FMSB
FINANCIAL MARKETS STANDARDS BOARD

Voluntary Carbon Markets: An Overview

Spotlight Review

Contents

Foreword

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How do you begin to understand the Voluntary Carbon Markets? Barely 20 years old, these markets have rapidly expanded in the last few years, with new participants abounding and the number of papers and primers published about them suggesting a hunger from the financial sector to understand how they will function, succeed or fail, and why.

When a member of the Secretariat joined FMSB in March 2022, with experience in creating new products in wholesale markets, I invited her and the team to write a primer that explained the Voluntary Carbon Markets in the context of our focus on the wholesale financial markets, and our Members, who are market practitioners drawn from the sell-side, buy-side and corporations as well as data providers, trading venues, exchanges and other platforms.

This document started life for internal use to brief our Secretariat. However, as the document developed, and more conversations with market experts took place, it was obvious that the wider financial sector could benefit from this commentary – whether the reader is a new analyst at an investment firm or a seasoned carbon trader forming a view on the development of the market as a whole.

Education is at the paper's heart, and it invites readers to ask questions about the present and think about 'design' for the future as they read; both of which are important steps to creating effective and efficient wholesale financial markets.

What our team have created, with the input of experts from FMSB Member firms and beyond – spanning diverse backgrounds, geographies and functions – is a paper that anyone can use to inform themselves impartially. We both go back to basics and take deeper dives into the background underpinning carbon capture, accounting, and more.

Peppered throughout the document are short case studies. One moment you are able to see how the Voluntary Carbon Markets might evolve based on other mature asset classes, and the next you're looking at a case study from the Congo on peatland, a reminder of what these market-led approaches ultimately seek to achieve. Finally, we ask design questions for market participants to consider, as they shape this nascent market during its growth.

FMSB has a simple remit to improve the transparency, fairness and effectiveness of global wholesale markets.

We never lobby and seek to:

- collaborate across all market interests;
- harness the market position, thought leadership, technical knowledge and expertise of Members;
- be forward-looking, alert to emerging risks to markets and market structures on the horizon and aware of disruptive impacts of innovation; and
- promote adherence to expert standards and individual understanding of the importance of fair and effective markets.

Normally, we publish on topics that our Members identify and develop with us into Standards, Statements of Good Practice and Spotlight Reviews. This time, the simplicity and ease of reference of this originally internal piece deserved to be shared more widely.

Of course, by the time you cross the road, more publications will be available, and they will all have slightly different focuses and angles. No paper can capture everything about a topic as diverse and complex as carbon and as rapidly evolving as its markets. Ours has no agenda except education and is written by financial markets experts with input from the industry and other membership bodies.

Thank you to the team behind it and to all those who provided their views. I hope you find it useful.

Myles

Myles McGuinness
CEO, Financial Markets Standards Board

September 2022

Summary

This paper explores the history and current landscape of carbon markets, with a particular focus on credits from voluntary emission reductions that are traded in the Voluntary Carbon Markets (VCM). While intended as a succinct primer, it is hoped that even experienced practitioners in this space will find value in the discussions on the markets' future evolution (from section five onwards).

Carbon credits originate from individual projects designed to generate verified emission reductions, measured against validated business-as-usual baselines. Credits may be generated through the avoidance of carbon emissions (e.g., the protection of forests, building of renewable energy plants), or the removal of existing carbon from the air (e.g., planting of new trees, or more recently, technological carbon capture and storage methods, which store carbon dioxide and/or convert the gas into a more inert form, delaying or stopping the re-release back into the atmosphere[1]), and have historically been marketed to be an "offset" to an end-user purchaser's own emissions[2].

The concept of carbon credits accelerated and became more widespread through the Kyoto Protocol applications, and several standards and methodologies that have further developed under the VCM have become accepted by both compliance markets (e.g., the California Cap-and-Trade Program) and semi-compliance markets (e.g., the International Civil Aviation Organization's Carbon Offsetting and Reduction Scheme for International Aviation – CORSIA), which allow a percentage of a regulated entity's emission allowance to be met by carbon credits.

In contrast to a carbon credit, a carbon allowance is a permit to pollute under a regulatory scheme, with no underlying emission reduction. A carbon allowance is arguably the purest form of commodity: as a contract for an intangible, there are no potential deviances from good delivery standards within an individual regulatory market. However, while holding and retiring a carbon credit is theoretically equivalent to holding and retiring an allowance, each representing the same unit of emissions, credits are not yet traded in as high a volume as allowances. Credits are created as a by-product of a specific (and often small) project's operation, with each project's credits distinct from those generated from other projects.

The VCM has begun to develop protocols which allow similar carbon credits to be grouped, hence enabling a diversification from an Over-The-Counter model with a broker as intermediary, to credits capable of trading on an exchange. However, this market, while growing rapidly, remains small.

Illiquidity does not explain why the pricing of carbon credits varies so significantly compared to the allowances traded on the compliance markets, given the theoretical parity between credits and allowances, each representing an additional tonne of emissions permitted, nor the differing prices between allowances under different compliance schemes, and between credit types and providers. As at 14 September 2022, the highest compliance market allowance price (the EU Emissions Trading Scheme) is over USD$69 while California's Cap and Trade allowance stands at USD$27. At the same time, natured-based voluntary carbon credits can be easily found for as little as $10. As allowances operate under distinct regulatory jurisdictions, they are not fungible between compliance schemes, so this disparity is driven by regionalised supply and demand, with authorities having a role in determining the acceptable price range for carbon emissions, and adjusting the scarcity of total available allowances respectively.

There is also significant variance in the quality of carbon credits and their underlying projects. Regulators of compliance markets have criteria for the types of credit that they view to be of sufficient quality or geographical origin to count as equivalent to a carbon allowance. A mature VCM must be able to distinguish between the quality of two products, which both purport to represent the same unit, to be truly efficient.

There are three key challenges with the VCM at the time of writing:

- Supply-side standards exist for carbon credits and their projects, and standard bodies/registries are well-established enough that almost all projects are now independently verified in this way. However, the standards need to evolve in the light of their historical performances, especially in a post COP26 world, to maintain trust in their quality and integrity.

Summary continued

- The demand-side for carbon credits has limited regulation, meaning that claims made by purchasers can be misleading (even if inadvertently). While multiple standards do exist, including from highly respected bodies such as the ISO, the landscape is incomplete, and adoption is inconsistent. Insufficient knowledge and confusion between terminology means that incentives to voluntarily comply with existing standards are limited. For example, there may not be sufficient additional benefit for a business claiming that their consumer product is "carbon neutral" to have this claim independently certified to PAS 2060 standards[3].
- Market infrastructure is nascent, with initiatives to allow greater liquidity and price discovery through other tools only gathering pace in the last year. More development is needed to create commonly accepted taxonomy, and market participants need to converge on metrics and drivers to allow for meaningful comparative analysis between types of carbon credits and issuers.

These issues are pressing for two intertwined reasons. From an environmental perspective, with the VCM entrusted to be a significant component of the world's path to Net Zero[4], trust in carbon credits and transparent price discovery are vital to ensure that the markets can grow at scale, and that capital can be directed in time to both reduce carbon emissions and help fund the development of carbon capture and storage solutions, which may have high initial costs and lead time before becoming commercially deployable at scale. Lessons also need to be learned from previous attempts to scale carbon markets, such as the failure of the Chicago Climate Exchange of the 2000s and the issues faced by the EU Emissions Trading Scheme (ETS) during its Phase II in the aftermath of the 2008 financial crisis. From a market perspective, newer and rapidly expanding markets without sufficient established standards of best practice are more likely to be prone to distortion, whether deliberate or not, and especially when they are complex.

If a mature carbon market should allow the greatest volume of capital to flow into green projects, other asset classes show that it may be possible for the VCM to support all qualities and types of project. However, this should be balanced against the need to maintain trust and integrity in the VCM as it grows, and market participants should remember that the VCM is only one tool in providing funding to projects which drive climate action. Transparency, while reducing complexity by allowing projects to be easily compared through metrics, will be key to ensuring a flourishing, fair and efficient market.

The five sections of this paper provide an overview of the Voluntary Carbon Markets and essential background information. First, we introduce carbon markets and their history, before leading into an explanation of carbon credits and their creation. Next comes an overview of current problems and key initiatives to solve them in the VCM. Section five focuses on future market infrastructure, and concludes with a vision of how a mature carbon market ecosystem could look. A table of key acronyms and initiatives is provided in the appendix.

1 In this paper, "carbon" refers to its form as carbon dioxide in the atmosphere, unless the context requires otherwise.
2 Other use cases include acting as a mechanism for results-based finance, making climate finance contributions, or surrendering the credits in a compliance market context, such as Singapore's carbon tax.
3 BSI, PAS 2060 – Carbon Neutrality Standard and Certification.
4 Net Zero is the target of eliminating all greenhouse gases emitted from human activity.

"While a diversity of views is generally positive, there is a risk that divergence creates market confusion and ultimately fatigue for a relatively nascent asset class."

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History of Carbon Markets

The 1997 Kyoto Protocol created the first large scale carbon market, with signatory nations as the participants. The 36 states which fully participated in the commitment to lower their greenhouse gas (GHG) emissions[5] could fulfil their promises through an actual reduction in emissions, using the "flexibility mechanisms" of purchasing allowances from other nations (International Emissions Trading) or funding approved carbon-reducing projects to offset their excess (the Clean Development Mechanism and Joint Implementation).

Hypothesised by Coase et al., Cap-and-Trade Emissions Trading Schemes (ETS) were formulated as a more cost-effective way of pollution control than the then-prevalent Command-and-Control methods. By allowing "permits to pollute" to find their own clearing price, delivery of emission reductions would be concentrated in enterprises which could do so at the lowest possible economic cost. The success of the US Clean Air Act of 1990 in reducing NOx and SO2 emissions responsible for acid rain proved the potential for similar trading schemes for other pollutants.

The Paris Agreement in 2015 that succeeded Kyoto now covers over 98% of human emissions after the readmission of the US, and marks a shift to a commitment to a Net Zero world[6].

It explicitly reaffirmed the role of markets in achieving global emission reductions in Article 6[7]. COP26 in Glasgow in 2021 reached final consensus on the detailed rules for a global carbon market mechanism, notably the Corresponding Adjustment (CA) that allows Internationally Traded Mitigation Outcomes (ITMOs) to be transferred between international parties to the Paris Agreement, without double-counting. This paves the way for the VCM between international private participants to be integrated with nations meeting their international obligations to decarbonise, with some nations already moving to establish government-managed projects to meet their Nationally Determined Contributions; the exact mechanisms and requirements for this are being developed.

At the time of writing, over 38 countries or supranational regions (most notably, China and the EU[8]) have created compliance markets for carbon emissions. Regulated entities must hold sufficient allowances (whose initial allocation may be free or auctioned) and eligible carbon credits to cover the tonnage of their carbon emissions or face regulatory fines.
These allowances are complemented by ETS to allow private actors to trade, therefore allowing the market to allocate the secondary distribution of top-level targets.

While international treaties apply to all emissions (to the extent that they can be measured), compliance markets for private enterprises have focused on the most heavily polluting industries which are the source of emissions, rather than the individuals and industries which demand their outputs.
For example, the EU ETS for carbon applies only to "electricity and heat generation, oil refineries, steel works, and production of iron, aluminium, metals, cement, lime, glass, ceramics, pulp, paper, cardboard, acids and bulk organic chemicals, and commercial aviation within the EEA".

This targeted approach has many reasons: these industries cover ~50% of global carbon emissions (the VCM has a role in the remaining half); further, as they have already been heavily regulated, they have existing infrastructure for measurement, reporting and verification (MRV). Finally, they have greater means and scale to make substantial differences in emission reductions.

Both the initial allocation of allowances and the overall number of allowances that are available are important design questions that go to the fairness and the efficiency of the market.
Too small the cap means too great the impact on economic activity, while too high means too little pressure to reduce emissions. Just like monetary policy, a well run Cap-and-Trade system should continually incentivise the reduction in emissions by restricting the number of permits and/or raising the price set for carbon allowances; the EU ETS Market Stability Reserve provides an example.

