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Carbon Markets

Voluntary Carbon Offsets – Enabling the "Net" in Net Zero

ESG Report

Thematic Research | Environmental, Social and Governance (ESG) Research

ESG Research

- **Demand for carbon offset credits will grow significantly in the coming years:** To date, a third of the world's 2,000 largest companies have made a net zero or equivalent commitment and 56% have an execution strategy; of those, nearly half plan to use offsets to help them meet climate goals. As global government policies continue to lag corporate commitments on climate actions, the demand for "high quality" carbon credits will inevitably grow. By most industry estimates, offset demand could reach 1 billion tonnes by 2030, >5x the 2021 level and this figure is likely biased higher *if* there's market integrity.
- **Voluntary carbon market (VCM) is the "Wild West" of carbon markets:** Unlike compliance carbon markets (such as the EU ETS) which are regulated by governments, VCM is currently self-regulated with poor transparency across the entire value chain. This brings a slew of credibility concerns, both in terms of the quality of credits on the supply side and the use of credits on the demand side. That said, based on our research and conversations with VCM participants, this is clearly changing, with an unprecedented push to improve integrity of the market and rising investments across public and private entities.
- **ESG engagement can play a key role in corporates' use of offsets:** Given that demand is by definition voluntary, corporates need to be accountable for how many and what type of credits they buy, and how they "take credit" for those purchases. The biggest current debate is the use of carbon avoidance vs. removal credits for "carbon neutrality" claims. While both solutions are needed today, carbon removals are required in the long run for corporates to reach "net zero". Ultimately, the focus should be on price as the goal is to raise companies' internal cost of carbon to incentivize reductions in their own emissions.
- **Where are the opportunities?** Many market observers see lack of correlation between price and credit quality, creating compelling opportunities for alternative asset managers, traders, and tech start-ups. Enablers of high-durability carbon removal technologies (e.g., direct air capture, BECCS) and nature-based solutions (e.g., forest management, sustainable agriculture) should benefit along with the emerging "carbon streaming" space.

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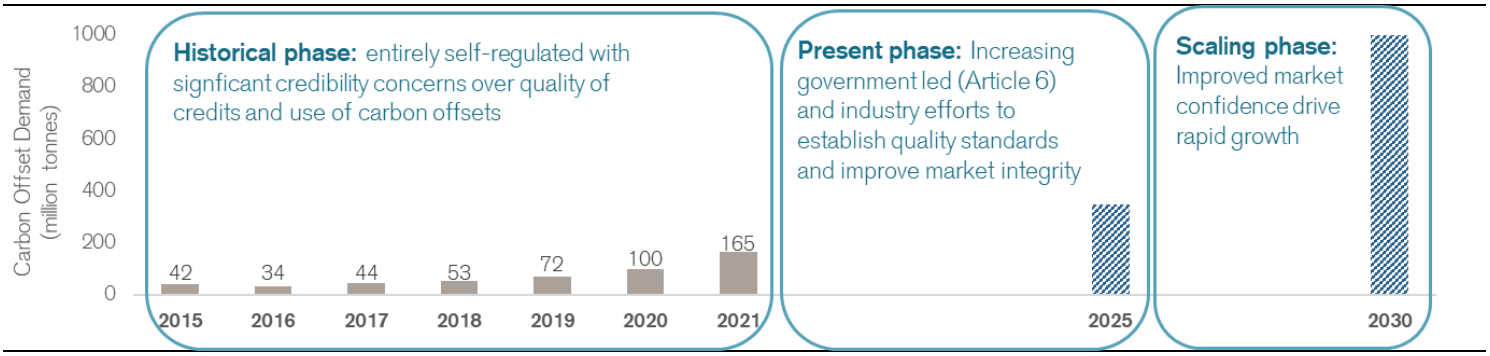
Figure 1: Demand for voluntary carbon offsets is poised to grow significantly



Source: Credit Suisse Research

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Executive Summary

We believe **the most effective way to accelerate climate action is to raise the cost of carbon**, either explicitly (through government regulations and cap-and-trade mandates) or implicitly (through investor pressure and corporate net-zero commitments). As we discussed in "Carbon Markets: The Beginning of the Big Carbon Age", carbon prices are rising around the world and should trend higher over time as decarbonization ambitions remain strong despite the current geopolitical turmoil. While compliance carbon markets (e.g. EU emission trading system) are often in the spotlight, **there are unprecedented private sector activities underway to transform the voluntary carbon market (VCM).** In our view, if government climate policies continue to lag behind corporate net zero commitments, it may drive further growth in demand for "high quality" carbon credits in the future. VCM has the potential to channel investments to developing countries and accelerate funding for emerging decarbonization technologies.

Today's VCM is still the "Wild West". There's no standard assessment for what qualifies as a "high quality" carbon credit and how credits can be used to achieve certain climate objectives. There's also little transparency and independent oversight to ensure integrity. Deals are often transacted through over-the-counter bilateral agreements. It's not entirely clear how pricing is set, margins are made, and whether there are benefits to local communities. Our conversations with market participants indicated that **there's low (if any) correlation between price and credit quality at present**. Despite this complexity, activity is surging, with a growing number of corporates seeking credits to satisfy their climate goals and financial players eager to "commoditize" credits with highly nuanced quality attributes. Based on current quality assessments, significantly scaling today's VCM could accentuate existing shortcomings, with companies potentially running the risk of "greenwashing". (Figure 2 for our long list of concerns).

Supply quality seems fixable but more scrutiny is needed on demand. There are two sides to VCM's integrity problem – uncertainty around quality of credit *supply* and concerns around the *appropriate use* of carbon credits. While credit quality is clearly a major flaw today, there are significant efforts to solve this problem in the coming years, from governments to industry standard-setters to rating agencies to various start-ups. However, what's less certain is corporate demand, as the market, by definition, is voluntary and there's little oversight holding companies accountable for their purchasing decisions. As such, **we believe use of carbon offsets is an area ripe for ESG engagement**. Pre-conditions to a credible carbon offset program should include: 1) existence of a vetted net zero transition strategy that focuses first and foremost on emission *reduction*; 2) transparency on credit pricing and project details; and 3) commitment to shift toward "high quality" removal credits *over time* in order to achieve net zero.

Where does the VCM go from here? Demand for voluntary carbon offset credits has surged in recent years, growing from just ~53 million tonnes in 2018 to ~165 million tonnes in 2021. **Most industry estimates point to demand growing to at least 1 billion tonnes by 2030** and we'd expect aviation, financial services and the energy sectors to drive the bulk of that growth. Meanwhile, we see two key drivers for higher prices: 1) credits becoming more valuable, with demand likely outstripping supply for "high quality" credits; and 2) "mix shift," as buyers increasingly move toward removal credits that are more expensive. However, rather than VCM being perceived as a single cohesive market, it's more likely to split up into separate market tiers, each with different attributes, supply/demand balances, and price levels. Such differentiation is already emerging in the market, with technology-based avoidance credits (e.g., renewable energy) at the low end (<$10/tonne or "t") and technology-based removal credits (e.g., direct air capture) at the very high end (well north of $100/t).

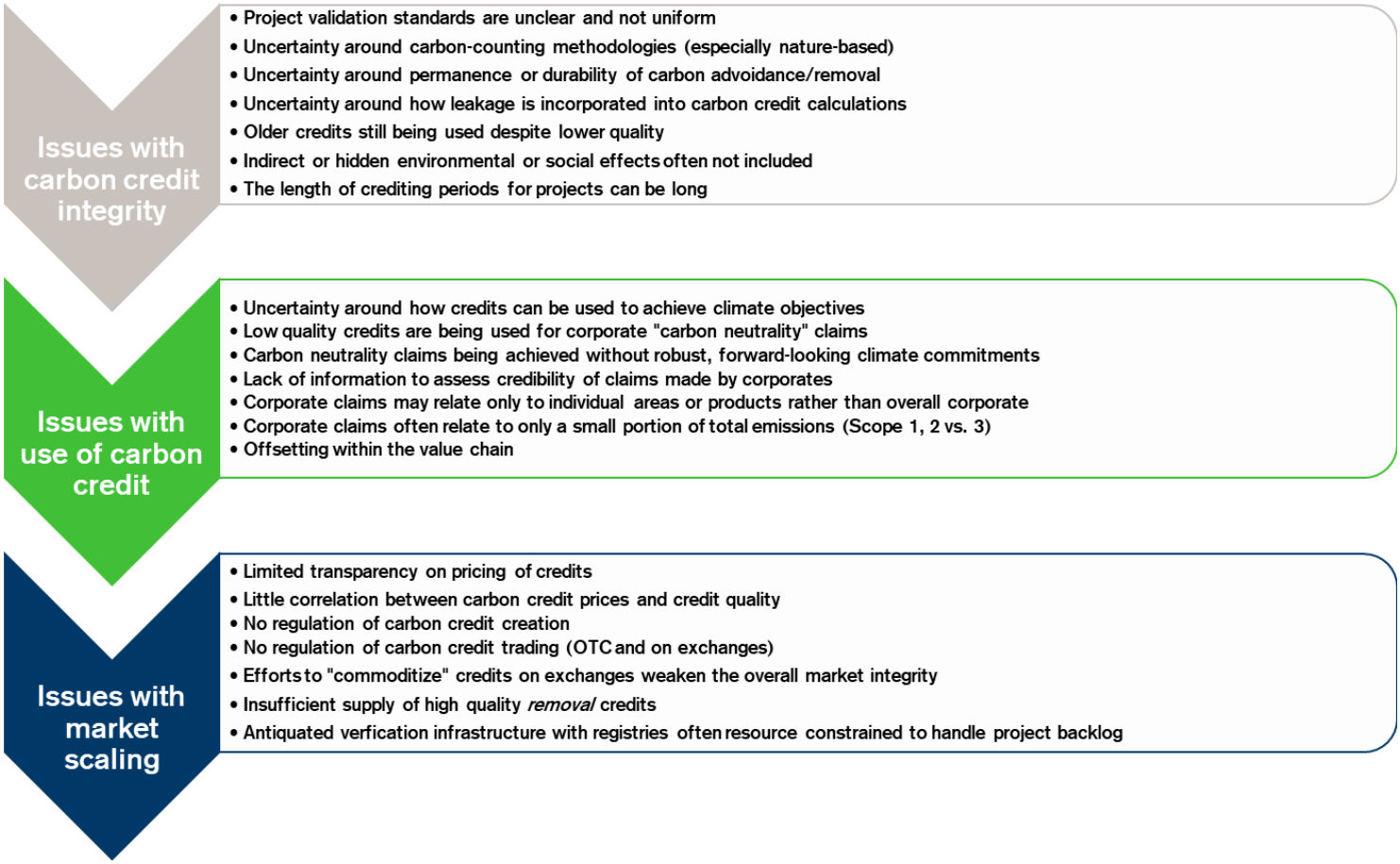
Abundant opportunities. Existing inefficiencies in the VCM present vast opportunities for alternative asset managers (direct investments in high quality credits by partnering with reputable developers), financial players (trading desks, exchanges, etc.), and entrepreneurs (technology solutions). Public equity investors can gain exposure through a small but growing group of "carbon streaming" companies whose business model is to finance and curate a diversified portfolio of high quality credit streams. In addition, VCM will incent significant

investments in high permanence carbon removal technologies (DAC projects a key beneficiary) and nature-based solutions (~5 GtCO2-eq. of mitigation potential at carbon price of <$50/t).

Within this report, we discuss

1. Supply/demand and pricing dynamics in the current voluntary carbon offset market
2. The use of carbon offsets in ESG strategies and our assessment of some of the largest corporate offset buyers
3. A closer look at the top 3 sectors that should drive the bulk of carbon offset demand growth
4. Key developments/initiatives to watch that are critical to improving integrity of VCM
5. Recent ramp up in activities in the high permanence carbon removal space as well as opportunities in nature-based solutions and "carbon streaming" companies
6. A primer on carbon offset ecosystem

Figure 2: Key concerns associated with the current voluntary carbon market



Source: Credit Suisse Research

VCM Ecosystem at a Glance

The voluntary carbon market (VCM) enables carbon emitters to compensate for their unabated emissions by purchasing carbon credits produced by projects targeted at removing or reducing GHG emissions from the atmosphere. Companies can participate in the VCM either individually or as part of an industry-wide scheme. Carbon offsetting has frequently been criticized by various non-governmental groups and environmentalists for allowing emitters to continue polluting and thus has been seen as a form of moral hazard that amounts to greenwashing[1]. However, there's growing consensus that a properly functioning VCM can be a powerful climate tool by channeling finance to developing countries and accelerating innovations that address difficult-to-abate emissions. Rather than dismissing VCM entirely, there's growing coalitions to build market integrity, which in turn spurs demand and investments. Finalization of Article 6 of the Paris Agreement and creation of regulatory bodies and standards all serve this purpose.

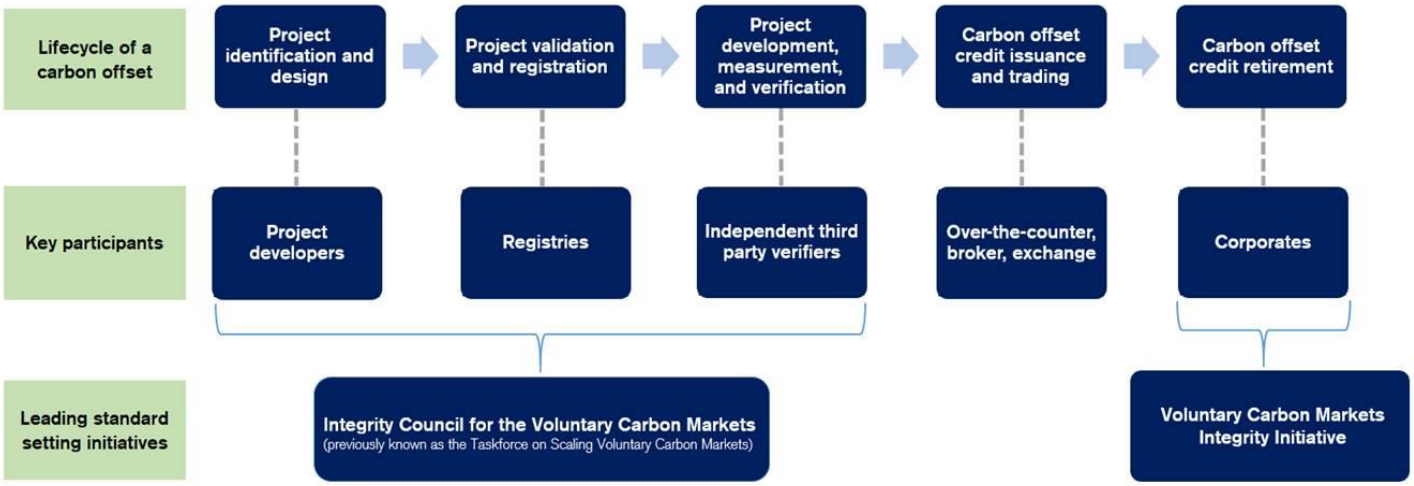
There are several parties active in the VCM and creating carbon offset credits, and their involvement can vary across projects. We provide a short overview of the key players within the VCM ecosystem below and a more detailed description of the carbon offset lifecycle can be found in the primer on page 41.

- **Project developers:** Design and develop emission reduction/removal projects with the intention to issue carbon offset credits. Revenue received from selling the credits is used to fund the project. While there are >1,000 project developers globally, the ecosystem is highly concentrated: the top 20 developers have issued ~40% of the total credits and only 37 developers have developed >15 projects.
- **Registries:** Validate the quality of and track each carbon offset that is produced. There are four primary registries – Verified Carbon Standard (or **Verra**), **Climate Action Reserve**, **Gold Standard**, and **American Carbon Registry** – that oversee nearly all of the activity in the market. Each has their own checklist of criteria that projects need to meet in order to produce credits. As credits often change hands multiple times, registries also track this movement throughout their lifecycle. Once validated from a registry, project developers can secure financing and begin to develop their projects.
- **Project financers**: Banks, private equity firms, private investors, non-profit organizations and other organizations can lend or invest equity to finance a project. Some registries have rules that define what kind of funding, other than offset revenue, is allowed.
- **Third party verifiers:** Confirm the actual emission reductions achieved from the project after it is up and running. Once verified, credits are deposited in a project developer's account at the registry where they are free to be sold/issued accordingly.
- **Brokers and exchanges:** While most transactions seem to occur directly between project developers and offset credit buyers (over-the-counter), project developers can also issue credits to brokers or list on exchanges. **Xpansiv** is currently the largest VCM exchange, responsible for over a third of the market volumes in 2021. However, given lack of transparency from purchases through the exchange, investment funds and more sophisticated corporate buyers of size are increasingly choosing instead to work directly with developers to share the revenue upside and access to long-term supply of credits.
- **Offset credit buyers:** Generally corporates with the aim to counter-balance their own greenhouse gas emissions. By purchasing the offset credits, a buyer essentially "owns" a share of the emission reductions or removals associated with a project. A carbon offset's

[1] Why We Can't Afford to Dismiss Carbon Offsetting (the Nature Conservancy, 2021)

life comes to an end once a buyer decides to "retire" it towards an emissions reduction or sustainability target, which means it cannot be traded again and is removed from circulation.

Figure 3: Carbon offset lifecycle and market ecosystem



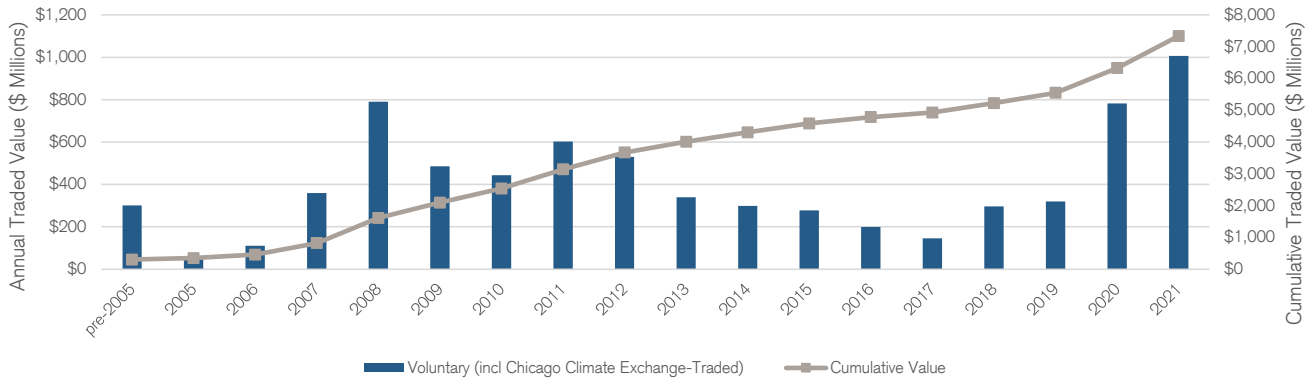
Source: Company data, Credit Suisse Research

State of Voluntary Carbon Offset Market

Demand for carbon offsets is surging

In recent years, there has been unprecedented momentum among global corporates to accelerate climate actions, driven by the growing pressure from governments, society and financial market players. Despite a myriad of concerns around the existing practice of using carbon offsets as part of corporates' environmental strategies (discussed later starting on page 10), corporate pledges have resulted in explosive growth in demand for voluntary carbon credits. The annual traded value in VCM has tripled from ~$320 million in 2019 to >$1 billion in 2021, according to Ecosystem Marketplace's (EM) Global Carbon Survey[2] (see Figure 4).

Figure 4: Market size by traded value of voluntary carbon offsets (pre-2005 to November 9, 2021)



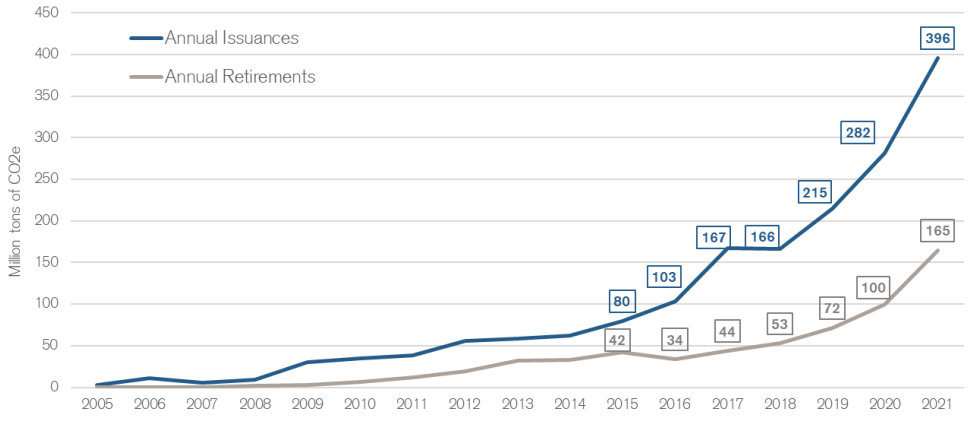
Source: Ecosystem Marketplace

While VCM has been in existence since the early 2000s, the market has only garnered wider interest in recent years. Global demand (i.e., retirement) for voluntary carbon credits doubled from just 42 $MtCO_2e$ in 2015 to 100 $MtCO_2e$ in 2020. The growing urgency to address climate change further propelled VCM into the spotlight, driving demand to surge ~65% YoY to 165 $MtCO_2e$ in 2021. (Figure 5). Notably, the private sector-led Taskforce on Scaling Voluntary Carbon Markets, joined by over 250 member institutions, had estimated demand for VCM to grow to 1-2 GtCO2 by 2030.

