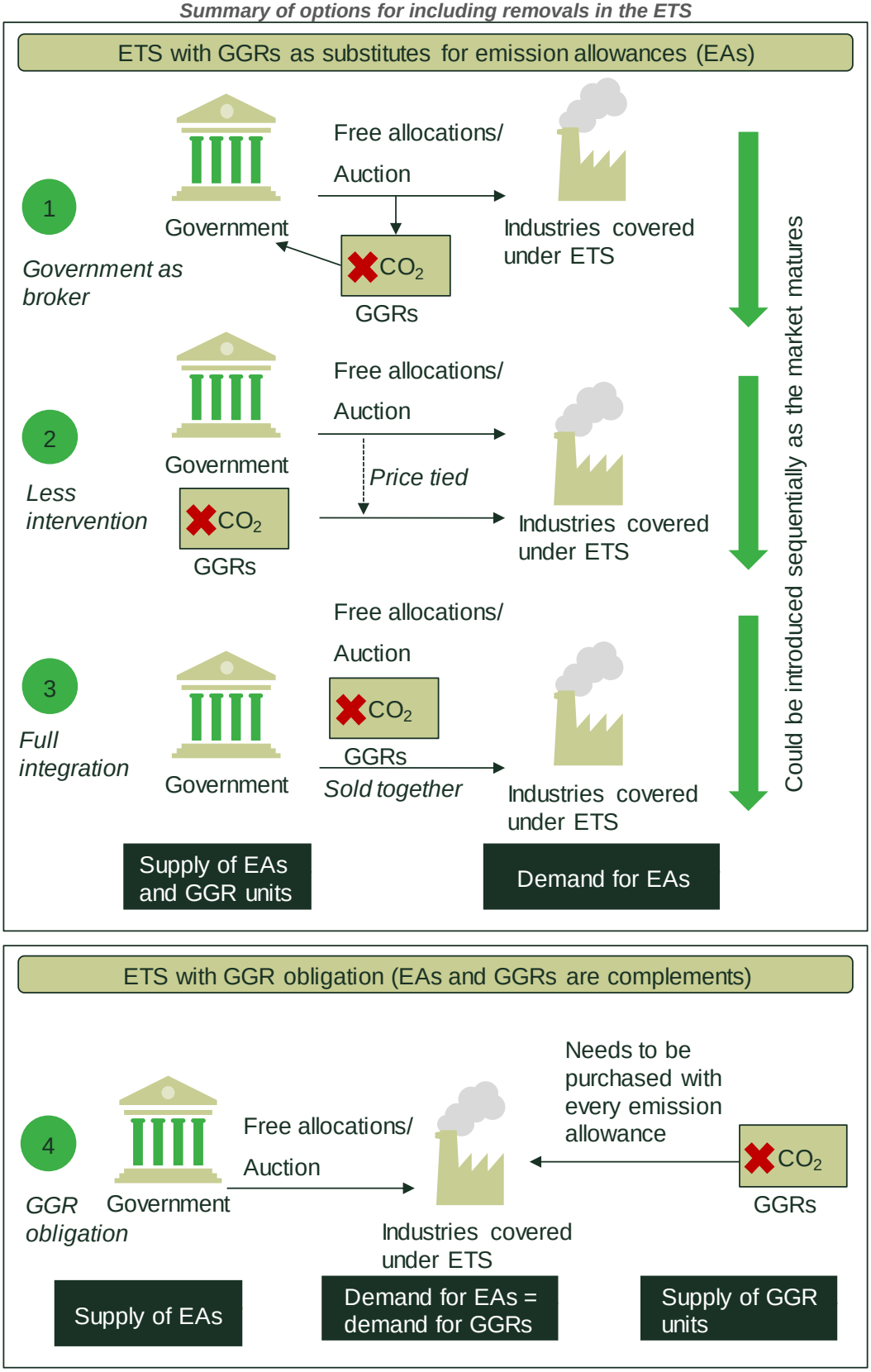
- establishing an MRV and discounting process;
- deciding how to ensure the uptake of GGRs in the ETS—by either adding more funding schemes to ensure competitiveness or mandating the use of removals.

The ETS is an area of ongoing policy debate and scrutiny. For example, as part of the Fit for 55 package, the European Parliament recently voted to make a number of changes to the EU ETS.[120] These include phasing out free allowances, extending the scheme to other industries, and strengthening the Carbon Border Adjustment Mechanism to tackle carbon leakage more effectively. These changes—which show that the ETS is continuously evolving—may also influence the direction of policy travel in the UK, to the extent that policymakers attempt to maintain compatibility between the two schemes.

Including carbon removals in the ETS could be a further change, the possibility of which has been signalled in the UK's net-zero strategy.[121] This article has discussed feasible market design options to achieve this.[122] Finding routes to market for carbon removals—for instance via the ETS—is vital given the importance of these technologies in meeting the Paris Agreement in the coming decades.

[119] The option is based on Bednar, J., Obersteiner, M., Baklanov, A., Thomson, M., Wagner, F., Geden, O., Allen, M., and Hall, J. W. (2021), 'Operationalizing the net-negative carbon economy', *Nature,* March, 596, 377–383, https://www.nature.com/articles/s41586-021-03723-9.pdf.
[120] European Parliament Committee on Environment, Food Safety and Public Health (2022, May), *Result of Roll-Call Votes of 16 and 17 May 2022*, https://www.europarl.europa.eu/cmsdata/248646/2022-05%2016-17%20roll-call%20votes.pdf.
[121] Department for Business, Energy & Industrial Strategy (2021, October), *Net Zero Strategy: Build Back Greener*, 184, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1033990/net-zero-strategy-beis.pdf.
[122] A BEIS consultation on the issue is forthcoming.

Summary of options for including removals in the ETS



Source: Oxera.

TO RENT OR TO BUY? HOW THE BIG REAL ESTATE QUESTION BECAME RELEVANT IN THE CARBON REMOVALS MARKET

Hasan Muslemani

Carbon emissions need to be both avoided and removed. This much was made clear by the International Panel on Climate Change (IPCC) in its 2021 special report *Global Warming of 1.5 Degrees Celsius*. Despite this assertion, the voluntary carbon market (VCM)—one of the main drivers of carbon avoidance and removal undertakings—remains historically dominated by avoidance credits: around 81 per cent of issued credits today are avoidance-based, while only around a fifth are removal credits.[123]

More recently, however, a trend of investments and research interest in carbon dioxide removal (CDR) methods has emerged. This is best highlighted by the establishment of an increasing number of carbon-removing businesses and start-ups.[124] These developments are now complemented with large-scale, CDR-focused international initiatives such as Frontier, a collaboration between five digital tech giants (Stripe, Alphabet, Meta, McKinsey & Co., and Shopify) that commits $925 million towards future investments in CDR developments.[125]

The rise in CDR interest, especially engineered solutions, has happened for a number of reasons.[126] First, CDR methods—whether engineered or nature-based solutions (NBS)—have the potential to instantly pull CO_2 out of the atmosphere, eliminating the greenhouse gas's warming effects which would have occurred otherwise. Put differently, these methods reduce the overall *stock* of CO_2 in the system, as opposed to avoidance projects which limit the *flow* of CO_2 into the atmosphere (and hence maintain current atmospheric CO_2 levels). Second, CDR methods have an element of permanence or durability, which is the subject of this article. Third, some engineered CDR methods such as direct air capture (DAC) technology have the potential for high scalability. For perspective, to capture 1 billion tonnes of CO_2 using DAC, only around 400 km^2 of land may be needed, while capturing the same amount through forestation would require an area of land more than 2,000 times larger, at 862,000 km^2.[127] As such, CDR solutions can rapidly expand the potential for removals.