Percentage of human emissions covered in The Paris Agreement

98%

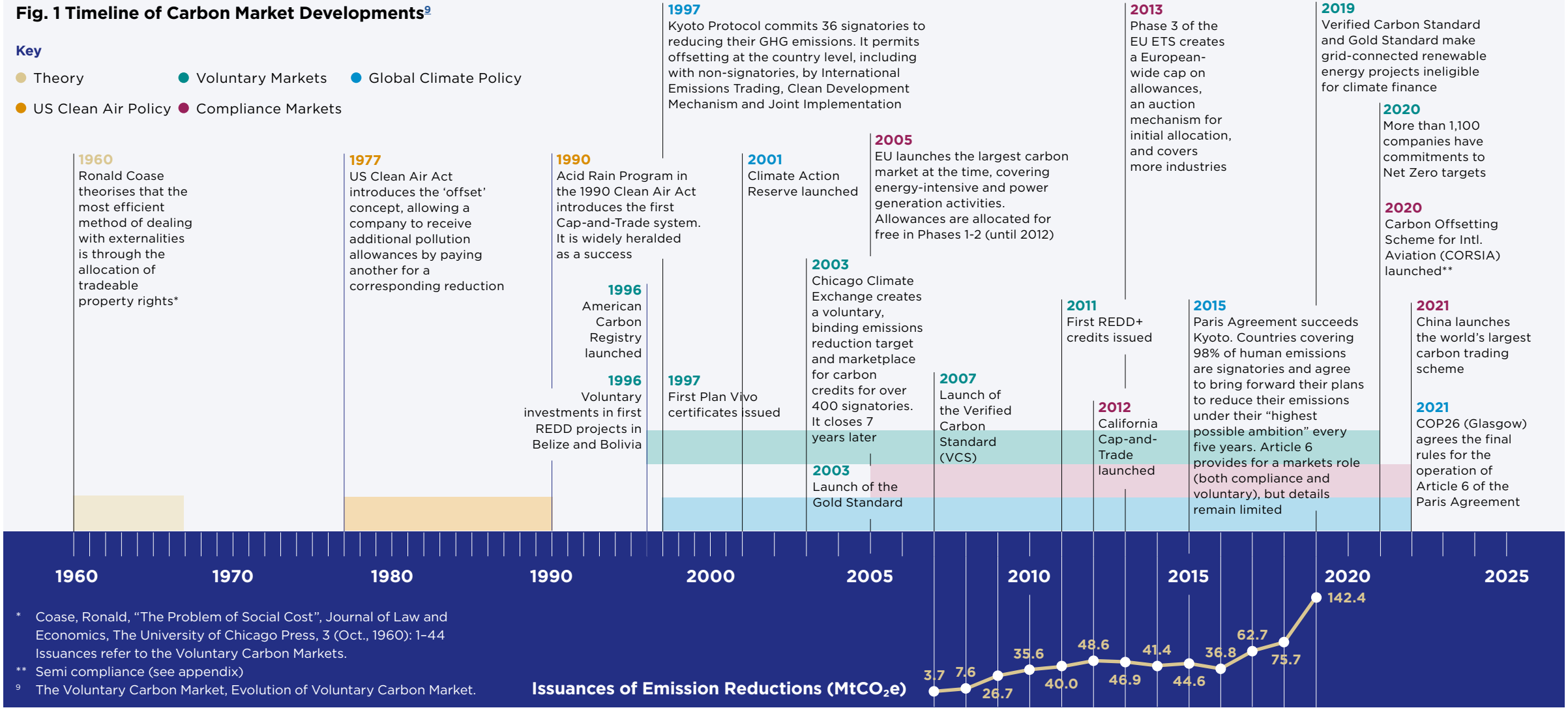
Number of countries or supranational regions that have created compliance markets for carbon emissions

38+

[5] While other GHG exist, this paper focuses on carbon dioxide, the "currency" into which other GHG credits are converted and traded. See also S&P Global, Carbon credits issued for cow methane reduction in potential world first.
[6] United Nations, The Paris Agreement.
[7] Ibid.
[8] EU counted as one country for this purpose.

History of Carbon Markets continued

Fig. 1 Timeline of Carbon Market Developments[9]



* Coase, Ronald, "The Problem of Social Cost", Journal of Law and Economics, The University of Chicago Press, 3 (Oct., 1960): 1–44
Issuances refer to the Voluntary Carbon Markets.

** Semi compliance (see appendix)

[9] The Voluntary Carbon Market, Evolution of Voluntary Carbon Market.

History of Carbon Markets continued

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

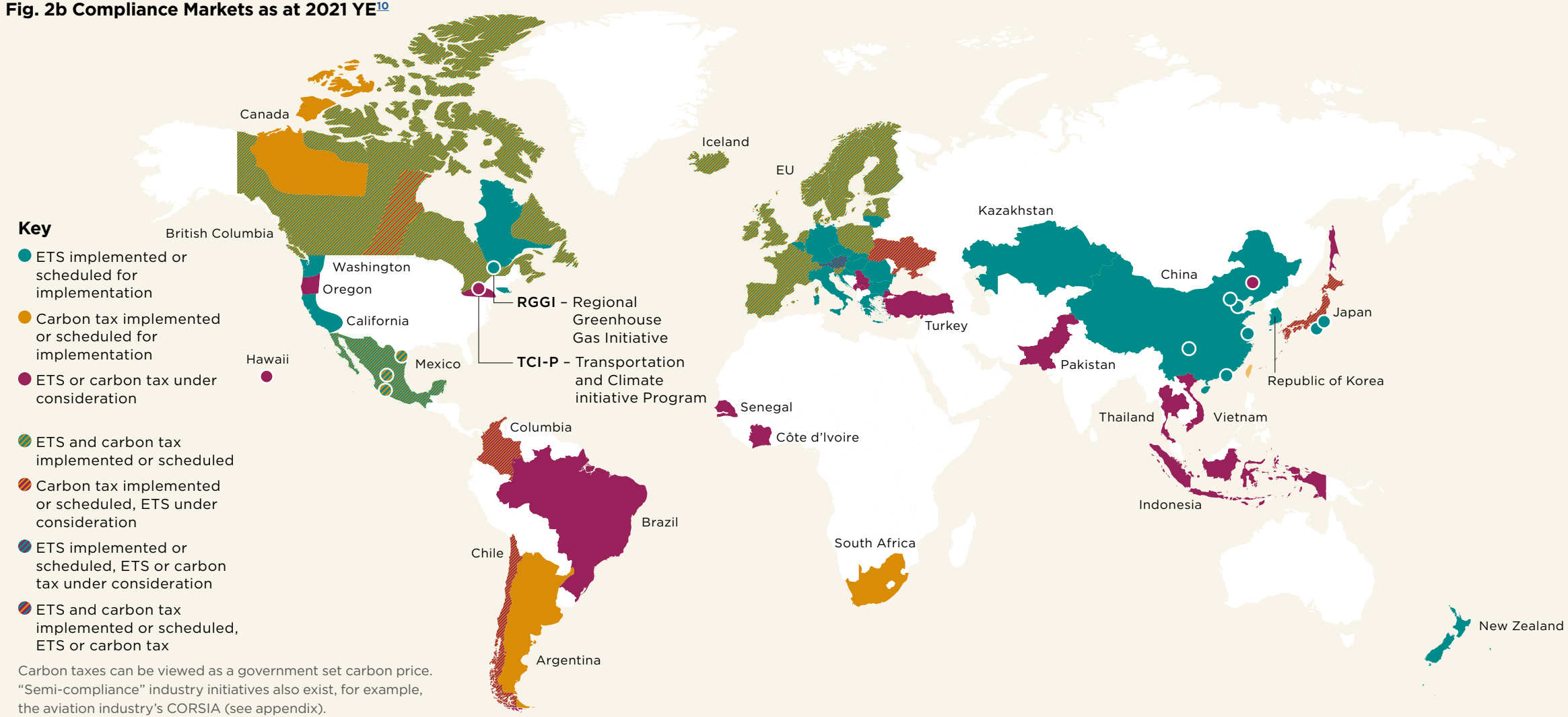
Fig. 2a Compliance Markets as at 2021 YE[10]

Continent	Country	Carbon Pricing (2021)
North America	Canada	Emissions Trading System (ETS) and carbon tax[11] implemented or scheduled for implementation in most states. Some areas do not yet have a carbon tax.
	Mexico	ETS and carbon tax implemented or scheduled for implementation.
	USA	ETS implemented or scheduled for implementation in Washington, California and Massachusetts. ETS or carbon tax under consideration in Pennsylvania and Oregon. Includes Transportation and Climate initiative Program (TCI-P), Regional Greenhouse Gas Initiative (RGGI) and California Cap-and-Trade.
South America	Argentina	Carbon tax implemented or scheduled for implementation.
	Brazil	ETS or carbon tax under consideration.
	Chile and Colombia	Carbon tax implemented or scheduled, and ETS under consideration.
Europe	Denmark, Estonia, Finland, France, Ireland, Latvia, Luxembourg, Norway, Poland, Portugal, Slovenia, Spain, Sweden, Switzerland, The Netherlands, UK	ETS and carbon tax implemented or scheduled.
	Austria	ETS implemented or scheduled, ETS or carbon tax under consideration.
	Montenegro, Serbia, Turkey	ETS or carbon tax under consideration.
	Belgium, Czech Rep., Germany, Greece, Italy	ETS implemented or scheduled for implementation.
	Ukraine	Carbon tax implemented or scheduled, ETS under consideration.
Africa	Côte d'Ivoire, Senegal	ETS or carbon tax under consideration.
	South Africa	Carbon tax implemented or scheduled for implementation.
Asia	China and Kazakhstan	ETS implemented or scheduled for implementation.
	Indonesia, Pakistan, Republic of Korea, Thailand, Vietnam	ETS or carbon tax under consideration.
	Japan	Carbon tax implemented or scheduled, ETS under consideration. ETS implemented or scheduled for implementation in two cities.
Oceania	New Zealand	ETS implemented or scheduled for implementation.

History of Carbon Markets continued

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

Fig. 2b Compliance Markets as at 2021 YE[10]



Carbon taxes can be viewed as a government set carbon price. "Semi-compliance" industry initiatives also exist, for example, the aviation industry's CORSIA (see appendix).

Carbon credits and the Voluntary Carbon Markets

What is a carbon credit?

While a carbon allowance is a pure "permit to pollute", which is based on national or international agreements on what the acceptable aggregate level of pollution is, a carbon credit represents the reduction in emissions of carbon dioxide (or other GHG) versus a baseline, created by projects that would not have happened if it were not for the credit holders' investment[12]. These projects have traditionally been dominated by energy efficiency schemes, renewable energy infrastructure or nature-based solutions such as forest protection, and often hosted by lower-income countries. In addition to the above "avoidance credits", "removal credits", which actively remove carbon dioxide from the atmosphere and store it also exist, the most common being reforestation (restocking of existing woodland) and afforestation (creation of new forests).

Recognising that carbon is fungible and emitted worldwide, some ETS have allowed for part of a regulated entity's allowance to be met through carbon credits as well as allowances. To qualify, the underlying project must be approved by the individual ETS or its nominated standard issuer – an independent organisation tasked with assessing the quality and methodology of the project in question.

Carbon credits cannot count against the holders' emissions until "retired" and are theoretically tradeable before then. At retirement, they are extinguished and can no longer be traded, ensuring no double-counting.

[12] Note that while some compliance ETS allocate the revenue from allowance auctions to climate projects, they are not credits as there is no linkage between the allowances and the amount of carbon offset by these projects.

[13] S&P Global, Voluntary carbon markets: how they work, how they're priced and who's involved.

Background: Carbon credit criteria

Background: Carbon credit criteria

A commonly agreed set of descriptive parameters for carbon credits are as follows[13]; without meeting these criteria, a project cannot be considered to generate carbon credits.

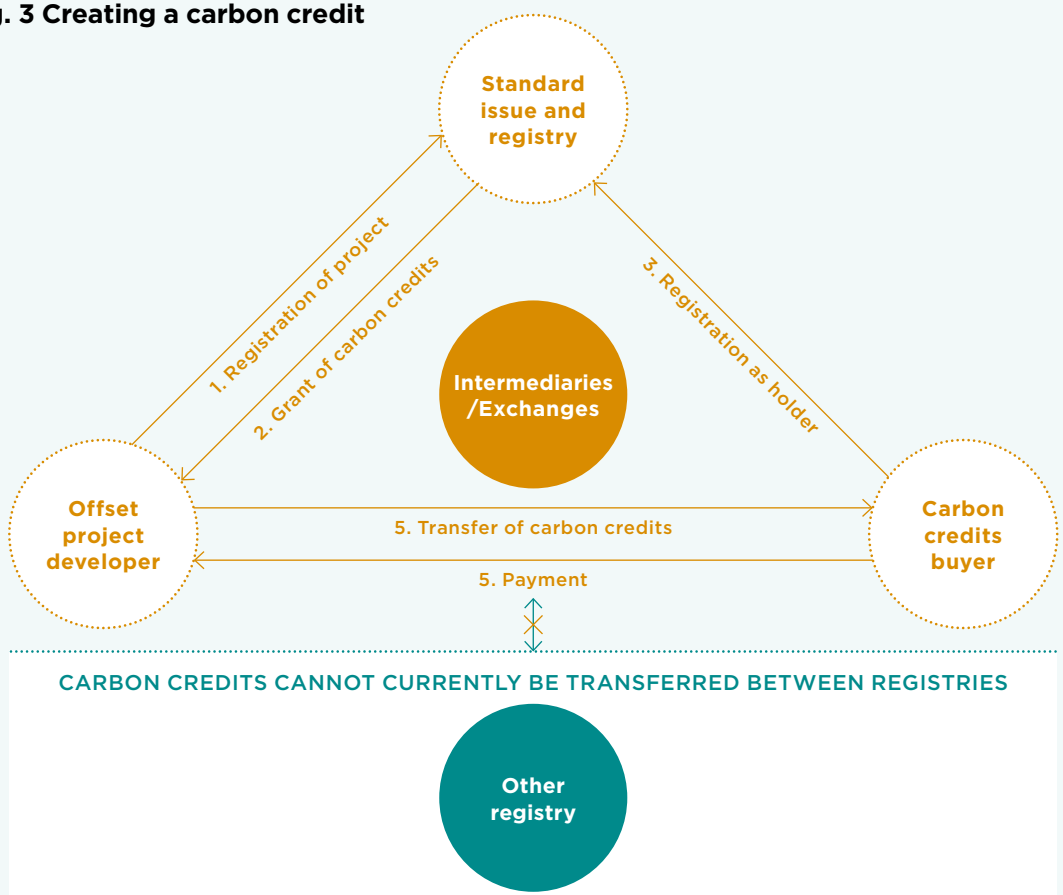
However, many organisations have additional, normative criteria for what they consider a "good" carbon credit looks like, for example, those with co-benefits such as biodiversity, or which help to advance the UN's Sustainable Development Goals (SDGs).

As further discussed in section three of this paper, the Integrity Council for Voluntary Carbon Markets launched a public consultation in July 2022 on a more detailed set of "Core Carbon Principles" to both set a benchmark for high quality carbon credits, and standardise additional attributes/co-benefits, which may be tagged to a credit. This accreditation is envisaged to allow for easier comparability between credits.

1. **Additionality:** In the absence of capital from carbon credit sales, this project would not have happened. The motivation cannot come from legal requirements or other financial gains, aside from those received from selling carbon credits.
2. **Exclusivity of credits:** Each credit can only be claimed by one party, and it becomes eligible to offset the holder's emissions when the credit is retired, as long as there is proof of the credit retirement.
3. **Leakage/over-estimation:** The emissions reduction and carbon credits issued should match, with the calculation considering any knock-on carbon impact of the project.
4. **Permanence:** The emissions reduction should result in a permanent drop in emissions, which cannot be reversed.