To date, credit issuances have outpaced retirements every year, resulting in a surplus of voluntary credits which has kept prices in check despite the demand growth. However, we believe transformative changes are underway on both supply and demand sides of the market, which could fundamentally change the VCM we see today.

[2] EM is a non-profit organization that's the leading market intelligence data platform for voluntary carbon credits. The information is confidentially collected from a network of respondents, including governments, companies, and non-profits. As of August 2021, 172 project developers, investors and intermediaries contributed to surveys, and roughly half of the respondents report transactions annually. The database is also no all-encompassing, particularly in the emerging field of carbon direct removal projects.

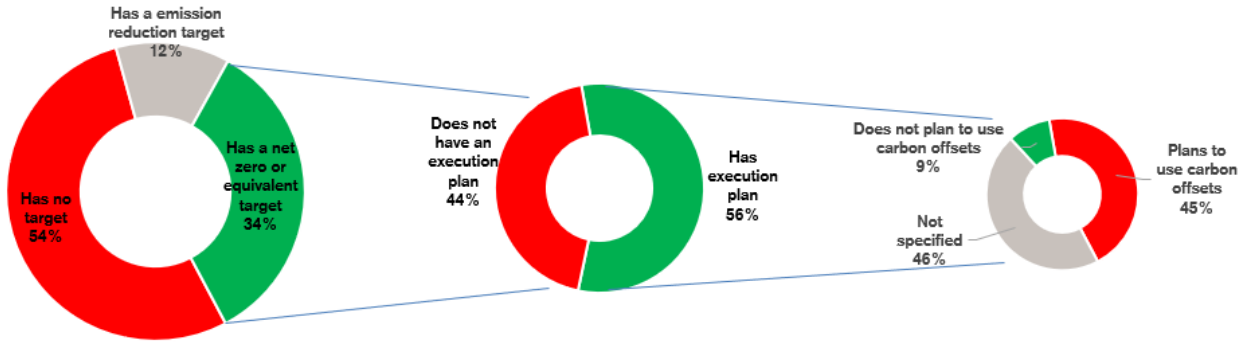
Figure 5: Absolute number of credits issued and retired by year



Source: Ecosystem, Credit Suisse Research

This growth momentum is unlikely to slow. According to the Net Zero Tracker which assesses emission reduction and net zero targets/plans for the world's largest 2,000 companies by revenue, nearly 700 with combined annual revenues of ~$22 trillion have made a net zero emission or equivalent target. Of those companies, 44% have no execution plan to achieve these targets; of the 56% that do have an execution plan, nearly half have explicitly stated that they intend to use offsets. Figure 6. Given the widening gap between where emissions are trending in the real world and what companies are targeting (due to disconnects on climate policymaking, incentives, consumer behavior changes, etc.), we'd expect reliance on carbon offsets will only grow over time.

Figure 6: Breakdown of corporates(1) by target, execution plan, and use of carbon offsets



Source: Net Zero Tracker, Credit Suisse Research

(1) Incudes companies in the Forbes 2,000 list (largest 2,000 largest publicly-traded companies in the world by revenue)

Breaking down current supply

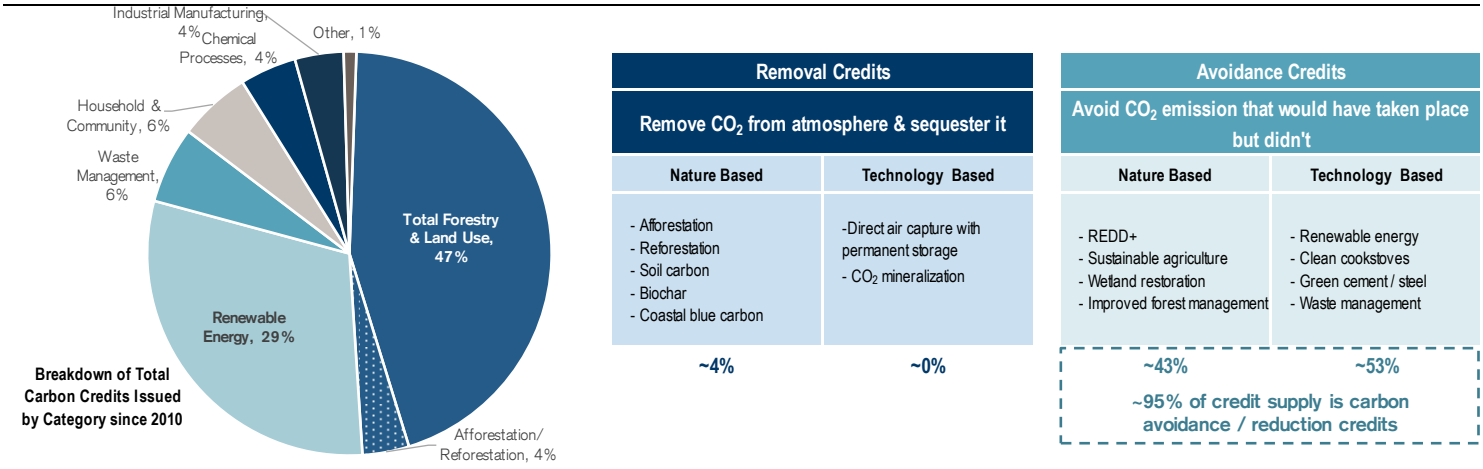
We have based our supply/demand analysis on the voluntary carbon registry offsets database developed by the Berkeley Carbon Trading Project in collaboration with Carbon Direct. In our view, this database is the most comprehensive and transparent source on carbon credits, from origination to retirement. The database covers the four major voluntary offset project registries (Verra, Gold Standard, Climate Action Reserve, and American Carbon Registry), which account for the vast majority of total credits issued to date.

Since the early 2000s, the Big 4 registries have issued nearly 1.5 billion tonnes of carbon credits that purportedly represent emissions either avoided, reduced or removed. Roughly half of those credits were issued in 2019-2021 and a quarter in 2021 alone, underscoring the momentum in the VCM just in the past few years.

Carbon offset project categories encompass various fields that span from renewable energy and industrial energy efficiency projects to avoided deforestation and agriculture. While the Berkeley database shows a total of 60 project types across 9 categories, it boils down to two major characterizations – whether it's a carbon avoidance/reduction or carbon removal project, and whether it's a nature-based or technology-based solution (see Figure 7). This effectively breaks down credits into four buckets that are indicative of price, credit quality and market segmentation going forward:

- **Technology-based avoidance (or reduction) projects.** Projects that do not involve the apparent storage of any carbon are considered avoidance/reduction projects, such as instances where renewable energy displaces fossil fuels or clean cook stoves displaces the use of biomass or firewood in developing countries. Renewable energy credits (e.g., from utility-scale wind, solar and hydro projects) are responsible for ~30% of the total credits issued since 2010. As we will discuss later, there are considerable quality challenges with these types of credits, particularly around "additionality" for renewable energy projects. Despite those concerns, reduction projects remain a key driver of credit supply due to robust offset demand, making up for over half of the total issuances in the past three years.
- **Nature-based avoidance projects.** This is the second largest credit supply category to date, which includes projects such as improved forestry management and avoided deforestation (REDD+) that protects the natural carbon sinks. For example, carbon emissions would be *avoided if* credit revenues prevent trees from being cut down. While there's also considerable concern on additionality/baselines, there are simply not enough carbon removal credits to meet the growing demand, which makes high quality nature-based avoidance credits the next-best option for buyers. The appeal of nature-based solutions also includes co-benefits such as increasing biodiversity, economic opportunity for local communities and promotion of resiliency and climate adaptation.
- **Nature-based removal projects.** Removals are project types that primarily draw carbon out of the atmosphere and are considered higher quality than avoidance credits. Essentially, all the nature-based removal projects are either reforestation (planting trees in areas that had been covered by forests) or afforestation (in areas that had not) and together account for a mere ~4% of credits issued since 2010. The primary drawback to nature-based removals is the lack of permanence considering carbon absorbed in the natural carbon cycle is eventually released back into the atmosphere through decomposition, fires etc.
- **Technology-based removal projects.** Technological removal offsets include projects that mechanically absorb carbon from the atmosphere and store CO_2 permanently in geological storage or through mineralization. These removal projects are considered to be the highest quality using today's standards (low risk of non-permanence), though they are typically very expensive (well north of $100/t) due to technologies still being in the early stages and deployed at small scale. As a result, volumes from permanent removals are almost non-existent in large traded markets.

Figure 7: Breakdown of total voluntary carbon credit supply since 2010



Source: Berkeley Carbon Trading Project, Carbon Direct, Credit Suisse Research

Problems with credit quality

Unlike prices in compliance carbon markets, which are driven entirely by supply and demand, prices in the VCM are influenced by various (often hard-to-quantify) factors that are linked to a project's sustainable development attributes and underlying environmental integrity. These include project category and type (and its corresponding additionality, measurability, permanence, leakage), project location, avoidance of double counting, carbon standard, vintage, among others. Currently, there's no standard measurement of "quality", making it difficult for buyers to appropriately price-in risk and project attribute differences.

- **Additionality:** Additionality is perhaps the most pervasive concern around quality of carbon offset credits as analysis[3] found that 85% of projects in the Kyoto Protocol's Clean Development Mechanism – the world's first government–led major offset program - would have happened without selling credits. Under Article 6 of the Paris agreement, additionality is now defined as actions that take into account *all relevant national policies*, such that any mitigation from the project is beyond what is required by law and regulation. Generally, the higher the carbon price needed to justify the investment in a project, the more likely it is that the project is truly additional and could only happen with the funding from the carbon credits. Emission *avoidance* projects (e.g., avoiding deforestation, clean energy developments, energy efficiency projects) tend to have relatively weaker additionality claims and are the low-cost options, while emission *removal* projects (e.g., reforestation and direct air capture) have a strong case for additionality and are the high-cost options.

- **Permanence/Durability:** The "permanence" nature of carbon storage is also an important factor that impacts pricing. Considering there's no guarantee of permanence for most projects available today, the industry focuses on the concept of "durability," which is the time that the specified emissions will remain removed and sequestered. We note that Microsoft categorizes projects as short term (up to 100 years), medium term (100 to 1,000 years), and long term (more than 1,000 years)[4]. Take forestry projects as an example: carbon sequestered in the saved or planted trees will ultimately be released back into the atmosphere (as trees die and decay or are destroyed by extreme weather events such as wildfires). This is the primary reason why nature-related removal projects are priced lower than technological removal projects (e.g., direct air capture) because they are less durable. To compensate for carbon reversals, project developers have "buffer pools" from which they can replace tonnes that are prematurely released back into the atmosphere.

- **Leakage:** Some projects displace emissions from one geographic area to another or from one activity to another. Leakage typically happens in situations where resources are being protected. For example, a project that reduces timber harvesting may indirectly result in increased (leaked) production elsewhere. There are protocols in place that attempt to use coarse assumptions to bake in the impact of leakage in credit calculations, which have led to systematic over-crediting. For example, academic research analysis[5] has found that 82% of credits issued under the California Air Resources Board's US Forest offset protocol underestimate leakage due to lenient methodology. As a result, these credits undermine the effectiveness of California's cap-and-trade program.

- **Vintage:** The year in which an offset's associated emission reduction took place. All else equal, older vintages are generally perceived as lower quality and priced lower relative to newer vintages. This is because older offsets may indicate a project developer's inability to

[3] "How additional is the Clean Development Mechanism?" (Öko-Institut, 2016)

[4] "Lessons from an early corporate purchase" (Microsoft, 2021)

[5] "The California Air Resources Board's U.S. Forest offset protocol underestimates leakage" (University of California, Berkeley, 2019)

offload credits to a credible buyer, or that a project is able to continue producing offsets without added revenue (weakening the additionality claim). Buyers also prefer to "offset" their emissions in any given year by retiring a credit associated with certain mitigation activity that happened in a similar time period rather than from an activity that occurred many years in the past. The Article 6 agreement includes a provision stipulating that only emission reductions from projects registered after 2013 may be used during the transition period of the new 6.4 carbon market. Similarly, all three of the spot contracts traded on CBL only include credit vintages from 2016 or later.

- **Other red flags:** Other considerations include **measurability**, which is the ability to quantify the emission reductions from a project. Those that are more difficult to measure are perceived (i.e., priced) as lower quality due to risk the offsets issued do not match the emissions avoided/removed. **Hidden environmental or social harms**, such as projects that promote widespread planting of non-native species without regard for water stewardship, or negatively contribute to water consumption or toxic waste, or do not have substantiation of climate equity or social equity claims.

With the above in mind, the project types that have been dominating (renewable energy and avoided deforestation/REDD+) come with a host of quality concerns.

Renewable energy carbon credits continue to come almost exclusively from utility-scale wind, solar, and hydro projects, which are already cost-competitive with fossil fuels in at least two-thirds of countries and often have government mandates (i.e., high risk of non-additionality). In other words, these projects would have likely been developed even without the revenue associated from selling carbon credits. Verification standards are now trending towards only qualifying renewable/clean energy projects in least-developed countries as carbon offset credits.

For avoided deforestation credits, there are also some major concerns with regard to environmental integrity: 1) very difficult to measure the emissions that would have occurred without the project, which means the amount of associated credits generated may be greatly over- or under-exaggerated; 2) risk of "leakage," which occurs when avoiding deforestation in one location simply shifts the deforestation other forests; and 3) risk of non-permanence, due to direct human intervention (e.g., ultimately forest gets converted for agriculture) or indirect effects of anthropogenic climate change (e.g., wildfires, drought, etc. destroys the forest).

Carbon offset prices poised to go higher

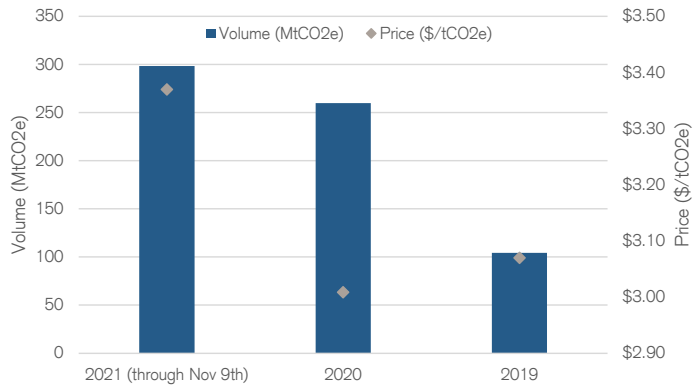
Market pricing is more nuanced than what meets the eye

There's limited transparency on carbon offset prices given the market is still largely driven by bilateral agreements and pricing data is often collected directly from market participants (such is the practice of Ecosystem Marketplace). While the launch of several spot/future contracts (see discussion on page 46) sheds some light on real-time market dynamics, it reflects only a subset of the market activities, as exchanges make up less than 40% of traded volumes in 2021. More importantly, such "benchmark" market data does not adequately reflect quality differences, which are determined by project specific attributes such as removal vs. avoidance, credit vintage, among others that are critical to pricing discovery in bilateral agreements.

With that in mind, we note that the weighted average price of transacted voluntary carbon credits was just \$3.3-3.4/tCO_2e in 2021 (through November 9th), according to Ecosystem. This is slightly above 2019-20 levels, but still unsustainably low and needs to increase significantly if they are to have high environmental integrity (see Figure 8).

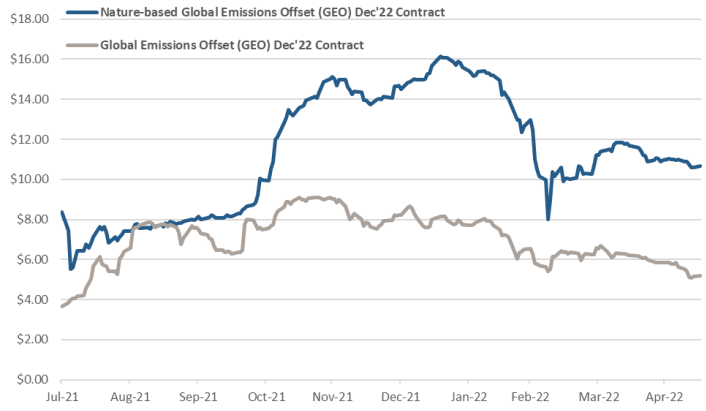
Even for the Xpansiv/CME carbon offset future contracts, which reflect a "higher quality" subset of the total credits available, prices for the CORSIA-aligned technology-based GEO contracts are hovering at just \$5-6/t while the N-GEO contracts for nature-based projects are at a higher, but still low \$10-11/t level (see Figure 9). Our conversations with market participants indicate that these public "benchmark" indices are often viewed as a floor for prices set in bilateral agreements, which can be much higher depending on project specific attributes.

Figure 8: Voluntary carbon credit volume traded and prices by year (2019-21)



Source: Ecosystem Marketplace

Figure 9: Price performance of CME GEO and N-GEO December 2022 future contracts



Source: the BLOOMBERG PROFESSIONAL™ service

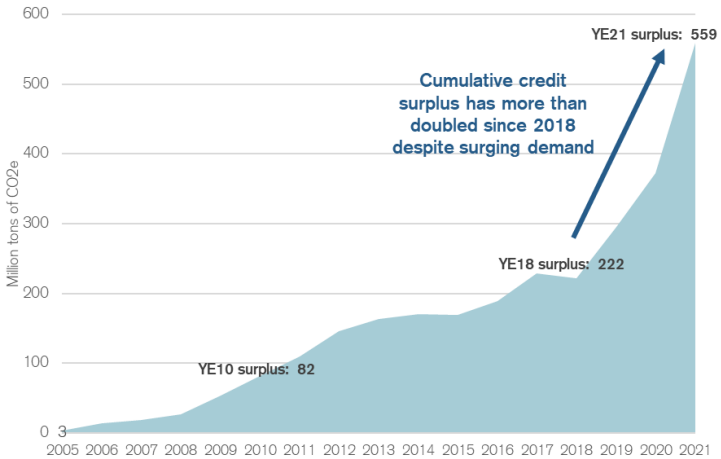
Why have the prices stayed low despite the significant growth in demand?

We believe the answer is two-fold: 1) more credits have been issued than retired (for now), creating a growing *surplus* in supply; 2) demand is not yet discerning enough to buy higher quality credits due to lack of market transparency and buyer education on the VCM.

On the first point, we note that supply has exceeded demand in almost every year since the inception of the VCM with the gap only accelerating in recent years. As a result, the surplus of carbon credits has more than doubled from ~225 million tonnes in 2017-2018 to 559 million tonnes at year-end 2021, according to Trove Research (see Figure 10).

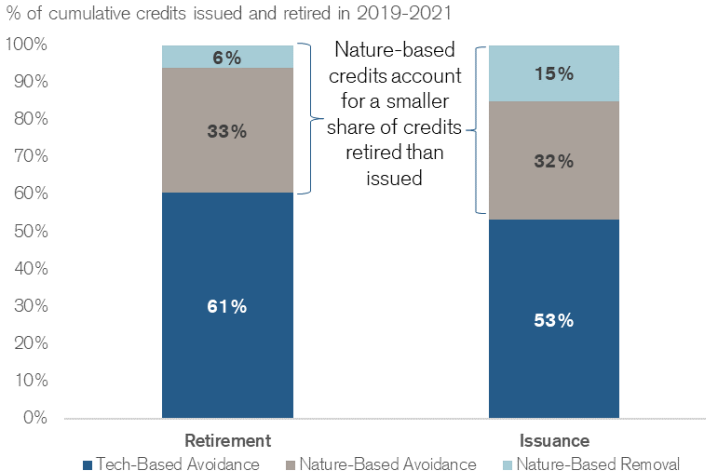
Meanwhile, on the demand front, over the 2019-2021 period, nature-based credits accounted for ~47% of total credits issued but a lesser ~39% of total credits retired. The delta is even greater for nature-based removal credits that made up 15% of supply and just 6% of demand. This is telling that market demand has been more price-sensitive than quality-sensitive, which should change going forward given increasing pressure to prevent greenwashing and scrutiny around corporate claims.

