October 2023

THE OXFORD INSTITUTE FOR ENERGY STUDIES

The creation of a global carbon market: A taxonomy of carbon pricing under Article 6

Introduction

Carbon pricing is a critical tool to help countries and companies achieve their climate targets by valuing the externality of carbon emissions. Carbon pricing exists as a penalty, subsidy, or valuation of a carbon sink with the key aim of delivering a price signal for investment in the reduction or the removal of carbon. The Intergovernmental Panel on Climate Change (IPCC) and the World Bank among many others consider it as a key instrument to incentivize and stimulate capital markets to deliver the emission reductions and removals required to achieve the targets of the Paris Agreement.

While a simple concept, the universe of carbon pricing is complex due to the breadth of activities, the variety of applications, and further what is a myriad of combinations depending on geographical opportunity and political will. The objective of this Energy Insight is to describe some of the basic features of carbon markets and analyse some of the wider consequences. It intends to distil some of the complexity inherent in these markets, not by oversimplifying into a 'singular' specification driven by a misguided desire for one-size-fits-all – be it for simplicity's sake or for business purposes, but by categorization into an understandable taxonomy.

This paper shows why having a one-size-fits-all carbon pricing mechanism is not only *not* possible, but that heterogeneity in carbon markets is in fact *needed*, if they are to reach their promised potential. Heterogeneity in carbon markets can be explained by the fact that different carbon reduction or removal solutions deliver with differing volumetric potential, at different implementation costs and different timescales, and cater to a wide range of buyers prioritizing different pricing applications. By approaching carbon on a multi-product, specification-based approach, we are able to embrace the inherent heterogeneity and nuance required by reviewing:

- What are the types of carbon pricing applications?
- Who determines the specification of a carbon unit?
- What are the core specifications of a carbon unit?
- What are the various types of carbon units and how do they vary in cost and scale?
- What is Article 6 and how will it underpin global carbon markets?

The paper will continually reference carbon in the context of a commodity. This is on the basis that the achievement of the Paris Agreement is measured indirectly in tons, and commodity markets have proven best suited to translate capital to goods and services required when that delivery is on a volumetric basis. Commodity markets have also displayed strong resilience in the face of change, be it

Energy Insight: 136

Hannah Hauman, Global Head of Carbon Trading, Trafigura
Bassam Fattouh, Director, OIES
Hasan Muslemani, Head of Carbon Management Research, OIES

specification, technology, regulatory, or market structure changes.[1] Based on this framework, we make the following key observations:

- Carbon pricing is key to achive climate targets as it delivers a price signal to capital markets and corporate decisionmakers to prioritize and invest in emission reduction and removals by valuing the externality of carbon emissions.
- The universe of carbon pricing is complex given the breadth of activities; the diverse and evolving specifications due to rapid developments in science and technology; the layered approaches due to variability in landscapes, politics, climate ambitions and prices; and fluidity due to change in policy as climate ambitions increase.
- The heterogeneity and the complexity of carbon pricing markets should be embraced as the delivery of emission reduction and removals occur in highly varied types of supply chains. This goes against the apparent desire for simplification that is not practical nor relevant for the problem set.
- Carbon is not a singular product and instead can be thought of an asset class with different characteristics to satisfy the requirements/preferences of a wide set of investors/buyers.
- There are continued calls from carbon pricing advocates for a “global carbon price”. While this is admirable from the perspective of encouraging global cooperation and investment towards energy transition, this oversimplification of a complex asset class would not deliver the impact and diversified capital investments that are required.
- Article 6 of the Paris Agreement is the first true global carbon market that will set a standardized and unified framework for carbon accounting and carbon credit qualities. However, this standardization will enhance the stratification presently seen in carbon pricing and carbon markets, with differentiated pricing for the various carbon specifications within the overall asset class.

What are the types of carbon pricing applications?

Carbon pricing exists in three key forms: as a penalty, subsidy, or valuation of a carbon sink.

Carbon penalties apply to “positive” emissions released by an activity or asset on an incremental ton of CO_2e emitted basis. Penalties most commonly take the form of “allowances” - or permits - to emit under regulated cap and trade schemes (or more generally, Emission Trading Systems - ETSs). Other forms of penalties include regulated carbon taxes and unregulated internal carbon pricing (ICP) by which companies may model a theoretical cost of carbon to their business (whether for investment decisions or risk/share price exposure). While the mode of delivery may differ, the common thread is that the price signal is meant to disincentivize future emissions – either via a downturn in production, greater efficiency measures, process conversions or activity changes, or deployment of carbon capture technologies. Where successfully deployed, carbon penalties will continue to grow in volume over time as ambitions and sectors in scope increases, and over time decrease as overall emissions decrease. Penalties can be static or progressive, such as in the instance of carbon taxes, or market based, as in the case of ETSs though for the most established ETS, the EU ETS, the main tool is the scheduled decrease in annual issuances that guides the market towards lower emissions by issuing fewer permits each year.