Carbon credits and the Voluntary Carbon Markets continued

Fig. 3 Creating a carbon credit



A buyer does not need to always register an account in the standard issuer and registry to receive carbon credits, as the seller or project developer can retire them on his or her behalf. Article 6 of the Paris Agreement will define the link between national and private registries, including transfers of credits between registries.

What are voluntary carbon credits?

Growing environmental awareness has sparked demand from industries, companies and individuals to reduce their carbon footprints. Not being regulated, they do not have "allowances" to trade and therefore the Voluntary Carbon Markets refer to the trade in credits by non-regulated companies and individuals, or by regulated companies going over and beyond their regulatory requirements[14]. There is no fundamental difference between the projects underlying "compliance" and "voluntary" credits or how they are verified or issued; rather, a carbon credit may become eligible under compliance programs if the project meets additional criteria set for the type and quality of project, while a "voluntary carbon credit" is simply a credit purchased voluntarily where the purchaser is not subject to such criteria.

As voluntary purchasers are yet to be bound by regulation, the quality of the credit demanded is determined only by the requirements of the purchaser, and their demands are much more varied, and price elastic, than purchasers of allowances for compliance purposes.

Use cases include:

- **Reputational/Public Relations** – heightened by the high visibility of recent voluntary initiatives to commit to Net Zero, such as the UN Environmental Programme-backed Net Zero Alliances and the Science Based Targets initiative (SBTi). The public statements of commitment made by members of the Net Zero Banking Alliance, Net Zero Investment Managers Alliance, Net Zero Insurance Alliance, among others, will require action to deliver on such promises and the VCM is expected to play a significant role in this.
- **Improving the cost of capital** – an issuer with higher ESG credentials/ratings may be able to access cheaper and/or a greater volume of financing, and use of carbon credits may be a factor in improving their ratings.
- **Access to new revenue streams** – e.g., the UK government requires firms bidding for government contracts over £5m per annum to commit to Net Zero[15].
- **Personal conviction** – e.g., one major software company has committed to offsetting its historic emissions and to become carbon negative by 2030 – including through investment in much more expensive, Direct Air Capture (DAC) technologies.
- **Fiscal incentives such as tax relief** – e.g., section 45Q of the US Internal Revenue Code offers a tax credit per metric tonne, though ability to transfer this credit is currently limited.

[14] Though theoretically private individuals or organisations could purchase allowances on the compliance market and retire them, thereby pushing up the price and further incentivising the reduction in emissions in the regulated industries, in practice this is both less efficient than, and psychologically less meaningful, than direct investment into carbon credits.

[15] GOV UK, firms must commit to Net Zero to win major government contracts.

Carbon credits and the Voluntary Carbon Markets continued

Have carbon credits worked?

When permitted under Kyoto, there was an implicit acknowledgment that carbon credits could be used by the industrialised signatories to direct capital into carbon reduction projects in developing and newly industrialising non-signatories. Hypothesised benefits included:

- Lower (global) compliance costs by allowing "low hanging fruit" to be picked, and effectively increasing the supply of credits in industrialised countries through the funding of projects which reduced emissions elsewhere;
- A "just transition" by encouraging capital flows into lower-income countries; and
- "Leap frogging" – allowing transfer of the newest technology from industrialised countries to industrialising countries, thereby skipping intermediate, potentially less efficient, infrastructure build.

Today, the supply of credits remains dominated by avoidance credits from lower and middle income countries. However, the historical success of these credits has been mixed.

On the supply-side (the projects creating the credits), global standard setters verify project developers' methodologies for calculating their emissions reductions (examples include Verra, Gold Standard, the American Carbon Registry, Climate Action Reserve and Plan Vivo, as well as national schemes). However, there is limited agreement on the principles and the methodology for certifying carbon emission reductions. Some stem from the intrinsic moral hazard of the offsetting concept: with the possibility of additional income from the sale of carbon credits – independently from the capital stack itself – there is always a financial incentive for a project developer to try and prove that the issuance of carbon credits was decisive and hence meet the criteria for additionality for the purposes of standard issuers/auditors. Others come from differences in subjective judgment over what is essentially an attempt to predict an alternative future, whether also in relation to the additionality of a project[16], or even if additionality is established, whether and to what extent the project will perform. While a diversity of views is generally positive, there is a risk that divergence creates market confusion and ultimately fatigue for a relatively nascent asset class.

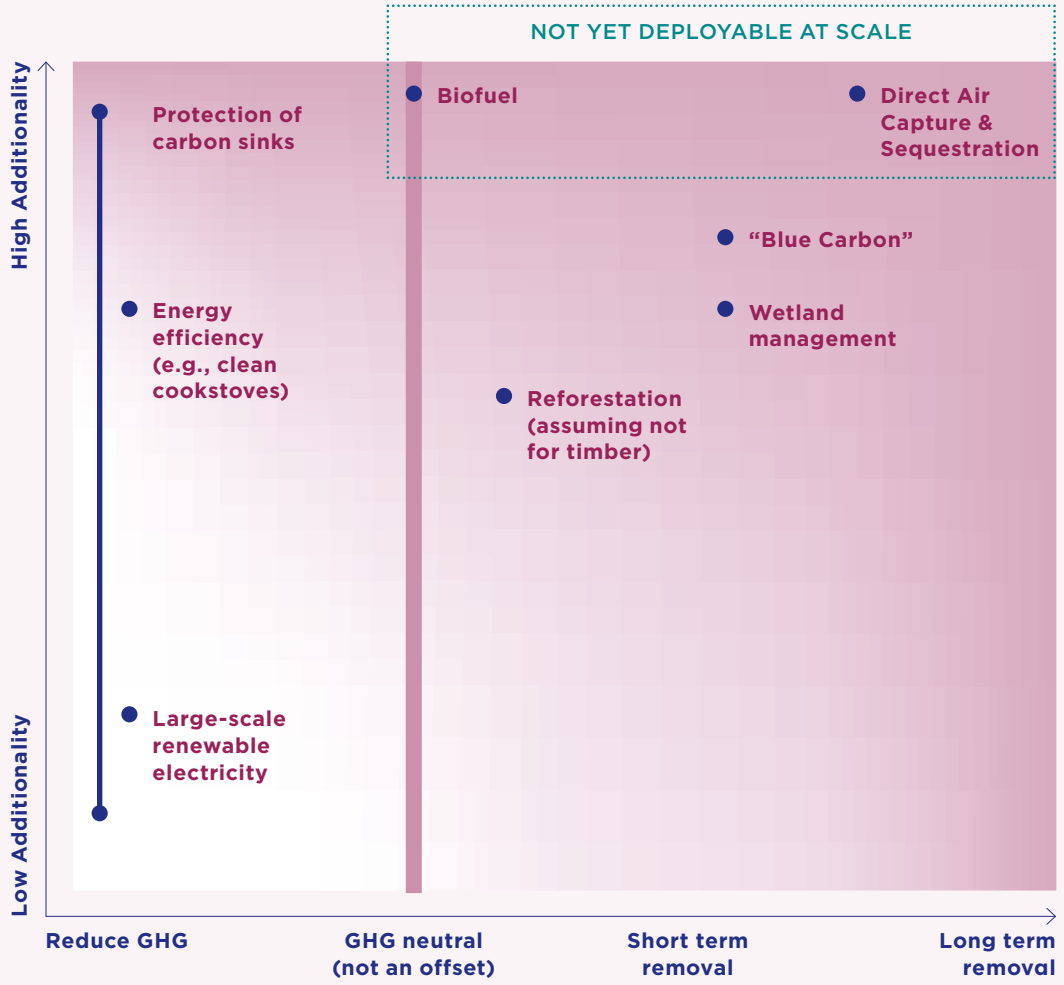
Technological progress has also complicated the judgment call. When conceived under Kyoto, the need for industrialising countries to continue their development pathway to alleviate human poverty was undisputed. High entry costs for renewable energy and continued human pressures on natural carbon-capturing resources meant that projects under the Clean Development Mechanism and Joint Implementation were indeed likely to have been additional in reducing overall global carbon emissions, even if not by the amount claimed. However, since then, the technology for renewable energy has fallen dramatically in price, so it is far less clear as to whether the capital from the purchase of credits has made the difference to whether a wind farm is being constructed instead of a coal-fired plant. Standard issuers have had to adapt to reflect these changes, as discussed in more detail in the next section.

The additionality of removal credits is theoretically clearer, as projects to capture and store carbon do not necessarily have other economically valuable outputs, but the evidence base is mixed[17]. Removal credits also come with their own challenges for assessing the quality of projects – in particular around permanence of storage. Nature-based removal credits, the planting of new organic matter capable of photosynthesis such as trees, rely on the most well-established and proven "technology". Plants, however, only remove carbon from the atmosphere at the speed at which they grow, and only store carbon for as long as they live. Thereafter, except in exceptional environmental conditions (such as peatland conditions), their organic matter begins to decompose, re-releasing carbon back into the atmosphere, so how the resulting forests, wetlands, or similar are managed, and the fate of mature and dying plants, also need to be considered. Just like avoidance credits, removal credits are not all alike[18].

[16] Carbon Offset Guide, Additionality.
[17] Note though that many afforestation and reforestation projects are linked to economically viable timber concessions.
[18] For a detailed analysis of key carbon removal project types and their potential, see: UN Framework Convention on Climate Change, Removal activities under the Article 6.4 Mechanism, section 3.1.

Carbon credits and the Voluntary Carbon Markets continued

Fig. 4 Indicative carbon reduction project types



Note that in the figure shown, the projects with the highest additionality also correlate to technologies not yet deployable at scale because of costs – the higher the cost compared to the other outputs, the more likely a project is to be "additional".

This FMSB chart is indicative only. Additionality should be measured for each individual project as project quality can vary significantly, even within the same type of projects.

Biofuels are effectively "self-offsetting" as the growth of the plants from which the fuel is extracted removes an equivalent amount of carbon as their combustion (assuming no friction costs of processing or transportation).

Newer carbon capture and sequestration technologies generate excitement as a way of mitigating the emissions from the most difficult industries to decarbonise, but most are still in development or not yet viable at scale. They range from new technologies and applications for existing products such as biochar (a type of charcoal made under a process which prevents dead biomass re-releasing carbon into the air and designed for soil enhancement rather than fuel), to technological capture of carbon dioxide. Capture from heavy industrial processes has the potential to contribute 14% of the emissions reductions required by 2050, and currently, 26 commercial-scale carbon capture projects are operating around the world, with 21 more in early development and 13 in advanced development reaching front-end engineering design[19]. However, only Direct Air Capture (DAC) is capable of capturing residual, non-industrial emissions. Because of the lower concentrations of carbon dioxide in the atmosphere compared to industrial emissions, the current cost of DAC is around $600 per tonne. DAC needs to scale dramatically to bring costs down to manageable levels, and there is doubt as to how much it can contribute before 2050[20].

[19] Center for Climate and Energy Solutions, Carbon Capture.
[20] Yale E360, The Dream of Carbon Air Capture Edges Toward Reality.

Carbon credits and the Voluntary Carbon Markets continued

Background:
Plants as a complement to decarbonisation

Why has there been investment in technological carbon capture and sequestration technologies when plants (trees, mangroves, wetland plants) are already able to remove carbon dioxide from the atmosphere?

1. **Speed:** Plants convert carbon dioxide into plant matter, so can only capture carbon at the speed at which they grow. A hypothetical effort to plant the fastest growing plants is possible, however, encounters a challenge.

2. **Duration:** As soon as a plant dies, it begins to decompose, releasing carbon dioxide back into the air (excepting any carbon it has sunk into the soil, or in specific conditions where decomposition is halted, such as arctic tundra or peatlands). Faster growing plants are correlated with those with shorter lifecycles, meaning that they store carbon for a shorter time. This is why carbon sequestration research focuses on how carbon, either as mature plant matter or carbon dioxide gas directly, can be converted into inert compounds and/or stored in such a way that there can be no leakage into the atmosphere.

3. **Risks:** As climate change increases the frequency of extreme weather events, the possibility of wildfires prematurely re-releasing all captured carbon back into the atmosphere becomes more likely. There would also be a significant impact on biodiversity.

4. **Competing land use:** Alternatively, planting the longest-lived species, or those which are most capable of soil sequestration (storing carbon longer-term in the soil layer) and therefore of greatest net negative value over a lifecycle, also encounters challenges. "Blue carbon" initiatives, which focus on the significant power of wetland growth and mangroves to sequester carbon for longer than trees, can only be deployed in certain environmental conditions. As for trees, there is not enough suitable land to plant in sufficient quantities to meet current emission levels: Imperial College London researchers estimate that planting trees on all land capable of supporting forestry, currently unused as cropland, could sequester up to 100 gigatonnes of carbon. This amount is equal to ten years of man-made carbon emissions at current rates, but the rate would be only a tenth of the speed. It would take about a century to capture this quantity of carbon[21] as the trees reach maturity. There are also potential social, ecological and biophysical impacts of the change in land use this would require, with certain previous nature-based solution projects being accused of human rights violations, biodiversity loss, and causing water shortages.

On the demand side, that is, the purchasers of credits and their use cases, a lack of common taxonomy and understanding around a myriad of competing standards in the marketplace have led to companies both intentionally and inadvertently purchasing credits that are unsuitable for the use case or making unsupportable claims. For example, there is confusion over terms such as "carbon neutral" products – what emissions have to be offset to count and are there restrictions on the kinds of credits that can be used? How does this differ from a claim of "Net Zero"? The average consumer might consider both terms synonymous to mean a product with no net environmental impact, yet carbon neutrality merely requires emissions to be offset and can be limited to a single product or activity, while Net Zero requires a firm to be working to decarbonise as much as possible, and only using offsets for the residual emissions it cannot eliminate. The Science Based Targets Initiative Net Zero standard does not permit carbon credits to be used at all to meet near-term or long-term targets, and only permanent removal credits are allowed to neutralise residual emissions.