Figure 10: Total VCM credit surplus has grown over time



Source: Trove Research, Credit Suisse Research

Figure 11: Demand is broadly lagging supply in quality



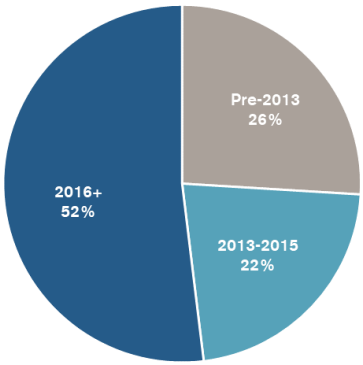
Source: Trove Research, Credit Suisse Research

Carbon offset prices should inevitably move higher over the coming years

Over the medium to long term, we see two key drivers for higher prices: **1)** credits becoming more valuable with demand likely outstripping supply for "high quality" credits; and **2)** "mix shift" as buyers increasingly move toward removal credits that are more expensive. Issues to consider:

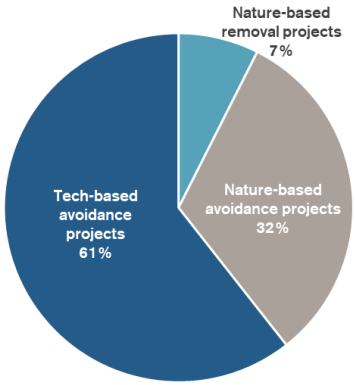
- **Shrinking issuable backlog.** The recent growth in credit supply has been in part fueled by a drawdown of an existing backlog of "approved but not issued" credits. In effect, the credit supply is artificially inflated by older projects that had "spare" credits rather than an increase in new projects. This is an entirely Verra registry phenomenon as developers must pay a fee for each credit issued and thus are not incentivized to do so unless there's demand visibility. Based on analysis[6] from Sylvera, a carbon credit rating agency**, the inventory of issuable credits has more than halved in 2021 (from over 600 million tonnes to just over 300 million**) and is expected to be exhausted within the next few years. In addition, the majority of credits that were drawn down recently was from the less expensive renewable energy credits, meaning even the remaining surplus should be higher priced than what's been released into the market to date.
- **More discerning buyers focusing on high integrity credits.** In the short-to-medium term, this means credits with high additionality and more recent credit vintages. The current supply surplus would shrink substantially once older vintage credits (pre-2013 credits account for ~26% of the surplus) and technology-based avoidance credits are discounted (accounts for 61% of the surplus) – see Figure 12 and Figure 13.
- **Inelasticity of new quality supply**. Given the complex nature of project development, credit verification and certification, credit supply generally would not be able to respond quickly to rising prices. For example, there's typically a 2-3 year gap between the official issuance of the credit and when emission reductions/removals actually occurred. Given growing preference for forestry projects, it also takes time to meaningfully scale nature-based solutions. Once the backlog is exhausted, the speed of new supply is likely to lag demand growth over time.
- **Shifting demand preference toward high caliber removal credits.** Over the long run, demand will increasingly shift toward carbon removal credits as such credits are the only corporates can purchase to authentically make "Net Zero" claims (discussed on page 17). Removal projects are further differentiated by permanence of storage with reforestation and nature restoration likely priced at the low end ($30-50/t today in our checks) and high permanence projects, such as direct air capture, at the high end (>$200/t).

Figure 12: Breakdown of YE21 surplus by project start year



Source: Trove Research

Figure 13: Breakdown of YE21 surplus by project type



Source: Trove Research

[6] 2022 Carbon Credit Crunch Report (Sylvera, 2022)

Future state of VCM

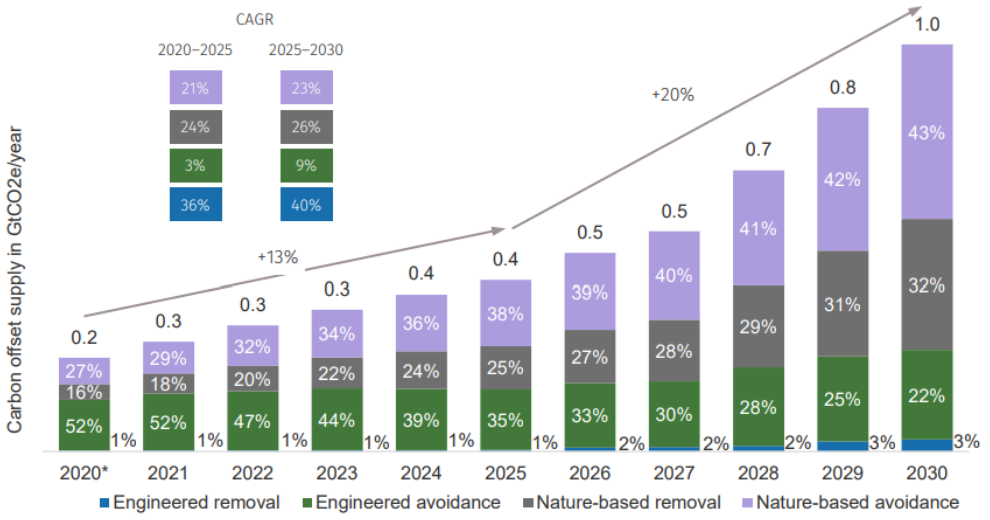
In our view, the longer-term market size and price potential of the voluntary carbon offset market will largely be demand driven as, by definition, it is voluntary. The specifics of corporate ESG strategies will determine (1) whether and to what extent carbon offset credits are used as part of emission-reduction options; and (2) what *type* of carbon offset credits will be in demand, which will drive pricing. Improved market integrity will and should equate to higher prices, though the question of "how high" hinges on how much companies are *willing* to pay. And that question is ultimately driven by corporates' internal cost of carbon and cost of emission *reductions* within their own value chain. Government climate regulations, carbon prices in compliance markets (e.g., EU ETS), and investor pressure should all contribute to a higher carbon price being used in corporate transition strategies.

To put the demand into perspective, Taskforce on Scaling Voluntary Carbon Markets (TSVCM) projects the carbon offset market will reach demand of 1-2 $GtCO_2$ by 2030. Trove Research, an independent research group, sees demand at a lower 0.5-1.5 $GtCO_2$, with the view that not all corporates will have 1.5 degree emission targets and be engaged in the carbon offset market. BNEF's forecast is in line with Trove, estimating that demand for credits from corporates to reach net zero goals could reach 1 $GtCO_2$ by 2030 and exceed 5 $GtCO_2$ by 2050.

Credit supply availability is also a factor. Our conversations with developers confirmed that there's a growing preference for nature-based solutions, not just because of a shift toward removal credits (such as reforestation, afforestation) but also other social and biodiversity co-benefits. Carbon Neutral Royalty, a private carbon streaming company, forecasts nature-based credits to materially outpace growth in technology-based avoidance credits and to reach 75% of the supply by 2030. Figure 14. However, growth is likely slower in the next few years due to long lead time of developing forestry and agricultural-based projects, which could be supportive of prices.

As such, rather than VCM being perceived as a single cohesive market, it's more likely to split up into separate market tiers, each with different attributes, supply/demand balances, and price levels. Such differentiation is already emerging in the market with technology-based avoidance credits (e.g., renewable energy) at the low end (<$10/t) and technology-based removal credits (e.g., direct air capture) at the very high end (well north of $100/t).

Figure 14: Growth of VCM is driven by higher volumes and mix shift in credit supply



Source: Carbon Neutral Royalty investor presentation with sources from Registries (Verra, Gold Standard, ACR, CAR); CORSIA; IMO; IEA; CDP; Company commitments; ICAP; Fraunhofer ISI; BCG analysis, Shell)

Figure 15 shows various scenarios for the size of voluntary carbon markets by 2030, with the market size ranging from $10 billion at the low end (reflecting largely the status quo of the oversupply of low-quality credits) to more than $200 billion at the high end if it is removal credits only. The former seems unlikely to us given our understanding is that avoidance carbon credits will be excluded in the new Article 6.4 carbon scheme and outside stakeholders are making companies accountable for their emission-reduction strategies. We believe an annual market size of $50-100 billion by 2030 is realistic at a carbon price of $50-100/t with 1 $GtCO_2$.

Figure 15: Voluntary carbon market size scenarios for 2030

Scenario	Pricing ($/Ton)	Demand (GtCO2/Year)	Market Size ($ Billion)
Taskforce on Scaling Voluntary Carbon Markets (TSVCM) Projections			
Prioritization of Low Cost Supply	$10-$20	1-2	$10-$40
Preference for Local Supply	$50-$90	1-2	$50-$180
Trove Research			
Trove Research	$20-$30	0.5-1.5	$10-$40
BloombergNEF Projections			
Maintaining Status Quo (primarily low-quality credits)	$11	1	$11
SBTi Scenario (removal project credits only)	>$200	1	>$200
Hybrid Scenario (gradual phase-in to removal only)	$48	1.7	$80

Source: BloombergNEF, Trove Research - Future Size of the Voluntary Carbon Market, TSVCM – Final Report, Credit Suisse Research

Carbon Offsets in ESG Strategies

Questionable use of offsets to reach climate goals

To have a credible transition strategy, corporates need to first identify and measure their emissions footprint across the entire value chain (Scope 1, 2 and 3), and then develop an interim and long-term plan to reduce emissions over time. Given the global momentum on climate actions from governments and financial markets, aligning these reduction targets with a science-based 1.5°C mitigation pathway is becoming almost a pre-requisite. This translates into a ~50% reduction in gross emissions by 2030, ~90% by 2050 (can vary depending on sector) with any residual unavoidable emissions eliminated with carbon removal.

Only when companies have already established an authentic transition plan can they be credible in using carbon offsets. In those cases, credits can be used to serve two purposes: 1) "compensate" for emissions that have not yet been eliminated in *the short-to-medium term* over the course of the transition; and 2) "neutralize" residual emissions that cannot be reduced due to costs or technological limitations *over the long run*. Done correctly, voluntary carbon credits could play an important, if not necessary, role in any phase of a corporate's climate strategy. However, the overarching issue today is that many companies with net zero targets do not even have transition execution plans and most do not disclose or even define residual emissions for which carbon credits would be applicable. There's simply not enough transparency to determine whether carbon credits are being used properly.

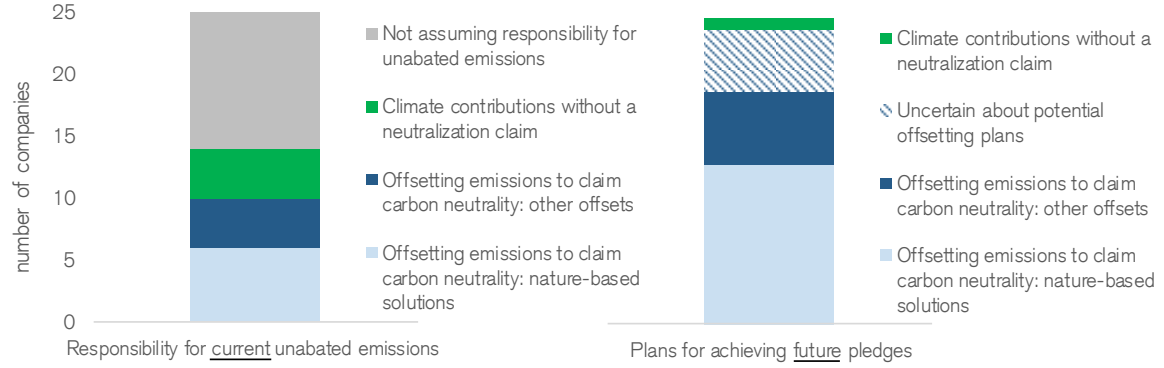
Significant credibility concerns around corporate use of carbon offsets

The 2022 Corporate Climate Responsibility Monitor (the "Monitor") – which takes the Net Zero Tracker a step further and assesses the transparency and integrity of 25 major global companies' net zero targets – identified **"significant credibility"** problems over the use of offsets for carbon neutrality claims and net zero pledges. The 25 companies assessed are multinational companies (all with some form of a net zero or carbon neutrality target), which collectively account for ~10% of the total revenue from the world's largest 500 companies and ~5% of global GHG emissions.

Out of the 25 companies, the Monitor found that

- **Only 3 companies clearly commit to deep decarbonization** of >90% of their *full value chain* emissions by their respective target years of their headline pledges.
- **10 companies are using offsets to claim "carbon neutrality" for their *current* unabated emissions** while only 4 companies are starting to do so *without* neutralization claims.
- **19 companies have explicitly stated they plan to rely on offsetting to achieve *future* pledges**, with only one company explicitly planning not to use offsets. This would suggest *increased* dependence on carbon offsets going forward.

Figure 16: Use of carbon offsets for 25 major global companies toward current and future climate goals



Source: Corporate Climate Responsibility Monitor 2022

Overall, the Monitor made critical assessments around the transparency and integrity of the corporate climate pledges and identified various common "bad practices" with respect to the use of carbon offsets and climate contributions. The examples below are fairly indicative of the pushback being placed on the use of carbon offsets:

- **Non-credible claims.** Aside from a lack of credible long-term net zero pledges, all 10 of the *current* offsetting claims assessed lack credibility due to limited information and the use of either nature-based solutions (uncertainties with permanence, leakage, and measurability) or projects where the additionality was highly questionable. Moreover, at least half of the companies plan to achieve *future* pledges with nature-based solutions. While there are very limited, if any, options on the current offsetting markets that are high quality enough to guarantee environmental integrity, this should not "lower the bar" for what constitutes a credible claim for compensating for or neutralizing emissions. There is also the questionable practice of claiming "carbon neutrality" only for Scope 1 and 2 emissions when they are a tiny portion of a company's total emissions footprint.
- **Carbon neutral brands or products.** All 10 of the *current* offsetting claims assessed also did so only for selected scopes, products, brands, or company divisions, which can be misleading. Some companies were found to explicitly distance themselves from the practice of offsetting at the level of the parent company but allow and encourage the use at their individual consumer-facing brands. Other companies claim carbon neutrality for specific products and services that cover only a small portion of total emissions (e.g., Scope 1 and 2 only).
- **Potentially misleading climate contributions:** While some companies are starting to make climate contributions without a neutralization claim, it often is unclear whether these companies might use the programs/funds to claim the neutralization of their emissions in the future. The contributions have also been generally small in scale relative to the company's own emission footprint.
- **Offsetting within the value chain:** Under this approach (sometimes referred to as "insetting"), companies claim the neutralization of their operational emissions through emission reductions, avoided emissions, or carbon removals connected to their value chain. There are at least two questionable ways in which this is used, according to the Monitor:

  1) **Emission reduction/avoidance projects in the value chain –** This is simply a reduction of the company's own Scope 3 emissions. In claiming that such measures "neutralize" the company's other emissions, the company is either rejecting responsibility for those scope 3 emission sources and excluding them from its target coverage, or it is counting the emission reductions of those measures twice (i.e., double counting) to claim reductions in scope 3 emissions *and* neutralization of other emissions.

  2) **Carbon removals in the value chain –** This may include carbon storage in agricultural soils or wood and wood-based products. However, the same environmental integrity issues apply as if it was an *offsetting* project (i.e., outside the value chain), such as permanence. A key difference is that companies implementing these measures in their value chain may not seek independent measurement and verification of the removals, whereas this is a requirement for removals through certified offsets.

Fierce debate around corporate claims

For a market where demand is entirely voluntary with no directly-linked economic incentives, corporates' ability to "take credit" for their climate actions could be viewed, somewhat cynically, as the only incentive to support future market growth. With growing call for climate action, there has been a flood of corporate climate commitments over the past few years. Hundreds of companies are making a variety of statements associated with their carbon credit transactions,

current GHG emissions performance, and future mitigation commitments, which has led to confusion and the potential to undermine the trust of the VCM. Even the most employed terms – such as "net zero" and "carbon neutral" – are used by different companies with different meanings and represent different actions. As a result, there's growing scrutiny by investors, regulators and even consumers to ensure claims are appropriate and not greenwashing.

In our view, **the single biggest debate and a critical determinant of the future growth of VCM is around how to *claim* use of carbon *removal* vs. carbon *avoidance* credits.** There's no debate around the benefit of either solution as both are clearly necessary to curb climate change. Rather, the question is how companies can claim use of avoidance credits. Currently, companies can claim to be "carbon neutral" if they "offset" unavoidable emissions with projects that avoid/reduce emissions (e.g., avoided deforestation). However, there's a growing chorus calling for a neutrality claim (if at all) to be made only with carbon *removal* credits which are more expensive and very low in supply. If current practices are frowned upon, it begs the question whether companies would still buy lower cost avoidance credits for just a "mitigation contribution" and alternatively, how much they'd be willing to pay for removal credits.

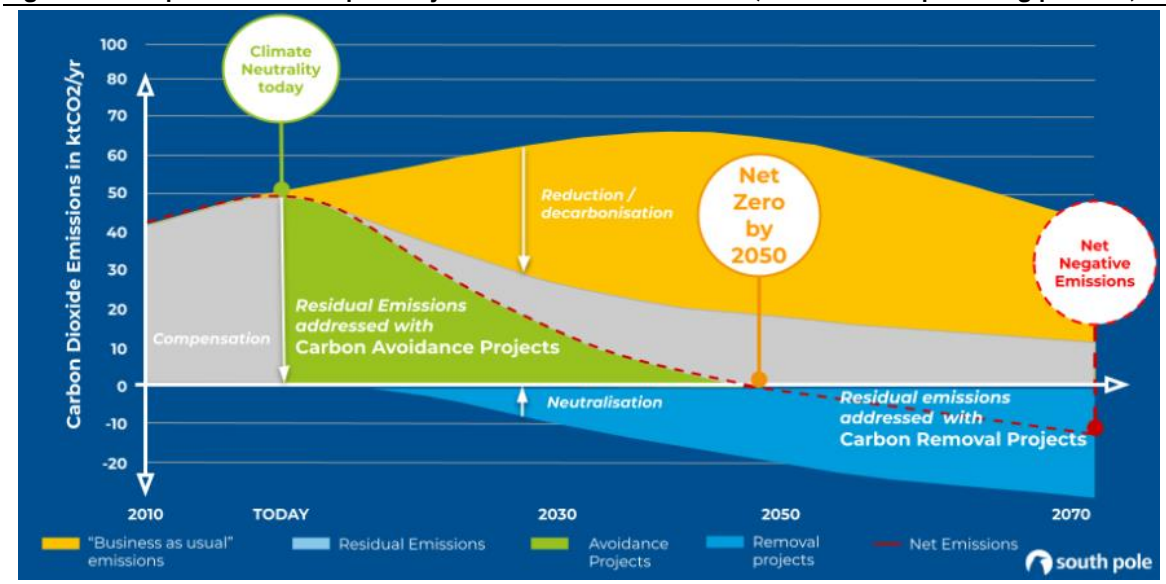
There's growing call, particularly in Europe, for governments to regulate or potentially ban corporations from making "net zero" and "carbon neutrality" claims all together – see open letter to the EU Commission from 27 NGOs. To better understand the debate, we need to first review the current understanding of these key claims:

- "**Net Zero**" **claim:** Introduced by the IPCC, net zero emissions are achieved when anthropogenic greenhouse gas emissions released into the atmosphere are balanced by anthropogenic *removals* over a specified period. Similarly, the Science Based Target initiative (the gold standard on assessing corporate climate strategies) states that, to achieve net zero, companies must have a Paris-aligned target to reduce their entire value chain emissions at a specific rate and by a specific date – aka "net zero abatement pathway" - with any residual emissions *removed* ("neutralized"). In general, "net zero" is a forward-looking commitment expected to be reached by mid-century as it would be very difficult for a company to abate all of its value chain emissions today.

- **"Carbon Neutrality" claim:** In the global context which is consistent with the IPCC definition, carbon neutrality (or climate neutrality when referring to all GHG emissions) is essentially the same as net zero. However, in the context of corporate target setting, the prevailing practice today is that companies can achieve carbon neutrality by "**offsetting**" all unabated emissions with the purchase of carbon credits from activities that *reduce, avoid or temporarily capture* GHGs emissions (rather than *removal* projects). This difference sits at the heart of today's debate. Opponents of the current carbon neutral/offsetting model argue **1)** it often involves a company purchasing carbon credits as a substitute for reducing emissions in their own value chain; and **2)** credits are not equivalent to emissions released elsewhere due to quality concerns (e.g., permanence, measurability, leakage, etc.)

- **"Mitigation Contribution" claim:** There's an emerging view among environmental and industry organizations that companies looking to address current unabated emissions should make a climate (financial) contribution *without* any carbon neutral claim. Such action is being referred to as "mitigation contribution" toward collective climate targets in the collaborative spirit of the Paris agreement, but no claims related to offsetting, compensation, or carbon neutrality can be made by the company. Adopting this approach would allow corporates to avoid pitfalls mentioned above and still take credit for the environmental and social impacts these VCM credits are enabling. While there's clear social and SDG benefits associated with certain projects, it's yet to be seen whether companies are adaptable to this framing of voluntary carbon credits and their price sensitivity in this application.