Carbon subsidies, defined as an incentive to reduce “positive” emissions or increase “negative” emissions related to an asset or activity take a variety of modes including credits, tax rebates, and other incentives. Carbon subsidies exist to bridge the economic gap to enable a change in business-as-usual

[1] For example, specification changes such as seen in the oil markets and in the global reduction in the sulphur content of refined products. Equally market structure changes, such as the increased commoditization of gas whereby pricing against crude oil benchmarks proved irrelevant over time and global gas pricing benchmarks are now the norm.

activity or to make viable early-stage technology or infrastructure for deployment of investment. This is commonly seen in projects involving renewable power or sustainable forestry projects, or to retire assets beyond economic factors such as the early retirement of coal powered plants. Whilst varying modalities of subsidies exist, a shared feature is that subsidies exist in an environment with more than one revenue stream related to the asset or activity.

Lastly, **carbon sinks** reference activities or assets whereby the carbon externality is the exclusive intent and the sole revenue stream. Sinks, similar to subsidies, exist for projects reducing "positive" emissions from either industrial or nature-based sources, such as point-source CCS (without Enhanced Oil Recovery (EOR)) or reduced deforestation, afforestation and reforestation.

It is worth noting that there is a final form of carbon value exchange, categorized as Results Based Payments. Results Based Payments involve capital transfer between two third parties, but without the pursuit of title or ownership of a unit of CO_2e. In most instances, Results Based Payments are targeting capital with ton-related incentives. Most often Results Based Payments are related to philanthropic efforts, however, increasingly are being utilized in financial instruments, such as sustainable sovereign bonds with rates tied to achievements against deforestation and forest degradation, measured, for instance, by the UNFCCC REDD+ programme.

Who determines the specification of a carbon unit?

The specification and design of carbon pricing applications is deemed by the purchasing party based on key considerations and informed by the latest science. Depending on the type of pricing application, a buyer may be:

- A regulator seeking to drive capital investment to a particular industry or activity
- A sovereign seeking to meet targets under the Paris Agreement
- A lender seeking to impose climate-related milestone achievement to capital structures
- A corporate entity seeking to meet carbon compliance requirements as set on a regional, national, or supranational level
- A corporate for voluntary climate finance purposes or to offset against a national carbon tax (as in Singapore and Colombia)

In this way, **each buyer is deeming their own specification depending on their priorities and objectives.** This is often a point of controversy in media as the tendency for oversimplification and the "singular" carbon is preferred. However, this ignores that despite climate change creating a global challenge, we see variations on a regional and even jurisdictional basis depending on the local industry and natural ecosystems, as well as political and economic factors and climate ambitions.

When it comes to specifications deemed by a regulator, there are often five key considerations:

1. Sectors (Industry and/or activity)
2. Natural ecosystems
3. Price
4. Indigenous communities
5. Temporal

"Sectors" references types of assets or activities. Sectors are generally prioritized due to their outsized contributors or mitigators of carbon emissions, or based on easiest achieved abatement versus hard-to-abate sectors. In regulated penalty systems, one of the common aspects observed is the inclusion of the power sector given the high concentration of emissions and relatively low abatement cost, which incentivizes either a fuel switch (for example, from coal to gas, or from thermal to renewable sources) or energy efficiency measures. For example, the US Regional Greenhouse Gas Initiative

(RGGI) covering 12 US states and the national Chinese ETS launched in 2021 exclusively cover power plant emissions. However, sectors can also extend to non-industrial activities, such as in Australia whereby a subsidy scheme is employed by the regulator to encourage emission reductions and removals related to the agricultural sector, focused on cattle farming and agricultural practices. Similarly, economy-wide carbon pricing in California incentivises agriculture, waste management, and transport fuels to decarbonize. Finally, a sector could also include a consumption pattern. For example, the New Zealand regulated scheme imposes penalties not on individual assets, but on use of fossil fuels in order to encourage lower carbon fuel consumption, whilst simultaneously providing a subsidy to the forestry sector to encourage restoration of degraded lands and rotational harvest practices. Sector-based schemes such as the EU ETS are not static as the scope of covered sectors can be extended over time – such as inclusion of maritime transport in the EU ETS starting in 2024.

“Natural ecosystems” references the opportunities and challenges of the biosphere and geosphere within a given jurisdiction and are naturally as varied as the geographical landscape. When it comes to the biosphere, whilst some nations are concerned with desertification, others are primarily concerned with deforestation and degradation, others yet with agriculture and food security. What is appropriate or achievable in one area may not be appropriate in all. For example, a key pillar in international voluntary carbon crediting mechanisms is the concept of non-disturbance of natural ecosystems. In countries like South Africa, where natural savannas are the dominant ecosystem, despite high carbon sequestration potential one would see a forestry restoration project regarded as ineligible if it were to alter the natural ecosystems and the biodiversity which depend on it. Similarly, for technology-based removals such as carbon capture for geologic storage, some locations are advantaged based on potential for carbon storage in depleted oil fields or salt caverns, whereas others lack local storage and/or transportation. It is worth noting that with natural ecosystems in the biosphere biodiversity and water-related outcomes are increasingly being viewed in concert with carbon sequestration, at times being carved out as parallel initiatives but most often being seen as a key motivation for prioritizing nature-based carbon applications as these can be monetized and marketed under the heading of ‘associated co-benefits’.