[21] Imperial College London, Q&A: Is planting trees the answer to climate change?

Carbon credits and the Voluntary Carbon Markets continued

Case studies like one major oil and gas company's examination of carbon neutral Liquid Natural Gas (LNG) highlight the tension. While oil and gas companies are usually covered by compliance markets (if existing in their region), many regulated entities additionally engage in the VCM in the pursuit of other goals. Note that the type and not the use of credits themselves is the question: there is general acceptance among climate scientists[22] that fossil fuels will still be needed, particularly for some industrials and off-grid energy needs such as transport, after a global Net Zero has been achieved.
Deep decarbonisation technologies and solutions (and the credits they generate) will still be required. Indeed, in specific instances, switching to a non-fossil fuel alternative may be less desirable than a carbon reduction project that offsets fossil fuel emissions: biofuels are carbon neutral (effectively self-offsetting) because the carbon dioxide produced by their combustion has already been mitigated through the plants' photosynthesis while growing; yet if the land were capable of supporting forestry, a significantly greater amount of carbon dioxide could be temporarily sequestered in the increased biomass of a larger plant with a longer lifecycle. While decarbonisation is undoubtedly required in the transition to a lower-carbon economy, how this is achieved for the "stickier" use cases is all in the detail.

[22] For example, Prof. Myles Allen CBE, Lead author and contributor to three IPCC reports University of Oxford, Why Net Zero (and what is it?).
[23] See section three of this paper.

Case Study:
EnergyCo's "First Carbon Neutral LNG Cargo"

In October 2020, EnergyCo delivered its first "carbon neutral" shipment of Australian LNG to China. The credits were purchased from two projects:

- Hebei Guyuan Wind Power Project, replacing coal-based electricity generation in northern China. Already 10 years old, would the project continue to have provided renewable power without this investment? Given the current energy policy in China and lowered costs of renewables, would such a project have been commissioned anyway today?
- Kariba REDD+(2)[23] Forest Protection Project in Zimbabwe. How much of this forest would have remained but for the protected status?

Background:
Measuring a carbon footprint

Before deciding on the quantum of credits required, an action, product or enterprise's carbon footprint needs to be established. Accounting for a carbon footprint is typically conducted using Enterprise Carbon Accounting (ECA) principles, utilising Life Cycle Analysis (LCA) to arrive at a conclusion. The most popular LCA method at present is Process LCA, which looks at stages of a product's life in turn to aggregate into single metrics.

Under the Greenhouse Gas Protocol (GHGP), the most widely regarded guide for corporate carbon accounting created by the World Resources Institute and the Business Council for Sustainable Development, emissions can be split into three scopes:

- **Scope 1** — GHG emissions that a company makes directly — for example, while running its boilers and vehicles.
- **Scope 2** — Emissions it makes indirectly – for example, from the electricity or energy it buys for heating and cooling buildings that is being produced on its behalf.
- **Scope 3** — All the emissions associated with the company both up and down its value chain.

Outside of regulated industries, there is no universal standard on which scopes, or which parts of a product's lifecycle need to be measured. There is some logic in the flexibility – for example, a supplier and a producer who both sought to measure their full "up" and "down"- stream emissions would create a partial double-count. However, this means that environmental claims made by companies need to be considered against the type of footprint being measured.

For intermediaries, such as financial institutions, Scope 3 emissions include all significant Scope 1-3 emissions of their investment and lending portfolios. The UN-convened Net Zero Banking Alliance asks signatory banks to commit to transitioning lending and investment portfolios to a Net Zero pathway, instead of banks offsetting on behalf of their clients.

Carbon credits and the Voluntary Carbon Markets continued

Fig. 5 Raw Material Extraction

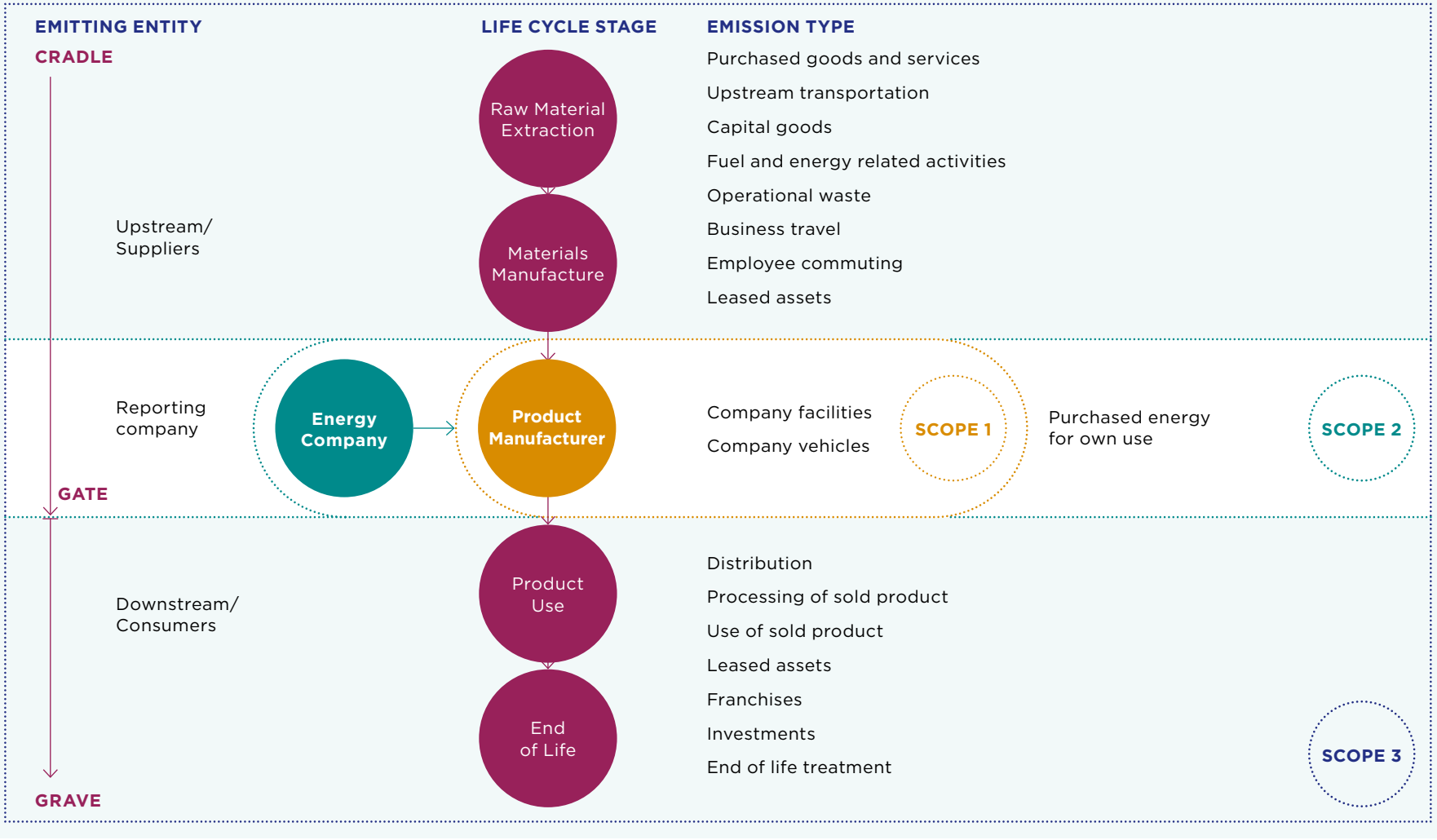


Figure source: FMSB

Finally, until the last couple of years, the bringing together of supply and demand has been dominated by brokers. While an OTC (Over the Counter) marketplace does not preclude price discovery, as has been seen in various commodity markets, the relative opacity, and lack of metrics to enable comparison between what are fairly distinct products, indicate room for greater efficiency of the VCM. Initiatives such as Xpansiv CBL's spot-traded platform, CME (Chicago Mercantile Exchange) and (Intercontinental Exchange) ICE's new futures contracts, as well as globally coordinated forums such as the Taskforce on Scaling Voluntary Carbon Markets (TSVCM) which have informed them, are discussed in section five of this paper.

With efforts to scale the Voluntary Carbon Markets an integral part of meeting targets for the energy transition pathway, creating clarity and integrity on both sides will be vital to encourage confidence in the growing market. The next two sections consider challenges, both existing and emerging, on the supply and demand sides, as well as outline current initiatives for change.

Creating supply-side integrity

Questions of quality

The challenges in the carbon credit market are reflected in the variance in credits' pricing, both relative to each other and relative to the compliance allowances for which they may be substitutes.

On the supply-side, that is, the project development side, there are two main, and interlinked, issues.

- Despite established standard setters, the probability, quantum, and non-additionality of carbon credits vary, with project qualities varying from the high to the more questionable:
  - Do projects actually achieve the level of carbon reductions advertised? (Measurement, Reporting and Verification, MRV, of carbon emissions are already notoriously difficult, with concentrations in air sample measurements hard to untangle from background variance in carbon dioxide levels[24].)
  - Has a reduction taken place at all? One analysis of credits focusing on the prevention of deforestation showed only minimal difference between the fell rates of protected and unprotected forests – certainly positive, but not to the extent claimed[25].
  - When emissions reductions have been achieved, would they have already occurred under the baseline scenario? Carbon credits, by their nature, require a judgment about an alternative future – and prediction is difficult.
- Despite carbon credits constantly being retired, there is a virtually infinite supply of theoretical credits: many basic human activities have an impact on carbon emissions, from energy efficiency to afforestation to clean cooking stoves and renewable energy, so there is an endless supply of projects which could potentially qualify as an emissions reduction credit. Trust in the integrity of the accreditation process is vital for higher quality credits to become scarce enough and avoid a "race to the bottom".

The developing market needs to ensure that higher quality credits can be appropriately distinguished, so that funding can be channelled towards projects which may effect greater change.

The projects behind lower quality credits can still yield real benefits in the fight against climate change, but if and what role they play in the VCM needs further consideration (and is discussed later).

There has been innovation in improving the design of projects, and one trend partially driven by Article 6 is projects managed by governmental agencies, rather than private participants or NGOs[26]. The Jurisdictional Approach for REDD+ is a potential example. While still at a developmental stage, a number of jurisdictions around the world are working to scale forest protection and shift the management of forest and land use projects towards governments. Governments have powers of enforcement and theoretically would be able to manage projects with larger scales.

Standard setters are also constantly adapting their criteria to acknowledge new developments. Verra, which certified EnergyCo's Hebei Wind Farm credits, has amended its policies to exclude large-scale renewables. Gold Standard, which verified projects under the previous UN Clean Development Mechanism, now excludes many forest protection projects. In the compliance markets, the EU ETS has banned the use of any international credits. Prior to 2021, the percentage of credits used to meet regulated entities' allowances was already capped, and land use change projects, such as the protection of existing forests, were already excluded due to the difficulties in proving additionality.

[24] Energy in Demand, Measuring Net Zero emissions is not simple.
[25] PNAS, Overstated carbon emission reductions from voluntary REDD+ projects in the Brazilian Amazon.
[26] This remains a complex and evolving area, and further progress is expected at COP27.

Creating supply-side integrity continued

Fig. 6 Characteristics of compliance and voluntary registries worldwide[27]

Registry	Location	Started	First issued	Type	Projects (% estimate, where known)	Type (removal vs reduction)	Key host countries (% estimate, where known)
Verra	Washington, DC	2007	N/A	Voluntary	• Energy (58%) • Agriculture, forestry & other (31%) • Fugitive emissions (5%)	Removal & reduction	• India (25.3%) • China (23.6%) • Indonesia (5.4%)
American Carbon Registory (ACR)	Arlington, VA	1996	2002 (earliest vintage 1998)	Voluntary	• Forest carbon (64%) • Carbon capture & storage (13%) • Ozone depleting substances (6%)	Removal (13%) & reduction	• US (97.4%) • Brazil (2.5%)
Gold Standard	Geneva, Switzerland	2003	2008 (earliest vintage 1996)	Voluntary	• Wind (32%) • Energy efficiency (29%) • Other (15%) – includes forestry	Removal & reduction[28]	• Turkey (25.5%) • India (14.0%) • China (13.6%)
CarbonPlan (CDR)	San Fransico, CA	2020	2020	Voluntary	• Forests (62%) • Biomass (17%) • Soil (9%)	Removal (4.9m $MtCO_2$)[29] & reduction	• US & North America (48.0%) • Australia (6.4%) • Philippines (5.9%)
Climate Action Reserve	Los Angeles, CA	2001	2005	Voluntary	• Forestry (50%) • Landfill (21%) • Ozone depleting substances (11%)	Reduction[30]	• US (99.8%)
Clean Development Mechanism (CDM)	Bonn, Germany (current) Geneva, Switzerland (previously)	1997 (with Kyoto Protocol)	2012	Compliance	• Energy industries & demand (51%) • Chemical industries (25%) • Waste handling & disposal (10%) • Afforestation & reforestation (8%)	Removal (8%) & reduction[31]	• Korea (33.5%) • India (17.6%) • Brazil (8.8%)

[27] J.P. Morgan Asset Management, The global carbon market: How offsets, regulation and new standards may catalyze lower emissions and create opportunities.
[28] The Gold Standard, What's a ton of good worth?
[29] CarbonPlan (sic), CDR Database.
[30] Climate Action Reserve, Voluntary Offset Program.
[31] UNFCCC, The Clean Development Mechanism.

Creating supply-side integrity continued

Paris 2015 and the agreement on Article 6 reached at COP 26 will also shift the paradigm. With almost all nations now committing to reduce their carbon emissions, at an aggregate global level, emission reduction projects will be insufficient. It is widely acknowledged that carbon removal projects will also be required. As of 2020, only 5% of credits were carbon removal projects, with 4% being forestation, and just under 1% coming from newer technological carbon capture and sequestration projects which have entered into use.