Cheaper is not always better

Regardless of the choice of credits, the effectiveness of the VCM in its current form has been questioned by many—and perhaps rightly so. Until recently, the VCM had lacked the tools and infrastructure to scale to a fully functioning market. For instance, from a buyer's perspective, whether it is a corporation or an individual, the cost of a carbon credit—reported in dollars per tonnes of CO_2 equivalent ($/t$CO_2$e)—has been one of the key determining factors against which these carbon credits are compared: cheaper credits are expected to be more desired as they help meet climate targets in cost-efficient ways. However, the cost metric on its own does not capture the quality (or even type) of credits, for not all credits in the VCM are created equal.

More critically, the price level of carbon credits in the VCM has remained significantly lower (e.g. <$10/t$CO_2$e) than that required to incentivize meaningful change and effectively achieve the climate goals, a level reported to be in the range of $40–80/t$CO_2$e by Stiglitz and Stern's *Report of the High-Level Committee on Carbon Prices*.[128] What's more, there is a clear lack of correlation between the quality of carbon credits (whether avoidance- or removal-based) that are available in the market and their price, which suggests that the market may be used as a vessel for greenwashing.[129] This mismatch has been driven by the fact that it is inherently difficult to measure carbon quality, and has often led buyers to rely on other non-carbon-related factors such as Sustainable Development Goals (SDGs) to gauge the value of a carbon credit, which, while important, are admittedly not what a credit was intended for (i.e. avoiding or removing CO_2e).

[123] Climate Focus (2022), *Voluntary Carbon Market Dashboard*, https://www.climatefocus.com/initiatives/voluntary-carbon-market-dashboard
[124] A number of existing and emerging carbon removal businesses can be found on www.airminers.org.
[125] Frontier, *An Advance Market Commitment to Accelerate Carbon Removal*, https://frontierclimate.com/.
[126] Wilcox, M. (2021), '*7 things to know about carbon removal markets'*, https://www.greenbiz.com/article/7-things-know-about-carbon-removal-markets
[127] World Resources Institute (2022), *6 Things to Know about Direct Air Capture,* https://www.wri.org/insights/direct-air-capture-resource-considerations-and-costs-carbon-removal
[128] Stiglitz, J., and Stern, N. (2017), *Report of the High-Level Committee on Carbon Prices*, World Bank Group.
[129] Shankleman, J., and Rathi, A. (2021), 'Wall Street's favourite climate solution is mired in disagreements', *Bloomberg News*, https://financialpost.com/pmn/business-pmn/the-100-billion-market-for-carbon-offsets-is-struggling-to-be-born

In addressing this gap, new agencies such as BeZero Carbon have developed credit ratings frameworks against which the quality of a carbon credit can be assessed.[130] One of the main risk factors assessed within these frameworks is additionality: whether carbon removal or avoidance would have occurred without support from carbon finance. Another, which is relevant to CDR methods, is permanence. This article sheds light on the significance of the latter for the quality, and in an ideal world the cost, of removal credits.

Carbon gone 3D

Traditionally, entities interested in the VCM are likely to view carbon credits and their associated projects in two different dimensions:

1. The ***monetary*** dimension involves the prices of various types of credits in the market, along with the potential of the underlying project or solution to achieve cost reductions over time. The latter is mostly relevant to engineered removal solutions which are in nascent stages of development or to renewables with potential for cost reductions in least developed countries.
2. The ***physical*** dimension speaks to the capacity of the solution to mitigate emissions, measured either in absolute terms (i.e. total tonnage of CO_2e per project), as emission reductions as a function of time (tCO_2e per annum over a certain period of time), or by assessing the solution's potential to scale up.

Solely looking at these factors, avoidance solutions would be implicitly favoured over removals as, firstly, options to avoid emissions are much more diverse and are generally at more mature stages (e.g. renewables). Secondly, there are not as many limits to scaling up some avoidance projects (e.g. enhancing energy efficiency, avoiding deforestation, and electrification of transport) as there are for removals, which may be limited by land availability or storage sites. Thirdly, avoidance credits boast significantly cheaper prices, ranging from the order of \$1–20/tCO_2e, up to \$4–75/tCO_2e for NBS removals and \$200–1,000/tCO_2e for engineered removals.[131]

Yet, the introduction of CDR methods into the VCM brings about a new dimension: the ***temporal***. CDR solutions, whether engineered or not, have the capacity to lock CO_2 out of the atmosphere for specific periods of time—up to decades or millennia—which renders them fundamentally different from avoidance projects.

More critically, CDR options differ amongst themselves, with different solutions having different permanence (i.e. durability) levels. Failing to clearly and adequately distinguish between their durability risks creating similar quality–cost discrepancy, market distortion, and even investor distrust as those seen in the current version of the VCM. In fact, the temporal relevance of CDR developments involves not only the *durability* of carbon removal but also its *timing or immediacy*.

The latter point is key. Engineered CDR solutions normally have higher permanence levels than most NBS options such as forestry or soil carbon projects. Yet, from a cost perspective, their associated credits would be at a disadvantage, as they are consistently the most expensive on the market. Moreover, these credits remain in very short supply while their associated technologies are yet to be commercially rolled out. This makes the case for relying in the short term on cheaper NBS and avoidance credits not only appealing but necessary, for there is higher value in removing or avoiding emissions today than in a few years' time.

Carbon removal as an asset

Carbon credits are assets companies sell which are often core to their business model. Buyers benefit from the value that accrues from the purchase of those credits. (For the purpose of this article, this value is limited to mitigating the buyer's own emissions, but it can also involve enhancing the public image or the financial value of the business, amongst other benefits.)

More importantly, this value benefits not only the credit's buyer but also the wider public, as removing or avoiding emissions will yield benefits on a global scale. For removal credits, this value is reflected by how long these emissions are mitigated. As such, the ownership of the asset itself becomes less relevant, while the longevity of its accrued benefit becomes more important. Specifically, as the value from undertaking CDR practices should be relevant on climatic time scales, removal credits should

[130] BeZero Carbon (2022), A *Brief Guide to BeZero Carbon Ratings*, https://bezerocarbon.com/insights/a-brief-guide-to-bezero-carbon-ratings/
[131] Price estimates are based on data sourced from the online platforms carboncredits.com and ecosystemmarketplace.com, complemented by data sources from carbon offset marketplaces including Patch.io and Persefoni.com.

therefore guarantee 'permanent' benefits, or at least for durations equivalent to the atmospheric residence times over which greenhouse gases exert global warming effects.

