CARBON MARKET: A TOOL TO REACH NET ZERO AND A GOLD MINE OF INVESTMENT OPPORTUNITIES

White paper

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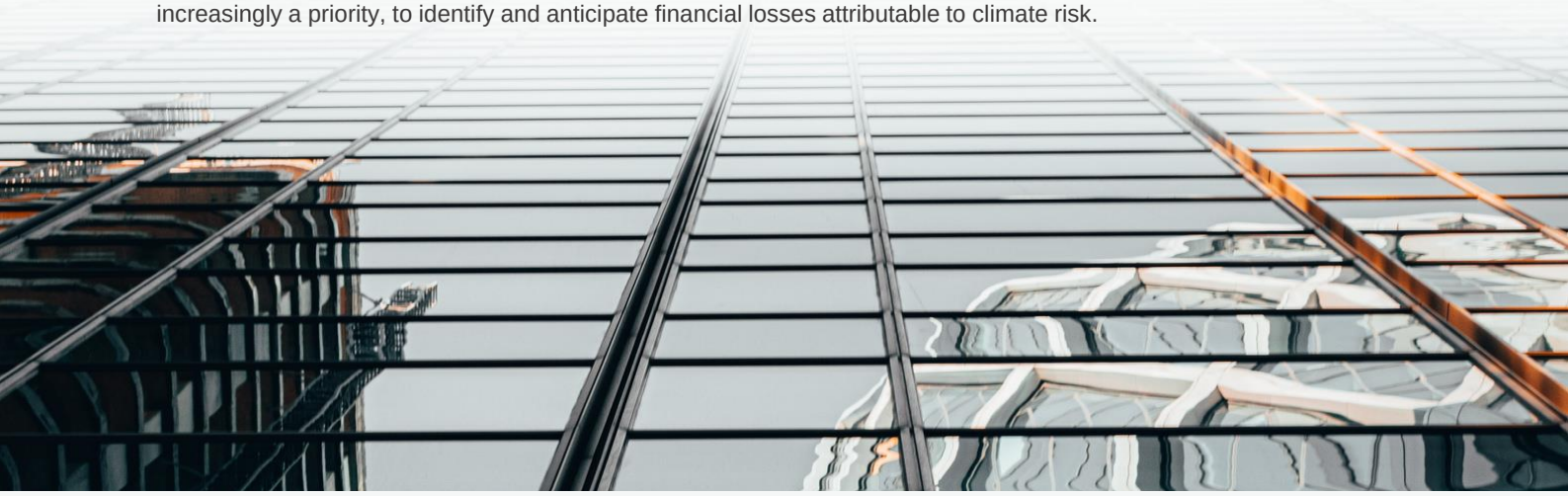
ABSTRACT

An increasing number of companies have committed to reduce their emissions and achieve Net Zero targets by 2050, in line with the goals of the Paris Agreement and with the objectives fixed by COP26 in Glasgow in 2021. At the same time, many actors are embracing the recently launched SBTi Net Zero Standard[1], actively striving towards the objective to 'cut all possible emissions before 2050'[2].

While for some companies the targets can be easy to reach, others find the path full of obstacles. In fact, while in some industry sectors the actors can change their business model fast enough to reduce or avoid emissions (e.g., electric power), others, such as heavy industries, chemicals, cement, steel, and infrastructure cannot, due to the intrinsic characteristics of their business activities. Hence, they will **need external support from financial institutions to finance and hedge their transition strategies** and they will also want to find **alternative solutions** to meet net zero objectives. In such a challenging context, companies would need for example to **compensate/offset residual unavoidable emissions**. In the meanwhile, new business opportunities are emerging for financial institutions not only as partners for corporations to support them in their path to net zero, but also as a key player to improve the efficiency of carbon markets.

At the same time, as the European compliance carbon market (the EU Emission Trading System 'ETS') goes through its revision while continuing to reduce the emissions cap, **a complementary carbon market defined as 'voluntary' grows, showing the appetite of financial and non-financial institutions to trade carbon credits**. Being outside of the regulated system, this voluntary carbon market offers more flexibility on the criteria for the definition of a carbon credit and on the possibility to use those certificates to offset emissions. This market is populated by several verified carbon standards certifying the quality of the carbon credit generated, based on defined methodologies which aim to improve trust and transparency. However, despite its expansion, **further efforts are required to scale up and increase the efficiency of the voluntary carbon market.** Recent initiatives propose blockchain as the solution to ensure traceability aiming to build trust in carbon certificates. Several use cases are already live, mostly outside of Europe for now.
Finally, ongoing regulatory initiatives such as the EU ETS reform, the Fitfor55 package, the Paris Agreement Art 6, CSRD and so on will impact the carbon market by affecting the carbon price, hence influencing companies' decarbonization strategies.

This challenging but evolving context offers a **wide range of opportunities for financial and non-financial institutions to play a key role on carbon markets**. While financial entities have participated in carbon markets for some time, it is only recently that they have started to **consider carbon certificates as an asset to integrate in investment portfolios**, in order to generate profit or hedge risk. Assessing companies' sensitivity to carbon pricing is increasingly a priority, to identify and anticipate financial losses attributable to climate risk.



[1] Science Based Targets, Science-based net zero – Scaling urgent Corporate Climate Action Worldwide (2022)

[2] Science Based Targets, Key components of the Corporate Net-zero Standard (2023).

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1. INTRODUCTION TO CARBON MARKETS

1.1 Genesis and different types of Carbon Markets

Joint international action to reduce carbon emissions globally started with the signature of the **Kyoto Protocol** during COP3 (1997). The Protocol, which represented the first binding application of the 1992 UN Framework Convention on Climate Change (UNFCCC) set the first-ever legally binding emission reduction targets, mandating 38 industrialized countries to cut their emissions by an average of 5.2% below 1990 levels between 2008 and 2012.

The Protocol entered into force in 2005 and established three flexible mechanisms, representing the regulated, or compliance carbon market (CCM): the **Clean Development Mechanism** (CDM), the **Joint Implementation** (JI) and the **Emission Trading**.
The CDM allows developed countries with greenhouse gas reduction commitments (Annex I countries) to invest in emission reduction projects in developing countries (Non-Annex I countries) as a way to offset their own emissions. The projects in developing countries are expected to contribute to sustainable development in the host nation while simultaneously reducing emissions. The CDM allows for the issuance of Certified Emission Reductions (CERs) when a project's emissions reductions are verified and meet certain criteria. These CERs can be used by Annex I countries to demonstrate progress towards their emission reduction targets.

In summary, while the CDM involves emission reduction projects in developing countries, JI involves projects between two developed countries.

The **Emission Trading** is a market-based approach used to control and reduce greenhouse gas emissions and it intends to allow participants to buy and sell emission rights. The Kyoto Protocol was the driving force behind the creation of the largest, earliest, and most actively traded compliance carbon market, the European Emission Trading System (EU ETS).

The CDM and JI laid the basis for a parallel carbon market, defined as the ‘offset’ or ‘voluntary’ carbon market (VCM). This is non-regulated carbon market where all type of participating organizations (financial, non-financial, governments…) can buy and sell carbon credits on a voluntary basis.

Although, while the CDM and JI are both compliance-based mechanisms under the Kyoto Protocol, the voluntary carbon market is non-binding and based on voluntary actions by entities seeking to offset their emissions beyond regulatory requirements. However, there are some connections between these systems:

- overlapping projects: Some projects that generate carbon credits in the CDM or JI may also participate in the voluntary carbon market. Such projects can double-count their emission reductions by selling credits in both markets.
- experience and infrastructure: the experience gained through implementing CDM and JI projects has contributed to the development of methodologies and verification procedures in the voluntary carbon market. Lessons learned from these compliance-based mechanisms have been valuable in establishing standards for voluntary projects.

The voluntary and compliance markets are getting increasingly interlinked, in fact compliance markets have already been leveraging voluntary market credits and standards for quite a while [3].

[3] California’s emissions trading system and the offsetting scheme for international aviation allow the use of certain voluntary market carbon credits.

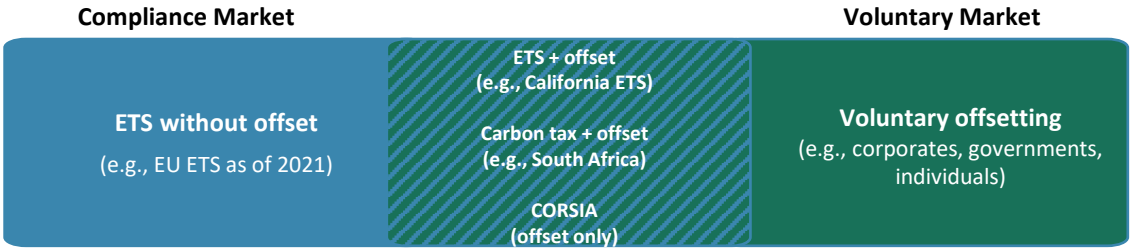

Illustration 1: Interconnection between the Compliance Carbon Market and Voluntary Carbon Market. Source: EEX

The following sections describe the main differences between Compliance Carbon Market (CCM - with a focus on the Emission Trading Systems) and a Voluntary Carbon Market (VCM) to give a proper overview of the carbon market ecosystem.

1.1.1 The Compliance Carbon Market (CCM)

The CCM are regulated by regulatory body and follow mandatory national, regional, or international carbon reduction regimes. Participants in the CCM must comply with the relevant market rules. As already mentioned, the first and most actively traded CCM is the European Union Emissions Trading System (EU ETS)[4], followed by the US Regional Greenhouse Gas Initiative (RGGI) established in 2009 and the California Cap and Trade Program (CCA), established in 2012. Those 3 markets cover around 90% of the global ETS traded volume[5].

Two are the main types of mechanisms which can govern an ETS: the "Cap-and-Trade principle" and "Baseline-and-Credit principle":

- **Cap-and-trade**: in a cap-and-trade market, the regulator sets an overall cap of the total greenhouse gas emissions that companies can emit in any given year. The cap amount depends on the reduction commitments of each jurisdiction and is represented in the form of allowances, each worth 1 ton of CO2e - RGGI being the only exception, where each allowances represents a short ton of CO2e. Allowances can be distributed to the market via free allocations[6], particularly to heavy industries, or via auctions[7]. Once distributed, allowances can be further traded on secondary markets. Each year, participating entities have to report on their emissions and surrender a quantity of allowances equivalent to each ton of CO2e emitted. Failure to surrender is rare and can be costly, as most CCMs implement strict penalties in case of non-compliance. As an example, in the EU ETS companies that do not hand in the required allowances are liable to a 100€ penalty per excess ton of CO2 emitted and are required to hand in the missing allowances the following year. While in Europe the ratio is 1:1 - 1 allowance to return the year after for a ton of CO2 equivalent emitted in excess in the previous year - in California, the ratio is as high as 4:1. (4 allowances to return the year after for a ton of CO2 equivalent emitted in excess) On the other hand, if an entity does not need to use all its allowances within the year, these can be banked for future use or sold to other participants. Most of the ETS markets are governed by the cap-and-trade mechanism.