Further, there are potential moves by industrialising countries to restrict their emissions reduction projects being "exported" to industrialised countries via the cross-border transfer of credits. Corresponding Adjustments, which subtract the carbon emission reductions from a project's host country and adds them to the account of the importing country, are designed to prevent double counting of emissions reductions. However, without limits on cross-border transfers, there is a risk that the lowest quality, cheapest reductions are exported from low and middle income countries to high income countries, leaving these host countries with the hardest residual emissions to clean up thereafter. (Of note, the EU has agreed on measures from the other perspective, with the Carbon Border Adjustment Mechanism aiming to stop EU regulated industries from exporting their emissions-intensive production elsewhere.)

In the last few years, wider international collaborative initiatives have sought to address both the demand-side integrity and international dimensions.

Creating further integrity and disclosure

Voluntary carbon credits have yet to fall under the direct remit of any existing legislation. As noted above, despite standard and registry bodies being well-established, there is limited self-regulation. However, new international governance structures have emerged to try to restore "integrity" to projects[32].

The most prominent is the **Integrity Council for Voluntary Carbon Markets (IC-VCM)[33]:** The IC-VCM was created by the Taskforce on Scaling Voluntary Carbon Markets, and was established with the aim of setting Core Carbon Principles[34] to help in the standardisation of quality of carbon credits. Tim Adams, the President and CEO of the IIF, and Mark Carney, the UN Special Envoy on Climate Action and Finance, sit on the Advisory Board.

Guided by the theory "build integrity and scale will follow", the IC-VCM's mandate covers three steps:

1. Create a set of Core Carbon Principles (CCPs) which will set standards for high-quality carbon credits and define which types of programs are CCP eligible.
2. Provide governance and oversight when setting CCP eligibility/adherence.
3. Coordinate interlinkages between bodies, to build towards a roadmap for the effective growth of the VCM.

With the high profile of its sponsors and backers, the IC-VCM's CCPs are aiming to become the definitive global threshold standard for high-quality carbon credits, effectively setting "Standards" for the standard issuers and registers. A consultation on the CCPs was issued in July 2022, with the final CCPs published in Q4 2022. Of particular note, the consultation paves the way for non-permanent removals to have a limited role in the VCM (subject to replacement of credits or other compensation for reversals), recognising that earlier emission reductions have greater impact on global temperatures than later ones. It also consults on the recognition of adaptation co-benefits, which may allow emission reduction projects that also reduce the impact of climate change on communities to command higher pricing.

As emission reduction projects are often pre-funded, that is, the issuance of credits comes sometimes years after the investment made into a scheme, supply-side integrity also involves the development of mechanisms to ensure future delivery or compensation for non-performance. The Taskforce on Scaling Voluntary Carbon Markets has, in parallel to the IC-VCM's work on CCPs, made significant progress on developing a blueprint for a standardised prospectus/contract, as discussed further in section five.

[32] Cool Effect, Medium, Upholding the Integrity of the Voluntary Carbon Market: Organizations You Need to Know.
[33] The Integrity Council for the Voluntary Carbon Market.
[34] IC-VCM, High Quality Voluntary Carbon Credits Principles.

Background: What is a vintage and why does it matter?

A credit's vintage denotes the time that the credit was issued, or when the claimed reduction in emissions took place.

Older credits are often priced at a discount, reflecting in part older methodologies which may be perceived to be less sophisticated by discerning purchasers, but also typical discounting seen by sellers with excess inventory. In turn, they may be perceived as lower quality, as the project's claim that it requires the sale of carbon credits to be viable becomes less credible, undermining the credit's additionality.

There is, however, a dichotomy: timing matters. From a scientific perspective, carbon's impact is cumulative, meaning that a unit of carbon emitted today will have a greater impact on global temperatures than a unit in the future, and a unit avoided today is therefore more beneficial. This adds a further dimension to the debate around how capital should be allocated between lower quality, but potentially immediate, credits such as energy efficiency and protection of carbon sinks, and high additionality technologies such as carbon capture and sequestration, but which are not yet deployable at large commercial scale.

Creating demand-side integrity

On the demand-side, i.e., the purchasers of carbon credits, the challenges are different to the supply-side. While regulation is limited, many detailed standards already exist for the measurement of a carbon footprint and several for GHG removals, including from respected bodies such as the ISO. However, the landscape is fragmented, leading to poorer understanding and potential market confusion.

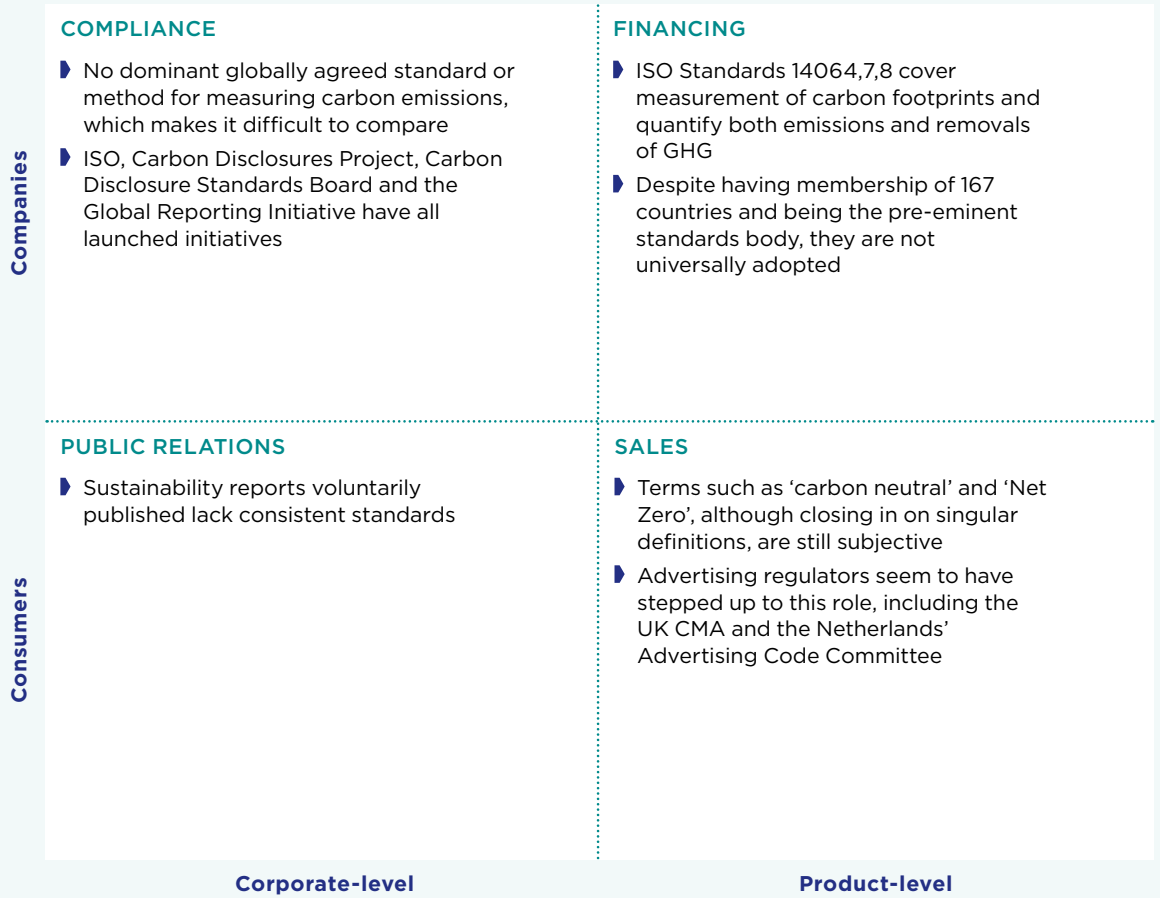
Purchasers of credits have many use cases, with different standards potentially applicable to each. Although some of these will not be relevant to the financial markets, they are covered briefly for the sake of completeness.

The lack of coalescence around a single standard or small subset of standards for each use case means that the value of adopting these voluntary standards has yet to reach its potential. Voluntary standards need incentives for adoption, and in the case of voluntary carbon credits, that means sufficient awareness that end users can exert direct pressure on companies, or indirect pressure through their purchasing patterns. Yet today, with some exceptions, meeting standards are a "bonus" badge of honour; making claims outside of a recognised standard fails to carry sufficient censure, unless clearly misleading. Recent regulatory and industry-led initiatives should begin to create a change.

Creating consistent and transparent disclosures

Disclosure begins with measurement. On the accounting side, the **International Sustainability Standards Board** was created in November 2021 by the IFRS Foundation, in response to increased demand for a reliable and comparable reporting standard on ESG issues. It is expected to comprise of 14 members from around the globe and will establish a set of comprehensive disclosure standards, which will be used globally by investors/capital market participants to help them understand climate-related risks and make informed decisions[36]. It is expected to base reporting off the most useful metrics which come out of the **Task Force on Climate-related Financial Disclosures** (TCFD), the Sustainability Accounting Standards Board (SASB), and the Climate Disclosure Standards Board (CDSB)[37].

Fig. 7 Indicative use cases for carbon credits and their usage and disclosure standards[35]



[35] FMSB.
[36] IFRS – International Sustainability Standards Board.
[37] KPMG, Introducing the International Sustainability Standards Board.

The last year has seen the first regulatory actions in the environmental transparency of the demand-side space, and although none have, so far, prescribed the use of credits, these are promising steps in the right direction:

- **The EU's Sustainable Finance Disclosure Regulation and Taxonomy Regulation** seeks to define what "good" ESG investments look like, as well as disclosure standards. One aspect of the Taxonomy regulation sets out that to be considered as environmentally sustainable, the activity should involve climate change mitigation or protection/restoration of biodiversity and ecosystems. This will influence when credits may be used to enhance the green credentials of an investment product. However, it fails to mandate how emissions for investment products should be calculated.

Creating demand-side integrity continued

- The UK requires mandatory sustainability reporting from financial years starting on or after 6 April 2022[38] and has published guidance based on the TCFD. However, scope 3 emissions, the largest for most companies, are excluded from the first wave and the FCA have proposed 2024 as the earliest adoption. Although stopping short of defining the treatment of credits, bringing climate reporting into the regulatory scope should help to increase standardisation in time.
- The U.S.' **Commodities Futures Trading Commission** released a Request For Information in June 2022 which asks whether their oversight might be desirable to "foster transparency, fairness, and liquidity" in the market, though given the Commission's mandate, this is likely to be restricted to derivative products rather than the underlying credits themselves[39].
- The U.S. **Securities and Exchange Commission** announced draft requirements for Climate-Related Disclosures[40]. These proposals include specific rules relating to the use of carbon credits, which is likely to impact the market.

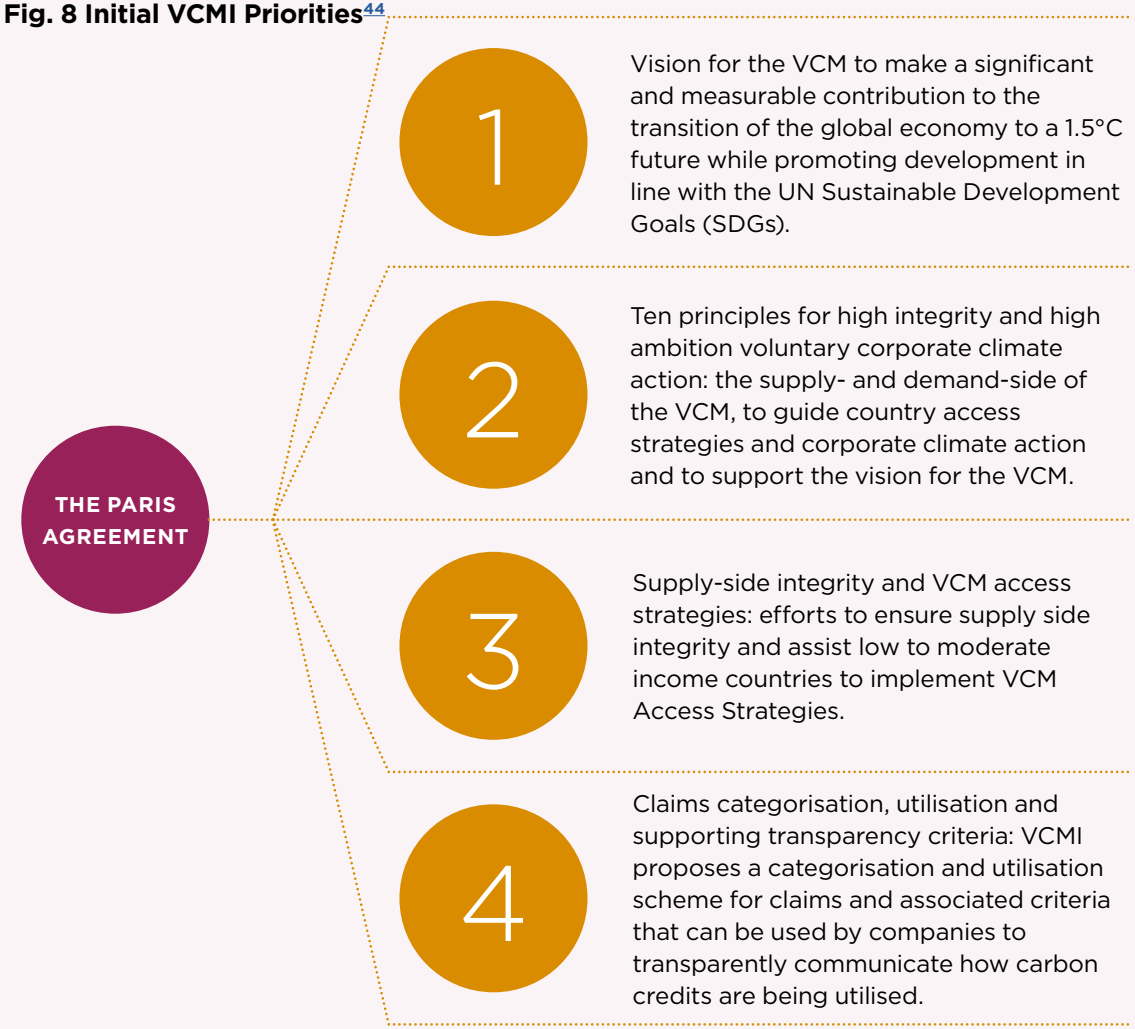
Additionally, another prominent international organisation has emerged to focus on the demand side integrity of voluntary credits. The **Voluntary Carbon Markets Integrity Initiative (VCMI)**[41] has proposed a categorisation scheme for legitimate voluntary use of carbon credits and related claims[42], to ensure that stakeholders can easily understand the climate impact of a company's actions. They will also promote the associated business cases for voluntary purchases of carbon credits. The VCMI notes that at present, there are few, if any, private sector standards on the demand-side that provide an assurance mechanism for determining the credibility of any claims made relating to the voluntary use of carbon credits.