From this perspective, purchasing removal credits which only offer a temporary storage option becomes more akin to renting an asset than buying it, where the benefit accrued (climate mitigation in this case) may not be long-lived as it may be subject to reversal if continuation beyond the commitment period is not guaranteed or long-term liabilities are not properly allocated. Hence, ideally, the cost of different CDR solutions should be correlated with the longevity of that value.

Current removal credit prices in the market do show that there is a positive, yet not so clear-cut, correlation between cost and permanence. Forestry-based credits sit at one end of the spectrum (temporary storage of <50 years at \$1–20/tCO_2e) and DAC-based ones sit on the other (storage of >10,000 years at \$600–1,000/tCO_2e).[132] The question then becomes: if 'permanence' were to be defined at a certain level of storage duration (say 100 or 1,000 years), should temporary storage options be considered effective in the climate debate? How could this be achieved? And which options are most economical in the long run?

To address these, a few approaches which deal with the benefits of temporary carbon storage have recently been put forward and are briefly discussed here.

Adjusting for time

'Tonne-year accounting' has been suggested as an approach to directly quantify the benefits of temporary carbon storage, to allow for a comparison of different storage solutions based on their durability. The method makes an explicit assumption that storing a larger quantity of CO_2 for a short period of time can be equated to storing a smaller quantity of CO_2 for a longer period of time. For example, producing wooden building elements which can hold 10 tCO_2e for 50 years (10 × 50 = 500 tonne-years) would be equivalent to removing 1 tCO_2e from the atmosphere for 500 years (for instance through biochar production).

While different schools of thought exist as to how to best apply tonne-year accounting and what its results mean in practice,[133] a few questions remain unresolved regarding it as a concept. Firstly, tonne-year accounting does not always accurately account for the dynamic impacts that carbon entering the atmosphere has on the global carbon cycle, specifically the capacity of land and oceans to act as buffers/sinks. Estimating these impacts involves complex climate modelling techniques which can themselves be subject to debate, as they seek to capture changes occurring over long time scales of centuries to millennia.[134]

Secondly, the concept measures climate impacts over a predetermined time horizon, the choice of which remains largely a policy decision rather than a scientific one. Thirdly, as noted in Carbon Market Watch's response to Verra's proposed adoption of tonne-year accounting,[135] the concept does not account for the timing of impacts, where the benefits of storing large amounts of CO_2 for a short time would not outweigh the climate impacts that they would cause once they are re-released into the atmosphere. For a comprehensive review of the issues pertaining to tonne-year accounting, the reader is referred to a recent article published by CarbonPlan.[136]

There clearly are many benefits to investing in temporary removal solutions in the short term—not least of which is the limited supply of engineered, permanent removal credits in the market today. Yet the question is whether they can be relied upon for credible, long-term carbon offsetting. To answer this, two methods have been prescribed in the scientific literature: vertical stacking and horizontal stacking.

Vertical stacking entails buying multiple short-term credits today to permanently offset a single tonne of emitted CO_2. For example, if 1,000 years were considered 'permanent', a company might purchase twenty 50-year credits (20 × 50 = 1,000) to offset 1 tCO_2e for that specific duration. The fundamental issue with this method is, as noted earlier, the fact that near-term benefits which occur during the first 50 years do not necessarily outweigh the long-term climate impacts once/if storage is

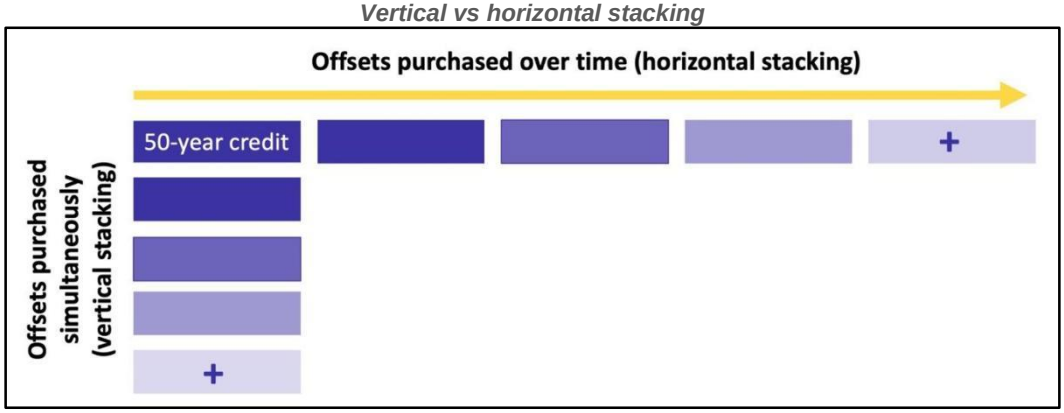
[132] See Oxfam's 2020 report *Removing Carbon Now* for a range of permanence estimates of different CDR methods.
[133] For an explanation of the different methodologies, see Fearnside, P. M., Lashof, D. A., and Moura-Costa, P. (2000), 'Accounting for time in mitigating global warming through land-use change and forestry', *Mitigation and Adaptation Strategies for Global Change 5*(3), 239–270.
[134] Pierrehumbert, R. T. (2014), 'Short-lived climate pollution', *Annual Review of Earth and Planetary Sciences*, *42*, 341–379.
[135] Carbon Market Watch (2022), *CMW Response to Verra's Proposed 'Tonne-Year' Accounting Method*, https://carbonmarketwatch.org/wp-content/uploads/2022/04/CMW-response-tonne-year-accounting.pdf
[136] CarbonPlan (2022), *Unpacking Ton-Year Accounting*, https://carbonplan.org/research/ton-year-explainer

reversed (i.e. between years 50 and 1,000). Perhaps more worrying is the fact that the practice merely delays carbon emissions rather than permanently mitigating them. This in turn raises questions regarding intergenerational equity, where future generations are burdened with recapturing the CO_2 again once it is re-released.

Economically speaking, and depending on the cost and storage duration of the temporary removal method in question and the defined time horizon, purchasing a permanent credit up front may be cheaper than buying multiple short-term credits (assuming enough high-quality, short-term credits are in supply). Here, assume a simple scenario where short-term credits are purchased at a cost of \$25/tCO_2e today, with a duration of 50 years and a permanence time horizon of 1,000 years, meaning that a company would need to purchase 20 credits at a cost of \$500/tCO_2e using a vertical stacking approach, a cost which is higher than most permanent storage solutions available in the market today (with the exception of DAC credits).