Figure 17: Corporate net zero pathway and the associated claims (under current prevailing practice)



Source: South Pole

Our assessment of large corporate offset buyers

We looked at the top purchasers globally for voluntary carbon offset credits (companies that purchased >1 $MtCO_2e$ in 2020 according to the latest CDP disclosure) to see what types of climate goals/targets they are claiming and the extent to which carbon offsets are being used (see Figure 19). We also offer our view ("CS view") for each company, with the following high-level takeaways:

- **Demand for carbon offsets grew materially in 2021 vs. 2020** for 4 out of the 5 companies on our list where 2021 data is available. Notably, Delta and Volkswagen's carbon offset credit purchases in 2021 were ~2x and ~5x their 2020 levels, respectively.
- While most companies indicate they are focused on absolute emission reductions, **current state of corporate claims ("carbon neutral" vs. "net zero") and transparency around use of carbon offsets varies widely**. We found that some companies are *not* clearly defining what they mean or how they differentiate between the two claims. And such discrepancies make it more difficult to assess and compare corporate climate targets against each other.
- **Use of carbon offsets is the primary mechanism by which companies are achieving "carbon neutrality" currently.**
- **Most are not publicly disclosing specific details on their carbon offsetting strategies and activities** (e.g., volumes, projects supported, credit vintages, prices paid, etc.). As it is, we found that companies provide project-level details on carbon offset projects as part of their CDP climate disclosure but this information is not widely disclosed in company's sustainability reports.
- Based on CDP disclosures, we can glean that **most of the companies are purchasing carbon offsets with potentially questionable environmental integrity** – such as those associated with renewable energy and REDD+ projects – to make claims of "carbon neutrality." In particular, we found that most of the renewable energy projects are not located in least-developed countries.
- Of the 14 companies we analyzed, **seven are already making some form of a "carbon neutrality" claim currently** using carbon offsets. And of those companies, **only three include Scope 3 emissions**, which are 90+% of the total emissions footprint for most of the companies (except airlines). In other words, most claims of "carbon neutrality" are being achieved with (questionable) carbon offsets and only include a tiny portion of a company's total emissions footprint. While future "net zero" claims generally do include Scope 3, the extent to which offsets play a role is often unclear.
- While commitments vary, there does seem to be a **general trend towards purchasing "high quality" or "removal"-based credits** over the long run.

Figure 18: Corporate climate claims/goals for the top global purchasers of voluntary carbon offsets (>1 $MtCO_2e$) in 2020[1]

Company	Country	Sector	2021[1] Scope 1 & 2 Emissions ($MtCO_2e$)	2020[2] Carbon Credits Purchased per CDP Disclosure ($MtCO_2e$)	Climate Claims/Goals	Use of carbon offsets
Delta Air Lines	US	Air transport	24.7	26.9 (2021)	Aim to spend $1 billion through 2030 toward "airline carbon neutrality"; "net zero" by 2050	Expects the rest of the $1 billion spending to focus on solutions rather than offsets going forward; planning to use removals and next generation offsets to achieve long term net zero goal
					CS view: *While 2021 offset was still concentrated in REDD+ and renewable energy credits, Delta made a notable shift in its strategy - moving away from "carbon neutral" claim made in 2020 to supporting solutions (such as sustainable aviation fuels) and removal credits going forward; however, specifics around how they plan to achieve "carbon neutrality" by 2030 is still unclear*	
Volkswagen AG	Germany	Transportation equipment	7.2	6.1 (2021)	Reduce emissions from passenger cars and light commercial vehicles by 30% by 2025 vs. 2015 levels (includes offsetting); also 30% reduction by 2030 vs. 2018 levels (excludes offsetting); "net carbon neutral" by 2050	Company committs to offset only unavoidable emissions though we note offsets used in 2021 was 5x the 2020 level. The company noted its "carbon-neutral handover" program for select EVs (offsetting unavoidable supply chain emissions) will be increasing its need for offsetting in the future.
					CS view: *Given the surge in offset use in 2021, project level details is lacking in disclosure. According to CDP report, around 70% of the carbon credits purchased by in FY20 were from a peatland restoration and conservation project in Indonesia. It's encourgaging to see company is actively supporting R&D in technical removal technologies, such as DAC and CO2 mineralization. While excluding offsetting from its 2030 target is sound, more detail is needed on its offset strategy to reach 2050 target.*	
Royal Dutch Shell	UK	Oil & gas	69.0	3.9	Reduce absolute emissions by 50% by 2030, compared to 2016 levels, for all Scope 1 and 2 emissions; "net zero" by 2050	Aims to use "high quality" nature-based solutions to offset emissions of around 120 million tonnes of CO_2 per year by 2030
					CS view: *The company's 2030 target to offset ~120 million tonnes of CO_2 per year is a significant step-up from current levels, and would position Shell has one of the major players in VCM (potentially >10% of market volume) by 2030. Through its commitment to "high quality" nature-based solutions, the company plays a critical role in supporting and defining market integrity. Disclosures to CDP reveal that ~40% of the credits purchased in FY20 do indeed support nature-based carbon removal projects. While Shell does not make any carbon offsetting claims themselves, how its customers claim fuels and product that have associated carbon offsets are equally important.*	
La Poste	France	Intermodal transport & logistics	0.5	2.2	"Carbon neutral" since 2019 including all three Scopes; "net zero" by 2030 for its logistics business and by 2040 for financed emissions	Emissions linked to mail, parcels, and express activities have been offset since 2012 through purchase of carbon credits in VCM
					CS view: *Data submitted to CDP reveals that the majority of the carbon credit purchases in FY20 support renewable energy credits from projects based in China and India, thus their "carbon neutral" claim can be seen as questionable especially considering its emissions have been rising each year from 2019 to 2021. However, the company did indicate that starting 2022, it plans to "gradually increase the share of carbon capture and sequestration projects versus energy efficiency projects by selecting the project with the best cost-benefit". However, specific details around volume or share of total offsets are lacking.*	
easyJet	UK	Air transport	2.1	2.1 (2021)	Committed to set an interim science-based target for 2035, through the UN-backed Race to Zero; "net zero" by 2050	Became the first major airline worldwide to offset the carbon emissions from the fuel used for all flights; this comes at no additional cost to passengers and only projects are supported that are certified by either Gold Standard or the Verified Carbon Standard; supported two REDD+ projects in 2020
					CS view: *While it is still developing its own "detailed pathway" to net zero, the company could improve its offsetting claims by committing to (and actually purchasing) higher quality credits and specify how offsets/removals will be used to achieve "net zero" by 2050.*	
Telstra Corporation	Australia	Media, telecommunications & data center services	1.2	2.1	Operations became "carbon neutral" in 2020, certified by Climate Active; reduce absolute emissions by 50% by 2030 (Scope 1, 2, and 3); "net zero" by 2050	Became "carbon neutral" in their operations in 2020 through purchasing credits that avoid, reduce or remove emissions; credits purchased have been from two project owners in Australia and three in India
					CS view: *Data submitted to CDP and company documents shows that the majority of the carbon credits purchased in FY20 support solar and wind projects in India. As we pointed out above, claiming "carbon neutrality" using renewable energy credits (particularly for projects not located in least-developed countries) can be seen as questionable. The company could also specify how offsets/removals will be used going forward and to achieve "net zero" by 2050.*	
BHP	UK	Metallic mineral mining	16.2	1.9	Keep operational emissions below 2017 levels by 2022; reduce operational emissions by at least 30% from 2020 levels by 2030; and "net zero" emissions by 2050 including Scope 3	Aims to prioritize emission reduction projects at operated assets, with investments in carbon offset projects considered as external emissions reductions or removals complementary to this 'structural abatement'. Plasn to directly invest in projects that
					CS view: *BHP has purchased carbon credits supporting REDD and REDD+ projects in FY20-FY21 as seen in the data disclosed to CDP, however, the company is not using these purchases against its own operational emissions targets (i.e., to make claims of achieving "carbon neutrality"), but rather includes "contributions from the retirement of carbon offsets." Use of offsets is determined based on its internal abatement cost curve and emission reduction targets, which we view as a high integrity approach. Its target for "net zero" by 2050 does include the use of carbon credits for unavoidable emissions, which is appropriate as long as these are removal-based credits.*	

Source: Company documents, CDP

(1) Scope 1 & 2 emissions shown are for 2021 except for GE and JetBlue where company data is not yet available

(2) Carbon offset purchased shown are for 2020 taken from CDP except noted, which are from company documents; companies sometimes made carbon offset purchases in 2020 but apply them to 2021 emission reductions

Figure 19: Corporate climate claims/goals for the top global purchasers of voluntary carbon offsets (>1 $MtCO_2e$) in 2020[1] - Continued

Company	Country	Sector	2021[1] Scope 1 & 2 Emissions ($MtCO_2e$)	2020[2] Carbon Credits Purchased per CDP Disclosure ($MtCO_2e$)	Climate Claims/Goals	Use of carbon offsets
BP	UK	Oil & gas	35.6	1.9	Reduce Scope 1 and 2 emissions by 50% by 2030 from 2019 levels; "net zero" all scopes by 2050	BP does not rely on offsets to meet its 2030 emissions reduction target or aims for Scope 1, 2, and 3 emissions, but it offers carbon offsetting service for its customers through bp Target Neutral
					CS view: *BP helps its customers to claim "Carbon Neutral" status as part of its carbon management services, which purchases and retires carbon credits on behalf of its customers. We question the overall integrity of the practice (given it doesn't include customers' Scope 3 emissions) and the quality of credits in BP's portfolio (which currently includes CDM credits and renewable energy projects that have additionality concerns). Data submitted to CDP shows that the majority of carbon credits purchased by BP in FY20 focused on renewable energy projects in China. That said, BP is looking to grow its credit offerings from nature-based projects.*	
Kering	France	Textiles & fabric goods	0.1	1.8 (2021)	"Carbon neutral" as of 2018 across own operations and supply chain; reduce Scope 1 and 2 emissions by 90% and Scope 3 emission intensity by 2030 from 2015 levels; "net zero" by 2050	Emission offset program includes Scope 1 and 2 emissions since 2011 and remaining Scope 3 emissions since 2019; primarily, focuses on verified REDD+, regenerative agriculture and mangrove/blue carbon projects
					CS view: *Kering has committed to ambitious climate objectives across Scope 1, 2, and 3 emissions and plans to reduce absolute emissions. However, the company's claim to be "carbon neutral" since 2018 using REDD+ projects may see pushback given current scrutiny around corporate claims. The company's target for "net zero" by 2050 does include the use of carbon credits for residual emissions though more details are needed on increasing use of removal credits to support long term climate goal.*	
General Electric	US	Powered machinery	2.1 (2020)	1.6	"Carbon neutral" by 2030 for Scope 1 and 2 emissions; "net zero" ambition by 2050 including Scope 3 (use of sold products)	"Majority" of 2030 goal will be achieved through absolute reductions of direct emissions, with the remaining balance from offsets; not specified for 2050
					CS view: *Positive GE is focusing on absolute reductions of emissions with the remaining balance (to achieve "carbon neutrality") filled from offsets; however, this does not include GE's Scope 3 emissions which are likely the overwhelming majority of its emissions footprint (albeit not disclosed). It could also improve on this claim by committing to increase purchase high quality removal-based credits and specify its plans for achieving "net zero" by 2050.*	
Netflix	US	Web & marketing services	0.1	1.5 (2021)	"Carbon neutral" for Scope 1, 2, and 3 emissions since 2021; "Net zero" by the end of 2022	Reduce *absolute* Scope 1 and 2 emissions 45% by 2030 vs. 2019; remaining Scope 1 and 2 (plus Scope 3) emissions offset with avoidance and removal projects each year after 2022
					CS view: *Not a credible use of a "net zero" claim which means reducing total operational and value chain absolute emissions as much as possible by a particular year (2050 or sooner) with any residual emissions balanced with removal-based offsets. It also does not have a longer-term target to address Scope 3 emissions (~95% of its emissions footprint) beyond using carbon credits. That said, the company is moving towards purchasing removal-based credits only and is relatively transparent about its project screening criteria and portfolio of projects.*	
Boeing Company	US	Transportation equipment	1.4	1.5	"Net zero" for Scope 1 and 2 (plus business travel) emissions since 2020	Reduce *absolute* Scope 1 and 2 (plus business travel) emissions 25% by 2025 and 55% by 2030 vs. 2017, with the remainder to be balanced with offsets to maintain "net zero"
					CS view: *Not a credible use of a "net zero" claim which means reducing total operational and value chain absolute emissions as much as possible by a particular year (2050 or sooner) with any residual emissions balanced with removal-based offsets. It's also purchasing carbon credits with questionable environmental integrity (e.g., renewable energy projects in China and REDD+ projects) based on its latest CDP data and not including Scope 3 emissions (~99% of its emissions footprint) in any of its targets.*	
JetBlue Airways	US	Air transport	4.1 (2020)	1.4	"Carbon neutral" for all domestic flights since July 2020; "net zero" by 2040	Account for nearly all of emissions currently; will only be used to balance "unavoidable, remaining" emissions by 2040
					CS view: *While it does not disclose specific projects, the company's latest CDP report notes it will support carbon offset projects "focused on but not limited to" renewable energy (solar/wind), forestry (deforestation), and landfill gas capture, which have questionable quality integrity for "carbon neutrality" claims. Only using offsets to balance "unavoidable, remaining" emissions by 2040 is encouraging, but only credible if the offsets used are from high quality removal-based projects.*	
Procter & Gamble	US	Household products	2.4	1.3	"Carbon neutral" for Scope 1 & 2 emissions for this decade; "net zero" for Scope 1, 2, & 3 emissions by 2040	Reduce *absolute* Scope 1 and 2 emissions 50% by 2030 vs. 2010 with the remaining cumulative emissions balanced with offsets; used only for unavoidable emissions by 2040 with "natural or technical solutions that remove and store carbon"
					CS view: *Positive PG is focusing on absolute reductions of emissions with the remaining balance (to achieve "carbon neutrality") filled by "nature climate solution" credits; however, this does not include PG's Scope 3 emissions which are ~99% of its emissions footprint. Meanwhile, its 2040 "net zero" target seems solid as it encompasses all three Scopes and unavoidable emissions are balanced with removals.*	

Source: Company data, CDP

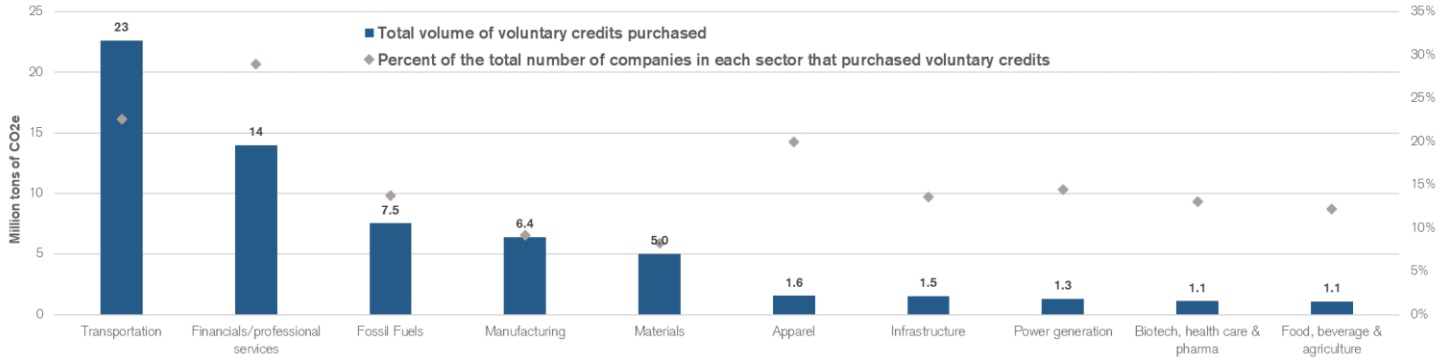
(1) Scope 1 & 2 emissions shown are for 2021 except for GE and JetBlue where company data is not yet available
(2) Carbon offset purchased shown are for 2020 from CDP except noted, which are from company documents; companies sometimes made carbon offset purchases in 2020 but apply them to 2021 emission reductions

Most Exposed Sectors

Industries that are most active in the VCM generally consist of companies involved in emission-intensive, hard-to-decarbonize businesses. Such companies are often under the most pressure from regulators, investors, and society to decarbonize, but meaningfully doing so generally requires new/more cost competitive abatement technologies, shifting business models, and/or consumer preference changes. Thus, the VCM can offer a near-term solution for these companies to take responsibility for their emissions footprint.

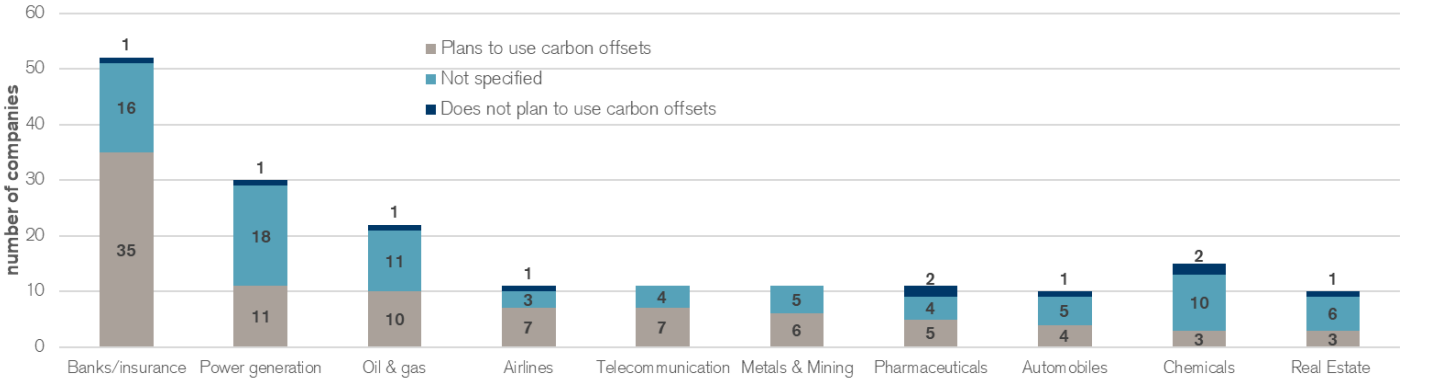
Based on existing activities (Figure 20), we note that **transportation** firms were the largest purchasers of carbon credits in 2020, accounting for a third of VCM credits acquired, using corporate data disclosed to CDP[7]. The airlines group is the primary contributor in part due to preparations ahead of the CORSIA mandate which begins in 2027. Use of carbon offsets is also prevalent in the **financial services** industry as nearly 30% of companies in the sector had purchased offsets in 2020. And on a forward-looking basis, the sector also has the highest number of companies looking to use offsets as part of their net zero strategy, according to Net Zero Tracker (Figure 21). **Oil & gas** and **power generation** sectors are also active in the space, with the latter likely playing a bigger role going forward.

Figure 20: Voluntary carbon credit purchased by sector in 2020 per CDP disclosure ($MtCO_2e$)



Source: CDP, Credit Suisse Research

Figure 21: Top industries(1) that plan to use carbon offsets to achieve net zero targets



Source: Net Zero Tracker, Credit Suisse research
(1) Incudes companies in the Forbes 2,000 list (largest 2,000 largest publicly-traded companies in the world by revenue); industries with at least 10 companies that have both a net zero or equivalent target and an execution plan made it into the chart

[7] As part of reporting requirement to CDP, corporates are asked to disclose the amount of project-based carbon credits originated or purchased by the company during the year (which can be retired during the year or later).

Aviation

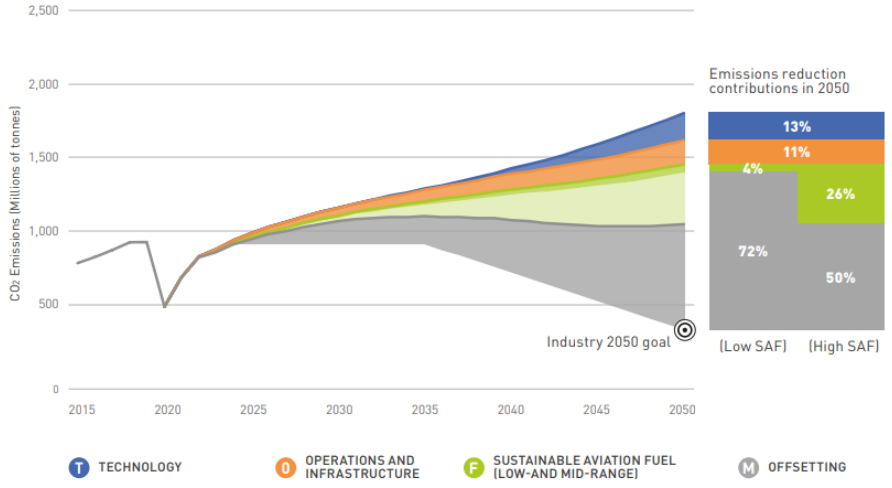
The aviation industry accounts for ~2-3% of global CO_2 emissions, but the non-CO_2 effects (such as aircraft contrails) puts the sector's overall global warming impact at ~3-4% of total human-induced causes and the share is likely to increase as aviation is expected to see the highest demand growth among all modes of transport due to rising income in developing and emerging economies. The International Air Transport Association (IATA) - which represents ~290 airlines comprising >80% of global air traffic - forecasts the number of airline passenger journeys is set to increase fivefold from ~2 billion journeys in 2021 to >10 billion in 2050.