“Price”, while not always a hard consideration, references a regulator’s target level of value of CO_2e. This can be based on a taxation revenue target, a hurdle to deliver corporate investments in particular abatement technologies, or a cap to manage the potential negative economic impact on industry and competitiveness. In Norway, regulators introduced a penalty in the form of an escalating carbon tax to reach 200 EUR/t by 2030. In Colombia, regulators employ a penalty in the form of a progressive fixed price carbon tax (approximately 6 USD/t in 2023) but with subsidy and sink credit offsetting to encourage low-cost mitigation, largely in the form of energy efficiency, reduced deforestation and degradation, and renewable energy projects. Finally, the US Inflation Reduction Act (IRA) passed in 2022 is a fixed price penalty of $900 escalating to $1,500 per ton of methane emissions from covered oil and gas facilities, equating to $32 to $54 per ton of CO_2e. While these are various versions of fixed price carbon pricing applications, this also exists in market-based carbon pricing applications, such as the price management role for regulators in the ETS design. This is evidenced in schemes such as the UK and EU ETS, whereby published rules mean a predetermined price floor triggers a reduction of stock and price spikes trigger a release of stock, in an effort for regulators to manage the price range of the scheme whilst encouraging free-market behaviour.

“Indigenous communities” and increasingly local populations in general are key factors in the design of carbon pricing applications as governments ensure benefit sharing and protection of disadvantaged populations. This can take place indirectly, such as the New Zealand approach in its recent redesign to ensure careful consideration of its rural communities and the Māori population, both culturally and economically. This can also be managed directly, such as the increasing number of provisions by African countries on export levies to include a direct revenue share to communities alongside fees paid to government.

“Temporal” is the final element of regulator consideration, in that carbon pricing applications are by design progressive, and what can deliver mitigation targets in 2025 might not be appropriate in 2040 and vice versa. This is largely due to the abatement cost curve in finding the “low hanging fruit" in countries to deliver emission reductions and removals, but also due to the delays in capacity building and technology. Capacity building is required at the governmental level from the perspective of administration and management of carbon pricing applications, and also at the level of individual obligated participants to be able to monitor, verify, and report as required. We often see carbon pricing application schemes launch on first a "reporting only" basis to aid in this administrative learning curve. In the EU ETS, the Carbon Border Adjustment Mechanism (CBAM) has a two-year reporting period prior to the pricing scheme going live. Similarly, in the Chinese ETS, the first compliance cycle covered a two-year reporting period. The final consideration on temporal elements is the availability and efficacy of low carbon technologies and alternative fuels – that is, a carbon price of 500 USD/t to encourage a full conversion to Sustainable Aviation Fuels for the airline industry would not be effective today due to production constraints, but 50 USD/t can be extremely effective in managing routes, aerospace efficiency, and policies around baggage and weight restrictions.

It is worthwhile noting that while this list includes the most commonly observed governmental considerations at this moment in time, it is not considered exhaustive and is expected that nuance will be observed based on geographical, cultural, and economic differences. Further, governments may use the above considerations to analyse individual sectors and activities, taking a separate view of utilities within this framework and a parallel view of transportation that leads to different conclusions and therefore different pricing application strategies.

Finally, it should be acknowledged that the other type of buyer deeming carbon specifications is the voluntary buyer. **The voluntary buyer is generally a corporate entity or lender, who seeks to deliver capital as climate finance for the purposes of a) in-house decarbonization (self-imposed carbon penalty price), b) delivering carbon reduction or removal outcomes (credits or subsidies), or c) tying lending or other commercial targets to results based payments related to climate achievement.** Voluntary buyers are typically more varied in preference and consideration – with the same internal screening considerations as described above but with the added complexity of jurisdictional origins with respect to operations. For some voluntary buyers, priority might be in the country of their domestic headquarters, their international operations, or even the countries of their key customers. Corporates today are purchasing voluntary carbon on the basis of Carbon Neutral or Net Zero claims, however these terms are rapidly evolving in the eyes of the public, regulators, and industry bodies (such as SBTi) and increasingly treated as binding investor and consumer claims. Further advances in carbon footprint declaration such as the EU CSRD (Corporate Sustainability Reporting Directive), the anticipated SEC requirements in the US, and even the EU CBAM are putting a finer point on carbon emissions reporting. However, the quality and even the use of offsets remains a controversial subject as the debate remains on how to accurately reflect the "net" in net zero. We would note that media headlines have been a key driver of controversy with a specific focus on REDD+ avoided deforestation projects that rely on counterfactual assessments, resulting in reduced voluntary carbon finance overall as project quality undergoes greater scrutiny. As the debate continues in the headlines, new governance is emerging in the voluntary carbon markets in the form of the Integrity Council for the Voluntary Carbon Market (IC-VCM) and the Voluntary Carbon Market Integrity (VCMI) initative, amongst others, that seek to provide international guidance on both quality of credits and the claim of the offset to best translate into the emerging regulatory frameworks. We will delve further into voluntary within the context of the Article 6 and Public Market Disclosure later in this paper.

What are the core specifications of a carbon unit?