In contrast to this approach, **horizontal stacking** is a method whereby credits are sequentially and continuously bought as they expire over time (at the end of each cycle), until the specified time horizon for permanence is met.[137] This approach assumes that the buyer will be liable for multiple offset purchases in the future, something which cannot be guaranteed for certain, as the removal time horizon may be longer than the span of a human lifetime or even a company's, not to mention the fact that appropriate monitoring techniques may not be in place or that policies are prone to change. While this may be dealt with by assuming a risk factor that reflects the likelihood of projects not materializing in the future, the method also necessitates making simplistic assumptions regarding cost reductions that will occur for certain removal solutions, especially the most novel and promising ones (e.g. DAC).[138]

Vertical vs horizontal stacking



The bottom line

The lack of consensus on how to integrate temporary CDR methods into long-term climate strategies leaves much to be contemplated. It is clear that, where possible, permanent removal solutions should be first pursued to effectively lock in certain, long-term benefits. This is especially needed as relying on multiple purchases of temporary removals—however they are stacked—brings about several uncertainties and remains a practice more similar to offsets rental than purchase. That said, a combination of both removal types will be needed—at least in the short term—along with precautionary measures such as having effective buffer reserves in place to account for potential reversals. This will help bridge the gap in availability of high-quality, permanent removal credits in the market and allow them time to become reasonably cost-competitive. Admittedly, while cost may be the most important factor in making a rent-or-buy decision, in the long run, buying usually tends to be more economical, yet it remains an option restricted to those who can afford it.

[137] Herzog, H., K. Caldeira, and J. Reilly (2003), 'An issue of permanence: assessing the effectiveness of temporary carbon storage', *Climatic Change*, *59,* 293-310.
[138] Goldman Sachs (2020), *Carbonomics Innovation, Deflation and Affordable De-carbonization*, https://www.goldmansachs.com/insights/pages/gs-research/carbonomics-innovation-deflation-and-affordable-de-carbonization/report.pdf

THE ROLE OF DERIVATIVES IN CARBON MARKETS

Olga Roman, CFA

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.

This article 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 how market participants use carbon derivatives to meet their compliance obligations, achieve corporate social responsibility goals, and manage risks.

Reducing emissions and adapting to climate change will require significant public and private investments. 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 channelled towards sustainable investments and net-zero-emissions activities.

Derivatives play a critical 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 the 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.

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.

Policymakers 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.

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 firms that are carbon intensive.

Key players in carbon markets

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.

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 Emissions Trading System (ETS) auctions. Similarly, investment firms and credit institutions are eligible to bid in UK ETS auctions.

Non-compliance entities in compliance markets (e.g. brokers) can act as intermediaries between regulated entities seeking to trade allowances. They can also provide liquidity to regulated entities (e.g. 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 trades to offset other financial exposures.

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 (e.g. 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.

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.

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.

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.

Exchange-traded carbon derivatives

Commonly traded types of carbon derivatives include futures and options, 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 contract, which does require the exchange to happen on the expiration date.

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

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

The Intercontinental Exchange global carbon futures index is made up of pricing from the three most actively traded carbon markets in the world, the EU ETS, the California Cap and Trade Program, and RGGI. The secondary futures market for those programs makes up the majority of volume in carbon-based futures contracts.

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.

Nodal Exchange, which is part of EEX Group, offers physically delivered futures and options for CCAs, RGGI carbon allowances, and sulphur dioxide/nitrogen oxide emission allowances, among other environmental products.

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 fulfil collateral requirements.

CME Group offers RGGI CO_2 allowance futures and options, in-delivery month EUA futures and options, California Low-Carbon Fuel Standard futures, and CCA vintage-specific futures.

Additionally, CME 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. GEO futures are based on CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation) eligible voluntary carbon offset credits from three registries, Verified Carbon Standard, American Carbon Registry, and Climate Action Reserve.

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 the 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 tonne/€10.00 per contract), contract months, and expiration date (last Monday of the contract month). Most of these contracts have short-term maturities.

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.

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 of time. Offset-allowance swaps allow companies that have not yet reached their quota of allowed offsets to sell their allowances and buy offsets and take 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.

OTC carbon derivatives can be customized based on the 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 that vary significantly. In addition to the price of emission allowances, their hedging needs would depend on fuel (input) and energy (output) prices. Hence, OTC emissions derivatives, with terms and notional amounts that are tailored based on actual emissions levels and duration needs, can better match the power plants' actual activity levels than exchange-traded derivatives.

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 pre-defined 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 is a way to eliminate market price risks 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 market 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.

Development of liquid carbon trading markets is crucial in the transition to a more sustainable economy. Exchange-traded contracts and OTC derivatives are both necessary to ensure mature, fully functioning carbon markets.

THE CARBON FUTURE MARKETS: PRICING CARBON EXPECTATIONS

Owain Johnson

There is a sizeable distance between the wildlife-rich grasslands of rural Kenya and the financial markets of Chicago and London, but over the past year the launch of voluntary carbon futures has brought the two worlds together.

The Rukinga Wildlife Sanctuary in Kenya is home to over 50 species of large mammals and includes the main migration corridor between the Tsavo East and Tsavo West national parks. The sanctuary was developed on the site of a former cattle ranch, which was gradually reforested by environmental project developer Wildlife Works. The project has proved a significant success. Reforestation efforts have captured carbon and prevented habitat loss, while new jobs have been created for local residents, thereby reducing the poaching and illicit logging that had led to declines in biodiversity.

The valuable development work undertaken at Rukinga was financed by the sale of carbon credits, which were issued by one of the world's leading carbon registries, Verra, under the terms of its Verified Carbon Standard. These credits can be sold to third parties, and in December 2021 some of the certificates generated by the Kasigau Corridor project, the second phase of development of the Rukinga Wildlife Sanctuary, were delivered as part of the expiry process for CME Group's physically delivered voluntary carbon futures.

This delivery—part of a record delivery that month of 5,916,000 offsets—confirms that voluntary carbon futures have emerged as a key mechanism that can successfully bring buyers of carbon credits together with developers of exciting projects like Rukinga.

Managing risk

Given the greater focus on environmental issues around the world, more and more firms and organizations have pledged to offset their carbon emissions. Firms are looking to reduce their own emissions profile, and pending the implementation of

reduction programmes, they are also turning to the voluntary carbon market to support projects like Rukinga that reduce carbon in the atmosphere.

Energy companies, airlines, and producers of consumer goods are among the most active buyers of carbon credits from these projects. Non-commercial entities with a strong environmental mandate, such as some cities and universities, are also present in the voluntary carbon market.

The growth in interest in offsetting carbon emissions, which are generally viewed as a complement to government-led efforts to mitigate carbon emissions, was a particularly key topic at the 2021 COP talks in Glasgow. This greater global focus on the sector has led to strong growth in the market for carbon credits, which are either bought and sold bilaterally or else traded on spot platforms such as CBL.

CBL reported in January 2022 that transactions in carbon offsets exceeded 121.5 million metric tonnes of carbon dioxide equivalent in 2021, up 288 per cent from 2020. CBL also noted that its voluntary certificate market attracted more than 150 different firms in 2021, including corporate sustainability managers, project developers, trading firms, banks, and brokers, representing a year-on-year increase in customer numbers of 131 per cent.

Amid such strong growth in the over-the-counter market for offsets, the next natural phase of market development was the emergence of a futures market for voluntary carbon.

There is a well-worn path for market development in the commodities sector. The initial market structure is typically a long-term sales agreement between a buyer and a seller. This is often followed by a trend towards shorter-term ‘spot’ sales, sometimes linked to a published floating price, which then often leads in time to the development of more sophisticated risk management tools such as futures and options. The voluntary carbon market has been closely following this very standard model of market development. The key difference is that the structures that took decades and even centuries to develop in the traditional commodity markets are developing in voluntary carbon at a significantly faster pace, with major changes and new mechanisms emerging almost on a monthly basis.