- **Baseline-and-Credit:** this market is built on project-based issuances of carbon credits. Carbon credits are tradeable certificates, representing each 1 metric ton of CO2e reduction, generated by a specific activity. Entities in this market must first develop a business plan to explain their reduction ambitions. A 'baseline' scenario is built assuming that the company continues its business as usual, and the amount of expected future emissions is estimated. If a company reduces its emissions beyond the baseline level, these reductions can be converted into carbon credits and sold to other emitters. Carbon credit can also be earned when a company invest in projects to support their emission-reduction strategy. One example of the use of this mechanism is the Australia's climate safeguard mechanism, undergoing reform[8]. It is important to note that this mechanism is limitedly applied – being thus a possible but very rare scheme.

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[4] Main sectors covered: electricity and heat generation, energy-intensive industrial installations, aviation within the European Economic Area and departing flights to Switzerland and UK, maritime transport.

[5] Refinitiv, Carbon Market year in review 2022, February 6th, 2023.

[6] Free allowances are mostly distributed to companies from sectors with high risk of carbon leakage. Those sectors are communicated in dedicated lists by the European Commission (last list published in May 2019). The list of companies as well as the rate of free allocation has been declining over time. With the introduction of the carbon border adjustment for the EU ETS (see below), free allocations are planned to phase out between 2025-2030.

[7] The auctioning of carbon allowances is the main method of carbon credit allocation to companies in the EU ETS. In the EU ETS system, it became the default allocation method since 2013. Most countries joined into a common auction system, with only German and Polish having individual auctioning mechanisms. All auctioning mechanisms (EU ETS, DE ETS & PL ETS) are managed by the European Energy Exchange (EEX) group. Financial institutions can also participate to auctions.

[8] Safeguard Mechanism Review – Climate council (September 2022)

As the Baseline-and-Credit mechanism is less common, the paper will focus on Cap-and-trade scheme and more specifically on the EU ETS where most of the volumes are traded (see section 2).

Each CCM has different mechanisms that ensure the correct pricing and distribution of carbon allowances. RGGI and California use minimum reserve prices to control auction prices and ensure that they do not drop below a certain level. No bid which is lower the minimum reserve price is considered, and if auction prices go too low, volume is withheld from the market to ensure a constant balance of supply and demand. Likewise, the EU ETS is regulated through a supply adjustment mechanism, this is the **Market Stability Reserve** (MSR), which began operating in 2019.

The MSR regulates the volume of allowances in circulation (and thus indirectly stabilizes the price), by reducing or increasing future auction volumes based on predefined ranges of the Total Number of Allowances in Circulation[9] ("TNAC"):

- If the TNAC rises above the upper threshold (833 million allowances), 24% of the allowances in circulation are removed and placed in the reserve.
- If the TNAC falls below the lower threshold (400 million allowances), the MSR releases 100 million allowances for auction.

The minimum number of allowances placed in the MSR is fixed at 200 million. These parameters were implemented with the latest revision of the mechanism, which doubled both the intake rate from the historical 12% to 24% and the minimum number of allowances from 100 million to 200 million. It has been now proposed to maintain these parameters until 31 December 2030[10].

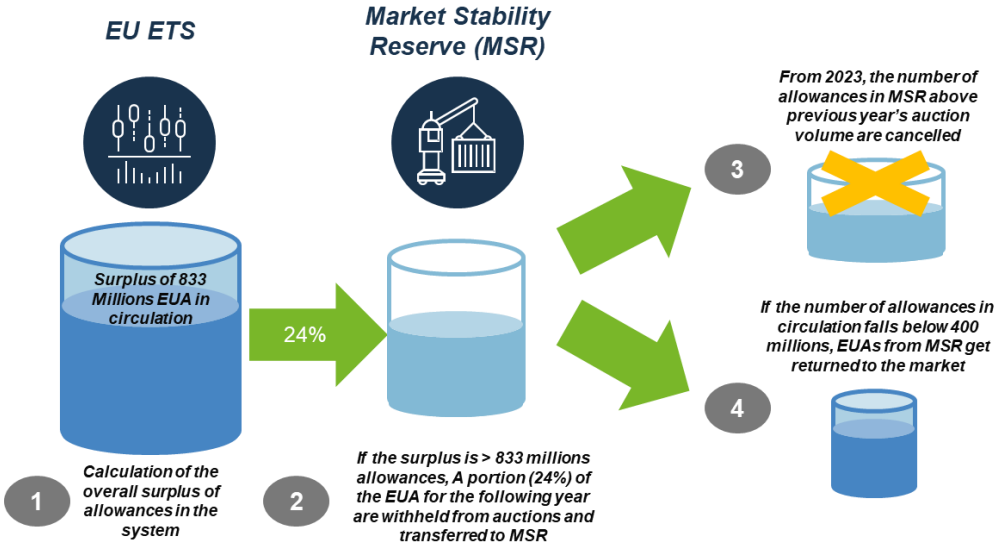

Illustration 2: the Market Stability Reserve

In parallel, to avoid **carbon leakage**[11], carbon-intensity industries such as cement, steel, manufacturing of specific products and mining receive a large share of their allowances for free[12]. However, the list of beneficiary sub-sectors as well as the rate of free allocation has been declining over time. For example, power producers in the EU ETS, in principle, are not entitled to any free allocation since 2013[13] and with the agreement on Fitfor55 reform, free allocations are planned to phase out starting from 2026 to 2034.

[9] The total number of allowances in circulation is calculated as the number of allowances remaining from the previous phase (not surrendered nor cancelled) minus the demand (emissions and allowances cancelled).

[10] The proposal to extend the validity of the current MSR feeding rate (24%) and minimum number of allowances in the reserve (200 mn) until end 2030 was adopted in April 2023 and entered into force in May 2023 – European Parliament, Revision of the market stability reserve for the EU emissions trading system, Fit for 55 package (May 2023)

[11] Carbon leakage refers to a situation where measures taken to reduce greenhouse gas emissions in one region or country lead to an increase in emissions in another region or country that has less stringent environmental regulations or climate policies. This phenomenon occurs because industries may relocate their production to areas with weaker climate policies to avoid higher costs associated with carbon emissions in their original location.

[12] The last list of "carbon leakage" sectors has been published in Mat 2019 by the European Commission for phase 4 (link). The list varied during the different phases.

[13] European Commission, Free allocation decreases each year: https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/free-allocation_en

1.1.2 The Voluntary Carbon Market (VCM)

The VCM is a non-regulated market where players can buy or sell emission reduction certificates. These certificates guarantee that 1 ton of CO2 emission has been reduced or removed from the atmosphere thanks to climate action projects, as reforestation, land restoration, renewable energy projects, community projects and so on. Further, the emission reduction or removal has to be measured and certified by an internationally recognized carbon standard.

Contrary to the CCM where carbon credit certificates are standardized in terms of size, conditions, certificates traded on the VCM present different features, due to the various nature of the underlying projects and the methodologies used by each standard body to certify the credit.

Once generated, the carbon credit certificate is recorded in public registries which are administrated by different entities (Illustration 3). The register's purpose is to keep track of the value of the certificate, the transfer, and the retirement once a credit is used to offset emissions.

Carbon certificates credits traded on the voluntary market fulfill a complementary role to the CCM, as they appeal to the increasing number of firms committing to achieve net zero by 2050 and seeking to address residual and unavoidable emissions in parallel to their decarbonization strategies.

It is also important to highlight that previously most of demand/supply of carbon credits in the VCM was coming from the United States[14], while today the voluntary market is much more global, and it starts to be connected to governments and private sector thanks to the publication of the Rulebook of Article 6 of the Paris Agreement. In addition, as the VCM is much smaller than the CCM[15], it has a significant growth potential for the coming years, an impressive expansion has already been observed between 2020 and 2021, as showed in the chart below based on data collected by the Ecosystem Marketplace[16].

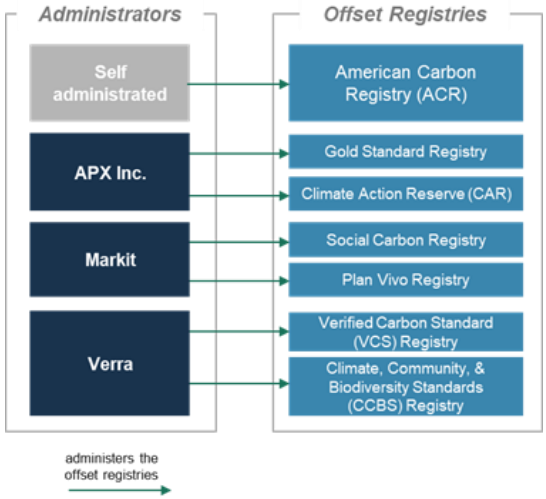

Illustration 3: Voluntary Offset Market registries currently operating

The Taskforce on Scaling Voluntary Carbon Market estimates that 1.5 – 2 billion carbon credits could be traded per year in 2030[17].

However, for this market to scale, existing issues must be addressed. These pertain mainly to the market segmentation, opacity, and to the uncertainties of the legal and regulatory framework of the jurisdictions which these projects fall under – the majority being in the Global South.

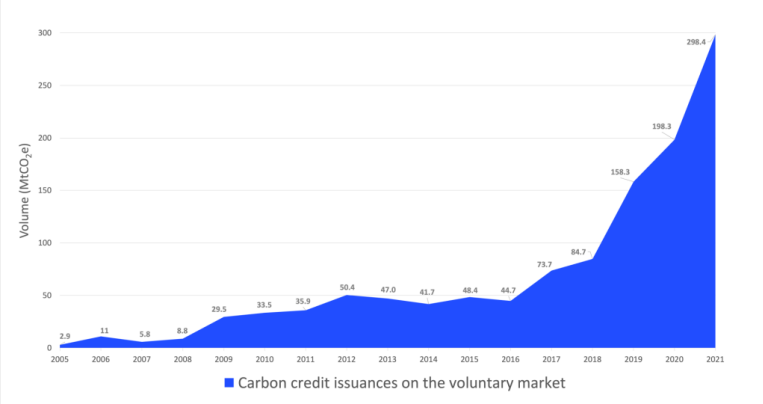

Illustration 4: The size of the voluntary carbon market.
Source: Ecosystem Marketplace

[14] Source: Ecosystem Marketplace, The Art of Integrity. State of the Voluntary Carbon Market 2022 Q3, August 2022.
[15] Proposition 1,5/1000 according to Sparkchange analysis (2021 volumes and % compared to 2020: CCM €759.2bn (+264%), VCM €1.1bn (+232%)). The market size is calculated based on the number of carbon credits or allowances, multiplied by their price. Average price of carbon credit in VCM was of $3.37 in 2021.
[16] Ecosystem Marketplace (EM) is a non-profit initiative of Forest Trends. EM is a leading global source of credible information on voluntary carbon market, and it has run the world's first globally recognized and standardized reporting and transparency platform for VCM credit pricing.
[17] The Taskforce on Scaling Voluntary Carbon Markets (TSVCM), sponsored by the Institute of International Finance (IIF) with knowledge support from McKinsey, estimates that demand for carbon credits could increase by a factor of 15 or more by 2030 and by a factor of up to 100 by 2050. Overall, the market for carbon credits could be worth upward of $50 billion in 2030.