Thus, in 2016, member countries of the UN's International Civil Aviation Organization (ICAO) agreed to establish the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), which aims to stabilize global airline emissions from 2019-20 levels (average of the two years) starting in 2021. As is stated in the name, CORSIA only applies to emissions from *international* aviation, which is not covered under the Paris Agreement (*domestic* aviation is covered under countries' own Nationally Determined Contributions or NDCs). Like the Paris Agreement, CORSIA is initially (from 2021-26) a voluntary scheme, with countries choosing if they will participate. In later years (2027-35), participation will be mandatory for all but small and developing countries.

While sustainable aviation fuel (SAF) is a long-term solution for the aviation industry to organically decarbonize, the world is likely decades away from it scaling in a meaningful way due to high production costs, strict performance criteria, lack of policy support, and competition for resources/capacity (mostly from road transport – i.e., renewable diesel). Electric and hydrogen aircrafts are also potential longer-term solutions. As such, in the near to medium term, CORSIA will rely heavily on emission units from the carbon market to offset carbon emissions. Indeed, airlines are currently one of the largest buyers in the VCM; however, they will have to shift toward purchasing credits for compliance reasons by 2027. Under a baseline/continuation of current trends scenario, the Air Transport Action Group (and supported by the IATA) sees **carbon offsets accounting for ~50-72% (740-1,100 million tonnes) of the airline industry's reduction to net zero CO_2 emissions by 2050.** As a reminder, the entire VCM retired 165 million tonnes last year.

While the quality of CORSIA eligible credits is often questioned today (given CDM credits are allowed), ICAO's process for offset criteria will likely evolve towards higher quality credits over time. In particular, Article 6 of the Paris Agreement mandates that credits used for "international mitigation purposes" (e.g., CORSIA) follow its strict protocols. This likely means airlines will need to move towards higher-priced *removal-based* credits, such as direct air capture projects. Despite current high costs, we note that DAC removal credits are still ~30-40% less expensive than equivalent emissions reduction using SAF currently.

Figure 22: Net zero CO_2 emissions in 2050 for the aviation sector ('baseline' scenario)



Source: IATA

Financial Services

In recent years, financial companies have shown growing involvement in the VCM. Banks are not only engaged as big buyers of carbon credits but the financial community is now also aspiring to have a pivotal role in facilitating transparent and secure transfers of certified carbon credits. Initially launched as a pilot in 2021, Project Carbon is a collective of banks that have teamed up with the aim of using blockchain to create a global market place, formally referred to as Carbonplace, for carbon offsets with clear and consisting pricing and standards. The aim is to simplify the purchase of carbon credits using a secure, energy-efficient distributed ledger technology.

CIBC, **Itaú Unibanco**, **National Australia Bank** and **NatWest** joined the collective of banks in 2021 and three more banks, namely **UBS**, **Standard Chartered** and **BNP Paribas**, followed course in February 2022. Carbonplace is expected to be fully operational by the end of 2022 and will facilitate the following features:

- Settlement infrastructure for marketplaces and exchanges
- Increased delivery of high-quality carbon credit projects
- A strong ecosystem for the voluntary carbon market
- The development of tools to help clients manage climate risk

Data submitted by companies to CDP show that BNP Paribas and Natwest also were two of the largest purchases of carbon credits within the financial services industry globally in 2020.

BNP Paribas: Since 2017, BNP Paribas claims to be carbon neutral on the emissions generated by its own activities. The residual emissions generated in the previous year are offset with the financing of carbon offset projects in the next year. For example, to offset 340,030 tonnes of CO_2 of 2019 residual emissions, BNP Paribas supported four carbon offset projects in 2020. These include the Kasigau projects which aims to preserve and restore 200,000 hectares forest in Kenya and an initiative to restore and preserve tropical peatlands in Indonesia, covering over 150,000 hectares of swamp forest.

Natwest: Natwest has also asserted to be carbon neutral across its own operations since 2020. According to the company, this was achieved through a combination of emission reductions alongside offsetting residual Scope 1, 2, and 3 emissions through the purchase of TIST Carbon Credits. Dual-validated by the Verified Carbon Standard and Climate, Community and Biodiversity Standards (CBB), the International Small Group Tree Planting (TIST) programme is a sustainable development and community reforestation initiative currently active in India, Kenya, Uganda and Tanzania. CDP data shows that Natwest purchased 120,000 TIST credits in 2020.

Oil & Gas

The global energy system – which includes the production/conversion/transmission of fossil fuels ("energy supply") and direct fossil fuel combustion by end use sectors (e.g., transport, buildings, industry, etc.). – accounts for roughly two-thirds of global GHG emissions. Over half of these emissions are from oil and natural gas with the remainder primarily from coal. However, the overwhelming majority (~75-80%) of hydrocarbon emissions over their lifecycle are from *combustion*, which means it occurs downstream ("Scope 3") at the customer level (e.g., power, use in materials, transportation, etc.). This makes it extraordinarily difficult for oil and gas companies to decarbonize, as even if they eliminate 100% of their controllable ("Scope 1" and "Scope 2") emissions, it would not be impactful enough. Thus, many oil and gas companies (particularly the Majors) are ramping up purchases of carbon credits and direct investments into specific projects that will generate carbon credits. These credits can then be paired with the energy/fuel products sold to their customers (mainly corporates) who wish to compensate for the emissions generated by their use.

Notably, **Shell, BP,** and **Chevron** have emerged as among the largest purchasers of carbon offsets in recent years and intend to continue ramping up in conjunction with growing global demand for carbon credits.

- **Shell:** Arguably the most vocal among oil and gas companies on participating in the VCM, Shell aims to use "high quality" nature-based solutions to mitigate emissions of **~120 million tonnes of CO_2 per year by 2030** (vs. ~3.9 million tonnes purchased in 2020 – second largest purchaser after Delta Airlines based on CDP data). Last November, Shell published its *Ensuring High Quality Nature-Based Carbon Credits* report which sets out its expectations and approach to quality across its nature-based portfolio. Recently, Shell has reportedly agreed to a joint venture with India-based EKI Energy Services to invest $1.6 billion on nature based solutions in India. The JV aims to produce 115 million carbon credits over 5 years, a large sum compared to its recent activities. In addition, Shell has made investments in C-Quest Capital for the creation of a portfolio of carbon credits from clean cooking stove projects in Sub-Saharan Africa. These credits may be used by Shell for its corporate offsetting needs or be re-sold to its retail and business customers as a way to "compensate" for emissions associated with products sold (aka Shell's Scope 3).
- **BP:** Rather than using offsets to compensate for the company's own emissions, BP helps its customers to claim "Carbon Neutral" status as part of its carbon management services (currently only offered for US customers). The business, named bp Target Neutral, purchases and retires carbon credits on behalf of BP's customers and helps them offset their self-reported residual *operated* emissions (excluding products and services). While the company does make efforts to enhance integrity around the *use* of carbon offsets (there's a 5-step protocol to ensure customers are reducing absolute emissions before offsetting), we question the overall soundness of the practice (given it doesn't include customers' scope 3 emissions) and the quality of credits in BP's portfolio. BP discloses that its portfolio includes CDM credits, which may have credibility concerns as we noted previously. Company's CDP disclosure also showed that credits purchased in 2020 included renewable energy credits from China and India, which we believe may have additionality concerns. However, the company is looking to ramp up nature-based credits, including Dec 2020 acquisition of a majority stake in Finite Carbon – the largest developer of forest carbon offsets in the US.
- **Chevron:** CVX also sees an opportunity to provide customers with offset-paired products. The company expects to spend $10 billion on its "New Energies" (i.e., low carbon) business by 2028, of which $3 billion is on carbon capture and storage (CCS) and nature-based solution offsets (e.g., soil carbon storage, reforestation, and mangrove restoration). CVX also plans to monetize excess credits and provide customers with "offset-paired" products. In March, the company announced a carbon offsets project with Restore the Earth Foundation for a reforestation project for up to 8,800 acres of property in St. Charles Parish, Louisiana. It also invested in Boomitra, a startup developing an agricultural technology to enable farm carbon sequestration and monetization. Notably, CVX retired 13 MtCO2e 2021, up substantially from 1-2 MtCO2 in 2019-20.

Solutions to Improve Market Integrity

A high-impact area for ESG engagement

In our view, almost all the issues we highlighted at the beginning of this report (Figure 2) can ultimately be addressed with two overarching outcomes: 1) enhanced transparency across every part of the value chain; and 2) higher prices. And **investors and corporate buyers sit at the tip of the spear to drive necessary changes in the market.** Demand for voluntary carbon credits will clearly grow given increasing climate commitments, but the supply response would be almost entirely driven by the boundaries set by the buyers on what they are willing to pay for, vs. what they are not. Further complicating the matter is that these actions are currently by definition voluntary with little oversight holding companies accountable for their purchasing decisions. As such, we believe the practice of offsetting is an area ESG engagement could be highly impactful to drive corporate behaviors. Below are a few key areas worth focusing on:

- **An authentic net zero strategy is a pre-requisite.** All of the pushback related to corporate offsetting distills down to the concern that it could substitute or dilute emission reductions that should be the central part of any climate strategy. At present, outside observers have little transparency to put offsetting in the context of a company's overall ambitions (e.g., what's the level of residual, unabatable emissions for which offsetting is relevant? And how are those emissions determined?); it's also not easy to differentiate actions of one company vs. another (e.g., a company that reduces emissions by 20% and offsets the remaining 80% could claim "carbon neutral" just the same as another that reduces emissions by 80% and offsets the remaining 20%). As such, a pre-condition to any credible use of carbon offsets is that a company must have a vetted net zero transition strategy and is tracking/executing according to its emissions *reduction* pathway.

- **Avoid credits that are questionable.** Out of all the project types in the market, renewable/clean energy projects appear to be most questionable given additionality concerns and they still account for roughly a third of the credit retirements in 2019-2021. Even registries are changing their criteria to certify renewable energy projects in least-developed countries only, which account for just 2% of the total credits in the category to date. We believe corporate best practice should aim to avoid buying vast majority of renewable energy credits in the market going forward.

- **Transparency on carbon offset pricing and internal cost of carbon.** Given the complexity and variety of carbon offset projects, it would be difficult if not outright impossible for non-experts to assess credit quality to the extent that's needed. Until better solutions emerge at scale (such as adoption of carbon credit ratings), one could only use prices as a non-perfect proxy for quality. In a world of escalating climate policies, projects that have high additionality should most likely sit higher up on the abatement cost curve; similarly, claiming "carbon neutrality" with $5/t carbon credits could also be seen as problematic. As such, it's important for companies to not only disclose amount of offsets used but also origin, verification, and costs of projects/credits. This should also inform a reasonably high cost of carbon being used in internal planning purposes. Notably, these are precisely the items being requested in the SEC's climate-disclosure proposal.

- **Reduced reliance on carbon offsets over time and shift toward carbon removal projects.** Given offsetting should be accompanied by absolute reductions in one's own emissions, demand for carbon credits should decline over time (for those companies that are already "compensating" all of their unabated emissions). Meanwhile, the type of credits purchased should also shift toward removal rather than avoidance credits *over time* as achieving net zero would require companies to "neutralize" emissions with only removal credits in the long run. Higher costs of removals may also push companies to invest more in reducing their own gross emissions, rather than tapping the voluntary offset market. At the very least, companies should clearly communicate a plan to support or purchase removal credits, regardless of where the debate lands on corporate claims today.

Key Initiatives to Watch

Complementing stakeholder engagement, there are various initiatives underway this year to bring standardization and definitional agreements within the VCM. Some of them were spurred by efforts that began as the Taskforce on Scaling Voluntary Carbon Markets led by Mark Carney in 2020 which have gained more traction post COP26 meeting. These developments could have potentially transformative impacts on the market we see currently as both supply and demand sides of the equation are being redefined. Perhaps most frequently discussed is the recent agreement on Article 6 of the Paris Agreement, which does not directly impact the VCM, but could have implications for how it operates and improve its environmental integrity. Other work is being done by third-party initiatives, such as the Integrity Council for the Voluntary Carbon Market (ICVCM), Voluntary Carbon Markets Integrity Initiative (VCMI), and Science-Based Targets Initiative (SBTI). Major carbon crediting programs, such as Verra and Gold Standard, are also modifying their criteria to be more stringent.

Below, we discuss why these initiatives are important and the potential impact they may have on the future of voluntary carbon market.

Figure 23: Key initiatives framing the future of voluntary carbon offset markets

Supply-Side Initiatives	Demand-Side Initiatives
Define what's a high quality credit	**Define how and what credits should be used against corporate claims**

United Nations Climate Change	Implementation and detailed rulemaking on **Article 6,** which defines what should *qualify* as a carbon credit and *how* it can be used for different purposes (to meet a country's emission-reduction target under the Paris Agreement, industry-led offset schemes, or voluntary carbon markets). **COP27 summit (November 2022)**
THE INTEGRITY COUNCIL FOR THE VOLUNTARY CARBON MARKET	Establish **Core Carbon Principles** that define a "high-quality credit" and assess which carbon crediting programs and methodologies are CCP-aligned **(Consultation in May, Final guide in 3Q 2022)**
VERRA / Gold Standard	Registries are **updating or creating new methodologies** for forest-based projects (Verra) and technology-based removal projects (Gold Standard)
VCMI Voluntary Carbon Markets Integrity Initiative	Release **guidelines** on what **claims** can be made by corporates based on the types of credits purchased **(June 2022)**
SCIENCE BASED TARGETS	**Net Zero Standard** defines use of carbon *removal* credits to "neutralize" unavoidable (i.e. residual) emissions

Source: Credit Suisse Research

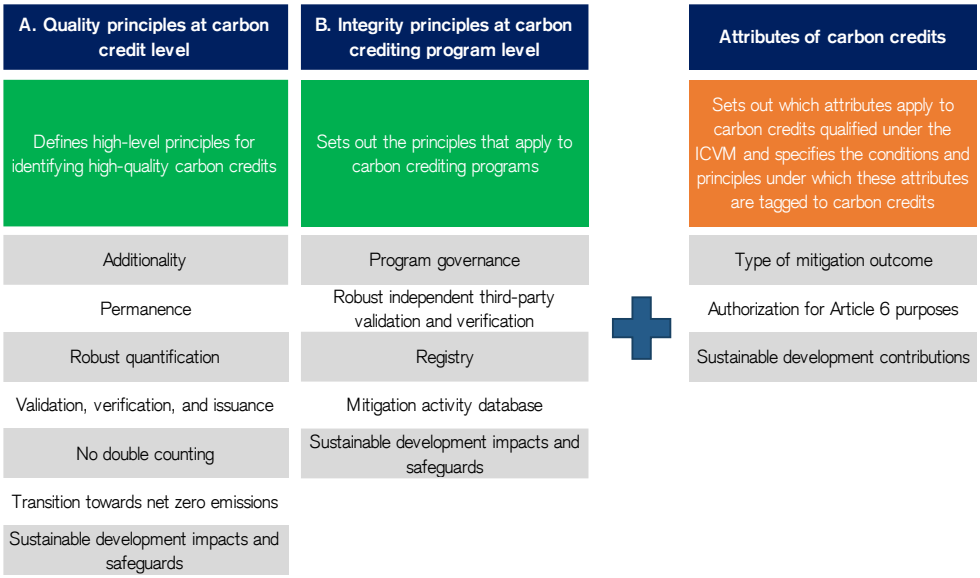
Integrity Council for the Voluntary Carbon Market

Previously known as the Taskforce on Scaling Voluntary Markets whose overarching mission was *growing* the market for carbon offsets, the Integrity Council for the Voluntary Carbon Market (ICVCM) was launched last September and is focused on assuring the *quality* of offsets sold. The new mantra is "build integrity and scale will follow." Thus, the ICVCM's first mandate is to establish a set of **Core Carbon Principles** (CCPs), which will set new threshold standards for high-quality carbon credits and define which carbon crediting programs and methodology types are "CCP-eligible." In other words, offsets that meet its standards will be marked with a "CCP" label at registries and on exchanges.

The CCPs are high level principles, which will be supported by an assessment framework that sets out detailed criteria for each principle. These are in two interlocking parts: at the carbon credit level (e.g., additionality, permanence, no double counting, etc.) and carbon crediting program level (e.g., governance, robust independent third-party validation and verification, etc.). For a carbon credit to be approved as "CCP-compliant," it needs to meet the carbon credit principles and be issued by a program that meets the program governance principles. Alongside these two parts, the ICVCM will also define certain attributes of carbon credits that need to be clearly tagged in registries (e.g., when a carbon project has significant additional social or environmental co-benefits).

The ICVCM plans to hold a full public consultation in May and, after digesting feedback and comments, will publish the CCPs and corresponding assessment framework in the third quarter. The next phase will be to apply those CCPs, both to assess types of carbon credits (by sector) and carbon crediting programs. This will then enable the issuance of accreditations where appropriate.

Figure 24: High-level Core Carbon Principles (CCPs)



Source: Integrity Council for the Voluntary Carbon Market

Article 6

One of the final outcomes of COP26 last November was reaching an agreement on Article 6 of the Paris Agreement, forming the rules governing the operation and integrity of a new global carbon market. By reaching an agreement on Article 6.4 (creating a new international carbon market) and Article 6.2 (the supporting framework for country-led trading schemes), there's now a common rulebook for what should qualify as a carbon credit and how it can be used for different purposes (to meet a country's emission reduction target under the Paris Agreement, industry-led offset schemes, or voluntary carbon markets).

While the impact from implementation of Article 6 on the voluntary carbon market is not yet fully understood (as details are lacking), there is an opportunity for governments to help define where and how the voluntary carbon market can be most impactful and also keep the voluntary carbon market better informed in developing their own standards in areas such as baselines, additionality, and crediting periods. Said differently, this should ultimately: **1) raise the bar on the quality of voluntary carbon credits**; **2) drive up prices** via more stringent quality criteria and potentially control the *type* of credit supply that enters the voluntary market.

For example, **proving additionality** has always been a challenge for projects in the voluntary carbon market. However, under Article 6.4, each methodology must "demonstrate using a robust assessment that shows the activity would not have occurred in the absence of the incentives from the mechanism, taking into account *all relevant national policies*, including legislation, and representing mitigation that exceeds any mitigation that is required by law or regulation." Said differently, Article 6.4-labelled credits should come from abatement opportunities *above and beyond* host country's emission-reduction goals under the Paris Agreement. Thus, these credits can help better inform the voluntary carbon market (registries, NGO's, etc.) about what is considered "additional" across regions.

Another example is the **shortened crediting periods** for newly registered projects relative to those registered under the CDM. If this feeds through into methodologies and standards for voluntary projects, it could act to limit the supply from future projects and raise prices, as project

costs would need to be recovered from the sale of credits over a shorter time period. Gold Standard is already proposing to adopt these shorter crediting periods in its Gold Standard for the Global Goals.

Projects registered as an A6.4ER also must **minimize the risk of non-permanence and leakage** (and address/adjust when occurs) as well as negative environmental and social impacts.

Host countries are incentivized to let "high-hanging fruit" projects into internationally traded carbon markets. Given the optionality available on whether to issue A6.4ERs for use in the voluntary carbon market, the long-term impact remains to be seen. Some countries may want to leverage the private finance provided by voluntary carbon markets to further their own climate action (i.e., make progress on their NDC), which is something many buyers will want to *contribute* to; other countries may choose to make accounting adjustments for voluntary carbon market transactions that arise from projects in their territories. Given countries have a choice of deciding whether or not to apply a corresponding adjustment on certain projects, the revenue they generate from those projects has to justify the cost of the adjustment (i.e., the cost of emission reduction through alternative means) while still enabling achieving their own NDC targets. As a result, abatement opportunities that are internationally transferred are likely higher-cost projects, driving up global carbon prices as a result.