Future certainty

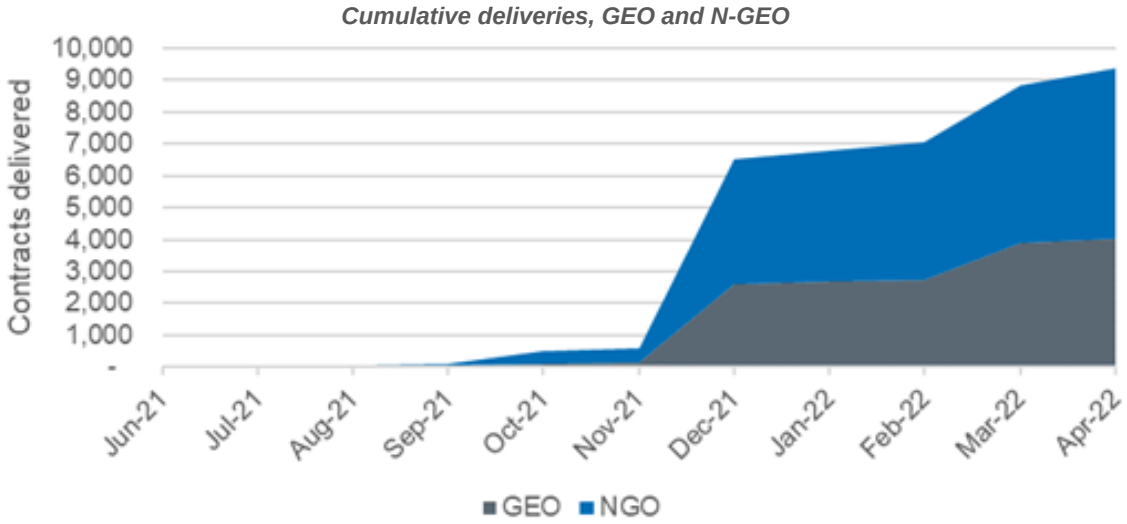
CME Group launched the first futures markets for voluntary carbon in early 2021. Higher prices and greater volatility during 2021 encouraged some participants to consider hedging their exposure to voluntary carbon, while others moved to lock in forward prices in order to ensure that they would receive certificates on a future date at a previously fixed price.

An active futures market allows project developers and offset buyers to hedge against the risk of price fluctuations for certificates, as well as to sell and procure certificates ahead of time for delivery in the next few years. This ability to hedge and to forward procure is particularly important for traders that want to sell term supplies of what have been described as zero-carbon commodities—for example, an LNG deal where all or part of the emissions profile of the gas contained has been offset by the purchase of voluntary certificates.

Sellers of such ‘carbon-neutral’ commodities need to hedge the carbon component of the deal, just as much as they need to hedge the commodity element. They make use of the voluntary carbon futures in much the same way as they use such well-established markets as West Texas Intermediate (WTI) crude oil and Henry Hub natural gas.

The first futures products to launch were the CBL Global Emissions Offsets (GEO) and CBL Nature-Based Global Emissions Offsets (N-GEO). In 2022, the exchange added a third product, the CBL Core Global Emissions Offsets (C-GEO), which was designed to reflect the general principles established by the Taskforce on Scaling Voluntary Carbon Markets.

Although most project developers don’t actively participate directly in the futures market, an active futures market ensures improved price transparency for all participants. Buyers and sellers know the current market prices of comparable projects and can price certificates accordingly.



This was a very significant development in a market where price transparency has been a challenge in the past, leading to accusations that project developers were left short-changed by intermediaries. For the first time, CME Group's publication of its daily settlement prices provided the market with a transparent forward curve. Previously, market participants were able to track the historical evolution of the spot price of voluntary carbon, but there was no market for the transfer of credits at future dates.

The transparent publication of a forward curve has proved to be a critical step forward for market development in that it provides an objective valuation of expectations of the current price for delivery of offsets in the months and years to come. This allows potential project developers to get a sense of how profitable it might be to develop new projects and also makes it easier for them to approach lenders for financing, as they can now show them a credible indication of likely future income and even potentially lock in part of their future profit at a level that will allow them to repay their borrowings.

In the case of both GEO and N-GEO, prices on that forward curve have been firmly in a contango structure from launch onwards. In a contango, prices for nearby contracts are cheaper than contracts further out along the curve, with the furthest dated contracts being the most expensive. This appears to reflect the market's belief that prices for carbon are only likely to increase in the future as greater emphasis is put upon environmental issues. This contango market structure has remained consistent, despite the fluctuating nature of outright prices.

Market share

Since the launch of voluntary carbon futures, around one year ago, the size of the derivatives market has grown steadily. The initial first wave of enthusiasm for derivatives clearly came from Europe, where there is arguably the greatest societal pressure on firms and where customers already had experience trading futures based upon the European Union's Emissions Trading Scheme. But it is interesting to note the recent growth of participation from the US, where the election of President Joe Biden has brought a greater focus on environmental issues, leading more and more US companies to commit to 'net zero' policies.

The increase in market participants and volumes is creating more liquidity and pricing transparency. May 2022 saw a sequence of records set for open interest in voluntary carbon futures, while Krane Funds Advisors announced the launch of the first-ever exchange-traded fund (ETF) linked to voluntary carbon futures (GEO and N-GEO). It is almost unheard of for a new futures market to develop so quickly that it attracts sufficient interest to underpin an ETF. Other ETFs and investment funds are also showing strong interest in voluntary carbon futures, given the rapid development of futures volumes and the strong public interest in environmental markets.

Nature dominates

The majority of trading activity—around 70 per cent to date—in voluntary carbon futures has been in the nature-based N-GEO product, which has become a benchmark cited in over-the-counter and financing deals.

While all three voluntary carbon futures products settle physically and work in a similar manner, they have different underlying specifications for eligible project types. GEO, for example, is based on carbon offset credits accredited by three registries—