Summary table of the main differences between Compliance and Voluntary Market

	Compliance	Voluntary
Description	Regulated market where participation is mandatory for companies operating in certain sectors, as defined by the regulator. Based on cap-and-trade or -baseline-and-credit system, the allowances' total supply is set by the relevant government body which also regulates the allocation among participants - i.e. compliance entities subject to the system.	Voluntary market on which carbon credits, namely certificates proving that 1 ton of CO2e has been reduced or removed from the atmosphere, are traded among companies, financial entities, and individuals. Certificates can be used for offsetting emissions and present different characteristics depending on the standard respected and methodology of the certifying body.
Main Stakeholders	Regulatory Bodies/mechanism, Compliance entities, Marketplace, Buyers, Carbon Accountant, Investment firms and Credit institutions	Standard Bodies, Registry, Local Community, Offset Project Developer, Verifier, Buyer, Broker, Carbon Accountant
Credit type	Reduction	Reduction, protection, removal
Price range	From 1 € to 100 € approximately, depending on the regime.	from € 0.5 to € 130, depending on the carbon credit type and features.
Market share	99,9% of total carbon market	0,1% of total carbon market (Carbon credits comprise all the voluntary market and a small part of the compliance market)

Illustration 5: Differences between the CCM and VCM

1.2 Carbon certificates and Carbon Offset

Carbon certificates and carbon offsetting are related to each other, but they are distinct concepts in the context of managing carbon emissions and mitigating climate change.

Carbon certificates, used both in CCM and VCM can be identified as:

- In the “cap-and-trade” Emission Trading System, they are instruments, certified by governments, which represent an emission reduction of one metric ton of GHG. They are often referred to as **carbon allowances**.
- In the VCM, they are instruments certified either by governments or independent certification bodies. Better known as **carbon credits**. They equally prove that one ton of CO2e has been reduced or removed from the atmosphere.

Here below we present a summary of the main differences between the two types of certificates.

Unit Type	What does it mean?	Where is it used?	Climate impact
Carbon Credit	1 carbon credit = 1 ton of CO2e reduced or removed	Mostly voluntary market + Article 6 compliance market under the Paris Agreement. Carbon credits are not systematically used for offset, it's possible to support climate projects for their own sake, without offsetting emissions.	Have a direct climate impact. They can lead to actual emissions reductions by funding projects that otherwise might not have been financially viable. These projects contribute to reducing the overall amount of greenhouse gases in the atmosphere. They promote the adoption of cleaner technologies and practices, leading to a net reduction in emissions. However, the effectiveness of carbon credits depends on the quality and credibility of the projects generating them. There have been concerns about the potential for "double counting" or insufficiently rigorous projects.
Allowances	1 allowance = the right to emit 1 ton of CO2e	Emissions trading systems (Compliance markets)	Have an indirect climate impact because they provide a financial incentive for industries to reduce their emissions. In fact, if a company manages to reduce its emissions below its allocated allowances, it can either sell the excess allowances or save them for future use. This encourages industries to adopt cleaner technologies and practices in order to remain within their allocated limits. As the overall cap on emissions decreases over time, the total amount of allowed emissions also decreases, leading to a gradual reduction in greenhouse gas emissions.

Illustration 6: Differences between Carbon Credit and Allowances

On the other hand, a **carbon offsetting** is the claim that a carbon credit reduces a company’s carbon footprint by using the certificate to compensate its emissions with a reduction occurring elsewhere.

Although, it is also possible to buy carbon credits without making offset claims but instead to support impactful solutions that will deliver removals reductions in the future or to invests in carbon credits for trading, hedging or other capital market activities. Several companies have now begun to support climate solutions and purchase carbon credits without calling it compensation. Examples include Paypal which has purchased avoided emissions credits and Klarna and Stripe which have purchased expensive carbon removal from new suppliers using nascent methods, without making offsetting claims.

Carbon credits can be divided into two main categories based on the underlying project's nature: **emission reduction credits** and **carbon removal credits**. These correspond to two types of projects: **nature-based projects** and **technology-based solutions**.

Carbon Credit Categories	Market share	Type of projects	
		Nature-based solutions	Technology-based solution
Emission Reduction Credits	>80% of the carbon credits	**Avoid** emissions from damages to ecosystems (e.g. avoid deforestation) – representing >80% of the carbon credits	**Reduce** emissions generated e.g. by increasing energ efficiency and/or implementing renewable energy; **Capturing** emissions **at the source** via at-sourc carbon capture and storage technologies
Carbon Removal Credits	<20% of the carbon credits	**Biologically remove** carbon from the atmosphere and **store it in plants**, e.g. via afforestation and reforestation, ecosystem restoration etc..	**Remove** carbon **from the atmosphere via technica solutions** such as direct air capture with geologica storage (DACCS) etc... [18]

Illustration 7: Type of carbon credits by project.

According to the information collected by Ecosystem Marketplace during their annual survey, as of today 170 types of carbon credit exists world-wide.

Illustration 8: EM Carbon Offset Prokect Typology.
Source: Ecosystem Marketplace

While most carbon credits so far have been carbon reduction credits, long-term innovative solutions are implemented to shift from emission reduction to carbon removal. Carbon removals have an advantage over emission reduction as they scrub carbon from the atmosphere, and doing so they play a key role in potentially further reduce the atmospheric carbon concentration in the future. Carbon removal credits are the most expensive one, as shown in the last World Bank report on carbon pricing.[19]

[18] See also EC definition extracted from the proposed regulation for EU Carbon Removal Certificates: Article 2 defines carbon removal as 'the storage of atmospheric or biogenic carbon within geological carbon pools, biogenic carbon pools, long-lasting products and materials, and the marine environment, or the reduction of carbon release from a biogenic carbon pool to the atmosphere'. In defining carbon removal only as relating to atmospheric and biogenic carbon, the text mutes any discussion on the role of nonbiogenic or fossil carbon emissions' at-source capture and storage, which does not remove carbon but avoids its release into the atmosphere (https://www.europarl.europa.eu/RegData/etudes/BRIE/2023/739312/EPRS_BRI(2023)739312_EN.pdf)

[19] World Bank, State and Trends of Carbon Pricing 2023, May 2023

2. CARBONE PRICING

There are two main different approaches to put and influence price on carbon emission: direct and indirect carbon pricing.

- **Direct carbon pricing**: it refers to the explicit levying of a price on carbon emissions. There are mainly two mechanisms: carbon taxes and emission trade systems. While carbon tax sets as fixed amount levied per unit of CO2 emitted, in the emission trading systems the price is established by supply and demand for emissions units.
- **Indirect carbon pricing**: it refers to measures that indirectly influence carbon emissions by incorporating the cost of carbon into products, services, or financial decisions without a direct carbon price applied to emissions. Some examples are consumption taxes and subsidies on fossil fuels [20].

Several organizations have already analyzed the direct and indirect carbon pricing impacts as for instance the Organization for Economic Co-operation and Development (OECD), who published Net Effective Carbon Rates in 2022 and 2023 [21]. Those impacts must be considered to deal in carbon market, understand pricing signals and more generally to define an efficient transition strategy.

As in every other market, once the price has been established, the carbon market relies on the supply and demand to fix the price. This is well noticeable, for example, in the evolution of EU ETS: by improving the monitoring and regulation of the supply volume, the system succeeded in establishing a carbon price which can truly act as a decarbonization incentive for companies. In VCM, supply and demand also influence the price, but the drivers will not always be the same as for the CCM.

In the CCM for instance, the evolution of EU ETS framework has been driven by 4 phases (we are in the 4th today) which progressively amended the rules of the market to become more are more stringent (and the price to progressively raise).

	Phase 1 2005 – 2007	Phase 2 2008 – 2012	Phase 3 2013 – 2020	Phase 4 2021 – *present*
Key Features	• Including only CO2 emissions from **power generation** and **energy-intensive** industries (roughly 20% of the allowances are attributed for free (mainly for heat and electricity) • Succeeded in establishing a **price** for carbon and **free trade** in emission allowances in EU • Penalty: **€40** per ton in case of non-compliance	• **Aviation** brought into the ETS • **Total cap on allowances** lowered by **6.5%** compared to 2005 level • **Union registry** replaced national registries • Included nitrous oxide emissions • Non-compliance penalty increased to **100 €**	• **Single EU cap** in place of national caps • **More sectors and gases** included • Since 2018 **steady reduction of allocation** (~1.74% per year) • **Auctioning allocation** progressively enlarged to additional sectors • Free allocations : o Power generation: 20% o Manufacturing: 80% in 2013 vs 30% in 2020 o Aviation: 82%	• ETS revised rules • Introduction & revision of the **Market Stability Reserve** • Updated **carbon leakage list** (100% free allocation sectors) • More flexible rules to align free allocation with **actual production levels** • Free allowances for innovation **Fit for 55 reform includes:** • More **ambitious emissions reduction goals** (from 42% to 62%) • Faster **reduction of the cap** (from -2.2%/year to -4.3%/year until 2027) • Scope extension to **maritime transport** and new ETS for **buildings, road, transports, fuels** • **Phasing out of free allowances** – after 2026, 0 to 30% max in certain sectors
Preferred Allocation	• **During the two firsts stages (2005 – 2012) : most of the allowances were attributed for free. But at this stage, the strategy was not efficient, and it leads the prices to tumble**		• **Auctioning** becomes the default allocation system (free allowances remaining granted to participants with a high carbon leakage risk)	• **Auctioning** and gradual phase out of free allocation after 2026

Illustration 9: EU ETS phases and development.