Similar to rest of VCM, long term development of 6.4 market depends on what buyers demand. At a high level, credits that follow Article 6 (i.e., include a corresponding adjustment or "adjusted" credits) will likely be considered higher quality (and, thus, priced higher) than "non-adjusted" credits, resulting in a two-tier carbon credit certification system. This is because adjusted credits will be seen as having more environmental integrity and thus enable a company to make a stronger case for "offsetting" its own emissions. Some buyers may prefer credits that are backed by corresponding adjustments to provide an extra assurance that the countries will not lighten the mitigation efforts set out in their NDCs because of successful voluntary market projects impacting their emissions. But it's still too early to tell buyers' preference today. Greater understanding and clarification are also needed among voluntary market participants and related stakeholders on whether (or when) corresponding adjustments are appropriate.

Voluntary Carbon Market Integrity Initiative

Given the discussion earlier on corporate claims, the Voluntary Carbon Market Integrity Initiative (VCMI) will soon be providing guidance on what constitutes a "credible" claim regarding net zero and carbon neutrality. This should help add much needed clarity to not only the definitions of various climate commitments/claims made by corporates, but also whether (or when) certain types of carbon credits are appropriate to be consistent with the temperature goals of the Paris Agreement.

The VCMI has already proposed that a credible carbon neutrality claim needs to be accompanied by a "robust, forward-looking commitment by the company." Thus, the existence of a strong commitment – such as net zero – is a precondition for a credible achievement claim. Also, when a company makes an achievement claim about a *product* being carbon neutral, it should clearly explain the limitations of that claim (i.e., that the company has not yet eliminated all its GHG emissions and that the use of a particular product or service does not mean the absence of GHG emissions). The VCMI will also address the type of credits that can be used in carbon neutral claims and how mitigation contributions can be framed to entice greater uptake and use by companies in their achievement claims.

Science-Based Targets Initiative

Key organizations and initiatives are pushing for the use of only *removal* offsets to achieve net zero emissions, with perhaps the most notable example being the Science-Based Targets Initiative (SBTI). The SBTI is arguably the gold standard initiative that verifies emission reduction targets for companies.

To date, over 2,700 companies have set or committed to set a science-based target (i.e., pledge to reduce their emissions on a Paris-aligned trajectory), which historically was not allowed to include carbon offsets. However, in October 2021, the SBTI published its **Net Zero Standard**, which is its most stringent pledge as companies commit to reducing their gross emissions by 50% by 2030 and at least 90% by 2050 with slight variations depending on the sector. At that point (or whatever year the company aims to achieve "net zero"), the SBTI allows companies to use carbon credits for "neutralizing" (i.e., offsetting) any emissions that cannot yet be eliminated (i.e., residual emissions), but these must come from *removal* (rather than *avoidance*) projects. In the transition to net zero, the SBTI's Net Zero Standard encourages companies to invest beyond their value chains ("Beyond Value Chain Mitigation") to contribute towards reaching societal net zero, which can include projects that *avoid* or *reduce* emissions.

Figure 25: Examples (not limited to) of avoidance vs. removal projects under SBTI's Net Zero Standard

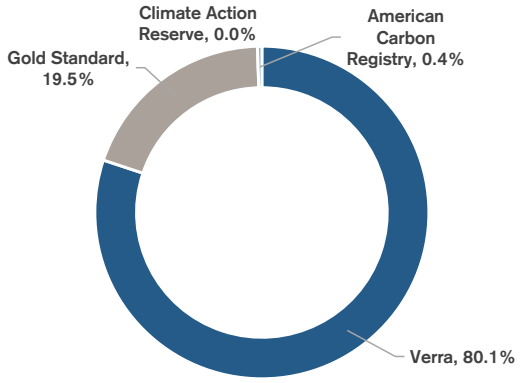
Avoidance Projects (for "Beyond Value Chain Mitigation")	Removal Projects (for "neutralizing" residual emissions)
Forestry (e.g., Jurisdictional REDD+)	Direct Air Capture (DAC) and storage
Conservation projects (e.g., peatland or mangrove)	Bioenergy with carbon capture and storage (BECCS)
Energy efficiency (e.g., cookstove projects)	Improved soil management
Methane destruction (e.g., landfill gas projects)	Improved forest management
Renewable energy (e.g., solar/wind/biogas)	Land restoration (e.g., of peatland, terrestrial forests or mangroves)
Industrial gases (e.g., N_2O destruction at nitric acid facilities)	

Source: Science-Based Targets Initiative

Carbon crediting programs/registries

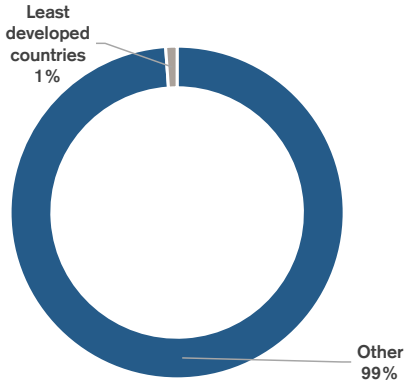
Major carbon crediting programs (including Verra and Gold Standard) are changing their criteria to only include renewable/clean energy projects in least-developed countries or LDCs. As determined by the UN, LDCs are countries that have the lowest indicators of socioeconomic development and the lowest Human Development Index ratings. There are 46 countries marked as LDCs, with 33 of these located in Sub-Saharan Africa. For reference, Verra and Gold Standard account for >99% of the renewable energy offset credits listed across the four major registries and such credits from Sub-Saharan Africa account for just ~2% of the total. This implies most of these renewable energy projects will be ineligible to participate in the offset market in the future.

Figure 26: Percentage of existing renewable energy offset credits across the four major registries



Source: Berkeley Carbon Trading Project's Voluntary Registry Offsets Database

Figure 27: Percentage of existing renewable energy offset credits across least-developed countries vs. everywhere else



Source: Berkeley Carbon Trading Project's Voluntary Registry Offsets Database, United Nations

As previously noted, these programs could also change their criteria as a result of Article 6. Both Verra and Gold Standard have already taken action to offer carbon credits with a corresponding adjustment. Gold Standard has recently opened registrations to an "early-mover program" for developers interested in issuing credits with a corresponding adjustment, while Verra is preparing for implementing an Article 6 label, which will be attached to credits with a corresponding adjustment obtained by the host government.

Carbon credit rating agencies

Emergence of carbon credit rating agencies will help to address one of the biggest hurdles in the VCM today – ability of market actors to assess "quality". Similar to credit rating agencies, these companies use a standardized set of criteria and methodologies to compare credits across different project types. At present, quality is being grouped bluntly using project categories, i.e. removal vs. avoidance, or reforestation vs. renewable energy, when in reality, high *and* poor quality credits exist in every category. Our conversations with market participants showed that there's little correlation between price and quality in today's markets and that needs to change for the market to scale and for VCM to deliver on its intended climate positive outcomes.

The three main entities leading in this space currently are **BeZero**, **Sylvera**, and **Calyx global**. It's notable that all three were founded since 2020 led by teams with expertise in climate science, data analytics, technology and financial markets. While each company has its own proprietary rating framework, they assess projects based on the probability that any given carbon credit can deliver on a tonne of carbon avoided or removed and that co-benefit claims are genuine. This also involves use of remote sensing technologies and advanced geospatial analysis to further authenticate credits that are already accredited by the registries.

We expect this space to evolve rapidly in the next couple years. To date, BeZero has already rated 227 projects and 51% of outstanding VCM credits and has made their ratings public. As these agencies establish their credibility and gain broad adoption by market participants, there's a real possibility that rating(s) would be required for carbon offsets to transact in the not too distant future. All of this effort should create momentum toward greater transparency and overall market development.

Opportunities for Investors

High permanence carbon removal

Removing and permanently sequestering a tonne of CO_2 from the atmosphere is the only way to truly counterbalance a tonne of CO_2 emitted elsewhere, thus the **only credible option to achieve net zero**. The newest IPCC report (see our takeaways) has confirmed that CO_2 removal is essential to mitigating climate change. According to CarbonPlan (a leading think tank in the carbon removal space), most forecasts put the demand potential for removal at 5-15 *billion* tonnes of CO_2[8] per year by 2050. Even in the most conservative case, 1.5-3.1 *billion* tonnes of CO_2[8] per year need to be removed in order to neutralize hard-to-avoid emissions. **This makes high permanence carbon removal projects the highest quality credits one can buy, and in order for that market to scale beyond 2030, investments need to start now.**

Until recently, only a small group of companies, mostly in the technology sector, have been pioneering the market for high quality *carbon removal* projects/technologies. Similar to what occurred with other technologies such as solar panels and hard drives, funding from early adopters/purchasers can help new carbon removal technologies get down the cost curve and up the volume curve in the hopes that such high quality removal credits can be mainstreamed for the rest of the VCM.

The most notable early adopters are privately-held **Stripe** (payment processor) and **Microsoft.** Both companies have developed a set of project criteria and encouraged eligible projects to submit applications for consideration. They have also made the chosen solutions public (database aggregated by CarbonPlan) to facilitate price discovery across a variety of project types and attributes (e.g., permanence, additionality, etc.) in the nascent removal market.

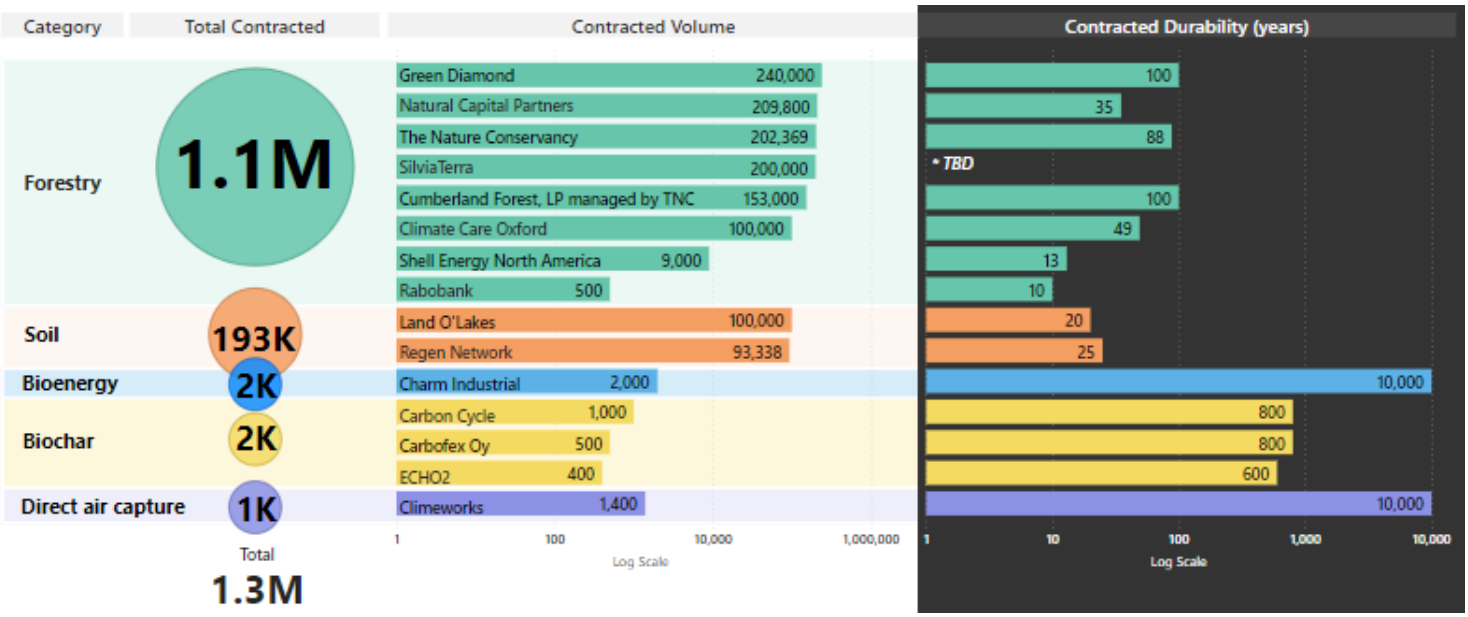
- **Microsoft**'s pledge to be "carbon negative" by 2030 is only reachable with *carbon removal* credits. The company purchased 1.3 $MtCO_2$ removal credits in 2021 primarily from nature-based projects, which were then "risked" to account for the shortcomings of nature-based solutions (see Figure 28). To achieve its 2030 goal, **Microsoft needs to buy at least 5 $MtCO_2$ per year by the end of the decade** and shift increasingly to "high-durability" technology-based solutions. Accelerating research in this area is part of the mandate for its $1 billion Climate Innovation Fund, which already includes investments in Direct Air Capture (DAC) technologies such as Climeworks and Heirloom.

- Operating at a much smaller scale, **Stripe** has pledged to pay "at any CO_2 price" for direct removal with long-term storage. The company also helpfully discloses price paid for each project. Since 2020, the company has made purchase commitments of $15 million across 14 companies/projects ($14 million across 10 companies/projects in 2021 alone), ranging from $75-$2,000/t of CO_2 (see Figure 29).

More recently in March, **Occidental Petroleum** sold 400,000 tonnes of carbon removal credits to **Airbus** from its first DAC facility expected to be operational by 2024. The transaction is for the delivery of 100,000 tonnes credits per year over four years and is magnitudes larger than any deal done to date. Price per tonne was not disclosed explicitly but Occidental (OXY) inferred it could be in the range of $250-$450/t, which would still be lower than the $775/t price Stripe had paid for Climeworks' removal credits. This suggests Airbus' deal was potentially valued at $100-$200 million, making an important milestone in the long-term carbon removal credit space.

[8] "The Case for Carbon Dioxide Removal: From Science to Justice" CDR Primer A Bergman & A Rinberg (2021)

Figure 28: Microsoft's carbon removal purchases for 2021



Source: Microsoft

Figure 29: Stripe's portfolio of carbon removal projects

	Company/project	Project Category	Removal type	Company/project description	Initial volume purchased by Stripe (tons of CO_2)(1)	Initial price paid by Stripe ($ per ton of CO_2)(1)
2021 projects	Heirloom	DAC/Mineralization	Capture + storage	Building a direct air capture solution that enhances this process to absorb CO2 from the ambient air in days rather than years, and then extracts the CO2 to be stored permanently underground.	244	$2,054
	Ebb Carbon	Ocean	Capture + storage	Uses a proprietary electrochemical system to remove acid from the ocean and enhance its natural ability to draw down atmospheric CO_2 and store it as oceanic bicarbonate.	256	$1,953
	Seachange	Ocean	Capture + storage	Leverages the power and scale of the world's oceans to remove carbon using an experimental electrochemical process that sequesters CO_2 in seawater as carbonates.	365	$1,370
	Sustaera	DAC	Capture + storage	Uses renewable energy and ceramic monolith air contactors to capture CO_2 directly from the air for permanent storage underground.	714	$700
	Eion	Soil	Capture + storage	Accelerates mineral weathering by mixing silicate rocks into soil. Their pelletized product is applied by farmers and ranchers to increase carbon in the soil, which over time makes its way into the ocean, where it's permanently stored as bicarbonate.	500	$500
	Mission Zero	DAC	Capture + storage	Electrochemically removes CO_2 from the air and concentrates it for a variety of sequestration pathways.	358	$319
	CarbonBuilt	Mineralization	Storage only	Converts dilute CO_2 to form limestone, permanently storing the CO_2 while creating a valuable concrete building material.	968	$260
	Running Tide	Ocean	Capture + storage	Removes carbon by growing kelp in the open ocean. After maximum growth, the free-floating lines of kelp sink to the deep ocean where the embodied carbon is stored for the long term.	600	$250
	The Future Forest Company	Soil	Capture + storage	Conducting a field trial to accelerate mineral weathering by crushing basalt rocks into dust, spreading them onto the forest floor, and then measuring CO_2 uptake.	1,500	$200
	44.01	Mineralization	Storage only	Turns CO_2 into rock, harnessing the natural power of mineralization. Their technology injects CO_2 into peridotite, an abundantly available rock, where it is stored permanently.	2,941	$170
2020 projects	Climeworks	DAC/Mineralization	Capture + storage	Uses renewable geothermal energy and waste heat to capture CO_2 directly from the air, concentrate it, and permanently sequester it underground in basaltic rock formations.	323	$775
	Charm Industrial	Mineralization	Storage only	Injects bio-oil into geologic storage. Bio-oil is produced from biomass and maintains much of the carbon that was captured naturally by the plants. By injecting it into secure geologic storage, they're making the carbon storage permanent.	416	$600
	CarbonCure	Mineralization	Storage only	Sequesters CO_2 in concrete by mineralizing it into calcium carbonate (CaCO3) - as a bonus, this has the side effect of actually strengthening the concrete.	2,500	$100
	Project Vesta	Ocean	Capture + storage	Captures CO_2 by using an abundant, naturally occurring mineral called olivine. Ocean waves grind down the olivine, increasing its surface area. As the olivine breaks down, it captures atmospheric CO_2 from within the ocean and stabilizes it	3,333	$75

Source: Stripe

(1) Stripe will make additional purchases contingent upon the successful completion of technical milestones; this "additional" amount is included in its $15 million of commitments made to date

Investments are heating up in the carbon removal space

According to BloombergNEF, investment in direct air capture has just exceeded $1 billion including the latest equity round in Climeworks. While the dollar amount is still tiny relative to other "green" spending, long-term addressable market is sizable and the demand growth in carbon removal credits should fuel further investments. Several major funding events occurred in the space this past April alone:

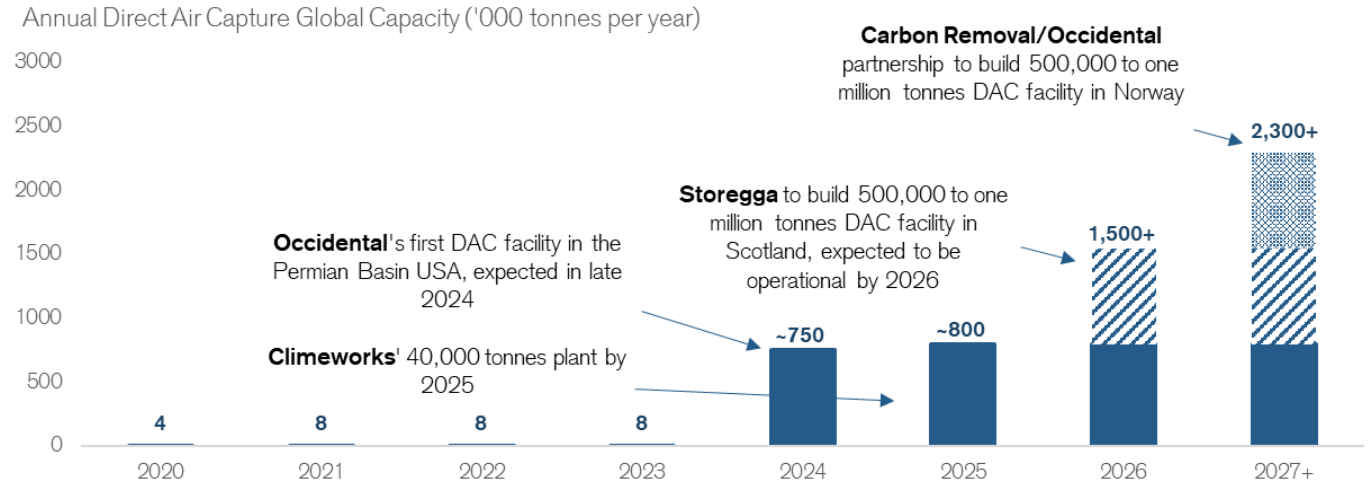
- **Swiss DAC startup Climeworks raised $650 million of equity in April.** This was the largest amount ever secured by a company in this field. Climeworks has already commissioned the biggest DAC plant built to date located in Iceland, with an annual capture capacity of 4,000 tonne per annum at a $10-15 million price tag. The new funds will go towards building an even larger 40,000 tonne per annum plant by 2025. And by 2030, Climeworks intends to capture over 1 million tonnes per year.
- **Frontier fund commits to spend $925 million on carbon removal credits by 2030.** Also in April, Stripe launched Frontier, which pools funds from other corporates who commit to buying offsets from companies that permanently remove carbon dioxide from the air. Frontier has also received funding from **Alphabet/Google, Shopify, McKinsey,** and **Meta/Facebook** and has initially committed to spend $925 million by 2030. The goal is to send a strong demand signal to the market for these technologies, which in turn should help companies secure access to venture-capital funding and, ultimately, cheaper debt capital to build large-scale plants. While it remains to be seen what companies/technologies Frontier will target, this could be an important source of funds for several direct air capture projects under development.
- **Lowercarbon capital raised $350 million specifically for carbon removal start-ups.** The venture capital firm primarily invests in seed and Series A-stage companies and this is the second of two climate funds the company has started. The founders made their fortunes from early tech start-ups (such as Twitter, and Uber etc.) and are now focused on climate tech start-ups.

Significant growth in Direct Air Capture (DAC)

While increase in investment should fund a myriad of early prototype technologies, the only "ready to scale" projects in the carbon removal space are direct air capture and storage (DAC) and bioenergy with carbon capture and storage (BECCS).