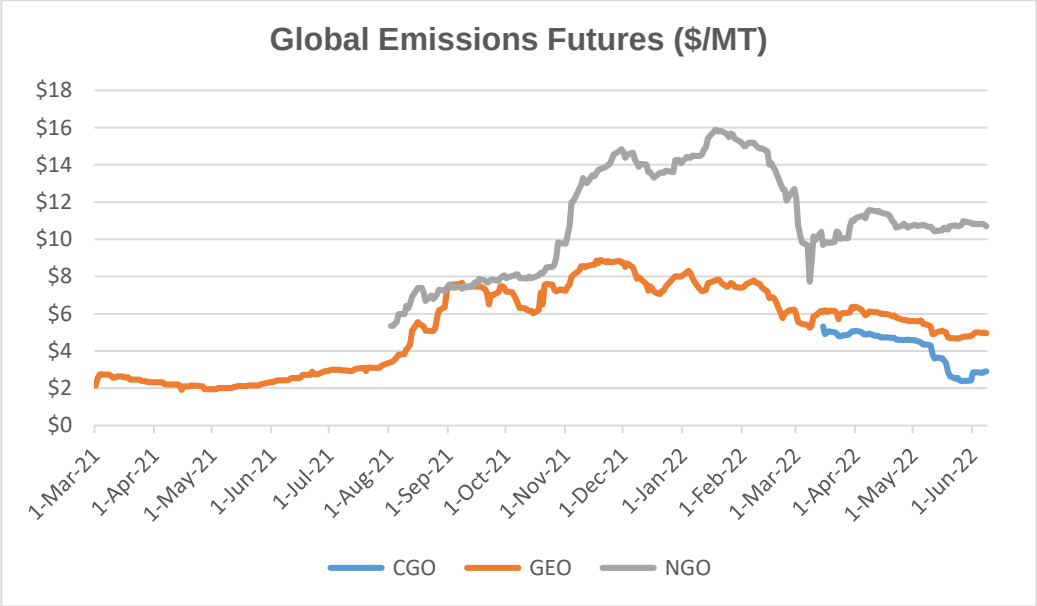
Verra, American Carbon Registry and Climate Action Reserve—while N-GEO focuses on eligible voluntary offsets from agriculture, forestry, and other land uses accredited by Verra only. The C-GEO is also solely based on Verra, but reflects certificates expected to meet the Core Carbon Principles of the Taskforce on Scaling Voluntary Carbon Markets.

The popularity of N-GEO relative to other offerings is likely the result of three factors:

1. Nature-based solutions are particularly appealing to corporate end-users of carbon credits.
2. N-GEO, which relies on a single registry, is simpler, at least compared with GEO, which requires customers to sign up for three different registries.
3. N-GEO takes a rolling approach to vintages, with new ones added as old ones roll off—unlike GEO, where, pending an update to CORSIA (the Carbon Offsetting and Reduction Scheme for International Aviation), only certificates from the 2016–2020 vintages are allowed to be delivered.

N-GEO also typically trades at a premium to GEO and C-GEO, although the price relationship between the different products has evolved with time and has proved to be far from stable.

GEO, N-GEO, and C-GEO prompt settles



When N-GEO futures first launched in August 2021, the front month was trading at around a $2 premium to GEO, but in September 2021 this premium collapsed and there were days when the spread was reversed to the point that GEO was trading at a premium to N-GEO. N-GEO returned to trading at a small premium to GEO in October, and the focus on carbon offsets, and particularly nature-based solutions, at COP26 sent the premium of N-GEO over GEO quickly surging to levels of $5–6 in November 2021, before the spread reached a high of $7–8 in early 2022.

The absolute levels of N-GEO's premium to GEO fell along with the sharp falls seen in the spot and futures prices of voluntary carbon in the wake of the Russian invasion of Ukraine in March 2022, before stabilizing at around the $5–6 mark in April and early May. Price indications from the forward curve suggest that nature-based solutions will continue to trade at a premium to the general emissions product.

Conclusion

The proliferation of futures products—three launches at CME Group within a year and other products launched and announced elsewhere—in a relatively small market reflects the strong interest in the voluntary carbon market, but also the complexity of the underlying market for physical certificates.

Different firms are looking for different types of certificates to meet their corporate mandates, and they therefore have different

risk management needs. One of the challenges for the further development of voluntary carbon futures will be that liquidity is ultimately likely to focus on one or, at the most, two futures products, which will then become de facto benchmarks for the sector, in the same way that WTI and Brent have become established for crude oil.

At present, the nature-based N-GEO is the frontrunner in terms of traded volumes, open interest, and participant numbers. Delivery volumes are strong, tying the futures firmly into the physical market for certificates, which are generated by exciting projects such as Rukinga.

Trading activity on deferred delivery months such as the December 2024 contract could indicate that participants are actively using the tool for forward hedging purposes. The rolling vintage structure makes sure that the price of the futures always reflects relatively recent vintages, which corporate buyers tend to prefer.

The ability of exchanges to bring together buyers and sellers from different worlds and different backgrounds as well as their ability to provide a transparent and public forward curve will be crucial in ensuring that sufficient financing flows to innovative new projects, while the risk management opportunities provided by futures means that buyers and sellers should be able to focus on projects rather than on day-to-day price fluctuations.

JUSTICE IN THE DEVELOPMENT OF CARBON MARKETS

Raphael J. Heffron

Carbon markets are a clear solution to the climate emergency faced by society today. There is already sufficient economic theory and data that show their benefits and demonstrate how they can solve the externality issue from carbon production. Part of the challenge in their adoption is acceptance by industry and a perception that they will result in higher costs of doing business. What is rarely reflected in the literature is how they can result in improved just outcomes for society.

Carbon markets can act as a cornerstone of new policy mechanisms that can restore justice to the energy sector and therefore contribute to the broader societal goal of a just transition to the low-carbon economy.

In this short article, the aim to is open the discussion in a conceptual way on how justice is achieved by the development of carbon markets. The discussion begins with why law in particular ignored the development of such markets and how this has resulted in the current situation whereby there is so much carbon dioxide pollution. Then some examples of early successes are discussed and how justice outcomes are improved in developing carbon markets. In the penultimate part of the paper, the advent of new technology and its impact on carbon markets is analysed in a broad way. The conclusion analyses the next steps in the advancement of carbon markets and key steps to ensuring just outcomes for society in their development.

Why were carbon markets ignored by justice scholars?

Carbon markets have not been a feature in the legal literature to date. Unfortunately, the legal community has too often focused on the development of energy resources rather than the clean-up (including decommissioning) or impacts of these resources.[139] Energy lawyers have discussed and debated contractual issues at length over revenue and/or profit-sharing around energy resources. Too few in the legal community have invested in exploring in-depth just outcomes such as in developing carbon markets.

Energy lawyers assess legal issues across the five stages of the energy life-cycle, i.e. from extraction to production to operation and supply to consumption to decommissioning and waste management. The fifth stage has been neglected, and it is only now that the legal community is beginning to address this major un-costed and untreated externality. Still, many lawyers (and economists too) fail to realize the interconnectedness of the five stages of the energy life-cycle. For example, if subsidies are offered at the extractive phase, then this will distort prices at the consumption phase. Similarly, if externalities are not costed for properly at the decommissioning and waste management stage, there is price distortion at the other phases. Perspectives on competitive markets in the energy sector ring hollow.

[139] Heffron, R. J. (2022), 'Energy law in crisis: an energy justice revolution is needed', *Journal of World Energy Law & Business*, advance access, 1–6, https://academic.oup.com/jwelb/advance-article-abstract/doi/10.1093/jwelb/jwac012/6581841?redirectedFrom=fulltext.

This price distortion has continued for decades in the energy sector, and this is what carbon markets can correct. Legal solutions driving carbon markets should be much more advanced, but in many cases there was a lack of envisioning the energy sector more holistically rather than in isolation (i.e. focusing on one stage only of the energy life-cycle). Indeed, many lawyers still refer to themselves as extractive lawyers, and even oil and gas lawyers. However, many more lawyers have changed their direction and renamed themselves as energy lawyers, acknowledging the errors of the past.