In the VCM is the increase of demand and the better quality of carbon credits which mostly drove the pricing raise.
It is hence possible to identify the key factors impacting the carbon price in both CCM and VCM (Illustration 10) are different. The following section explores how each of these components affects the supply and demand dynamics and therefore influences the carbon price, as summarized below:

	Supply-side factors	Demand-side factors	Macro-economic factors
CCM	• **Supply volume:** volume of allowances and auctioning • **Allocation system:** free vs auctioning	• **Emission Reduction Targets** • **Voluntary Corporate Sustainability Initiatives** • **Investor and Consumer Pressure:** • **Profitability and value-added:** • **Credibility and reputation of Project Developers/Crediting Bodies** (only for VCM)	• **Slower economic growth** • **Geopolitical crises** • **Policy and Regulation**
VCM	• **Carbon projects timing** • **Valuation models**		

Illustration 10: Factors affecting demand and supply dynamics with an impact on carbon price

[20] Fuel taxes that apply a fat tax amount to gasoline per liter indirectly place a price on the carbon emissions from the gasoline's combustion. Inversely, fuel subsidies that reduce the price of fossil fuels create a "negative" indirect carbon price signal, which incentivizes higher consumption and therefore increases carbon emissions.
[21] OECD, Net Effective Carbon Rates, May 25th, 2023

2.1 Supply-side factors impacting the carbon price in CCMs

- **Supply volume**

In the CCM, the **volume of the supply** of carbon allowances is managed via regulatory initiatives (in each phase and by the MSR), considering:

- **The number of actors** covered in the emission trading systems. This can be increased, decreased, or vary following an extension of the carbon market's scope. For instance, the Fit for 55 Package proposed an extension to maritime transport and a new ETS for buildings, road transports and fuels, which impacts the volume of the allowances put in circulation.
- **Management of surplus**: if allowances exceed actual emissions, the supply and demand dynamics of price setting would no longer work. Therefore, the regulating body must accurately monitor actual emissions and the demand for certificates and take actions to prevent both allowances surplus and shortening the market. This is the role of the MSR (see section 1.1.1)

- **Allocation system**

Carbon certificates can either be allocated through a free granting process or via auctions (as explain in section 1.1.1). Modifying the allocation structure (ex. distributing more or less allowances for free) is therefore another key leverage to affect the supply (and demand) dynamics and hence the carbon price.
In the EU ETS for example, both the volume of free allowances and the volume of auction allocation are being gradually decreased. Since its Phase 4 (2021 – 2030), the cap on emissions decreases at an increased annual linear reduction factor of 2.2%. The proposal to increase the cap to 4.3%, discussed in December 2022, was adopted[22]. Free allocation also is in a decreasing trend, with the objective stop the distribution of free allowances in 2026.
As it can be observed in the illustration 11, the EU ETS carbon price skyrocketed from around 5€ in 2014- 2017 - at a time when the market experienced several episodes of oversupply[23] - to 90 € in 2023, with maximum prices bid peaking over 105 €. The introduction of the MSR in 2019 marked the beginning of a new phase where better accounting and management of the supply, combined with a shift from free allocation to more auctioning, brough the cost of allowances to a price record. Its positive effect started to be visible after the COVID-19 pandemic recovery as allocations were postponed.

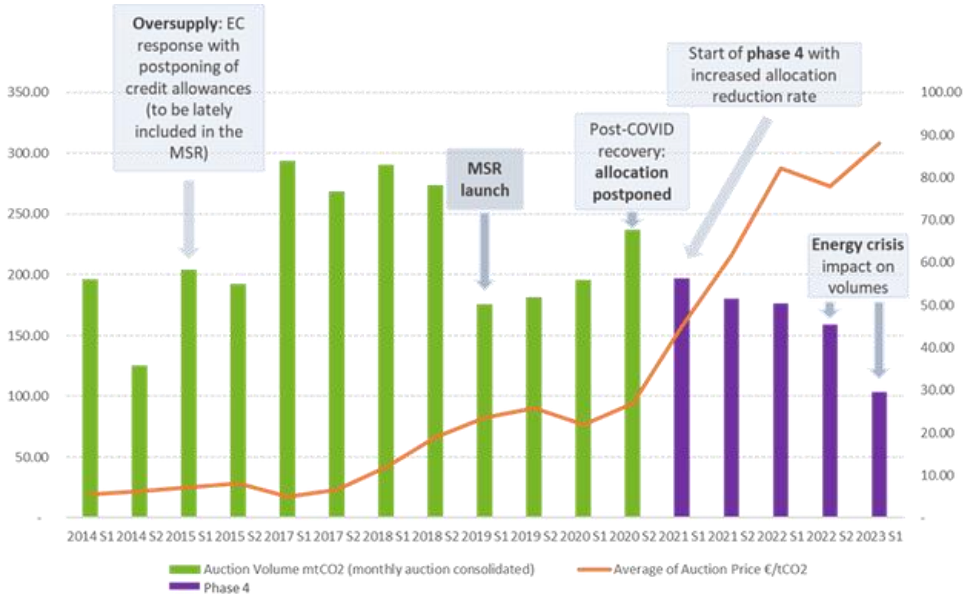

Illustration 11 : EU ETS Auction volumes & price
Source: Emission Spot Primary Market Auction Reports, EEX

The past emissions meaning the number of allowances returned at the end of the previous period: a variation in the returning of carbon certificates will indicate to regulators if there is an unnecessary surplus of carbon certificates in the market or a lack of certificates that push for adjustments.

[22] EU Council, 'Fit for 55': Council and Parliament reach provisional deal on EU emissions trading system and the Social Climate Fund, 2023.
[23] In 2012 the EU ETS market experienced an overflood of carbon certificates that almost collapsed the market by crushing down the price of the carbon certificate.

2.2 Supply-side factors impacting the carbon price in VCMs

- **Projects timing and availability**

In VCMs, the supply of carbon certificates is driven by projects that reduce or remove carbon emissions from the atmosphere. They are mainly carried out by private entities such as industry leaders, forest and landowners or managers.

These projects require, on average, at least one year to produce significant results, that can then be certified and brought to the market in the form of an **issuance of carbon certificates**. Hence, the timing of projects development and of the certification process influence the market supply. For instance, 2022 exhibited a significant drop in the number of new projects launched and certified due to the global pandemic in 2020. This delayed the launch and certification of new projects in 2021, leading to a possible congestion of projects that will need to be certified in 2021-2022, reversing the growth trend experienced since 2021.

- **Valuation models**

Considering the VCM nature of not centralized and harmonized market, various methodologies exist for the valuation and pricing of a certificate.

  - **Cost-based model**: all costs related to the projects (physical investments, energy consumption, raw materials, maintenance costs…) are taken into consideration to set the price including either a business margin to compensate involved parties and/or a premium to compensate local communities and facilitate the adaptation.
  - **Value-creation model**: projects bringing strong social action objectives in addition to the carbon component often carry premiums to account for the positive impacts created. These include, for example, climate action projects carried out in UN Least Developed Countries (LDCs); projects providing additional social safeguards and/or projects ensuring economic viability by minimizing transition risk, protecting against climate adaptation.

In addition, internal carbon pricing models also influence the determination of a carbon certificate's price. Internal carbon pricing refers to the methodologies for corporate accounting of the cost of CO2. By placing a financial value on their own emissions, companies can better understand the carbon impact of their business model, analyze their exposure to climate-related risks and factor the carbon price into business and investment decisions to guide the development of net zero strategies. As internal carbon prices give an indication of the price that corporates can be willing to pay for their emissions, certification bodies take them into considerations when determining the price of a certificate.

2.3 Demand-side factors impacting the carbon price

The demand for carbon certificates is influenced by various factors, including regulatory policies, market dynamics, corporate sustainability goals, and investor preferences.

- **Emission Reduction Targets**: countries, regions, and companies often set emission reduction targets to combat climate change. Achieving these targets may require purchasing carbon certificates to offset their emissions, especially for those entities facing challenges in directly reducing their emissions through operational changes.
- **Voluntary Corporate Sustainability Initiatives**: many companies commit to voluntary sustainability initiatives, aiming to reduce their carbon footprints or achieve carbon neutrality. Such entities may purchase carbon certificates to demonstrate their environmental responsibility and meet their sustainability goals.
- **Investor and Consumer Pressure**: investors and consumers are prioritizing environmentally conscious practices when choosing companies to invest in or buy products from. Companies that can demonstrate their commitment to reducing their carbon impact through the purchase of carbon certificates may gain a competitive advantage in the market.
- **Profitability and value-added**: finally, demand for carbon credits can also be stimulated by financial objectives, as in the case of carbon credits trading or results-based finance (see section 4). This demand can come from:
  a) Financial markets participants, who seek to hold certificates bought either on the CCM or on the VCM as an asset.
  b) Governments aiming to incentivize climate action by purchasing carbon credits. This approach, usually referred to as results-based climate finance help recipient countries to meet their nationally determined contribution ('NDC') targets.

- **Credibility and reputation of Project Developers/Crediting Bodies (only for VCM)**: the reputation of the project developer and crediting organisms can also affect the demand for certificates, having an impact on the price. As an example, the demand for certificates issued by renowned market players such as Verra continued to increase finally leading to a sharp price run-up in 2021 but followed with a drop with due to accusation of overstating the level of carbon offsetting achieved.

2.4 Macro-economic factors impacting supply and demand dynamics in carbon markets

The evolution of carbon prices following macro-economic events such as geopolitical crises and growing inflation illustrates the direct relationship between the demand for carbon certificates and the economic situation, two main examples below:

- **Slower economic growth affects emission trend and can delay climate commitments**
  In the CCM, regulators must consider external macroeconomic factors that affect the emissions trend, such as the COVID-19 crisis and its impact on the economy. The global lockdown spurred an unusual drop in emission to which regulators responded with an extraordinary postponement of auctioning.
  Likewise, both in the CCM and in the VCM rising inflation and slower economic growth can have a short-term temporary negative impact on carbon prices. This can be due to corporates stepping back from their voluntary climate commitments when struggling with price increases and declined profitability.

- **The Ukraine conflict is accelerating the development of ambitious climate and energy policies**
  Since the beginning of the Ukrainian conflict, the EU ETS faced one of its worst crashes witnessing a sharp decrease in the price of carbon allowances. This is due to several factors linked to the European industries' dependency on Russian oil and gas, rising energy prices and the accelerated phasing-out of fossil fuels. Investors anticipate that concerns over energy security will lead to even more ambitious EU Climate policy. By accelerating the deployment of renewable energy, the trend is expected to spur a lower demand for carbon allowances[24].

- **Policy and Regulation**
  Keeping a close eye on government policies, international agreements (such as the Paris Agreement), developments in climate change policies, and regulatory changes related to carbon emissions is crucial in understanding how the carbon market may evolve, which can have significant impacts on carbon prices.
  (See section 5.3).

[24] Source: IETA GHG Market Sentiment Survey Report 2022 (link)

3. GLOBAL FIGURES OF CARBON MARKET

Volume and price of carbon allowances and certificates have risen sharply in the recent years as presented in illustration 12 showing the evolution of the allowance's prices by ETS since 2005.

This trend is not the same across all ETSs. **The largest price increases have been observed in the EU ETS, the UK ETS and the Swiss ETS** (all in Europe), while in other ETSs, such as RGGI, prices raise has been less important. This trend is confirming that price incentive, for instance in RGGI, have a more limited role in reducing emissions compared to the EU ETS. In fact, RGGI's carbon prices are capped, which put a less intense pressure on companies to reduce their emissions.