The VCMI has stakeholders from various groups such as governments, businesses, NGOs, Indigenous Peoples, civil society actors, and climate change experts. It is funded by the Children's Investment Fund Foundation and the UK Government Department for Business, Energy, and Industrial Strategy.

The work of the VCMI and IC-VCM are complementary[43]: The IC-VCM have created the CCPs, which should ensure the quality of supply of carbon credits. The VCMI should ensure the quality of claims made by the credit purchasers. With influential backers, a wide network of stakeholders and the world's attention honed after COP26, the success of the two organisations is eagerly awaited.

38 GOV UK, Mandatory climate-related financial disclosures by publicly quoted companies, large private companies and LLPs.
39 CFTC, Request for Information on Climate-Related Financial Risk.
40 SEC, Proposed rule: The Enhancement and Standardization of Climate-Related Disclosures for Investors.
41 VCMI, Roadmap: Ensuring High-Integrity Voluntary Carbon Markets.
42 VCMI, Provisional Claims Code of Practice.
43 City of London, The Future of Voluntary Carbon Markets.
44 VCMI (Voluntary Carbon Markets Integrity Initiative).

Fig. 8 Initial VCMI Priorities[44]



Building market infrastructure and ecosystems

Assuming the measures to improve the supply- and demand-side of credits are successful, the third part of the puzzle is to bring both sides together. Historically, purchasers and suppliers of credits have met in the middle through the use of a broker, but rarely, if ever, have deep and liquid markets developed in any product based on private, bilateral transactions alone. Even mature, OTC commodities markets rely upon a degree of transparency of OTC bids and offers, as well as trading of derivative products, which allow for price-discovery.

Market participants have already innovated to build some of the necessary infrastructure to help solve the twin problems of liquidity and price transparency:

- **Transparent price-discovery and liquidity through listing:**
  - Carbon reduction projects are all unique, and as such have historically been purchased on a bilateral basis, with pricing set by individual brokers. One way of increasing liquidity is to embrace the uniqueness and allow individual projects to be publicly traded, rather than the current status of being private investments. The London Stock Exchange Group has announced plans to allow future projects to be listed either individually or pooled in a fund, which may also increase disclosure standards. Kraneshares recently developed the KSET ETF (KraneShares Global Carbon Offset Strategy ETF)[45] which tracks the S&P GSCI Global Voluntary Carbon Liquidity Weighted Index.

- **Pooling liquidity through standardisation/ commoditisation:**
  - This is a challenge with projects having their unique attributes, but exchanges such as Xpansiv CBL or the blockchain-based AirCarbon Xchange allow similar projects to be traded together under a single spot contract, pooling and therefore increasing the liquidity of the underlying eligible credits. For example, CBL's GEO (Global Emissions Offset), launched in August 2020, is based upon delivery of CORSIA-eligible credits[46]. N-GEO (Nature-Based Global Emissions Offset) followed in March 2021, backed by nature-based credits[47] and C-GEO[48] (aligned at the time of creation with the expected IC-VCM Core Carbon Principles) joined the product suite in January 2022. AirCarbon also offers "enhanced" Tokens which represent additional ESG benefits, such as biodiversity or sustainable benefit goals.
  - A concern is that there may be a "race to the cheapest" for credits eligible under each standardised contract; there is a judgment call to be made between creating additional categories for trading versus splitting liquidity, and robust standards and oversight will be required to manage this challenge.

- **Price-differentiation through increased transparency of projects:**
  - Many standards issuers/registries are aiming to make their databases more accessible, providing further information to the market. Listing, and the associated disclosures required by exchanges, may also help in this regard.

The most significant collaborative effort on market infrastructure to date has been the aforementioned Institute of International Finance (IIF)-sponsored **Taskforce on Scaling Voluntary Carbon Markets** (TSVCM), bringing together more than 250 institutions from around the world, and which established the IC-VCM. Their recommendations are a comprehensive blueprint for a voluntary carbon credit market, which should help enable the development of a deep, liquid, and coherent ecosystem over time.

It aims to establish:

- **An umbrella governance body**
  - The IC-VCM was launched with a mandate to implement, host and curate a set of Core Carbon Principles, provide oversight over standard issuers and coordinate interlinkages between individual bodies.

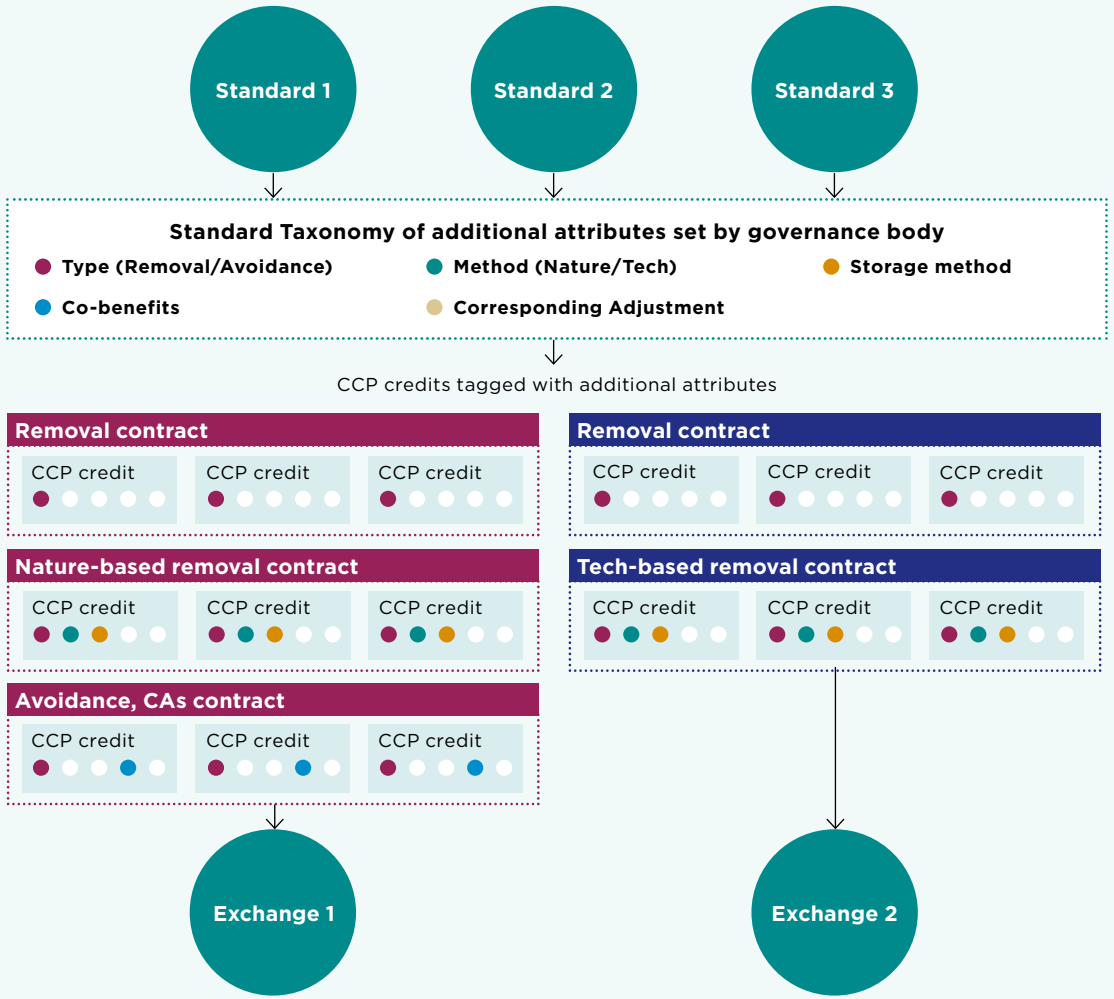
- **Legal principles and standardised legal contracts**
  - Standardising the legal framework behind issuance and trading, with common contractual clauses on liability, ownership, delivery etc. akin to those seen in more mature asset classes.
  - Defined use cases to drive awareness of potential ways to use the market.
  - Developing general trading terms clauses (e.g., standard settlement, definitions of force majeure, defaults in delivery etc.)

- **Credit-level integrity**
  - A Core Carbon Principle threshold standard that does not exclude credits from the market but marks out those that satisfy a high-quality standard.
  - A proposal for a taxonomy of additional attributes.

[45] KraneShares, KSET Global Carbon Offset Strategy ETF.
[46] Xpansiv, CBL Launches Global Emissions Offset, a Tradeable Product and Carbon Benchmark.
[47] Xpansiv, CBL Launches Nature-Based Global Emissions Offset.
[48] Xpansiv, CBL Launches Core Global Emissions Benchmarks.

Building market infrastructure and ecosystems continued

Fig. 9 A blueprint for standardisation of carbon credit contracts[49]



The TSVCM's Blueprint has the "look and feel" of a mature asset class trading environment and is expected to rapidly increase the speed at which the VCM can scale. By setting standards for carbon credit contracts, it also paves the way for the development of additional post-trade solutions, such as clearing houses.

How exactly the Taskforce's vision influences the development of the marketplace will become clearer with time. For example, will the recommendations "gold plate" credits to the extent that lower quality, but still valuable, projects are ignored completely? Does the possibility of "default" for innovative technological start-ups reduce the amount of financing that they are able to receive, and therefore invest into development? Indeed, should the market find ways of allocating capital to lower quality and/or not-yet-developed credits through different instruments?

What should a Voluntary Carbon Market do?

"A liquid voluntary carbon market at scale would allow billions of dollars of capital to flow from those making Net Zero commitments into the hands of those with the ability to reduce and remove carbon, accelerating the transition to Net Zero[50]**."**

Before considering the potential future directions of the VCM, market participants should consider the role that the VCM should play against the wider backdrop of which projects that drive climate action get funded, and how.

The focus of global VCM initiatives so far has been on increasing integrity, liquidity and market infrastructure. Trust and integrity in a nascent market is vital to create the confidence for investors to allocate capital at scale. However, the underlying purpose of the VCM in creating the most efficient allocation of available capital into projects to help fight climate change should not be forgotten. While it may be appropriate to question the issuance of carbon credits due to the doubtful additionality of new large-scale wind farms, the magnitude of benefit of the preservation of forests, or chances of success in the case of new technologies, it is undeniable that projects such as these are necessary to combat climate change. The question is how to establish which ones truly require additional capital to materialise, and if and how they may fit into the VCM landscape. Will eliminating low quality but high magnitude credits for not having "integrity" reduce investment, or will expanding the VCM to include low quality credits risk faith being lost in the asset class – especially as certain influential NGOs oppose either the market mechanism itself or the implications? Or is there a middle way?

[49] IIF, TSVCM Phase 2 Report, p 97.
[50] City of London, The Future of Voluntary Carbon Markets.

Building market infrastructure and ecosystems continued

Background: Lessons learned from Gold?
How much differentiation can there be in a mature market? Drawing a parallel to one of the oldest commodities, gold, may yield some insights.

Buying a spot gold contract means the buyer immediately owns (and if electing to be delivered, to receive) the agreed number of troy ounces of 99.5% pure gold in bullion form. This is the standard reference contract. However, those looking purely for exposure to gold may elect to invest in related assets for different risk exposure. An investor may instead choose to purchase the equity of a monoline producer to increase their leverage and exposure to rising prices, but also at the expense of exposure to the producer's overall strategy and governance. Even higher risk and reward might be a stake in an exploratory mine, but this also brings discovery risk, as well as a likely less liquid investment. Abilities to hedge are introduced through the introduction of derivatives, or investing instead in a diversified miner, portfolio, or fund.