For regulatory or voluntary buyers, carbon specifications have a baseline of parameters including:

- **Registry**
- **Origin**
- **Methodology**
- And occasionally, **Vintage**

Registries reference carbon accounting platforms which manage carbon unit issuance (supply), transfer, and retirement (demand) in accordance with a determined set of published standards, analogous with issuance and distribution of currency by central banks. Registries can be regulated, such as the European Single Union Registry or the Chinese national ETS registry, or voluntary, such as the VCS or Gold Standard. Registries are typically specific in architecture to facilitate carbon penalties, subsidies, or sinks. Whilst registries most often operate independently of one another, there is precedence for transfer of units across registries as per their acceptance and published modalities, and in the future will find linkage under the Article 6 mechanisms. Registries manage their approved list of methodologies and issuers, and units will always be accompanied by the stamp of the registry, which can determine eligibility into a compliance scheme, or acceptance and suitability by a voluntary corporate buyer.

Origin determines eligibility into a regulatory or a voluntary purchasing program and is defined as the country of origin, but in some instances can also have state or provincial sub-origins, depending on the purchasing specification. For example, China operates national and provincial schemes that require all projects to be of Chinese origin – but then has further restrictions at a provincial level. Similarly, the US Californian scheme enables all US origin projects, but bifurcates units and therefore pricing depending on the state origin level. Finally, even international units eligible into domestic regulatory schemes will often have a whitelist of approved country origins. Voluntary buyers similarly often express preference on country of origin depending on their areas of operation, or perceived quality of the unit from that particular geography.

Methodologies reference the type of activity which is recorded in the registry. Methodologies in simplest terms delineate different "types" of assets or activities, but at their core are a scientific modality for reporting emissions and/or emission reduction or removal activities. For example, even the EU which employs a single unit penalty system under its ETS has a methodology for accounting emissions related to the sectors covered by the scheme. On the other hand, the most varied range of methodologies observed are in the registries that largely cater to the voluntary carbon market. Methodologies include a specific set of scientific protocols in an effort to enable comparative ton-for-ton emissions accounting from a varied set of sources and activities and there are ongoing initiatives to improve the comparability of methodologies for the voluntary market, for instance through the IC-VCM's Core Carbon Principles (CCP). "Positive" emissions due to industrial activity are easiest to assimilate as they mostly involve the combustion of fossil fuel. However, emission reductions or removals are assessed on a gradient to best equate ton-for-ton accounting, noting methodological adjustments on a by-methodology basis such as crediting period, permanence, environmental additionality, risk of carbon leakage, amongst others.

Finally, **vintage** references the time stamp or calendar year in which the activity or emission occurred. We note that this is not a universal consideration, as with both regulatory and voluntary buyers there are both vintage-restricted and vintage-agnostic pricing applications. For example, the international aviation compliance scheme under CORSIA mandates not only vintage year eligibility restrictions but also project registry start date restrictions. Other regulated schemes treat emissions as bankable under the overall cap-and-trade budget with no time limit, such as the UK and EU ETS. Others yet deem same year vintage surrender for eligible subsidy units, such as the German UER scheme or prohibit regulated entities from using future allowances to satisfy compliance in advance of the year associated with the allowance, such as RGGI, WCI or the Washington ETS. Voluntary buyers impose perhaps the highest rate of vintage importance, with the majority of voluntary retirement concentrated in vintage years newer than 2016, despite eligible stock of 120 million tonnes in years prior, with most requiring a maximum five-year vintage window from year of emission, if not narrower. And finally, Australia despite having a vintage-agnostic regulatory schemes, sees select obligated parties voluntarily demanding newer vintages to better manage quality and policy risks.

The above serves as a simple framework for the lowest common denominator specifications that deem eligibility into both regulated and voluntary frameworks, but it is worth noting there is a vast universe in the methodologies or "types" which is where we see the largest disparity in global carbon pricing applications based on regulator or corporate activity.

What are the various types of carbon units and how do they vary in cost and scale?

There are as many carbon methodologies as there are sources of emissions – so indeed it is no wonder that the range of carbon methodologies is highly varied and diverse. As defined previously, **methodologies are scientific protocols catering to a particular sector or activity type to best quantify and ascertain a like ton-for-ton accounting across varied activities.** Activity-specific adjustments apply to both positive and negative emissions, to industrial and natural processes, and are consistently evolving and improving with advances in technology and science. Further, each methodology (or activity type) varies in terms of its potential total absolute impact in terms of CO_2e volumetric reduction, and the implementation cost curves implied to do so, and vary further on an individual country basis. Also, buyers will assign a different likelihood that the expected carbon outcome will be achieved depending on specific factors such as technology, jurisdiction, etc. This is effectively like a risk premium in other commodity markets, where buyers typically pay a lower price if the counterparty is considered to be less creditworthy. Herein lies the real cause for disaggregated and heterogenous carbon markets. As whilst our globally understood metric is reduction of tons, these deliver with differing volumetric potential, at different implementation costs, and on differing timescales, with a heterogenous class of buyers prioritizing different pricing applications in order to achieve the desired impact.