Illustration 12: Carbon Allowances price evolution since 2005 by ETS
Source: ICAP Allowances Prices

Another interesting chart below (Illustration 13) represents the **Real Carbon Price Index**[25] trend showing the consolidated carbon price across jurisdiction, weighted by the % of global GHG covered. As the chart shows, the global coverage significantly increased with the launch of the China National ETS, and today EU ETS combined with the China ETS both cover the largest part of the GHG emissions traded on ETS globally. Although considering that only the 23%[26] of the global GHG emissions are currently covered by both direct carbon pricing instruments (carbon tax and ETS mechanisms), CCM has the potential to expand to other sectors and jurisdiction[27]. Moreover, several initiatives are under consideration in emerging economies as African countries and Middle East driven by the need to implement climate change mitigation policies and manage transition risks.

Furthermore, it is interesting to note that prices jump in 2020, when Paris alignment objectives within the EU ETS were set out and the curve starts its exponential trend.

Illustration 13: Representation of Real Carbon Price Index as of June 30th, 2023
Source: realcarbonindex.org

[25] The Real Carbon Price Indices represent the carbon price across all emissions from all jurisdictions. This includes emissions which are covered by a carbon price and those which are not – the latter being included as a zero price. These indices enable a carbon price and price history to be determined which reflects the global value of carbon

[26] The first report published by the World Bank ten years ago, only 7% of global emissions were covered by either a carbon tax or an ETS. Today, as highlighted in the 2023 report, almost a quarter of global greenhouse gas emissions (23%) are now covered by 73 instruments. (State and Trends of Carbon Pricing 2023)

[27] Some possibilities of expansion for direct carbon pricing instruments have been described by Bloomberg in their article "The Untapped Power of Carbon Markets in Five Charts", September 16th, 2022.

The index also includes the carbon tax initiatives, even if, as shown in illustration 14, carbon price is mostly driven by ETS, specifically EU ETS.

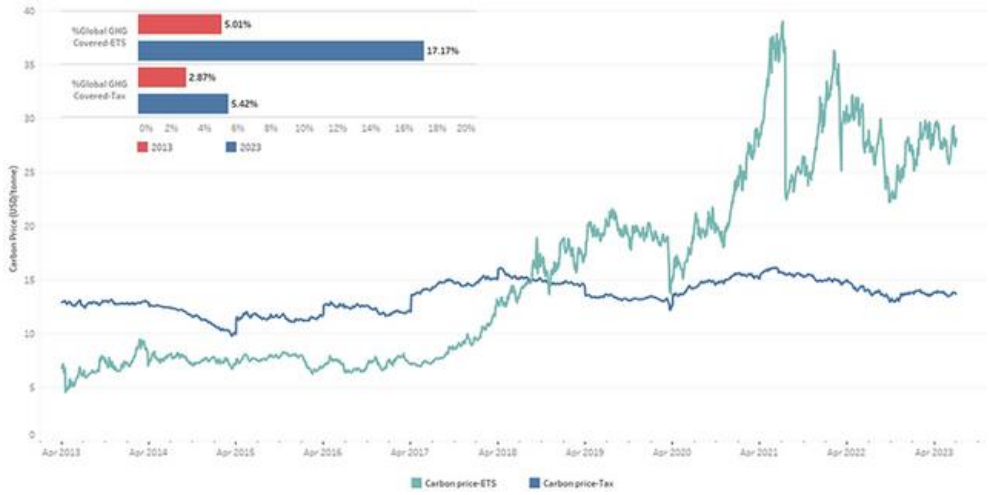

Illustration 14: Representation of Aggregated Real Carbon Price by Tax/ETS as of June 30th, 2023
Source: realcarbonindex.org

The EU ETS also dominates in terms of generated revenues (Illustration 15), those revenues are meant to be used to support the need of investment for the transition of the European Unition.

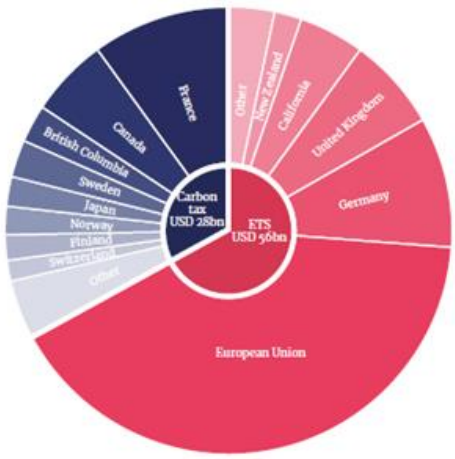

Illustration 15: Revenue generated per carbon pricing instrument in 2021
Source: World Bank 2022. "State and Trends of Carbon Pricing 2022"

4. CARBON-BASED INSTRUMENTS AND SOLUTIONS

The growth of carbon markets in recent years has resulted in an increased interest from the investment community for two reasons: first, to see how carbon as an asset class can be included in an investment strategy; second, to understand the risk and opportunities for corporates arising from evolving carbon pricing.

Both aspects have been analyzed and are detailed in the below sections.

4.1 Carbon certificates as an asset class

At this point in time, most trading activity in carbon markets is focused on compliance or, in case of the VCM, on fulfilling emission reduction commitments. The growing interest from the financial industry has spurred the launch of investment products for the carbon market.

Carbon-based investment products support three use cases:

- **Generating returns**: Over the past 5 years, carbon allowances have been one of the best performing asset classes, driven by the price increases described in chapter 2[28]. With increasing regulatory ambition, and growing demand for net-zero solutions, the value of carbon allowances is expected to continue its upward trajectory. Carbon allowances have low historic correlations to other asset classes, and correlation among different carbon markets (i.e., EUAs and CCAs) remains low[29].
- **Hedging risks**: For most companies, rising carbon prices represents a growing operational cost which inherently drives down profitability. As a result, most well-diversified portfolios will be negatively exposed to rising carbon prices. A direct investment in carbon allowances can hedge the carbon price exposure within a portfolio.
- **Generating impact**: Driving the decarbonization of investment portfolios and ultimately lowering real-world emissions is key to impact investing. Offset credits are a commonly used instrument. Investors can buy and retire offset credits to reduce the net financed emissions of their portfolio. This is, however, not widely accepted as a path to net zero and drags down financial performance – once the environmental benefit of an offset credit is realized, the financial value of the instrument goes to zero. On the other hand, investment in carbon allowances from regulated carbon markets creates environmental impact during the investment period and, in the case of the EU ETS, this impact is neither reversed nor negated when the investment is sold. This is due to the MSR, that allows investors to trigger reductions in the future supply of European Union Allowances (EUAs) as a result of their investment. This reduction in supply effectively lowers the emissions capacity of the bloc, forcing companies to decarbonize more quickly.

The way in which the MSR is applied is mechanistic. As a result, the precise impact of holding one EUA can be quantified, and by extension the allocation to EUAs required to deliver an environmental goal within a portfolio can be calculated. For example, making a 1% allocation to EUAs to an average developed markets Paris Aligned portfolio, can be sufficient to mitigate the emissions of that portfolio. For emerging markets portfolios that tend to have a higher carbon footprint, a 3.5% position can be sufficient to generate a net zero portfolio[30].

	Solactive EM	Solactive DM PAB
Financed emissions (per €m invested)	95.98 tCO2e	30.86 tCO2e
EUA position in 2022 (as % of AUM)	3.48%	1.06%
EUA position in 2030 (as % of AUM)	7.1%	2.16%

Assumption: 2% portfolio growth, 5% emission reduction y-y for DM and EM, 7% for DM PAB

Illustration 16: EUA position as % of AUM.
Source: SparkChange

[28] Using Physical Carbon Allowances to mitigate financed emissions, Sparkchange, 2022
[29] Using Physical Carbon Allowances to mitigate financed emissions, Sparkchange, 2022
[30] Using Physical Carbon Allowances to mitigate financed emissions, Sparkchange, 2022

There are several products available that allow investors to gain exposure to carbon markets, both voluntary and compliance. The products can be categorized based on two criteria: the underlying carbon instrument (single market asset or basket) and the type of exposure (synthetic or physical).

Underlying	Exposure	Profit	Hedging risks	Generating impact	Example product
Carbon allowances single market	Synthetic	Yes	Yes, for the relevant market	Only during investment period	Wisdom tree, Krane Shares
	Physical	Yes	Yes, for the relevant market	During investment period for all markets, permanent emission reductions with EUAs	SparkChange CO2.L (EUAs only)
Carbon Allowances basket	Synthetic	Yes	Yes, for included markets	Only during investment period	KraneShares Global Carbon Strategy ETF KRBN
	Physical	Yes	Yes, for included markets	During investment period for all market, permanent emission reductions with EUAs	This does not exist
Offsets	Synthetic	Yes	Yes, but only limited to offset price risks	No	KraneShares Global Carbon Offset Strategy ETF (KSET)
	Physical	Yes	Yes, but only limited to offset price risks	No	This does not exist

Illustration 17: Products overview by underlying carbon instrument and exposure type.
Source: Sparkchange

Investable products in CCM focus on the EU ETS and the North American carbon markets (California and RGGI), as they are the most liquid carbon markets. With interest in the VCM growing, more products for offset credits will follow. To generate an impact with Offset credit investment products, the underlying offsets would have to the retired, resulting their financial value to go to 0. Thereby offset credits can have either a financial value during the investment or an impact value, but not both at the same time.

4.2 Where to start to trade on Carbon Market?

Allowances can be traded in the spot market, or the (usually much more liquid) futures market.

In 2021, according to Refinitiv, 91.7% of EUA's trading volume traded in the futures market. Even though it is possible, directly trading carbon allowances can be cumbersome.

Options to trade EUAS	Benefits	Cons
1 Open a registry account and directly hold physical carbon allowances in the registry	• Most direct approach, once set up low maintenance cost • Indirect environmental impact	• Operationally challenging for non-compliance companies
2 Trade Futures on a commodity exchange such as the ICE, CME, EEX or Nodal Markets	• High liquidity in future markets • No need for registry account • Potential for leveraged or unfunded positions	• Access to commodity exchange needed • Minimum trading volumes of 1000t • UCITS ineligible
3 Invest in a financial product that is backed by carbon allowance futures	• Easier to hold for investors • UCITS eligible	• Annual rolling cost can add to fees, higher upfront costs compared to trading futures directly • Uncertain environmental impact
4 Invest in a financial product that is backed by a physical carbon allowance	• Easily investable while liquidity is backed by both futures and spot markets • UCITS eligible	• Higher upfront costs compared to trading futures directly • Indirect environmental impact

Illustration 18: Options to trade EUAs.
Source: Sparkchange.

4.3 Risk and opportunities from a rise in carbon pricing

The first step to implement an efficient investment strategy is to be able to correctly measure carbon price exposure, otherwise management and monitoring are not possible.