Carbon markets have been mistakenly shrouded in negativity

Carbon markets have been seen as a negative in society from an economic and business perspective. They are considered to increase the costs of doing business and therefore to impact negatively upon society. This is the mantra put forward by industry and various business practitioners for decades. However, recent examples show they can contribute to economic success; in particular, this can be seen in Canada and South Africa. These are early examples, but they challenge the viewpoints of traditional economists and those in the commercial sector who want to continue with a business-as-usual approach. Indeed, there are echoes of the tired, continuous, and outdated arguments against renewables because they were too expensive and too subsidized and needed to compete in the market system—while fossil fuels enjoyed enhanced subsidies across the energy life-cycle, so the markets were already unfair.

Carbon markets were pushed forward by the 2015 Paris Agreement—which is a remarkable UN legal agreement signed by nearly 200 countries; in contrast, not even 100 countries backed in essence an UN statement that Russian actions in the Ukraine are wrong.

Carbon pricing is addressed within the Paris Agreement in Articles 6.2 and 6.4.

Carbon pricing within the Paris Agreement

Article 6.2

Parties shall, where engaging on a voluntary basis in cooperative approaches that involve the use of internationally transferred mitigation outcomes towards nationally determined contributions, promote sustainable development and ensure environmental integrity and transparency, including in governance, and shall apply robust accounting to ensure, inter alia, the avoidance of double counting, consistent with guidance adopted by the Conference of the Parties serving as the meeting of the Parties to this Agreement.

Article 6.4

A mechanism to contribute to the mitigation of greenhouse gas emissions and support sustainable development is hereby established under the authority and guidance of the Conference of the Parties serving as the meeting of the Parties to this Agreement for use by Parties on a voluntary basis. It shall be supervised by a body designated by the Conference of the Parties serving as the meeting of the Parties to this Agreement, and shall aim:

a) To promote the mitigation of greenhouse gas emissions while fostering sustainable development;

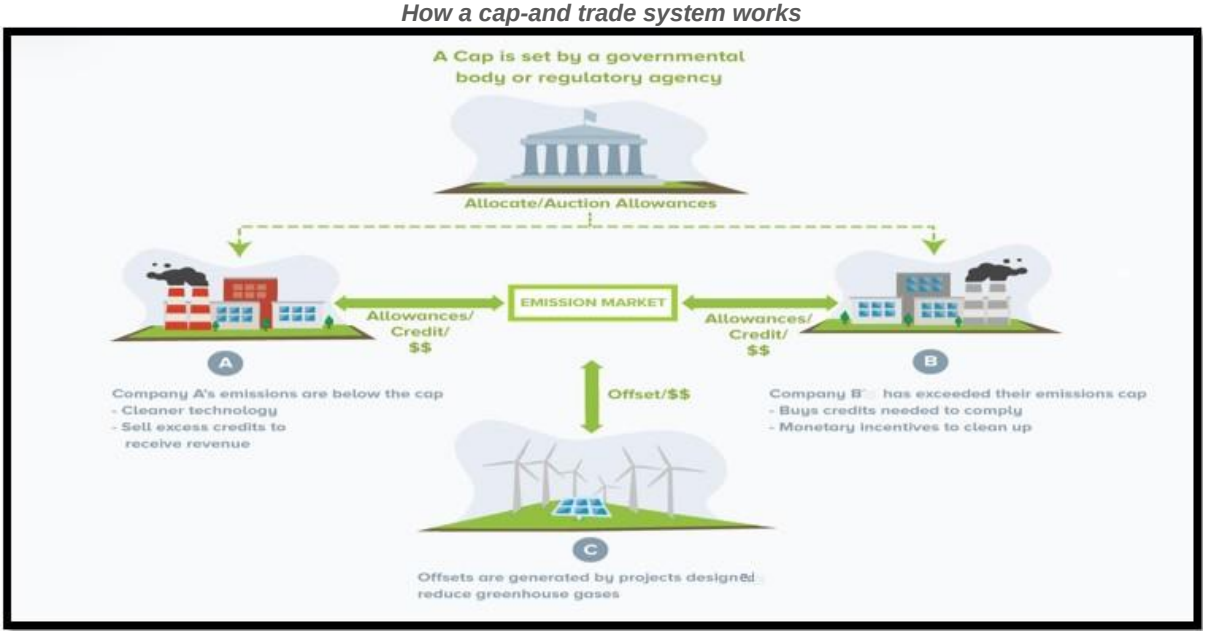
b) To incentivize and facilitate participation in the mitigation of greenhouse gas emissions by public and private entities authorized by a Party;

c) To contribute to the reduction of emission levels in the host Party, which will benefit from mitigation activities resulting in emission reductions that can also be used by another Party to fulfil its nationally determined contribution; and

d) To deliver an overall mitigation in global emissions.

In part, this has advanced the case for carbon markets, and a major success story has taken place in Canada. They have developed a cap-and-trade scheme which works as shown in the figure below.

How a cap-and trade system works



The advantage of such cap-and-trade schemes is that they are low-cost and efficient. This is vital considering the lack of funds directed at carbon reduction activities by many governments today and also because of a general lack of funds. The advantage of Canada's carbon market policy however—like that of South Africa's—is that the funds collected are redistributed to develop low-carbon infrastructure.

The legislation responsible for introducing this in Canada was called the Greenhouse Gas Pollution Pricing Act in 2018. This was challenged, of course, by various stakeholders in the energy and commercial sectors; however, these legal challenges were rejected. The Canadian Supreme Court held the considered view that national coordinated action was needed on carbon reduction, and carbon markets enabled that to happen. There was a reflection no doubt as a result of Canada having signed the 2015 Paris Agreement and therefore having commitments to keep.

A key reflection from what has happened in Canada is that polluters are being forced to pay or be innovative so that they can reduce their carbon. For decades polluters had in essence been avoiding being innovative in trying to reduce their carbon footprint, and this incentivization to be innovative should benefit these companies over time. Further, finally the externalities from the energy sector are being costed fully, and society is realizing in Canada that fossil fuel energy is not so cheap after all.

Indeed, Canada also confounds the critics who have long argued that carbon markets result in higher costs of doing business and therefore will impact upon economic growth. Studies on Canada are now widespread, and it is evident that the carbon tax policies in Canada have reduced emissions by up to 15 per cent while economic growth has been higher where they have been introduced than in those regions which did not introduce them (see research on the success of carbon pricing in British Colombia[140]).

Carbon markets should be encouraged and, given their low-cost introduction, should become more widespread. They can revitalize an economy by making industry be more innovative, improving efficiency, and redistributing capital (and finance) to cleaner and more sustainable solutions.

Carbon markets improve energy and climate justice outcomes

There are clear injustices occurring in the energy sector as a result of carbon emissions. For example, it is clear from World Health Organization data[141] that low-income populations suffer the most as a result of the ill effects of carbon emissions on their

[140] Canadian Government. 2022. How Carbon Pricing Works https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/putting-price-on-carbon-pollution.html

141 World Metrological Organisation. 2022. WMO Catalogue for Climate Data https://climatedata-catalogue.wmo.int/

health. Further, the renowned inequality economist Thomas Piketty has demonstrated with other scholars how a rise in carbon dioxide emissions will result in increased inequality in society[142]. Also it is documented that increased carbon emissions are leading to violations of human rights.[143] Hence, for these two reasons alone (and there are many more), it is vital to search for solutions to these injustices. The theory behind ensuring just outcomes provides a platform for demonstrating how carbon markets can deliver justice within society.