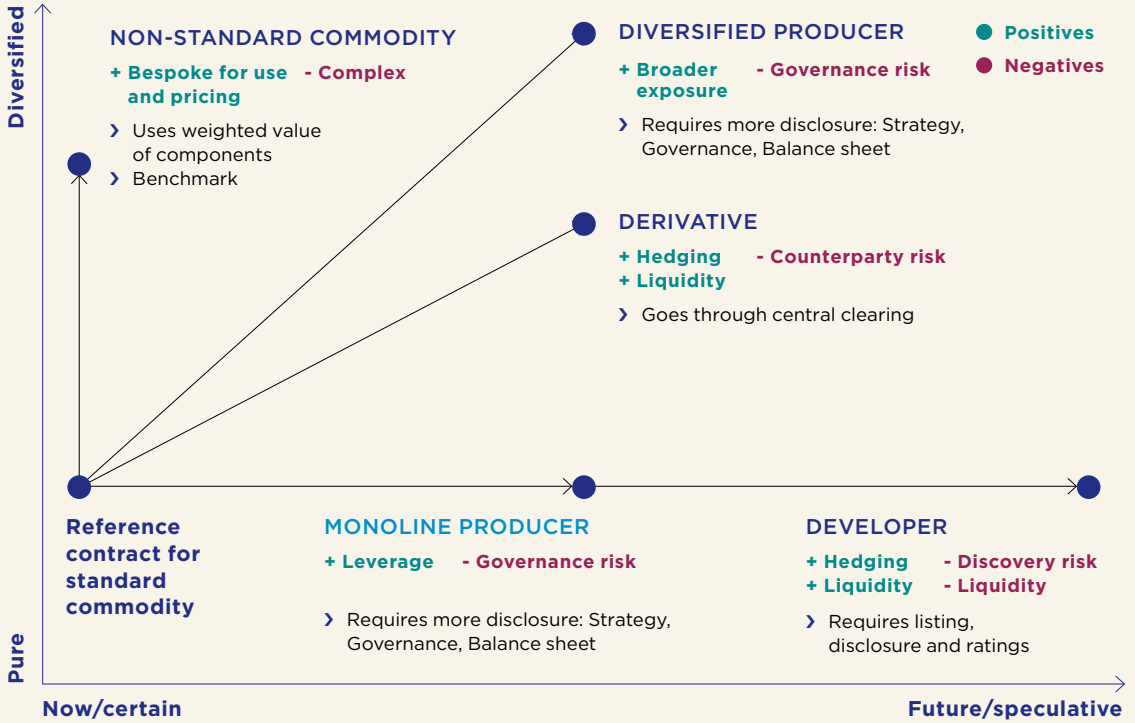
Then there are end users of gold in industry or luxury products. Pure gold may not be desirable, being too soft to grip securely onto gemstones in the case of jewellery. The cost of design and labour may make a finished piece multiple times more expensive than the cost of the raw materials, and less secure as a store of ultimate value, but fulfil a specific aesthetic desire.

Of course, there are also those who desire the appearance but not the price – hence the enduring allure of fools' gold (greenwashing, however, should not have a place in the VCM).

Purchasers of these related assets do not significantly impact the gold standard. Indeed, investors in the producers help with the production of more gold. End users of alloys do not alter the pricing of bullion, provided there is sufficient transparency around their composition. The question is whether a similar level of understanding, transparency and trust can be developed in the VCM, and sufficiently quickly.

Yet gold also has substitutes, depending on the properties desired by the use case. Similarly, there are other mechanisms by which capital can be directed towards climate-friendly goals. Some recent innovations have been created just for this purpose – e.g., Green Bonds "ringfence" debt funding for environmentally green projects. Traditional products – equity or debt funding into climate-aligned companies – also have a role to play, as do grants, be they governmental (in the form of international aid) or private philanthropy. Which types of projects are supported through the issuance of carbon credits, and which are better suited for other sources of funding, are important design questions for the VCM.

Fig. 10 An indicative commodity ecosystem



Building market infrastructure and ecosystems continued

Case Study:
The Cuvette Centrale Peatlands of the two Congos

In 2017, scientists discovered the world's largest tropical peatland in the Congo Basin, a long-term carbon sink the size of the UK.
Comprised of thousands of years of dead organic matter whose decomposition has been stalled due to the waterlogged conditions, peat does not capture additional carbon.
Yet draining the peatland for economic development, either for palm oil plantations (as seen across Southeast Asia) or oil exploration would rapidly release this stored carbon into the atmosphere as emissions – estimated to be between 3-7 years of the world's total emissions if considering the entire basin.

How should the preservation of the peatlands be incentivised?
A similar peatland in Angola is being preserved through a donation by a major mining company with geographical links to the area, as part of its Corporate Social Responsibility initiatives.
But can this arrangement last? And is there sufficient supply of funding available, without a financial return or receipt of credits in return, to scale this model?

A mature Voluntary Carbon Markets ecosystem?
If we assume that the VCM can and should support a broad range of types and qualities of credit, there remain gaps in the wider ecosystem to enable this to happen. Liquidity and transparency are only part of a mature market – the ability to calculate relative value between different asset qualities, as well as along a time horizon, are also essential.

The existing and future industry-led efforts on the market have all been trying to solve an unusual conundrum. While carbon allowances are commodities, being entirely fungible with each other within a regulated market, carbon credits are the opposite. Unlike most assets, where pricing of derivatives and related assets are based on the underlying, carbon credits are currently bespoke products from which we are still trying to derive the price of the hypothetical underlying pure credit. If the carbon credit market is to replicate the size and depth of other mature asset classes, other indicators to help with price discovery will be required.

Also of significance is that, while growing, the VCM remains relatively small in comparison to other asset classes, in particular, the volumes traded on the new exchanges. With over 35% of market share, the leading trading platform for carbon credits saw just over 120 million tonnes traded in 2021 (although an almost three-fold increase on the prior year), compared to almost 11 billion tonnes for the EU ETS[51] over the same period. Additional market data and pricing signals will allow judgment to be made about credits' relative value, helping to sustain this continued growth in volume and transforming these exchange markets from illiquid to liquid.

120m tonnes

traded in 2021 on the leading trading platform

11bn tonnes

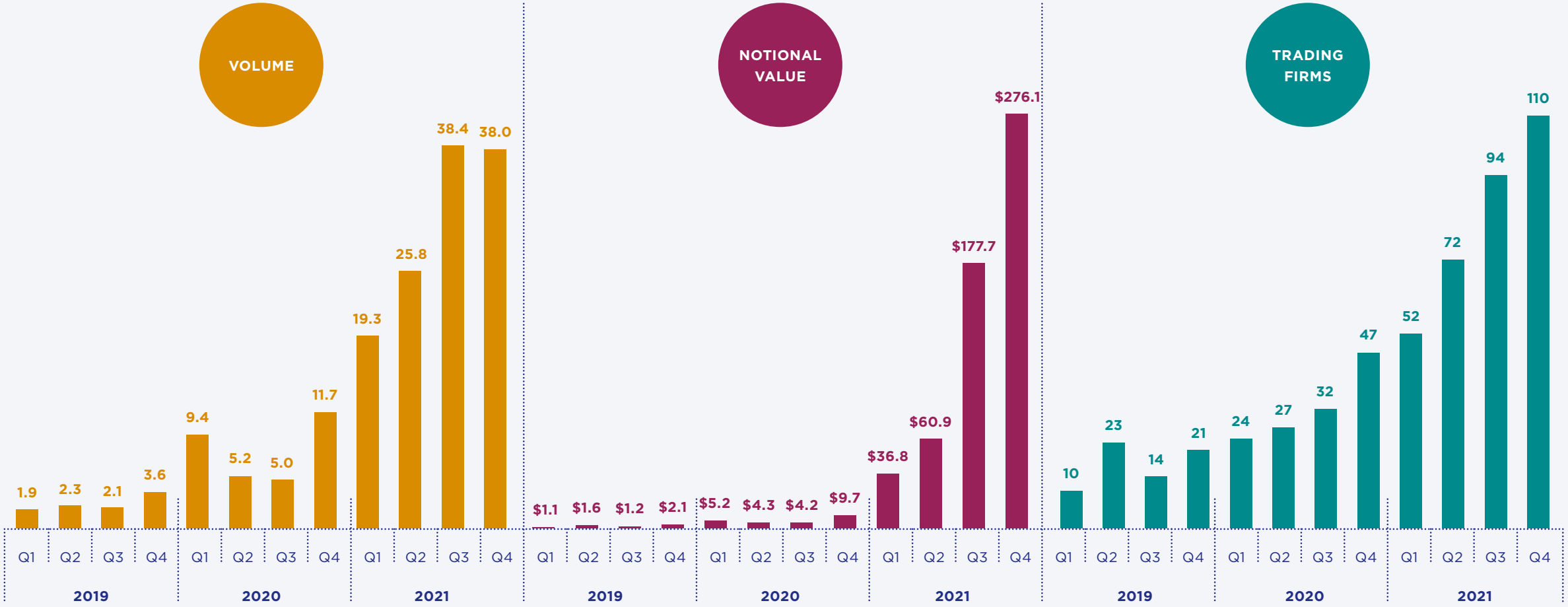
traded for the EU ETS in 2021

[51] EcoAct, Key messages from 2022 State of the EU ETS Report.

Building market infrastructure and ecosystems continued

Fig. 11 Xpansiv CBL Voluntary Carbon Market Metrics[52]

[52] Xpansiv, 2021 Xpansiv Carbon Volume Rises.
Note: this graph includes trading data from all CBL carbon futures contracts.



Building market infrastructure and ecosystems continued

Such indicators and market information could include:

- **Ratings**
  - Verification by one of the standard organisations simply certifies a project as counting, or not counting, as capable of generating carbon credits under their methodology.
  - There is a risk that capital might be disproportionately allocated to the lowest quality credits that meet the criteria. Alternatively, some market participants might elect to purchase only the highest quality credits, meaning that those of lower quality, but backed by still worthwhile projects, may be neglected if verification standards become more stringent. Could non-binary ratings provide a solution, allowing a larger basket of lower-quality credits to be equated to a smaller basket of high-quality ones?
  - Carbon credit rating firms such as Sylvera, Calyx Global and BeZero Carbon Ratings have been established in recent years. Their aim is to give greater confidence surrounding the integrity of carbon credits. While methodologies may vary, the overarching purpose of ratings is to give an indication of how likely it is that a carbon reduction project will deliver on its claimed carbon removals or reductions[53]. Ratings may consider factors such as the claimed additionality or permanence[54] of a project, and how accurate this claim is.
  - Calyx Global and Sylvera also provide information about the Sustainable Development Goals, which may be linked to a carbon credit. Both the Calyx Global SDG Rating and the Sylvera Co-Benefits Rating give an indication to the quality of the certification claiming the SDG impact[55].

- **Benchmarks**
  - This would allow for plus/minus pricing for individual contracts, depending on how much they deviate positively or negatively against an average credit of its type.
  - Observable market prices e.g., tradeable spot contracts, of course act as a benchmark for the categories of carbon credit which are eligible under them. For other credit types which are not yet traded, index companies are stepping in to fill the gap, such as S&P Platts' CARBEX indices: standalone and basket assessments for different categories of credits.

- **Derivatives**
  - Already well-established in the compliance allowance markets, derivatives may help to assist with hedging.
  - CME[56] has been active in expanding derivative contracts to carbon credits, and has jointly launched futures contracts with Xpansiv CBL, whose spot contracts form the underlying, with the GEO future first trade occurring in March 2021, and N-GEO and C-GEO futures following in August 2021[57] and March 2022[58] respectively. Two more trailing futures contracts are expected to launch in August 2022[59]. ICE, although predominantly covering compliance markets with its index and futures products, has also launched a Nature-Based Solutions future (NBS), allowing delivery of credits certified by Verra and deriving from Agriculture, Forestry and Other Land Use (AFOLU) Projects[60].
  - Futures contracts will also help the market to price the time-element of carbon credits, towards the creation of forward curve-like metrics.
  - The International Swaps and Derivatives Association (ISDA) has signalled its intention to strengthen its involvement in this space in due course, with the expected publication of its Voluntary Carbon Credits template later in 2022[61].

53 Sylvera, Carbon Credit Ratings Platform.
54 BeZero Carbon Ratings.
55 Calyx Global.
56 CME Group, CBL Global Emissions Offset Futures.
57 CME Group, CME Group Announces First Trades of Nature-Based Global Emissions Offset (N-GEO) Futures.
58 CME Group, CME Group to Launch CBL Core Global Emissions Offset Futures.
59 CME Group, CME Group Expands Suite of Voluntary Carbon Emissions Offset Contracts Amid Record Volume, Open Interest.
60 Intercontinental Exchange, ICE Launches its First Nature-Based Solutions Carbon Credit Futures Contract.
61 ISDA, Legal Implications of Voluntary Carbon Credits.

Building market infrastructure and ecosystems continued

Fig. 12 S&P Platts VCM Indices and Baskets

Source: S&P Platts

STAND-ALONE-ASSESSMENTS

PLATTS CEC
CORSIA- eligible credits + 0 SDGs

→ **PLATTS RENEWABLE ENERGY**
- Current and Year+1
- Wind, solar, geothermal and hydro

PLATTS CNC
Nature-based credits + biodiversity SDGs

→ **PLATTS METHANE COLLECTION**
- Current and Year+1
- Landfill, livestock and waste gas

CARBEX INDICES

ECO PROTECT CARBEX
- Avoided deforestation + Bio SDGs

ECO PROTECT CARBEX SOCIAL
- Avoided deforestation + Bio + Social SDGs

ECO CREATE CARBEX
- Reforestation + Afforestation+ 0 SDGs

ECO CREATE CARBEX BIODIVERSE
- Reforestation, Afforestation + Bio SDGs

HOUSEHOLD DEVICES CARBEX
- Cookstoves + Bio + Social SDGs

SOIL CARBEX
- Soil Sequestration + Bio + Social SDGs

BASKET ASSESSMENTS

PLATTS CAC

→ **HOUSEHOLD DEVICES**
- Current and Year+1
- Cookstoves and water access
- Social SDGs, 2017+

→ **NATURE-BASED AVOIDANCE**
- Current and Year+1
- REDD+, no-till farming and wetlands
- Bio SDGs, 2016+

→ **INDUSTRIAL POLLUTANTS**
- Current and Year+1
- Water purification, NO_2 destruction and ozone
- Social SDGs, 2017+

PLATTS CRC

→ **TECH-BASED CARBON CAPTURE**
- Current and Year+1
- Direct air capture, CCUS and mineralisation
- Social SDGs, 2017+

→ **NATURE CARBON CAPTURE**
- Current and Year+1
- Reforestation, afforestation and soil sequestration
- Bio SDGs, 2016+

Conclusion

In the carbon markets, as with all other financial markets, there will be different types of participants with different risk and exposure appetites. As the Voluntary Carbon Markets start to scale, the industry needs to consider how the end state of these markets should look from a normative perspective, considering the multiple use-cases for carbon credits, and the derivative products which may develop.