Carbon markets are an essential part of the world's transition to a low-carbon economy, where several CCMs around the world are currently increasing the ambition of their programs. This makes it more expensive for corporates to emit CO2e, the resulting risk, referred to as "Carbon price risk", is therefore continuously increasing.
In its latest climate risk stress test, the ECB (European Central Bank) estimates that banks could lose at least €70bn in the next three years due to climate change, with transitional risks (including carbon price risk) the most significant risk factor by far, responsible for €53bn of those losses.

Despite the potentially high impact of carbon pricing on corporates' balance sheets, transition risk analysis often focusses on carbon footprint as the primary driver of carbon price risk, thereby falling into the trap of treating all emissions as created equal. Emissions are created equal from an environmental perspective, but from a financial risk perspective, the picture is quite different. SparkChange's carbon price exposure metric is the most detailed representation of carbon price risk currently available. As carbon price risk mainly originates from CCM, the first step is to account for the specifics of each carbon market, mapping local emissions to local regulations. But their dataset goes much further, analyzing the direct and indirect carbon costs that a company incurs because of their operations, their compliance and trading strategy, as well as the revenues that a covered company accrues because of successful decarbonization strategies, carbon-efficient productions, and the capability to pass-through their carbon costs to their clients. Therefore, providing a broad picture of the financial effects of carbon pricing and climate regulation on companies' earnings.

The chart below shows how widely carbon price exposure varies across sectors and the companies within the sectors within the EUROSTOXX50 index. Looking at this, investors can identify potential outperformers in a high carbon price future.

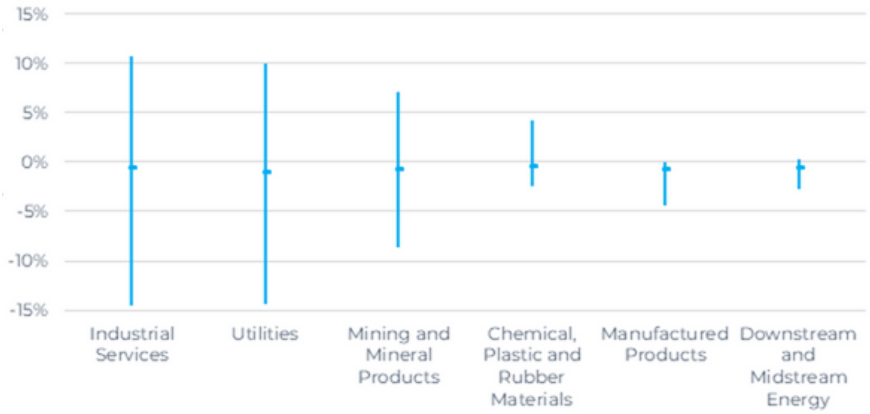

Illustration 19: Carbon Price exposure as % of market cap.
Source: SparkChange[31]

Only a metric that goes into this level of detail can accurately represent carbon price risk in the granular and forward-looking nature required in order to develop carbon price risk hedging strategies.

[31] A 3-Pronged Approach to low carbon, Sparkchange, 2022

4.4 Role of derivatives on Carbon Market

Derivatives play a crucial role in carbon markets, helping participants to **manage and hedge their exposure** to price fluctuations in carbon credits or allowances to mitigate climate change and transition risk.

Carbon markets are established to regulate and limit greenhouse gas emissions, and derivatives provide financial tools to **mitigate risks and enhance liquidity** in these markets. Thus, the development of a derivative carbon market is one of the key elements to **grant the efficiency of the carbon market**.

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

- **Carbon derivatives strategies**

There two main approaches in carbon market strategies, which are methods of managing risks or seeking opportunities the market:

  - **Top-Down Carbon Derivatives Strategy**: investors or market participants focus on broader economic or market factors that can influence carbon credit prices. They analyze macroeconomic trends, policy developments, and global market dynamics to make their investment decisions. This approach is more concerned with understanding how larger factors can impact carbon prices and emissions trading systems.
  - **Bottom-Up Carbon Derivatives Strategy**: in contrast, a bottom-up carbon derivatives strategy focuses on specific companies, industries, or carbon-intensive assets to identify investment opportunities or manage risks. This approach involves a detailed analysis of individual entities' emission profiles, carbon reduction strategies, and their exposure to carbon prices.

Both top-down and bottom-up carbon derivatives strategies have their strengths and weaknesses. Top-down strategies provide a broader perspective on the overall market and policy environment, while bottom-up strategies offer insights into individual entities and their emission profiles. Some investors may choose to combine elements of both approaches to develop a comprehensive carbon derivatives strategy tailored to their investment goals and risk tolerance.

- **Exchange traded and OTC derivatives**

Derivatives can be traded on exchanges or OTC depending on the underlying and the purpose. Exchange traded derivatives are mostly the ones related to regulated market allowances like EUA, CCA and RGGI with a large majority of those being futures (options are also traded on exchange), but they can also be related to eligible voluntary offsets.
Analyzing the market trends for carbon derivatives traded on ICE[32], we observe that the open interest and volume seems to be correlated, although for EUA derivatives volume and open interest are closer in terms of amount while for North America Markets the open interest are proportionally higher than the contract volume. This could mean that in North America Markets (CCA and RGGI) trades are mostly holding positions on carbon derivatives, while in the EU ETS positions are more often offset.

While derivatives on CCM (carbon allowances) are well known and largely used, derivatives on VCM (carbon credits) are also starting to be traded as the demand of carbon certificates and the size of the VCM increase:

  - **European Energy Exchange AG (EEX Group)** introduced a dedicated voluntary carbon product suite in June 2022. The first VCM products were listed at EEX Group's US-based Nodal Exchange and in 2023 at EEX in Europe.
  - **Chicago Mercantile Exchange 'CME Group'** launched on 2021 a nature-based global emission offset (N-GEO) future and a global emission offset (GEO) future. GEO futures are based on the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).[33]
  - **Intercontinental Exchange (ICE)** launched 10 new Nature-Based Solutions Carbon Credit futures contracts.

[32] Global Environmental Markets Report, The ICE, 2023
[33] CBL Global Emissions Offset, CME Group, 2023

5. TENDENCIES IN THE VOLUNTARY CARBON MARKET

Voluntary demand from companies has so far been the primary driver of VCM activities. However, with emissions policies becoming more stringent, the increase of regulatory requirements, and the growing awareness on the climate urgency, a wider range of actors are starting to be attracted by the carbon market.

In this fast-moving environment, we observe several tendencies:

- **Rise of the voluntary carbon market**: The voluntary carbon market is growing rapidly, as companies and individuals look for ways to offset their emissions. This is being driven by several factors, including the increasing demand for carbon offsets, the development of new standards and certification schemes, and the growing awareness of climate change.
- **Increased focus on quality**: There is a growing focus on the quality of carbon offsets, as buyers become more aware of the importance of ensuring that their offsets are actually reducing emissions. This is leading to the development of new standards and certification schemes for carbon offsets.
- **Technological Innovations**: advancements in technology, such as blockchain and IoT (Internet of Things), were being explored to improve transparency, traceability, and efficiency in carbon markets. Blockchain, in particular, is seen as a promising solution to enhance the credibility and integrity of carbon certificates and offset projects.
- **Increased government involvement**: Governments are increasingly getting involved in the carbon market, as they look for ways to regulate emissions and promote the development of low-carbon technologies. This is being seen in the development of carbon pricing schemes, the regulation of the voluntary carbon market, and the support for carbon capture and storage technologies.

5.1 Standardization & harmonization initiatives in the VCM

Historically, voluntary demand led to a proliferation of privately governed certification standards, with several carbon voluntary offset programs coexisting today (American Carbon Registry, Climate Action Reserve, Verified Carbon Standard, Gold Standard, Plan Vivo System, …). Each of these programs adopts different rules and criteria for carbon certificates. As a result, the market is populated by various types of carbon credits, each presenting different intrinsic features.

For such a market to be efficient, it is key to ensure the credibility of the certification process and the high quality of the credits issued, i.e., in terms of amount of carbon reduced/removed, standards ensured by the certification body, co-benefits created by the activity, location, vintage and so on. The long-standing debate on the quality and role of the carbon credits has been addressed mainly by voluntary initiatives, but regulators are also becoming more proactive.
There are several voluntary initiatives around the standardization and harmonization of carbon markets:

- **The International Emissions Trading Association (IETA)**: is a non-profit organization that was founded in 2002. The IETA is the leading global association for the carbon markets. The IETA's mission is to promote the development and use of carbon markets to reduce greenhouse gas emissions.

- **Voluntary Carbon Market Integrity Initiative (VCMI)**: multi-stakeholder initiative that was launched in 2019. The VCMI's goal is to "ensure that the voluntary carbon market is a high-integrity market that delivers real environmental benefits." The recently released (on 28 June 2023) *VCMI Claims Code of Practice*[34] which provides a rulebook for companies on credible use of high-quality carbon credits on the path to net zero.
    - To make an enterprise-wide claim, companies must follow four simple steps:
        - Comply with foundational criteria,
        - Select the claim level (Silver, Gold, or Platinum),
        - Meet carbon credit use and quality thresholds,
        - Obtain third-party assurance per the VCMI Monitoring, Reporting, and Assurance Framework.

- **Taskforce on Scaling Voluntary Carbon Markets (TSVCM)**: is a group of leading organizations launched in 2020. Its goal is to "scale the VCM to deliver significant and credible climate benefits." The TSVCM's work is helping to build a more transparent and credible market that can help to address climate change.

- **Integrity Council for the Voluntary Carbon Market (ICVCM)**: governance body launched by the TSVCM in 2021 to promote integrity and transparency in the voluntary carbon market. The initiative resulted in the creation of an internationally recognized standard to help buyers identify high-quality carbon credits: *Core Carbon Principles (CCPs)*[35] published in March 2023.

[34] VCMI Claims Code of Practice , Voluntary Carbon Markets Integrity Initiative, June 28th, 2023.
[35] Core Carbon Principles -ICVCM

- **International Swaps and Derivatives Association (ISDA)**: in December 2022, ISDA developed the Verified Carbon Credit Transactions Definitions (VCC Definitions), a set of standardized terms and conditions that can be used to structure transactions involving the purchase and sale of verified carbon credits (VCCs). This initiative aims to support the growth of OTC and exchange-based secondary trading.

5.2 Developments of Carbon credits marketplaces

Following the trend of harmonization and framing of VCM, some marketplaces have been recently launched trying to fill the market gaps and to bring together climate action ideas (projects) and capital. Those marketplaces have been conceived to allow corporates on one side and investors on the other to source, purchase, settle and retire voluntary carbon credits in a more efficient way and to increase transparency forcing the participants to disclose several types of information (including type of project, standard applied, eventual reference to an international classification of environmental and social benefits – United Nations Sustainable Development Goals, …). In some cases, third-party ratings companies are also allowed to join the marketplace through the publication of ESG ratings or by providing independent verification against global standards.