Energy and climate justice scholarship is belatedly arising and creating impact. For too long much engineering, economic, business, and legal scholarship did not examine how it contributed to addressing inequality in society or in effect solving the injustices. Now, however, there are five key forms of justice that carbon market policy should and can aim to achieve:[144]

- *Distributive justice*—this concerns the distribution of benefits from the energy sector and also the negatives—for example, are energy revenues shared sufficiently; carbon markets can have major positive distributive effects, as will be discussed briefly next.
- *Procedural justice*—the focus here is on legal process and questions around market structures and whether processes have been followed and there is access to justice, efficient and working systems, etc.
- *Restorative justice*—any injustice caused by the energy sector should be rectified—for example, impacts from the environmental effects of carbon dioxide emissions such as on health; it can enforce the polluter-pays principle.
- *Recognition justice*—this is concerned with the recognition of rights of different groups and in particular local and/or indigenous communities, or vulnerable energy groups.
- *Cosmopolitan justice*—in essence, this stems from the view that in energy we are all citizens of the same world and therefore the cross-border effects of energy activities need to be considered, such as the effects from cross-border carbon dioxide emissions.

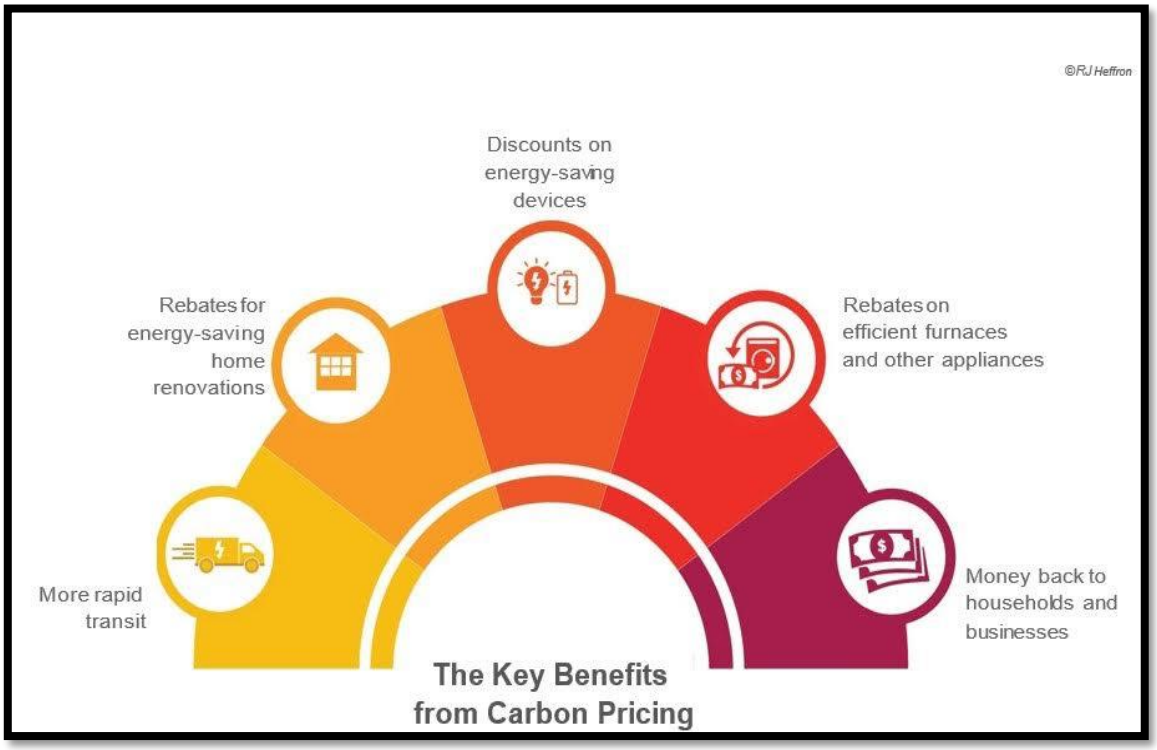
As stated earlier, one of the positives of a carbon market is that it can raise revenue and ensure there are finances there to redistribute. This is far more positive for society than leaving these finances with energy companies earning super-normal profits while causing major socioeconomic issues across society due to their carbon emissions and non-proactive policy action. It is only a matter of time before many company executives and board members will be declared negligent in their actions towards ensuring that shareholder values and interests are upheld in strategic decision-making for their companies. Examples of the redistributive benefits from the Canadian carbon market in Quebec are many. The figure below highlights these benefits for low-income households, and hence, carbon markets have in this instance both a distributive and recognition justice benefit.

Carbon markets can accelerate a just transition to a low-carbon economy

Carbon markets and their introduction will address major injustice in the energy sector. They can contribute to tackling the UN-stated climate emergency. Significantly, they contribute to five key forms of justice—distributive, procedural, recognition, restorative, and cosmopolitan—that can ensure society advances in its mission to have a low-carbon economy. There are only positive outcomes by introducing carbon markets, and further, they need to be viewed as revenue-raising policies that can ensure a fairer distribution of financial resources in today's modern economy.

[142] Chancel, L. and Piketty, T. 2015. Carbon and inequality: from Kyoto to Paris. Paris School of Economics (November 2015). https://efaidnbmnnnibpcajpcglclefindmkaj/http://piketty.pse.ens.fr/files/ChancelPiketty2015.pdf
[143] Heffron, R. J. (2021), The Challenge for Energy Justice: Correcting Human Rights Abuses, Springer: Heidelberg, Germany, https://www.waterstones.com/book/the-challenge-for-energy-justice/raphael-heffron/9783030800963; Heffron, R. J. (2021), 'Energy multinationals challenged by the growth of human rights', Nature Energy 6, 849–851, https://doi.org/10.1038/s41560-021-00906-6.
[144] Heffron, R. J., and McCauley, D. (2017), 'The concept of energy justice across the disciplines', Energy Policy 105, 658–667. https://www.sciencedirect.com/science/article/abs/pii/S0301421517301593

Benefits to the public of carbon pricing



A key message needs to be realized that society is evolving. This evolutionary process should not be feared but should be welcomed. Carbon markets can be utilized to manage carbon emitting sources and infrastructure out of existence. New technology can be encouraged too from aiming to reduce carbon and also from the revenue raised. Similar to other sectors of the economy, technology or products evolve and society replaces them. Carbon markets can ensure that old conventional energy sources are replaced, and provide a fresh impetus to driving forward the much-needed clean energy technology in a fair, transparent, equitable, and inclusive approach.

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The views expressed here are those of the authors. They do not necessarily represent the views of the Oxford Institute for Energy Studies or any of its Members nor the position of the present or previous employer, or funding body, of any of the authors.

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