While in truth we could dedicate an entire paper to just the variety of types or in fact even a single type, we will review high level types of methodologies including their mitigation cost curves and potential volumetric delivery in an effort to demonstrate the suitability of diversified frameworks for carbon pricing.

In its simplest form, the IPCC suggests that total mitigation potential across all sectors is over 70Gt/annum, with the largest of these coming from the agriculture, forestry and other land use (AFOLU) sector, followed by power and heat, and finally industry and transport, at a weighted average abatement cost of $90/t. Compared to current global emissions at 58Gt and an EU ETS price of $95/t – this should be well within reach. So what’s the problem?

The reality is, behind the headline figures and generalizations which already address multiple sectors, within each sector we find varying causes for individual sources of emissions. This means we have numerous methodologies (or activity types) even on a sectoral basis. Take for example the AFOLU sector. The headline for potential emissions mitigation is over 35Gt (greater than total annual fossil fuel emissions globally) at a weighted average price of $50/t (Figure 1). However, below the average reveals six key categories of activities, including activities such as avoidance of deforestation and degradation (REDD+), land and wetlands restoration, and bioenergy with carbon capture and storage (BECCS), each with vastly different operational elements and therefore methodologies to calculate a CO_2e ton (Figure 2).

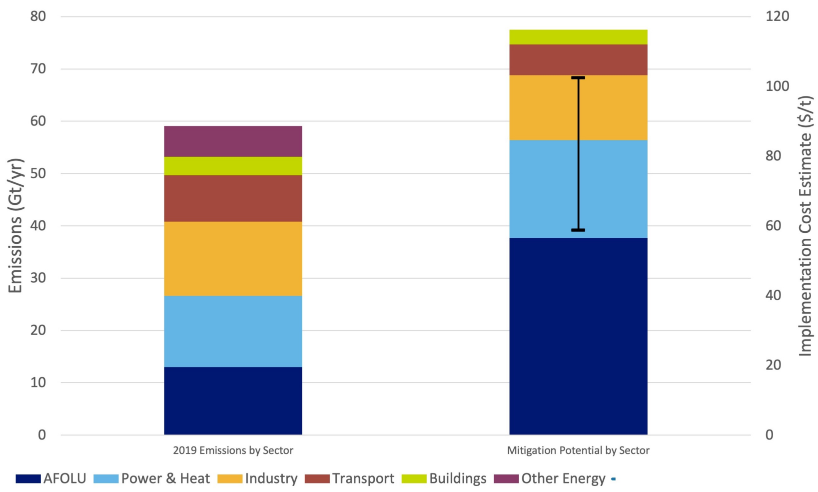

Figure 1. Global emissions (2019) vs mitigation potential by sector.

Source: IPCC, Environmental Defense Fund, World Resources Institute, Goldman Sachs, McKinsey, Trafigura Research

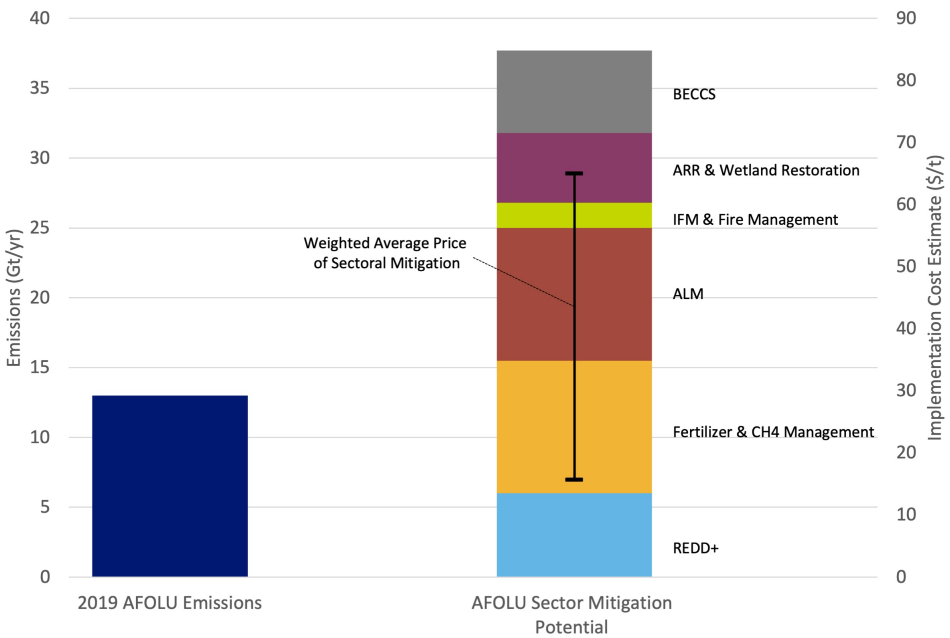

Figure 2. Categories of activities included under the AFOLU sector.

Source: IPCC, Environmental Defense Fund, World Resources Institute, Goldman Sachs, McKinsey, Trafigura Research

Each methodology also has unique cost hurdles for implementation, with REDD+ having the ability to deliver 6Gt at a weighted average price of $10/t whilst BECCS can achieve the same volumetric contribution but only at a price above $150/t (Figures 3 and 4). It is worthwhile noting that even this “subcategory” approach remains a vast oversimplification, as indeed within subcategories we have individual methodologies to apply specialized science to landscapes. For example, REDD+ alone has 5 different methodologies in the VCS to account for the difference in biomass and carbon sequestration calculation in varying landscapes (peatlands vs mangroves vs rainforests, etc), but this again speaks to the need for heterogenous and layered approaches in carbon pricing.