Currently, there are three large-scale (500,000 to 1 *million* tonnes per year each) direct air capture projects in the planning phase (two of which are being developed by **OXY** under partnership with another company) - see Figure 30. This compares to current DAC capacity of just under 8,000 tonnes per annum.

Figure 30: Large-scale direct air capture projects in development



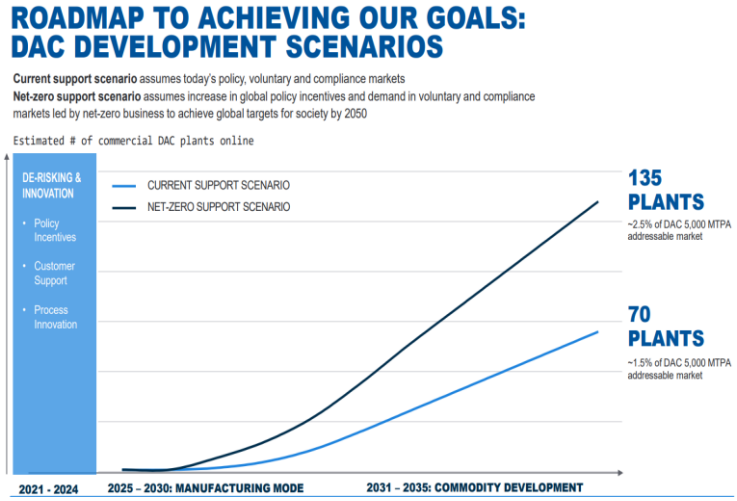
Source: Company documents, Credit Suisse Research

For investors, we believe **OXY is the only public company with material exposure to DAC** given synergies with its existing OxyChem (supplying the key chemical components) and EOR operations in the Permian (existing skill sets, carbon management expertise and infrastructure). Notably, OXY created 1PointFive, a subsidiary development company, in 2020 to deploy DAC technology. OXY has exclusive license in the US and has also secured worldwide agreement to

be the deployment and execution partner for a private company's DAC and air-to-fuels solutions. OXY envisions substantial DAC volume growth in the next 10-15 years with rapid reduction in cost. Below we include a few key highlights on the company's efforts, which was discussed at the company's recent Low Carbon Venture (LCV) Investor Update:

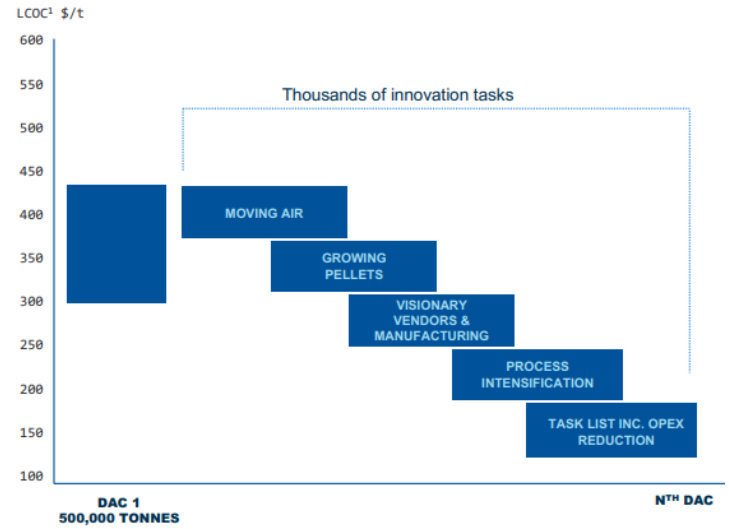
- **DAC and CCUS critical to OXY's net-zero by 2050 goal.** OXY is one of only two North America oil & gas companies with net zero all scope emissions target, both thanks to growing carbon capture businesses. The company has committed to geologically sequester or utilize 25 $MtCO_2$ per year (MTPA) by 2032 and achieve net zero Scope 1 & 2 emissions before 2040 (potentially before 2035) and net-zero all scopes by 2050.
- **First facility expected to be operational by 2024.** FEED study is currently underway for its first 0.5 MTPA DAC facility located in the Permian basin which has the option to be expanded to 1.0 MTPA with addition of a second train. The company plans to deploy up to $300 million this year in its LCV business (if construction begins in 2H 2022 as planned), a fraction of its overall budget of $3.9-$4.3 billion. The first train is expected to cost ~$800-$1,000 million while doubling the capacity would cost 1.6x that amount.
- **Targeting 70 plants and <$150/t DAC capture cost in 10 years.** OXY believes current policy, voluntary and compliance markets would support 70 plants by 2035. With technology maturation and economics of scale, OXY envisions leveled cost of capture (to generate an unlevered project IRR of 7%) could fall to as low as $125/t, achievable by plant number 30-50. While this is a substantial decline from today's $300-$425/t cost, it also implies a learning rate of ~15% per doubling of production, which is conceivable given learning progress curves on other modern day technological innovations.
- **Substantial addressable market.** At $250/t DAC capture cost, the total addressable market (TAM) for DAC is estimated at 5 *billion* tonnes per year, equivalent of 5,000 MTPA DAC plants. The aviation industry alone would require 1,200 MTPA of DAC demand either for carbon removal credits or CO_2 as feedstock for sustainable aviation fuels. At $125/t, TAM could reach 15 *billion* tonnes per year given DAC could become a competitive abatement option to address emissions from the hard-to-abate sectors.

Figure 31: Current environment already justifies rapid growth



Source: Company data

Figure 32: Declining cost of capture with production scaling



Source: Company data

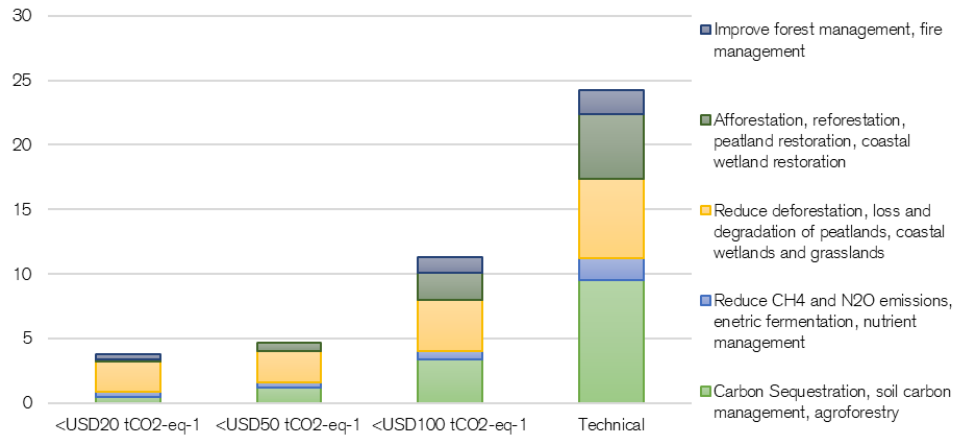
Nature-based solutions

AFOLU is central to climate change

In our latest work on the IPCC's recent update on climate change mitigation progress and pledges (see: Mitigation, AFOLU, the food system and IPCC and IPCC Take 3: Mitigation – The Final Installment), we outline how the sector of Agriculture, Forestry and Other Land Uses (AFOLU) plays a key role when trying to articulate pathways towards a net zero world. AFOLU accounts for 13-21% of global GHG emissions. According to IPCC estimates, the total economic land-based mitigation potential stands between 8-14 $GtCO_2$-eq. at a carbon price of US$100 per tCO_2-eq, which is about half of the technical mitigation potential that could be achieved without economic constraints. Roughly 30-50% of this potential could be reached at a lower carbon price of US$20 per tCO_2-eq.

Notably, the IPCC stated that AFOLU is the only sector with large-scale carbon removal potential in the short-to-medium term through reforestation, forest management and soil organic carbon management. The IPCC's latest update, the so-called Working Group III report of the Sixth Assessment Report (link to report), provides an updated assessment of progress and pledges related to emission reduction and mitigation efforts. It provides new insight in relation to AFOLU which, given our recent ESG work on the land-use ecosystem, we believe is relevant for investors to be made aware of.

Figure 33: Emission mitigation potential by 2050 by carbon price (GtCO2-equivalent/yr)



Source: IPCC, Roe et al. (2019)

AFOLU mitigation solutions

Across sectors

AFOLU mitigation measures, also commonly referred to as land-based climate change mitigation, consist of a plethora of land management interventions (i.e. supply-side) or demand management changes that reduce greenhouse gas emissions and/or enhance carbon sequestration within the land system focusing on in forests, wetlands, grasslands, croplands and pasturelands. These mitigation measures are also referred to as nature-based solutions when combined with co-benefits to human well-being and biodiversity.

In Figure 34, we show an overview of 20 AFOLU-related measures that help reduce emissions. These focus on land management practices relating to forests and other ecosystems and agriculture as well as demand-side measures such as a change in consumer behavior. The IPPC report includes estimates for AFOLU measures by economic potential (i.e. constrained by costs such as a carbon price) and technical potential (i.e. the biophysical potential or amount possible with existing technologies).

Figure 34: Overview of measures that help reduce emissions associated with AFOLU

Land based mitigation measures	Mitigation Potential		
	Economic ($GtCO_2$ yr^{-1})	Technical ($GtCO_2$ yr^{-1})	Confidence level
Forest and other ecosystem			
Reduce deforestation and degradation Control drivers of deforestation (subsistence agriculture, mining, urban expansion) and forest degradation (fuelwood collection, overgrazing and wildfires). Improve forest governance and land tenure; introduce forest certification, support community forest management and secure land rights	3.4	4.5	Medium
Afforestation, reforestation and forest ecosystem restoration Converting land to forests on areas that previously contained forests as well as new land; management of tree species	1.6	3.9	Medium
Improved forest management One or combination of longer rotations, less interval harvests, continuous-cover forestry, mixed stands, more adapted species, high quality wood assortments	1.1	1.7	Medium
Fire management (forest and grassland/savanna fires) Prevention, detection, control of fire in natural ecosystems including activities such as controlled/prescribed burning with low intensity fires	0.05	0.1	Low
Reduce degradation and conversion of grasslands and savannas Controlling conversion drivers (commercial and subsistence agriculture), improving policies and management	0.04	0.2	Low
Reduce degradation and conversion of peatlands Conservation of peatland carbon stocks by controlling conversion and degradation drivers (commercial and subsistence agriculture, mining, urban expansion), improvement of governance and management	0.5	0.9	Medium
Peatland restoration Rewetting and revegetation that helps increase carbon accumulation in vegetation and soils; Top soil removal; Collaborative and transparent planning process to reduce conflict between competing land uses	0.4	0.8	Medium
Reduce conversion of coastal wetlands Limit drivers of conversion which include intensive aquaculture, agriculture, salt ponds, urbanisation and infrastructure development; extensive use of fertlizers and extraction of water resources	0.17	0.8	Medium
Coastal wetland restoration Includes passive restoration (removal of activities that cause degradation or prevent recovery); active restoration (purposeful manipulations to the environment to achieve naturally functioning system)	0.1	0.3	Medium
Agriculture			
Soil carbon management in croplands and grasslands Crop management through improved crop varieties, crop rotation, integrated production systems, crop diversification, agricultural biotechnology; Nutrient management; Reduced tillage intensity; improved water management; management of vegetation through improved grass varieties, deep rooting grasses; livestock management through fodder banks and diversification	0.6 (croplands) 0.9 (grasslands)	1.9 (croplands) 1.0 (grasslands)	Medium
Biochar Produced by heating organic matter in oxygen limited environments (pyrolysis and gasification). Mitigation strategies include "negative priming" where biochar is added to stabilize soil carbon; displacing fossil fuels with pyrolysis gases, addition of biochar to compost, paddy rice among others	1.1	2.6	Medium
Agroforestry Agroforestry systems include windbreaks, farmer managed natural regeneration, alley cropping, silvopastoral systems, among others	0.8	4.1	Medium
Enteric fermentation Mitigate methane emissions by targeting emissions per animal or unit of feed consumed or increasing production efficiency through methods such as chemically synthesised inhibitors, improved livestock breeding and feeding	0.2	0.8	Medium
Improve rice management Reduction of CH4 and N2O emissions through improved water management (single drainage and multiple drainage practices); residue management; use of slow release fertiliser and nutrient application; soil amendments such as biochar	0.2	0.3	Medium
Crop nutrient management Optimisation of fertiliser application delivery, utilising different fetilizers (organic, compost, etc); use of nitification inhibitors'; Intercropping, nitrogen biological fixation; soil testing	0.2	0.3	Medium
Manure management Measures include anaerobic digestion; nitrification or urease inhibitors to stored manure; composting; changes in grazing practices; alteraton of livestock diets	0.1	0.3	Medium
Demand-side measures, change in consumer behaviour			
Shift to sustainable healthy diets Shift to dietary patterns that promotes individuals' health and wellbeing; have low environmental pressure and impact. Transition to more plant based consumption and reduction of animal based foods	2.5	3.6	Medium
Reduce food loss and waste Measures that reduce food loss and waste include investing in harvesting and post harvesting technologies, taxing and other incentives to reduce business and consumer level waste, mandatory reporting and reduction targets for large food businesses, regulation of unfair trading practices,		2.1	Medium
Improved and enhanced use of wood products Increasing carbon storage in wood products by changing the allocation of harvested wood to long-lived wood products or by increasing products' lifetime and increasing recycling. Material substitution through the use of wood for building, textiles, or other applications instead of other materials (e.g. concrete, steel which consume more energy to produce)	0.4	1.0	Strong evidence and medium agreement

Source: IPCC, Credit Suisse Research

Important to highlight is that most mitigation options reviewed by the IPCC are available and ready to deploy, without additional upfront investments. The protection of natural ecosystems, carbon sequestration in agriculture, sustainable healthy diets and reduced food waste have especially high co-benefits and cost efficiency. Furthermore, the IPCC notes that avoiding the conversion of carbon-rich land is particularly relevant. The carbon that would be lost from the conversion of these ecosystems is irrecoverable through reforestation by the 2050 timeline according to the IPCC. In other words, cutting down a tree and planting a new one will likely worsen net emissions for many years.

Across regions

Due to the large potential from reducing deforestation and sequestering carbon in forests and agriculture, the greatest economic mitigation potential up to US$100 per tCO2-eq across regions is estimated to be the highest in tropical countries in Asia and developing Pacific (34%), followed by Latin America and the Caribbean (24%) and Africa and the Middle East (18%). The IPCC also highlights considerable potential in Developed Countries (18%) and some potential in Eastern Europe and West-Central Asia (5%). The protection of forests and other ecosystems is the main driver of mitigation potential in tropical regions, whereas carbon sequestration in agricultural land and demand-side practices are important in Developed Countries and Asia and developing Pacific, according to the IPCC.

Companies exposed to credit origination in our ROE of a Tree universe

There is a growing number of companies active within the AFOLU sector who are not only purchasing carbon credits but are also directly engaged on the supply-side of voluntary carbon markets through their involvement in the project-based origination of credits. Using corporate data disclosed to CDP, we identify three companies in our Treeprint universe who have been involved in the origination of credits focusing on either agriculture or forestry project-types.

- **UPM-Kymmene Corporation (forestry):** according to data submitted to CDP, UPM-Kymmene, a Finnish company that produces paper and forests products, originated 210,375 credits through the UPM Blandin Native American Hardwoods Conservation and Carbon Sequestration project. This initiative aims to improve forest management on more than 175,000 acres of mixed native hardwood forest in northern Minnesota. There are also biodiversity co-benefits as the project area provides critical habitat for rare species (e.g. northern long-eared bat and the golden winged warbler).
- **Sime Darby Plantation (forestry):** A total of 80,000 credits have been originated by Sime Darby Plantation, the world's largest producer of certified sustainable palm oil, across a variety of forestry projects. Example include a reforestation collaboration with Nestle where more than 580,000 trees were planted as well as the Northern Ulu Segama Orang Utan habitat reforestation initiative. The latter aims to ensure planted trees are in optimal condition to create a healthy habitat for orangutans.
- **Corteva (agriculture):** CDP data shows that Corteva, a major American agriculture chemical and seed company, has facilitated the sale of credits through its independent, wholly owned subsidiary Granular. Using precision agriculture software technology, Granular collects data on farming practices. One of the company's operating systems, Nori, utilizes a marketplace where CO_2 in soil is calculated, verified, and carbon credits are issued for sale allowing US farmers to monetize removing CO_2 from the atmosphere by storing it in their soil. In its disclosure to CDP, Corteva highlights how Harborview Farms, for example, had over 14,000 agriculture carbon credits verified and sold. By employing continuous no-tillage, utilizing cover crop mixes, and applying compost and manure and keeping detailed digital management records since 2010, Harborview Farms became the first participant to sell credits on the Nori platform.

Emerging "carbon credit streaming" companies

With the growth of carbon markets, there is an emerging set of companies offering investors exposure to carbon credits and their corresponding price movements. In particular, companies involved in "carbon credit streaming" make upfront and delivery payments to project developers in exchange for the right to receive all or a portion of future carbon credits generated by the project (which can then be sold in the VCM, likely through bilateral agreement with corporate buyers). For these companies, they are not responsible for operating or capital costs and realize potential value appreciation with purchase terms of credits set upfront, while gaining access to a steady stream of credits each year; for the developers, they gain some certainty with upfront cash and annual income for decades and a sales channel to monetize carbon credits.

Interestingly, newly-launched carbon credit streaming companies are moving to Canadian exchanges – the Wall Street Journal recently reported about a dozen are expected to list their shares. Below we highlight three carbon credit streaming companies: two that recently listed on Canada's NEO exchange and one that is still private.

- **Carbon Streaming Corporation:** The first carbon-credit company to list on NEO (last July), Carbon Streaming focuses initially on REDD+ projects, with a current portfolio of four projects (across Indonesia, Mexico, Brazil, and Republic of Congo) in various stages of production/development. The company has sourced a potential deal pipeline of over $700 million with its near-term pipeline valued at ~$200 million at target IRRs of 15+%. It is also working towards a potential listing of its common shares on the US Nasdaq exchange.
- **Base Carbon:** Listed on NEO in March and is focused currently on cookstove and re-/afforestation projects but also evaluates other project types (e.g., biochar, methane emission avoidance, carbon capture, etc.). The company's initial project investment ($8.75 million) will fund the distribution of 250,000 fuel-efficient cookstoves to rural families in Rwanda in exchange for 7.5 million credits over 10 years. It also has >50 discreet carbon project opportunities in various stages of evaluation (six in advanced negotiations and/or development with potential for near-term capital deployment) with >$400 million in potential commitments at full scale.
- **Carbon Neutral Royalty (private):** The company is primarily focused on the restoration of Mangroves (falls in the *removals* bucket), which are 10x more productive at sequestering carbon per hectare than terrestrial forests and 1/3 the planting cost. Existing Mangrove restoration projects have recently traded up to $34/t. The company has partnerships with various Mangrove-focused developers, most notably World International Foundation (WIF) – the world's largest issuer of blue carbon/mangrove carbon credits. Carbon Neutral has a Right of First Investment to finance a minimum of 50% of WIF's projects for up to 5 years. The first five projects are under development across Myanmar, Sri Lanka, and Gambia with various start dates over the next 3-4 years. Planting schedules with WIF, based on closed transactions to date, are expected to generate +70 million credits to Carbon Neutral over a 30-year period.

Carbon Offset Ecosystem Primer

Carbon offset lifecyle

Although the project implementation process, from project design to implementation, can be different under the voluntary standards versus the Clean Development Mechanisms (CDM), the Carbon Offset Guide and the Oxford Institute for Energy Studies use the CDM project cycle as a useful framework to help outline a process that can be vastly similar across carbon offsetting projects.

1. Methodology development

A carbon offset project methodology defines the parameters and operations required to define project additionally as well as for the calculation of emission reductions or removals from a project during its lifetime. These are also known as the **monitoring, reporting and verification** (MRV) requirements. A project developer can either use a pre-existing methodology or submit a new methodology for approval with existing standard bodies, also referred to as "registries". A new methodology can be created through a peer/public review process by a project developer, a credit buyer or registry itself. We note that each registry has their own defined rules and standards. One of the challenges in this part of the process is that a unifying body to harmonize the different rules across methodologies does not exist (Oxford Institute for Energy Studies, 2021).

Typically, carbon offset methodologies consist of two main elements, including:

- **Baseline methodology**: baseline emissions are the reference against which emission reductions are calculated, or in other words, the emissions that would have occurred without any carbon offsets. A baseline methodology is important in calculating the total number of carbon credits that have been created.
- **Monitoring methodology**: in order for the project to collect all information required for monitoring, a methodology that allows for the calculation of the project's emissions reductions or removals is required (Overseas Development Institute, 2021).