Perhaps a venture capitalist seeks to invest in a so far unknown technology, and part of that investment proposition requires a projection of cash flow from the potential sale of carbon credits in the future. Or a company committed to sustainability wishes to lock in the pricing for its carbon credits to avoid volatility on its journey. Or an ESG-focused investor still prefers the personal link between purchasing credits directly from an individual project and fostering the link with the communities whose sustainable development that enables. And maybe becoming a steward of a patch of forest gives an individual a sense of hope in the face of the formidable challenges humanity faces in the journey to Net Zero.

Whatever international organisations and collective market participants settle on as acceptable carbon credits and acceptable use cases of voluntary carbon credits, key to a future VCM's fairness is transparency – both to the immediate purchaser, and any others downstream. Key to the markets' effectiveness are tools for liquidity and price discovery, allowing for comprehensive comparison of credits along multiple parameters, as for more mature asset classes.

The industry, both in isolation and collectively, has begun to lay the groundwork for scaling the Voluntary Carbon Markets. It is now up to market participants to further occupy this developing infrastructure and allow capital to flow, at scale, to carbon reduction and removal initiatives that will be vital to the world's goal of Net Zero 2050.

Appendix

Organisations

Name	Who	Description	Output
Climate Disclosure Standards Board (CDSB) (2021)	IFRS Foundation	No longer running – has been consolidated into the IFRS foundation following creation of ISSB (below).	Standards of disclosure
Climate Warehouse	World Bank	Using blockchain technology to better report climate project information and issuances. The goal is to increase transparency and enable traceability of projects.	Public data
COP 26 (2021)	United Nations Framework Convention on Climate Change (UNFCCC)	26th meeting of the supreme body of the UN Framework Convention on Climate Change. Bringing countries together to discuss climate change and reach an agreement on how to collectively tackle it.	International legislation
EU Sustainable Finance Disclosure Regulation and Taxonomy Regulation (2022)	EU	An action plan to help meet the EU's 2030 climate and energy targets. The plan covers 6 main environmental objectives.	Regulatory disclosure
Glasgow Financial Alliance for Net Zero (GFANZ)	Global financial institutions	Global coalition of financial institutions with a commitment to the decarbonisation of the economy.	Voluntary commitment to decarbonisation
International Association of Insurance Supervisors (IAIS)	Members from over 200 jurisdictions	A global standard-setting body for insurance supervisors. Climate risk is an area of focus.	Standard setting to address climate risk
International Sustainability Standards Board (ISSB) (expected 2022)	IFRS Foundation, anticipating 14 members globally	Aim to create standards for disclosure on ESG reporting, to make it more reliable and comparable.	Standards of disclosure
Sustainability Accounting Standards Board (SASB) (2011)	Independent Board. Precursor to ISSB	Published 77 Industry Standards in 2018, which outline the minimal financial sustainability topics and metrics.	Voluntary standards for disclosure
Task Force on Climate-related Financial Disclosures (TCFD) (2021)	Financial Stability Board (FSB), 31 members in the Task Force from across the G20	Makes recommendations with the aim of encouraging greater transparency related to climate change and the associated risk management processes.	Voluntary disclosure
Taskforce on Scaling Voluntary Carbon Markets (TSVCM) (2021)	Sponsored by IIF, with over 250 member institutions	Recommendations to improve the integrity of Voluntary Carbon Markets, bringing together participants from all areas of the market.	Voluntary standards to scale the VCM
The Integrity Council for the Voluntary Carbon Market (IC-VCM)	Independent	Create a set of Core Carbon Principles, which aim to improve integrity and quality of carbon credits. Established by the TSVCM (above).	Voluntary standards to improve quality of credits

Appendix continued

Organisations

Name	Who	Description	Output
The International Emissions Trading Association (IETA) (1999)	Global members	Aims to help deliver the Paris Agreement's climate protection goals, by accurately pricing carbon and delivering net zero targets. Members form the Working Groups.	Voluntary commitment to improve carbon pricing and promote decarbonisation
The Oxford Principles for Net Zero Aligned Carbon Offsetting (2020)	University of Oxford	The principles give suggestions for how to ensure that carbon offsets are delivering emission reductions, to reach Net Zero.	Principles to promote decarbonisation and credit quality
Voluntary Carbon Markets Integrity Initiative (VCMI) (2021)	A range of global stakeholders representing all aspects of the market	Produced 10 principles for guiding corporate climate action. Now creating a Claims Code of Practice to help drive the use of voluntary carbon credits. It looks to promote both demand and supply side integrity.	Voluntary standards to scale the VCM
Voluntary Registry Offsets Database	Developed by the Berkeley Carbon Trading Project and Carbon Direct	A database with information from voluntary offset project registries, including all carbon offset projects, credit issuances, and credit retirements from Climate Action Reserve, American Carbon Registry, Verra and Gold Standard.	Registry database

Appendix continued

Regulations/Standards

Name	Organisation	Who	Description	Type
CORSIA Initiative (2016)	ICAO	Aviation industry – 193 governments directing ICAO	An initiative to reduce net carbon emissions from the aviation industry through offsetting. Compulsory for signatories after first phase ends in 2026. 115 countries are participating for 2023.	Regulatory standards for decarbonisation
EU Emissions Trading Scheme (ETS) (2005)	EU	All EU countries, plus Iceland, Liechtenstein, and Norway	Targets emissions from specific industries in the EU. A cap is set on the total amount of emissions which are allowed, and allowances can be traded. The cap is gradually reduced.	Regulatory carbon trading market
EU Green Bond Standard (EUGBS) (2022)	European Parliament	EU countries	Creates an official standard for green bonds, which is aligned to EU taxonomy. This should reduce greenwashing and improve transparency.	Voluntary standards for green bonds
Global Resilience Index Initiative (GRII)		Global	Pillar 2 to complement the ISSB recommendations, which will be Pillar 1.	Standards
Greenhouse Gas Protocol (GHGP) (2021)	World Resources Institute and Business Council for Sustainable Development	92% of Fortune 500 companies adopted the GHG Protocol in 2016.	Provides global greenhouse gas accounting standards, to measure and report GHG emissions.	Voluntary standards for reporting
ISO Standards: ISO 14064 (2018)	ISO	Membership of 167 countries	Set of requirements to calculate and report GHG emissions and removals.	Voluntary standards for reporting
Kyoto Protocol (1997)	United Nations Framework Convention on Climate Change (UNFCCC)	192 parties	Commits countries to climate policies agreed by the UNFCCC.	Regulatory standards for decarbonisation
Paris Agreement (2015)	United Nations	193 parties	Create a set of long-term goals to help all countries reduce their greenhouse gas emissions, to achieve a limit of 1.5°C on the global temperature increase.	International treaty

Appendix continued

Regulations/Standards

Name	Organisation	Who	Description	Type
Partnership for Carbon Accounting Financials (PCAF) (2020)	Independent	Financial institutions	Provides guidance on how to measure and report GHG emissions for 6 main asset classes.	Voluntary standards for reporting
Provisional Claims Code of Practice	VCMI	Global	Guidance on how to categorise carbon offsetting claims, based on the VCMI's 10 principles for corporate climate action. Aims to improve credibility of offsetting.	Voluntary guidance for quality of offsets
Standardizing Climate-Related Disclosures	SEC	US	Proposal for specific rules relating to the use of carbon credits and rules for disclosure and reporting.	Regulatory standards for disclosure

Discussion pieces

Name	Organisation	Description	Type
Mind the Gap: How Carbon Dioxide Removals Must Complement Deep Decarbonisation to Keep 1.5°C Alive (March 2022)	Energy Transitions Commission	Conducted analysis to argue that even with the quickest emissions reductions, the economy will still need significant carbon removals to reach the global goal of 1.5°C.	Report
Unlocking the Potential of Carbon Markets to Achieve Global Net Zero (October 2021)	GFMA (Global Financial Markets Association)	Discussion of how compliance and voluntary carbon markets can contribute to the transition to a low-carbon economy.	Report

Key acronyms

Acronym	Term
ACR	American Carbon Registry
AFOLU	Agriculture, Forestry and Other Land Use
CA	Corresponding Adjustment
CAR	Climate Action Reserve
CCPs	Core Carbon Principles
CDM	Clean Development Mechanism
CDR	CarbonPlan Database
CDSB	Climate Disclosure Standards Board
DAC	Direct Air Capture
ECA	Enterprise Carbon Accounting
ETS	Emissions Trading Scheme
EUGBS	EU Green Bond Standard
GFANZ	Glasgow Financial Alliance for Net Zero
GFMA	Global Financial Markets Association
GHG	Greenhouse Gas
GHGP	Greenhouse Gas Protocol
GRII	Global Resilience Index Initiative
IAIS	International Association of Insurance Supervisors

Acronym	Term
IC-VCM	Integrity Council for Voluntary Carbon Markets
IETA	The International Emissions Trading Association
ISDA	International Swap and Derivatives Association
ISO	International Organization for Standardization
ISSB	International Sustainability Standards Board
ITMO	Internationally Traded Mitigation Outcomes
LCA	Life Cycle Assessment
PCAF	Partnership for Carbon Accounting Financials
REDD+	Reducing Emissions from Deforestation and Forest Degradation
SASB	Sustainability Accounting Standards Board
SBTi	Science Based Targets initiative
SDG	Sustainable Development Goal
SFDR	Sustainable Finance Disclosure Regulation
TSVCM	Taskforce on Scaling Voluntary Carbon Markets
UNFCCC	United Nations Framework Convention on Climate Change
VCC	Voluntary Carbon Credit
VCM	Voluntary Carbon Markets
VCMI	Voluntary Carbon Markets Integrity Initiative

End notes

1 In this paper, "carbon" refers to its form as carbon dioxide in the atmosphere, unless the context requires otherwise.
2 Other use cases include acting as a mechanism for results-based finance, making climate finance contributions, or surrendering the credits in a compliance market context, such as Singapore's carbon tax.
3 BSI, PAS 2060 – Carbon Neutrality Standard and Certification.
4 Net Zero is the target of eliminating all greenhouse gases emitted from human activity.
5 While other GHG exist, this paper focuses on carbon dioxide, the "currency" into which other GHG credits are converted and traded. See also S&P Global, Carbon credits issued for cow methane reduction in potential world first.
6 United Nations, The Paris Agreement.
7 Ibid.
8 EU counted as one country for this purpose.
9 The Voluntary Carbon Market, Evolution of Voluntary Carbon Market.
10 World Bank, State and Trends of Carbon Pricing, 2021.
12 Note that while some compliance ETS allocate the revenue from allowance auctions to climate projects, they are not credits as there is no linkage between the allowances and the amount of carbon offset by these projects.
13 S&P Global, Voluntary carbon markets: how they work, how they're priced and who's involved.
14 Though theoretically private individuals or organisations could purchase allowances on the compliance market and retire them, thereby pushing up the price and further incentivising the reduction in emissions in the regulated industries, in practice this is both less efficient than, and psychologically less meaningful, than direct investment into carbon credits.
15 GOV UK, firms must commit to net zero to win major government contracts.
16 Carbon Offset Guide, Additionality.
17 Note though that many afforestation and reforestation projects are linked to economically viable timber concessions.
18 For a detailed analysis of key carbon removal project types and their potential, see: UN Framework Convention on Climate Change, Removal activities under the Article 6.4 Mechanism, section 3.1.
19 Center for Climate and Energy Solutions, Carbon Capture.
20 Yale E360, The Dream of Carbon Air Capture Edges Toward Reality.
21 Imperial College London, Q&A: Is planting trees the answer to climate change?
22 For example, Prof. Myles Allen CBE, Lead author and contributor to three IPCC reports University of Oxford, Why Net Zero (and what is it?).
23 See section three of this paper.
24 Energy in Demand, Measuring Net Zero emissions is not simple.
25 PNAS, Overstated carbon emission reductions from voluntary REDD+ projects in the Brazilian Amazon.
26 This remains a complex and evolving area, and further progress is expected at COP27.
27 J.P. Morgan Asset Management, The global carbon market: How offsets, regulation and new standards may catalyze lower emissions and create opportunities.
28 The Gold Standard, What's a ton of good worth?
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30 Climate Action Reserve, Voluntary Offset Program.
31 UNFCCC, The Clean Development Mechanism.
32 Cool Effect, Medium, Upholding the Integrity of the Voluntary Carbon Market: Organizations You Need to Know.
33 The Integrity Council for the Voluntary Carbon Market.
34 IC-VCM, High Quality Voluntary Carbon Credits Principles.
35 FMSB.
36 IFRS – International Sustainability Standards Board.
37 KPMG, Introducing the International Sustainability Standards Board.
38 GOV UK, Mandatory climate-related financial disclosures by publicly quoted companies, large private companies and LLPs.
39 CFTC, Request for Information on Climate-Related Financial Risk.
40 SEC, Proposed rule: The Enhancement and Standardization of Climate-Related Disclosures for Investors.
41 VCMI, Roadmap: Ensuring High-Integrity Voluntary Carbon Markets.
42 VCMI, Provisional Claims Code of Practice.
43 City of London, The Future of Voluntary Carbon Markets.
44 VCMI (Voluntary Carbon Markets Integrity Initiative).
45 KraneShares, KSET Global Carbon Offset Strategy ETF.
46 Xpansiv, CBL Launches Global Emissions Offset, a Tradeable Product and Carbon Benchmark.
47 Xpansiv, CBL Launches Nature-Based Global Emissions Offset.
48 Xpansiv, CBL Launches Core Global Emissions Benchmarks.
49 IIF, TSVCM Phase 2 Report, p 97.
50 City of London, The Future of Voluntary Carbon Markets.
51 EcoAct, Key messages from 2022 State of the EU ETS Report.
52 Xpansiv, 2021 Xpansiv Carbon Volume Rises.
53 Sylvera, Carbon Credit Ratings Platform.
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61 ISDA, Legal Implications of Voluntary Carbon Credits.

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