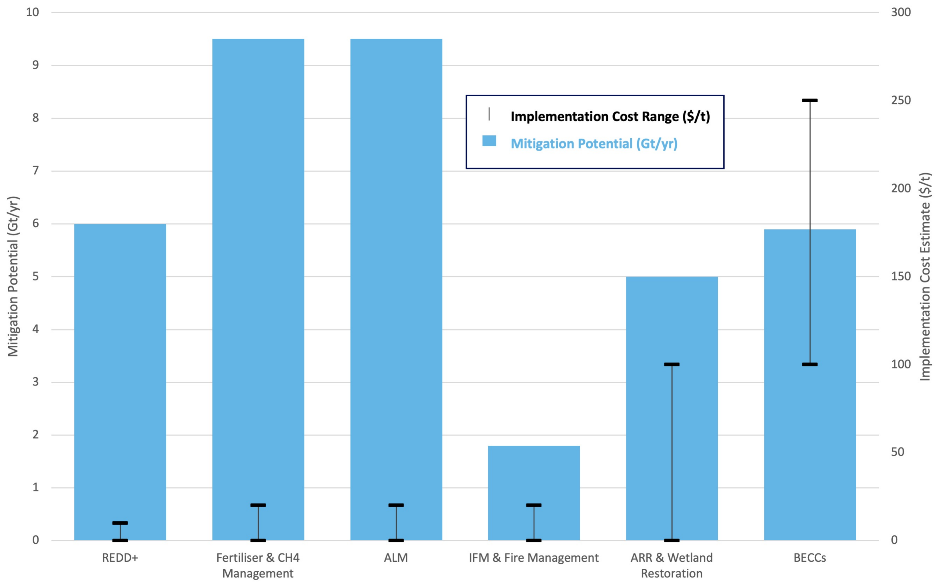

Figure 3. AFOLU subsector mitigation potential and implementation costs.

Source: IPCC, Environmental Defense Fund, World Resources Institute, Goldman Sachs, McKinsey, Trafigura Research

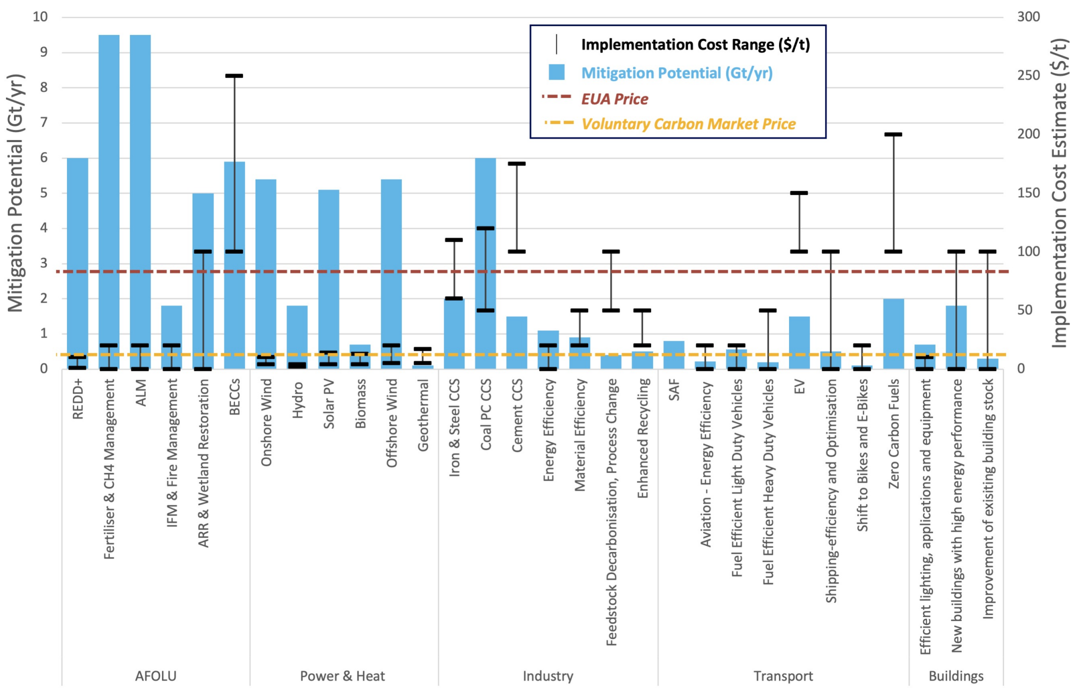

Figure 4. Mitigation potential (in Gt/yr) compared to implementation cost ($/t) by sector.