Some examples of these marketplaces include:

- The **London Stock Exchange Voluntary Carbon Marketplace**, announced in November 2021 and operating since October 2022.
- The **Hong Kong Exchange Core Climate**, launched in October 2022.
- The **Sales Force Net Zero Marketplace**, launched in September 2022.

Here below an illustration of a VCM ecosystem and the role of carbon marketplaces.

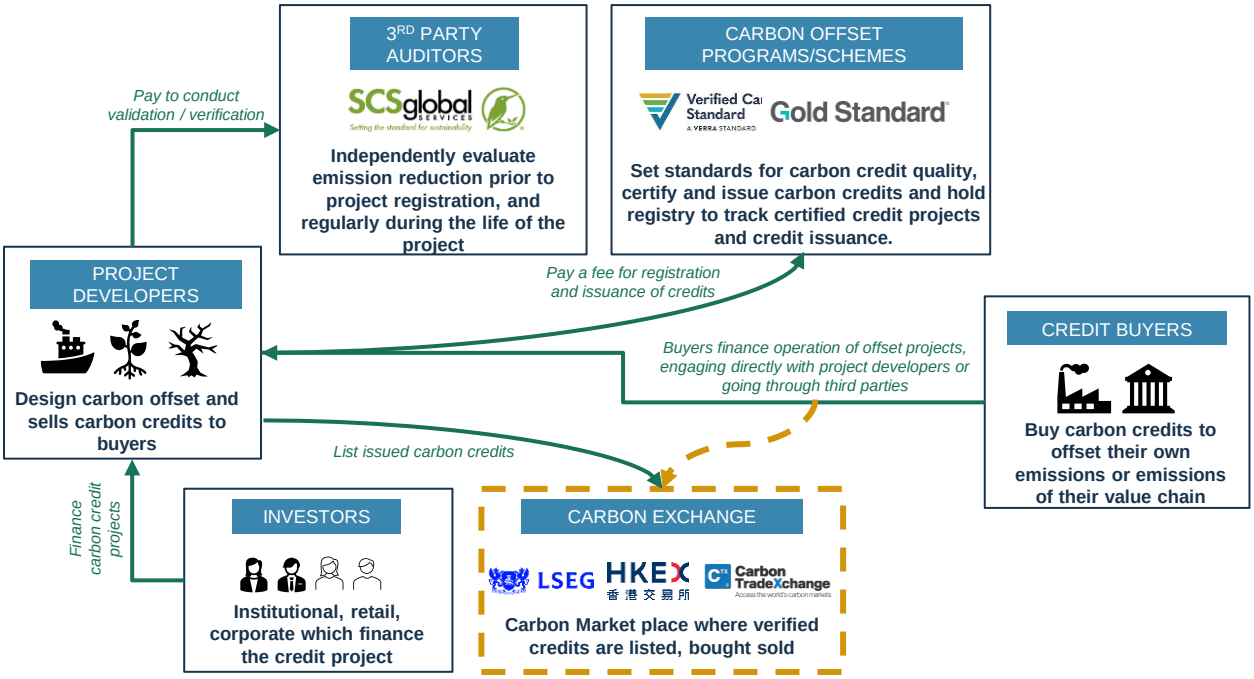

Illustration 20: Example of VCM ecosystem
Source : the Carbon Credit Ecosystem by the Paia Team and Ailancy analysis

5.3 The role of digital technologies in VCM

Technologies such as blockchain start to attract increasing attention as a powerful instrument to improve transparency and reduce transaction costs on carbon markets, particularly on the voluntary markets. It allows for instance to solve problems around carbon credits trust and solve inefficiency to allow the market to scale up, by addressing challenges such as:

- **Transparency of carbon credits assessment methodology**: by recording the issuance, transfer, and retirement of carbon credits on a blockchain, stakeholders can easily trace the origin of each credit, ensuring their legitimacy.
- **Possible double count/double use of the same carbon credit**: blockchain solutions are designed to be decentralized platforms connecting various registries worldwide, hence detecting 'double claiming' when multiple entities claim the same emission reduction credit.
- **Poor data quality**: carbon markets involve the exchange of complex data related to emissions, offset projects, and credits. Blockchain technology can ensure data integrity and accuracy by using consensus algorithms to validate information across the network. This reduces the risk of errors and fraudulent activities in the carbon market.

The use of blockchain on carbon market has gone so far that several actors have already started to launch tokens based on carbon certificates:

- **BetaCarbon**: Australian initiative that proposes tokens based on Australian Carbon Credits Units issued by the government for carbon capture projects (Australian Carbon Tokens (BCAUs)). The Australian Carbon Token is used as an investment asset, not as offset.
- **Toucan Procol**: carbon credits issued by Verra[36] into the blockchain by retiring the credit in exchange for a tradeable token, known as a Base Carbon Token, or BCT.
- **Climate Action Data Trust**[37]: created by the World Bank, the Government of Singapore and IETA, aims to establish a decentralized metadata system that is able to link, aggregate and harmonize all major carbon market registry data. It was officially launched at the Asia Climate Summit in December 2022.
- **Carbonplace**[38]: initiative launched in July 2021 by a group of financial institutions (CIBC, Itaú Unibanco, National Australia Bank and NatWest Group) announced the launch of Project Carbon, a Voluntary Carbon Marketplace pilot. The purpose of this project was to create a marketplace to track the generation and use of carbon credit. On February 2022, three additional banks joined the initiative (BNP Paribas, Standard Chartered, and UBS). It will provide "settlements infrastructure" and IT systems for marketplaces and exchanges. In other words, it aims to be an IT infrastructure provider and create an ecosystem. joint the initiative.

[36] Verra is the largest credit offset register. For more information, see https://verra.org/
[37] https://climateactiondata.org/
[38] For more information, see: https://carbonplace.com/how-it-works/

6. REGULATORY INITIATIVES AROUND CARBON MARKETS

In addition to bottom-up voluntary initiatives, regulators are also becoming more proactive in seeking to scale standardization and efficiency of carbon markets. 2022 marked a change of vision as many regulations have been reviewed, modified, or created to regulate this market in a better way. Four main initiatives already under implementation need to be mentioned – as well as constantly monitored for changes to come: the Fit for 55 Package, REPowerEU, the Fundamental Revision of the Trading Book, the developments under Article 6 of the Paris Agreement and the standards under CSRD.

- **The "Fit for 55" Reform**

The "Fit for 55" package includes several proposals to revise and update the EU legislation to meet the goal of reducing net greenhouse gas emissions by at least 55% by 2030. Proposed legislative initiatives cover several topics, such as the EU emission trading system, energy taxation, social climate funds, alternative fuel infrastructure etc.

Changes to the existing **EU ETS aim to bring an overall emission reduction in concerned sectors of 62% by 2030**. To reach this new target, current provisions are reinforced, and new ones are included, such as:

- **Extension of the scope of application of the scheme to maritime transport** - including emissions from shipping in the EU with the proposal of gradually introducing of obligations for shipping companies to surrender allowances.
- **Creation of a separate ETS for the buildings, road transport and combustible and fuels sectors**. This initiative is also implemented in the German national ETS, showing the convergence among European policies. This proposition will allow a reduction of emissions by 43% in this sector by 2030.
- **Phasing out the free allocation of allowances to sectors to be covered by the Carbon Border Adjustment Mechanism (CBAM)**[39] with a slower reduction at the beginning of a ten-year period (2026 – 2035) and an accelerated rate of reduction at the end.
- **Phasing out the free allocation of emission allowances to aviation sector**. The EU ETS will apply for intra-European flights (including the United Kingdom and Switzerland), while CORSIA[40] will apply to EU operators for extra-European flights to and from third countries participating in CORSIA.
- **Increasing the funding available for the "modernization fund and innovation fund"**
- Revise the **market stability reserve** to continue ensuring a stable and well-functioning EU ETS by prolonging beyond 2023 the increased annual intake rate of allowances (24%) and setting a threshold of 400 million allowances above which those placed in the reserve are no longer valid.

These changes entered into force on May 16th, 2023, with the publication of the updated regulatory texts on the Official Journal of the EU.[41]

While voting on the system's revision, the role of financial participants in the EU ETS raised debates, with one group in the Parliament proposing to limit the access to the market to regulated entities. The proposal was based on the conviction that financial institutions participating in the market were to blame of speculation and price increase. This accusation was discredited thanks to the European Central Bank's analysis on the role of speculation in the EU ETS[42] demonstrating that surges in the carbon price have been driven mostly by policy changes and rising energy prices.

However, restricting market access would have simply impeded the correct functioning of the auctions and the long-term markets efficiency. Financial operators facilitate the transfer allowances from the seller to the buyer, granting access also to small-sized buyers who do not have the resources to access the wholesale market, providing liquidity by buying and holding allowances, ensuring price transparency, and taking on an element of the price and supply risk that would otherwise remain at compliance entities level.

- **The REPowerEU package**

Following the economic and energy crisis that hit Europe since the beginning of Ukrainian conflict (February 2022), phasing out the dependency on Russian oil and gas has become of utmost priority. **REPowerEU** is the European plan to rapidly reduce Russian oil and gas consumption and accelerate the green transition through energy savings, diversification of energy supplies, and accelerated roll-out of renewable energy to replace fossil fuels. The plan will also be financed through the budget made available with the Fit for 55 Reform.

[39] The CBAM, officially entered into force on 16 May 2023, will enter into application on 1 October 2023. It will apply to import of goods whose production is carbon intensive and at high risk of carbon leakage: iron, steel, cement, aluminium, fertilizer, electricity and hydrogen. It will require to confirm that a price has been paid for the emissions generated in the production of the imported goods. For more information, see: Taxation and Custom Union, European Commission (2023)

[40] CORSIA is a global offsetting scheme, whereby airlines and other aircrafts operators will offset any growth in CO2 emissions to stabilize the aviation's net CO2 emissions. Source: ICEAO, Carbon Offsetting and Reduction Scheme for International Aviation, 2023

[41] Official Journal of the European Union, L 130, 16 May 2023

[42] ECB, The role of speculation during the recent increase in EU emissions allowance prices, ECB Economic Bulletin, Issue 3/2022, 2022. 2022

The Commission has proposed to more than double the rate of renewables in the EU from 20% to at least 45% by 2030.

This would be achieved by implementing the following measures:

- Rapidly scaling up the deployment of renewable energy, particularly wind and solar power, across Europe. The objective is to reach 40% to 45% in renewable energy by 2030 under the Fit for 55 package.
- Investing in energy efficiency measures to reduce overall energy demand such as the use of fuel substitutes, electrification, renewable hydrogen etc.
- Prioritizing the development of community-led renewable energy projects and ensuring that benefits from the transition to renewable energy are distributed fairly.
- Phasing out subsidies for fossil fuels and introducing a carbon price to reflect the true cost of greenhouse gas emissions.
- Supporting workers and communities that are affected by the transition away from fossil fuels through targeted support and retraining programs.