2. Project Design Document (PDD) and Project Validation

Once a project is determined to be viable, the next step for the project developer is to create a carbon Project Design Document (PDD) that sets out how a project meets the requirements as defined in the MRV methodology. In essence, the PDD is a business plan that outlines the project mission, the implementation schedule, project boundaries, baselines conditions, processes for data collection data management and quality control, personnel expertise, and estimated emission reductions or removals (Oxford Institute for Energy Studies, 2021). The project developer submits the PDD to a third-party auditor, also called VBBs, for the project validation process. This typically involves five steps as outlined by the Carbon Offset Guide:

- A desk review of the PDD;
- On-site visits and follow-up interviews with project stakeholders;
- A 30-day public comment period after the PDD has been made available via the internet;
- Resolution of outstanding issues; and
- The issuance of the final validation report and written by the VBB.

3. Project financing and registration

The project developer has to identify the source of funds to roll out the project before project implementation. Financing can be sourced from prospective credit offset buyers or the project developer may have enough funds for self-financing. The latter allows for maximum ownership of the credits and the flexibility to implement the project during the best pricing opportunity. Another, and more common approach, is the Emission Reduction Purchase Agreement (ERPA),

which is an agreement between the buyer and seller for future delivery of offset credits, or options (Oxford Institute for Energy Studies, 2021).

According to the Carbon Offset Guide, the vast majority of projects are directly approved by VBBs and do not go through an additional registration process. The Gold Standard, however, upholds an exception to this practice as project approval is also assessed by the Gold Standard Technical Advisory Committee. Standard bodies, or registries, are typically non-profit organizations and by letting an independent third party evaluate the project viability, any incentives for profit-maximization are minimized.

Figure 35: Typical transaction costs with methodologies and project design

Activity	Transaction costs
Feasibility Assessments	$5,000 - 20,000
Preparation of project design document	$25,000 - 40,000
Any necessary communication with local and/or national government	Unknown
Validation, verification and certification costs	$10,000 - 15,000
Executive Board administrative costs and registration fees, if a CDM project *	$10,000

Source: Overseas Development Institute

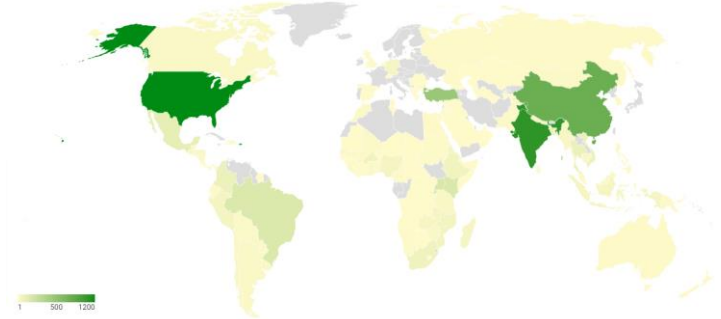
*For the CDM, any new methodology must be approved by the CDM Executive Board under the United Nations.

4. Project implementation and verification

Project implementation can involve a variety of steps. Typically, the project developer has to coordinate technology development, calibrate monitoring systems to make sure the quality assurance and control requirements as part of the defined methodology are met, collect, analyse and report data, and calculate the emission reductions based on comparison of project baseline and project emissions.

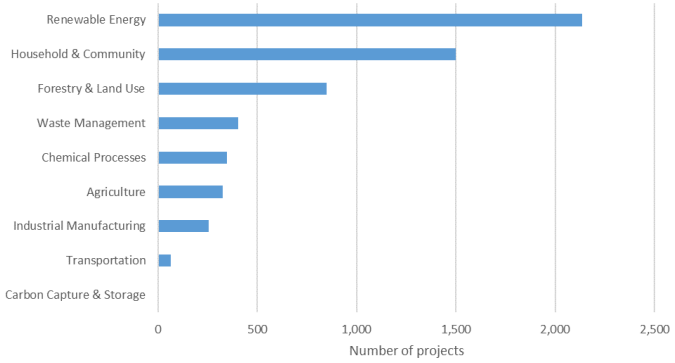
Once a project is implemented, a project developer has to hire an independent third party again. This will normally be the same VBB that assessed the initial project validation. To complete verification, a VBB will conduct audits, in-person site visits as well as an analysis of all project-related data. The VBB then submits a final verification report to the registry to verify that the project meets the requirements as set out in the methodology or protocol. (Oxford Institute for Energy Studies, 2021).

Figure 36: Location of carbon offset projects



Source: Berkeley Carbon Trading Project

Figure 37: Number of carbon offset projects by scope



Source: Berkeley Carbon Trading Project

5. Offset credit issuance and registration

Once the verification process is completed and the verification report is approved, the registry issues the number of carbon credits equal to the verified emission reductions. A credit normally equates one metric tonne of CO_2 sequestered or reduced. The offset credits are then deposited

into the project developer's registry system, which can be publicly accessed online (Oxford Institute for Energy Studies, 2021). According to Verra, the registry system is the cornerstone for the implementation of projects and issuance of credits as it is the central repository for all information and documentation. It facilitates the transparent listing of information on certified projects, issued and retired units, and also enables trading of units.

6. Offset credit transaction and retirement

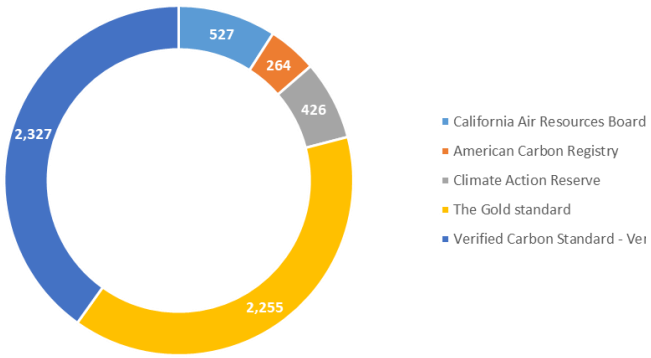
Finally, once the carbon offset credits are issued, they can be purchased by credit buyers. Credits can change ownership multiple times before they retired and are permanently taken out of circulation. Buyers that retire the credits can claim the emission reductions towards their net-zero goal or other sustainability goals.

Figure 38: Examples of carbon offset Standard Bodies

	Carbon offset programs	Description	Headquarters	Established	Geographic coverage	Renewable energy	Forestry	Waste Management	Community Services	CCS/CCU	Agriculture	Energy Efficiency	Fugitive Emissions	Manufacturing	Transport	Fuel Switch	Other Land Use	Industrial Gases	Registered projects to date	Countries with projects to date	Label used for offset credits - *1 unit equals 1 metric tonne of CO2 sequestered or reduced*
1	The Gold Standard	The Gold Standard is a foundation established in 2003 by WWF and other international NGOs that operates an offset standard focusing on environmental and social benefits.	Geneva, Switzerland	2003	International	x	x	x	x		x	x	x						2,255	65	Verified Emission Reductions (VERs), Gold Standard labelled Certified Emissions
2	Verified Carbon Standard (VCS) - Verra (formerly the Voluntary Carbon Standard)	The VCS Program is a widely used voluntary GHG program. Over 1,775 certified VCS projects have collectively reduced or removed more than 865 million tonnes of carbon and other GHG emissions from the atmosphere.	Washington, DC	2005	International	x	x	x			x	x	x	x	x	x		x	2,327	82	Verified Carbon Unit (VCU)
3	Climate Action Reserve	Climate Action Reservse is a registry for the North American carbon market, which establishes high quality standards for carbon offset projects, oversees independent third-party verification bodies, issues carbon credits generated from such projects and tracks the transaction of credits over time in a transparent, publicly-accessible system.	Seattle, WA	2001	United States, Mexico		x	x			x						x	x	426	3	Climate Reserve Tonne (CRT)
4	American Carbon Registry	The American Carbon Registry (ACR), a nonprofit enterprise of Winrock International, was founded in 1996 as the first private voluntary greenhouse gas registry in the world.	Arlington, VA	1996	United States, some international	x	x	x		x	x	x		x	x	x		x	264	10	Emission Reduction Tonne (ERT)
5	Plan Vivo	Plan Vivo is an Offset Project Standard for forestry, agricultural, and other land-use projects with a focus on promoting sustainable development and improving rural livelihoods and ecosystem services.	Edinburgh, UK	1994	International		x				x						x		TBC	TBC	Plan Vivo Certificate (PVC)

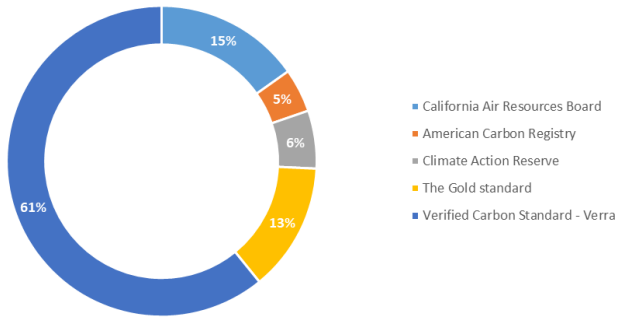
Source: Organisation websites, World Bank, Berkeley Carbon Trading Project

Figure 39: Number of carbon offset projects by registry



Source: Berkeley Carbon Trading Project

Figure 40: Percentage of total credits issued by registry (~1.46 bn in total)



Source: Berkeley Carbon Trading Project

Acquiring carbon offsets

There are several channels to acquire carbon offset credits and the path taken for buyers depend mainly on 1) volume of credits needed and timing of delivery; 2) level of transparency sought on credits purchased; and 3) level of involvement the buyer is willing to put in to influence or control credit quality. In general, the earlier in the lifecycle of the carbon credit, the better the nominal price, terms and quality transparency will be – but the greater the engagement, delivery risk and time it may take to actually receive offset credits.

Currently, the vast majority of market transactions occur after credits have already been verified by an independent third party. Once the associated carbon offset credits are deposited into a project developer's account on one of the registries, the project developers can hold the credits, issue the credits directly to brokers or end-buyers, or list the credits on an exchange. In addition to retiring the credits, offset credit buyers have the same options (e.g., hold, sell/transfer, or list on exchange), which means offset credits may change hands multiple times (getting transferred among various registry accounts) before they are ultimately retired and used.

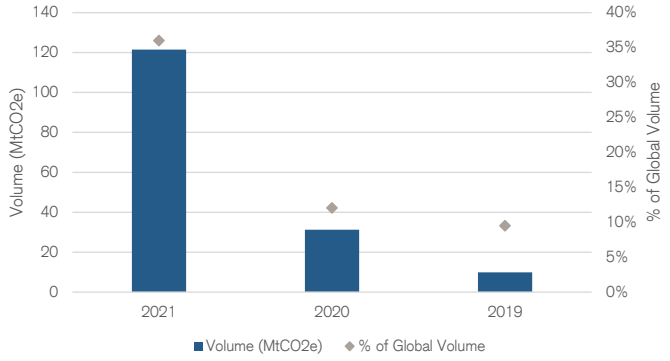
- **Over-the-counter (OTC):** Offset credit buyers work/contract directly with project developers, which can occur at various stages of the offset's lifecycle. This enables buyers to not only save on transaction fees, but also to have deeper engagement and input with a project. However, it can be a complex and time-intensive process and thus is generally a more preferred method for experienced buyers.
- **Brokers:** Offset credit buyers work/contract with a third party (known as a broker) to help them choose and contract offsets. Brokers procure offset credits and then can transfer them to a buyer or retire them on a buyers' behalf. From a buyers' perspective, the main advantage is reduced complexity, as brokers make it easier to identify offset credits based on certain criteria (e.g., sector, region, price, etc.). However, the additional commission fee for this service makes using a broker more expensive than OTC. In addition to projects developed by others, some brokers also sell offset credits from projects they have directly invested in. This practice may provide increased transparency in pricing, but it can affect the ability of the broker to be impartial about the credits they sell.
- **Exchanges:** Developers and brokers list their offset credits on an exchange for anyone to purchase. There are a number of environmental commodity exchanges emerging – mostly in North America and Europe – that list carbon offset credits for sale and work with registries to enable transfers. While purchasing offset credits on an exchange is perhaps the quickest and easiest method, there is an added commission charge and, perhaps more notably, it can be harder to obtain the information needed to evaluate the quality of credits. That said, the largest exchanges – such as New York-based Xpansiv (CBL) and

Singapore-based AirCarbon Exchange (ACX) – are creating standardized products to improve on this issue and drive more trading of offset credits. This has been a key driver of the voluntary carbon market's recent growth (more detail below).

For perspective, Xpansiv is the world's largest voluntary carbon offset exchange, with more than 120 million tonnes of carbon traded on its platform last year. This equated to a fourfold increase over 2020 and global market share of ~35-40% based on Ecosystem's volume and notional value figures.

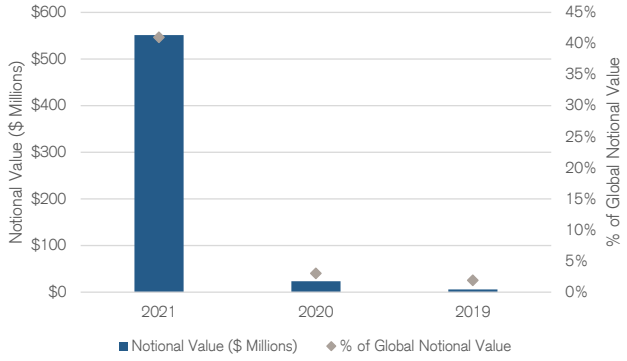
A carbon offset's life comes to an end once an end-buyer (typically a company) decides to "retire" it towards an emissions reduction or sustainability target, which means it cannot be traded again and is removed from circulation. Each registry has slightly different processes for retiring offsets, and only companies with an account for that registry can retire them. The agreement on Article 6 at COP26 last November will make it possible for countries to purchase voluntary carbon credits towards their NDCs, as long as Article 6 rules are applied.

Figure 41: Xpansiv exchange's voluntary carbon market trading volume and global share (2019-21)



Source: Xpansiv, Ecosystem Marketplace

Figure 42: Xpansiv exchange's voluntary carbon market trading notional value and global share (2019-21)



Source: Xpansiv, Ecosystem Marketplace

Figure 43: Summary of various contracting methods for carbon offsets

Purchase Counterparties	Key Market Participants	Description	Ease of Transaction	Transparency / Quality Control
Direct Investment	Microsoft, Stripe among select corporates	Invest in an offset project in return for rights to (some portion of) the carbon offset credits the project is able to generate	Resource intensive Less contract flexibility Long lead time Difficult to scale Project execution risk Higher transaction costs	Deep engagement Assurance on credit quality Access to credits "at cost"
Project Developer	South Pole, Natural Conservancy, ClimeCo, Blue Source, 3Degrees, among hundreds	Contract directly with a project developer for delivery of carbon offset credits as they are issued (Emission Reduction Purchase Agreements) or purchase unsold/remaining offset credits directly from project developer		
Broker	Project developers are often brokers as well	Work/contract with a third party (broker) to help choose and contract offsets; brokers procure offset credits and then can transfer them to a buyer or retire them on a buyers' behalf		
Exchange	Xpansiv CBL, Carbon Trade Exchange, AirCarbon Exchange	Developers and brokers list their offset credits on an exchange for anyone to purchase	Quick and easy Access to large volumes No long term contracts Wide range of choices Lower transaction costs	Difficult to assess credit quality No project level transparency on standardized spot contracts based on pre-selected carbon offset standards

Source: Carbon Offset Guide, Credit Suisse Research

Market developments

To accelerate growth of voluntary carbon markets, there are ongoing efforts to standardize carbon offset credits to enable their trading similar to conventional commodity markets. Such standardized products aim to unify credits with similar characteristics, such as the type of underlying project, a fairly recent vintage, a certification from a particular group of verifying standards, etc., which enables market participants to buy carbon offsets without having to evaluate the vast universe of listed projects. Some also believe this process enhances price transparency as these products can be viewed as global benchmarks, similar to how normal commodity markets function (e.g., Brent crude oil benchmark), which in turn should help sellers decide how much to charge for offsets and buyers better evaluate potential purchases.

However, many climate groups believe that standardization of credits that are highly differentiated (and potentially questionable) in their climate benefitting attributes could instead weaken the overall market integrity. Such discrepancy has been recognized by the Taskforce on Scaling Voluntary Carbon Markets initiative, which has since re-focused its efforts to ensuring credit quality rather than scaling markets.

Still, standardization efforts are becoming more prevalent in today's markets. A key development in the growth (and evolution) of the market was the uptake of Xpansiv's suite of three standardized spot contracts for voluntary carbon markets:

- **Global Emissions Offset (GEO).** The first of standardized contracts (launched in late 2020), GEO is underpinned by a subset of offsets that meet the eligibility criteria defined by CORSIA, which is a carbon market designed by the International Civil Aviation Organization specifically to reduce emissions from the international aviation sector. GEO includes 3 of the 8 registries qualified under CORSIA and also just on tech-based (aka non-nature based solutions) projects.
- **Nature-Based Global Emissions Offset (N-GEO).** Subsequent to GEO contracts, Xpansiv launched the N-GEO spot contract in March 2021, which is based on nature-based solution projects with additional Climate, Community, and Biodiversity (CCB) accreditation ("co-benefits") from Verra's registry.
- **Core Global Emissions Offset (C-GEO).** Earlier this year, Xpansiv launched its latest spot contract, which is based on projects aligned with the previously mentioned Core Carbon Principles (CCP). The CCPs are an emerging set of "high quality" standards that is *expected* to be released in 3Q22. We certainly question the integrity of this particular contract given it's trading in advance of the release of the actual standards. More notably, this supposedly more stringent criteria include more credit supply today than either of the prior two contracts.

Beyond the *spot* market, carbon offset *futures* are also rapidly emerging. In the last year, CME Group launched futures contracts backed by Xpansiv's aforementioned three spot contracts (GEO, N-GEO, and C-GEO). In November, the Intercontinental Exchange (ICE) announced plans to launch a nature-based solutions carbon offset futures contract that is certified under Verra's Verified Carbon Standard and CCB Standards programs (similar to CME's N-GEO).

Figure 44: Summary of carbon offset related standardized products

CBL Standardized Product	Global Emissions Offset (GEO)	Nature-Based Global Emissions Offset (N-GEO)	Core Global Emissions Offset (C-GEO)
Launch Date	10/5/2020	3/11/2021	1/5/2022
Type of Projects*	Tech-based (non-AFOLU)	Nature-based (AFOLU)	Tech-based (non-AFOLU, large hydro excluded w/ exception of Run-of-River hydro)
Framework Alignment	ICAO's CORSIA	Verra's VCS w/ CCB co-benefits	TSVCM's Core Carbon Principles (CCPs)
Offset Registries	3 (Verra, ACR, CAR)	1 (Verra)	1 (Verra)
Offset Vintage Years (as of Q1 2022)	2016-2020 (5 years)	2016-2020 (5 years)	2016-2021 (6 years)
Underlying Supply	~40 million credits	~70 million credits	~100 million credits
Futures Offerings	CME	CME, ICE (pending)	CME

Source: CME Group, Credit Suisse Research *AFOLU stands for Agriculture, Forestry and Other Land Use

Companies Mentioned *(Price as of 16-May-2022)*
Airbus Group (EADSF.PK, $62.35)
Alphabet (GOOGL.OQ, $2288.9)
BHP Group Limited (BHPB.L, 2577.0p)
BHP Group Limited (BHP.AX, A$45.31)
BMW (BMWG.DE, €77.66)
BNP Paribas (BNPP.PA, €52.31)
BP (BP.L, 418.35p)
Base Carbon (BCBN.NLB, C$0.495)
Boeing (BA.BA, A$4370.5)
CME Group (CME.OQ, $196.17)
Chevron Corporation (CVX.N, $173.01)
Corteva, Inc. (CTVA.N, $56.54)
Delta Air Lines, Inc. (DAL.N, $38.17)
General Electric (GE.N, $74.63)
Kering (PRTP.PA, €460.75)
Meta Platforms, Inc. (FB.OQ, $200.04)
NatWest Group (NWG.L, 210.1p)
National Australia Bank (NAB.AX, A$31.32)
Netflix Inc. (NFLX.OQ, $186.51)
Occidental Petroleum Corporation (OXY.N, $67.72)
Procter & Gamble (PG.N, $155.12)
Shell (SHEL.L, 2337.5p)
Shopify Inc. (SHOP.N, $359.95)
Sime Darby Plantation Bhd (SIPL.KL, RM5.12)
Standard Char (SCB.GH, GH¢20.3)
Telstra Corporation (TLS.AX, A$3.93)
UBS Group AG (UBSG.S, SFr17.03)
UPM-Kymmene (UPM.HE, €31.9)
Unibanco (UBBR11.SA^C09)
Unibanco (UBBR11.SA^C09)
Unibanco (UBBR11.SA^C09)
Unibanco (UBBR11.SA^C09)
Volkswagen (VOWG_p.DE, €144.74)
Walmart Inc. (WMT.N, $148.21)
easyJet (EZJ.L, 499.6p)

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