Source: IPCC, Environmental Defense Fund, World Resources Institute, Goldman Sachs, McKinsey, Trafigura Research

Finally, **there are continued calls from carbon pricing advocates for a "global carbon price". While this is admirable from the perspective of encouraging global cooperation and investment towards the energy transition, this oversimplification of a complex asset class would not deliver the impact and diversified capital investments that are required.** For example, if we look at other commodity classes such as agriculture, energy, or metals, there is recognition of the asset class followed by individual product markets, which enables clear market fundamentals and price response to ensure capital is directed to where it is needed. It is difficult to imagine a world otherwise – where a single price for "ags" meant that the world received corn and no soya, a single price for metals delivered iron and no nickel, for oil delivered only fuel oil, so on and so forth. In this paradigm, the concept of carbon would be anomalous to every other commodity suite and not deliver diversified capital into diversified approaches for achievement of global emission reductions. This is already observed in existing carbon market successes and failings. For example, a parallel approach in the EU provides a subsidy for biofuels at $300/t via the Renewable Energy Directive (RED II) but an emissions price for industry at $95/t under the EU ETS, or a gross/net approach as observed in California or China whereby the "net" credits are categorized as a separate unit and capped in terms of total delivery into the gross scheme. This results in a price difference which enables investment hurdles to be achieved simultaneously across varying requirements. The "single carbon price" effect has already been felt in New Zealand, where the domestic compliance scheme treats emissions related to fuel imports the same as emissions related to forestry. As carbon pricing rises, the country faces an unprecedented growth in carbon-based forestry – an increase of 10 times in less than 10 years due to incentives – whilst road transport decarbonization remains uneconomical. In this way, the government is unable to manage the scheme to match its intentions, that is, to direct investment into the activities which it deems a priority.

Perhaps then the correct phrasing would be a "minimum global carbon price" – or a lowest common denominator assumption that enables countries to work cooperatively, threading the needle on avoiding the impairment of growth in developing countries whilst enabling a shared baseline. In many respects, this is how one can best conceptualise the Paris Agreement's Article 6.

Article 6 and Robust Accounting

Article 6, whilst indeed a legal clause in the Paris Agreement, commonly refers to the global mechanisms enabling international trade for countries to cooperate globally towards NDC (nationally determined contributions) achievement, or said simply, to trade against their own commitments under the Paris Agreement. Article 6 was written to enable greater ambition of targets for countries who will be limited in opportunity and economic capacity to drive emission reductions domestically, but also to contribute to Sustainable Development through flows of climate finance into developing countries. While written through the lens of sovereign achievement of UNFCCC goals, Article 6 is the only clause of the Paris Agreement to also reference the "private" sector, be that as project owners, sellers, traders, or end buyers.

The key underpinning of Article 6 is the concept of robust global carbon accounting balances – and specifically no double-counting – with assurance that every traded credit also ties back to country-level debits. This is markedly different from the first regulated, international carbon market, the Clean Development Mechanism (CDM) of the Kyoto Protocol. The key difference between the Article 6 of tomorrow and the CDM is that the latter's key consideration was the delivery of international climate finance, so "credits" to purchasing countries were accounted for, but there was no "debit" system on the exporting side. While this was appropriate in the context of the Kyoto Protocol to enable richer countries demonstrating climate ambition to deliver capital outside of their borders, in the current Paris age, the key consideration is global accounting and achievement of national goals. The underpinning of Article 6 accounting modalities is in the *corresponding adjustment* (CA). The CA enables accountability on the exporting nation and a greater balance of "carrot and stick" – creating the basic foundations of a robust fundamental market.

While Article 6 contains sub-elements that enable carbon applications of penalties (Article 6.2 ETS linkage) and Results Based Payments (Article 6.8), for the purposes of this section we shall focus on

Article 6.4 which is related to subsidies and sinks in the form of credits. To borrow on our previous framing, the Article 6.4 mechanism registry will be governed by the UNFCCC with origins open to units from all countries with willingness to export, a defined set of approved methodologies (activity types), and acknowledgement of vintage eligibility. While this strongly implies an effective "minimum global carbon price", far more interesting are the layered approaches for use.

Despite Article 6.4 eligibility deeming what methodologies (activity types) can be acceptable as a common denominator definition of quality for compliance under the Paris Agreement, purchasing remains varied in terms of buyer specification as well as buyer type. While the 6.4 mechanism was primarily designed to enable international trade of units for the purpose of compliance with UNFCCC goals, there has also been an accommodation of voluntary demand in the form of the "mitigation contribution unit" (MCU) designation – or specifically, an Article 6.4 compliant credit without CA that is consequently not designated for sovereign accounting purposes. In this way, corporates can purchase Article 6 eligible units for voluntary purposes and contribute to emission reductions on the global ledger whilst being assured of no double counting between countries, alongside integrity of quality and governance. In this way, we see governments and corporates aligned in their Net Zero approaches as there can exist two harmonious ledgers of country Paris commitment accounting and corporate voluntary climate finance (Figure 5).