- **Carbon certificates under FRTB**

Another challenge for financial market participants comes with the new rules proposed under the Fundamental Review of the Trading Book (FRTB), which would set disproportionately high capital requirement for carbon credit certificates. Under the FRTB, carbon certificates would attract a 60% risk weight (twice that of cruel oil). However, the analysis performed by the International Swap and Derivatives Association ('ISDA')[43] on the price volatility during periods of stress suggests the risk weight should be closer to 37%.

The high-risk weight given to carbon credit certificates by the regulator would have a significant impact on the role of the bank as intermediary in the emission trading system, affecting the extent to which banks can participate in carbon trading and ultimately impacting the speed and effectiveness of the green transition.

Secondly, the FRTB reform also identifies a low correlation (0.99) between spot and forward position that is warranted by analysis of data on EU allowanced trades. This implies that it will not be possible for the banks to offset opposite spot and forward positions of the same commodity (banks buy spot and sell forward). For other commodities which carry physical storage cost, the cost of carry can in fact generate an imperfect correlation between spot and forward. However, carbon certificates are not typical commodities and do not have physical storage costs. In this case spot and forward positions should be closely correlated, hence the ISDA recommendation that correlation between spot and forward position in the EU ETS market should be increased to 0.996.[44]

- **Developments under Article 6 under Paris Agreement**

Article 6 of the Paris Agreement allows countries to voluntary cooperate to achieve the emission reduction targets sets out in their National Determined Contributions (NDCs). Article 6.2 sets the basis to trade GHG emission reductions across countries, while Art. 6.4 establishes a mechanism for trading GHG emission reductions between countries under the supervision of the decision-making body of the UNFCCC, the Conference of the Parties. Finally, Article 6.8 recognizes non-market approaches to promote mitigation and adaptation.

Specifically, these define the following approaches:

- **The cooperation approach (Art. 6.1, 6.2, 6.3)**: this approach sets a bilateral or multilateral market between countries. Article 6.2 fosters cooperation between countries by allowing the trade of Internationally Transferred Mitigation Outcomes (ITMO, measured in CO2 equivalent or other metric), which are carbon credits representing exceeding CO2 reduction from their nationally determined contribution (NDCs). NDCs are a percentage of emission reduction target by a certain year, publicly announced by each country. Countries with a single year target for their NDC (e.g. reducing x% emissions by 2050) will apply adjustments in the target year as an average of all credits over the entire NDC period. Countries using the carbon market have to report trade information, unless this information contains confidential elements. Emission avoidance cannot be converted into ITMO.
- **The contribution approach (Art. 6.4, 6.5, 6.6, 6.7)**: Article 6.4 creates an internationally centralized market mechanism (under the authority of the UNFCCC[45]) to exchange or buy/sell carbon credits from carbon reduction or sequestration. This market mechanism includes both public and private parties. It allows for transfers of carbon reduction allowances: a firm with excess reduction emissions can convert this excess into transferrable carbon credits and sell them on the carbon market to a firm that needs to emit more carbon than it is allowed. The company that buys carbon credits uses them for complying with its own emission reduction obligations or to help meets net-zero.

[43] Implication of the FRTB for carbon certificates: a global perspective, ISDA, 2022

[44] Progressing on Carbon Trading, ISDA, 2022

[45] UNFCCC: United Nations Framework Convention on Climate Change

- **The non-market approach (Art. 6.8, 6.9)**: this allows a closer collaboration between countries without the need for transacting on a market. Countries will more efficiently reach their carbon reduction target thank to less frictions. Countries share their technology, experience, or capacities to create synergies between independent mechanisms. This approach requires an expertise regarding the wide variety of subjects.

To prevent double accounting problem (1 ton of CO2 being accounted twice), Article 6.4 associates each ITMO or carbon credit to a corresponding adjustment in inventory for both parties and for each transaction. The selling party deducts the sold carbon credit from its inventory (greenhouse gas or other metric), whereas the buying party adds the bought carbon credit to its inventory (greenhouse gas or another metric).

These adjustments ensure that a party cannot use a sold ITMO or carbon credit to reach its own carbon reduction objectives. Existing carbon market needs to clarify if a country only accepts Art. 6.4 standard or wishes to extend to other independent standards. The European Union is at the forefront with the conception of a standard for the common European carbon market aligned with Article 6.4 of the Paris Agreements. The objective is to create a centralized carbon removal certificate framework, used by both private and public parties within the European Union, convertible and transferable to external parties on international markets. This also address the concerns raised by ISDA in their response to the European Commission's consultation on the creation of a standard certification of carbon removal, related the lack of clarity about the legal nature of carbon credits, specifically how they can be created, bought, sold, and retired. For instance, it is not clear how should be treated in case of insolvency[46].

- **Creation of a carbon removal certificate framework (European Commission initiative)**

On 19 October 2021, the Commission announced in its 2022 Work Program a proposal for the **certification of carbon removals** with a view to scaling up the deployment of sustainable carbon removals and creating new business models for land managers and industrial companies, in line with the European Green Deal and European Climate Law objectives.

On 15 December 2021, the Commission adopted a **Communication on Sustainable Carbon Cycles**. The Communication focuses on short-term actions to (i) upscale carbon farming as a business model incentivizing practices on ecosystems that increase carbon sequestration, and (ii) foster new industrial value chains for the sustainable capture, recycling, transport, and storage of carbon.

A major barrier to the upscaling of carbon removals is the lack of a common EU standard for the transparent identification of activities that remove carbon from the atmosphere in a sustainable way. Existing public and private schemes, such as in voluntary carbon markets, certify carbon farming practices but apply a wide variety of approaches to quantify their climate benefits. Industrial carbon removals are rarely addressed.

The establishment of a framework for the certification of carbon removals is an essential steppingstone towards achieving a net contribution from carbon removals in line with the EU climate-neutrality objective. The certification framework should identify the types of carbon removals to consider and set robust requirements for quality of measurement, monitoring, reporting and verification.

The initiative will assess whether:

- An EU certification framework should set common minimum standards for the certification methodologies, including on monitoring, reporting and verification, or provide for comprehensive rules on the certification of each type of carbon removal.
- The different functions, including the prior validation of projects and the subsequent verification of carbon removals achieved, should be carried out by private operators or by public authorities, possibly as part of a centralized EU system.

- **CSRD and its impact on carbon pricing models**

It is expected that CSRD will also impact the transparency of carbon pricing and carbon offsetting processes. The standards for corporate sustainability reporting[47] require undertakings to disclose in detail the applied internal carbon pricing scheme, how this supports decision making and the assumptions made to determine such price. This requirement is expected to provide further transparency on the methodology used by corporates to determine the value of carbon certificates and increase the credibility of their internal carbon pricing scheme, by disclosing the type, scope of application, relation with scientific guidance and role in covering part of the total undertaking's GHG emissions. The Standard hence aims to address the current gap of universally accepted concepts and methodologies for accounting for GHG removals and reductions.

[46] Legal Implications of Voluntary Carbon Credits, ISDA December 2021 (link)

[47] Draft European Sustainability Reporting Standards- ESRS 1 Climate Change, EFRAG, 2022.

7. OUR CONVICTIONS ON FURTHER DEVELOPMENTS ON CARBON MARKET

The development of the VCM shows the necessity for an increased scope of entity that should comply with the emission compensation. However, the credibility of such market is still to construct through a shared referential, efficient technological solutions, structured methodologies, and standards.

As such an extension of the CCM regime to additional participants could improve the adoption of such regime such as the press opinion.

- **Compliance carbon markets will see increased ambition**

Most major carbon market across the world (EU, WCI, China) are currently updating their policies to increase the ambition of their market. This is done either via reducing the cap more steeply moving forward (i.e. in the EU and WCI) or by extending the market to more sectors (i.e in China and the EU ETS). Furthermore, the EU intends to launch the first adjustment mechanism for carbon prices when goods are imported – the Carbon Border Adjustment Mechanism – making producers outside of the EU paying for the carbon when importing in the EU. Such mechanisms will likely reduce free allocation volumes, resulting in higher carbon costs for corporates even if carbon prices themselves might not increase. With the EU being the first mover, such measures gain increased attention in the US as well.

- **Carbon pricing will continue its raising trend**

To align with the objectives of the Paris Agreement, carbon prices need to increase significantly. The Paris Agreement, adopted in 2015, aims to limit global warming to well below 2°C above pre-industrial levels, with efforts to limit the temperature increase to 1.5°C. Achieving these temperature targets requires substantial reductions in greenhouse gas emissions, including carbon dioxide (CO2), which is the primary driver of climate change. In a recent report published Network of Central Banks and Supervisors for Greening the Financial System (NGFS) it is suggested that carbon prices need to be around USD 69 by 2030 and around USD 276 by 2050 to achieve a below-2°C outcome. Of course, prices will need to be much higher to meet the 1.5°C equivalent scenarios. As of today, only prices in Europe and New Zealand are high enough to meet the goal of the Paris Agreement[48].

- **Race between Paris Agreement article 6 mechanisms and VCM development**

At the COP27 very little progress on the article 6 was made, however, the market is waiting for clarity on how particularly article 6.4 will be implemented. Once an agreement has been reached, this will impact the carbon market significantly, particularly on how the corresponding adjustments for any international offset credits will be accounted for. The right balance must be found to avoid too lax rules which will harm the credibility of the offset market, or too tight and heavy rules which will make the system unworkable and move the market towards Article 6.2 and bilateral agreements (which have been dominating the COP27). The “Mechanism” under art. 6.4 will probably push the CCM to absorb the VCM as a regulatory framework will help to grant the integrity and the quality of the market.
Although, the longer it takes to operationalize the “Mechanism”, the more the capital would already have been committed to voluntary markets.

- **Removal carbon credits will gain most of the attention in the coming years**

Most of the issued offset credits so far have been avoidance credits, generated by renewable energy or efficiency projects. Many initiatives aiming to bring integrity to the offset markets and net zero claims are putting their focus on removal credits rather than avoidance credits (i.e. SBTi, Oxford Offset principles). This focus on removal-based offsets is also prominent in the current discussion around article 6.4 of the Paris Agreement. However, many mythologies for removal credits are still in early stages of their development (i.e.. technological removal projects) or highly debated in their additionality (forestry credits). Many more experimental projects offer credits at high prices of about $900 or allow to invest into potential future emission reductions rather than already issued credits, increasing the uncertainty for buyers significantly. Despite its current challenges, the mid- to long-term future of offsets and carbon markets in general will be to incentivize and price carbon removals in order to plot a reliable pathway to a net zero world.

- **Financial players will continuously change the market**

CCMs and the VCM have recently seen an influx of new players, including from the financial markets. New investable products for different carbon markets show that there is interest to access carbon as an asset class. Specifically, within the voluntary market, which is still very opaque and scattered, financial players are entering the market with the aim to increase liquidity, price transparency and thereby efficiency of the markets.

[48] Source: Bloomberg, The Untapped Power of Carbon Markets in Five Charts, September 16th, 2022

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