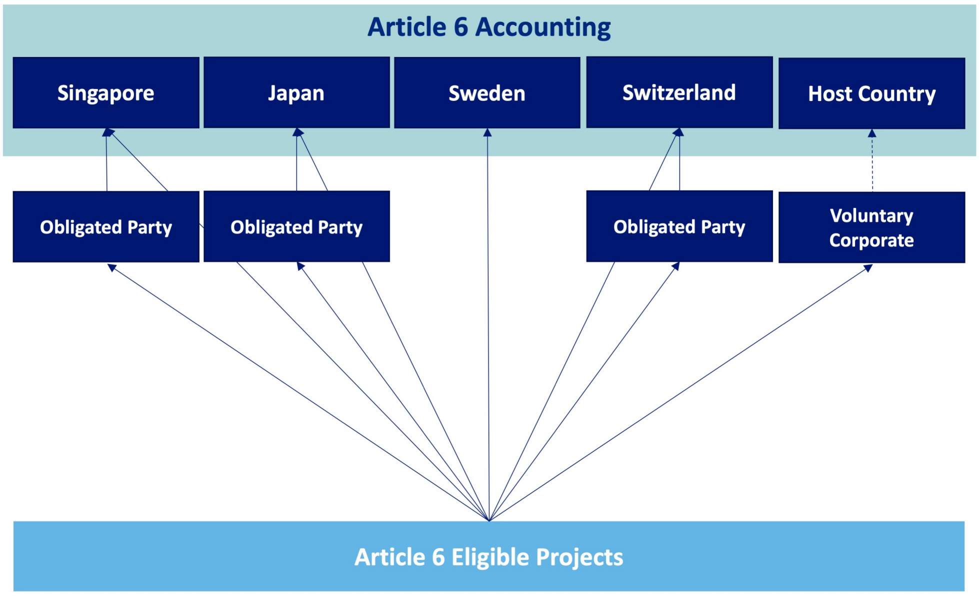

Figure 5. Global market structure under Article 6.

The final mode of use enables governments to not just harmonize with their private sector counterparts, but to mobilize them for sovereign purchasing requirements. This is observed in the integration of domestic regulatory markets whereby the mandated carbon unit for the domestic scheme is in fact an Article 6 compliance unit. This enables governments to simultaneously establish carbon pricing in country to encourage private sector investment in decarbonisation, whilst increasing country-level ambition in targets under Paris.

In this way, we see direct links across the Paris sovereign compliance market (with domestic regulatory markets) and the voluntary market based on a shared source of credit supply enabling greater fungibility and liquidity. These are key aspects in development of a commoditized carbon market, though bifurcated by either "CA compatible" or "not CA compatible" attributes.

However, this remains a "lowest common denominator" approach, as there is a high likelihood that the refined buyer will specify preferences and requirements in addition to Article 6 standards. For example, Switzerland's sovereign purchasing arm, the KliK Foundation, today prioritizes some methodology types – specifically technology avoidance projects and excluding nature-based solutions, whereas the imminent Japanese domestic regulation has a prioritization of country of origin. Further, a voluntary corporate buyer might have a motivation around biodiversity, in which case they will forego technology-based projects in favour of restoration projects. So, whilst Article 6 will bring about a unified carbon accounting ledger and a simplified definition of qualities, the reality is that the heterogeneity of the product suite, divergence in values, and complexity of the market structure is likely to increase. This complexity should not be shunned but embraced as it will enable the proper flow of capital to the requirements demanded by the market – and in ways that are appropriate to the individual project type or problem set.

Conclusion

Carbon pricing delivers a price signal to capital markets to prioritize and invest in emission reduction and removals by valuing the externality of carbon emissions. Carbon pricing takes many shapes and forms, from penalties on industrial emissions, to subsidies for green hydrogen, to credits from small scale solar in developing nations – with its specification being deemed by a buyer, be that a regulator or a corporate entity, based on their interests and motivations at that period in time. It is acknowledged that climate change is a multifaceted problem that therefore requires diversified solutions. In this way, the heterogeneity and the complexity of carbon markets should be embraced as there is increased understanding that delivery of emission reductions and removals occur in highly varied types of supply chains. On the other hand, what is an apparent desire for simplification is not practical nor relevant for the problem set.

Whilst complexity and change are inherent to the asset class, we believe that the concept of taxonomies and in particular framing as a commodity specification are the most appropriate mode of understanding and referencing carbon markets. Commodity markets have proven adept at mobilizing private sector investment at scale to produce the goods and services demanded by the market – especially when the deliverable is volumetric versus a generic flow of capital. Equally, commodity classes have proven resilient in the face of change. This has been observed in many dimensions and products in specification changes in oil markets and the global reduction in the sulphur content of refined products. But this has also been observed in adapting to market structure changes, such as the increased commoditization of the gas markets leading to away from crude oil pricing benchmarks to gas pricing mechanisms that more accurately reflect fundamentals.

Article 6 of the Paris Agreement is the first true global carbon market that will set a standardized and unified framework for carbon accounting and carbon credit qualities. However, this standardization will increase the stratification presently seen in carbon pricing and carbon markets, with differentiated pricing for the various carbon specifications within the overall asset class. Further to additional pricing mechanisms, we will continue to see iterations in science and technology, for both abatement opportunities as well as measurement of the underlying performance of positive and negative emissions. This volatility in the asset class should be embraced as it represents advancements in both the science and ambition, and the risks are better understood with an improved framing of the dialogue and the debate that is appropriate for the asset class.