Deep Dive on Carbon Offsets

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Carbon offset credits, which are transferable instruments that represent an emissions reduction of 1 tonne of CO2 equivalent, offer a convenient and cost-effective way to reduce greenhouse gas ("GHG") emissions, or in some cases, achieve carbon neutrality. Since it is not possible for most organisations to eliminate all GHG emissions associated with their activities and products, carbon neutrality is typically premised on the idea of using external GHG reductions to balance emissions that cannot readily be eliminated. Carbon offset credits are the primary tool for achieving such reductions. In 2020, companies purchased more than 93 million carbon offset credits, equivalent to the pollution from 20 million cars in a year. That's a 33% increase over 2019, according to BloombergNEF, with the market poised to grow sharply as net-zero commitments accelerate. The first two sections of this paper outline basic definitions, and how the offset market operates and functions.

Despite their rising popularity and associated increase in demand offsets also face criticism, on one hand that they create perverse incentives (by allowing companies to rely on offsets instead of making structural changes to the way they do business or investing in changes to reduce their footprint), and on the other that some credits are not valid CO2 reductions at all. The final section of this paper addresses the five key criteria required for an offset to be considered high quality. While these criteria make sense in principle, implementation in practice is challenging, as illustrated by the case study on The Nature Conservancy included at the end of the paper.

Finally, it is important to mention that overly relying on using carbon offset credits to reach net-zero would be a mistake. Collectively, all CO2 emissions from burning fossil fuels must cease altogether well before the end of the century if we are to meet global climate goals. Therefore, in future, there will be little room for anyone to "net out" their emissions using someone else's GHG reductions. Thus, although the idea of achieving zero net emissions is compelling and necessary, the focus should be on reducing GHG emissions directly in line with global mitigation goals with credits being used once these efforts are exhausted.

Offsets Basics

— The terms carbon offset and carbon offset credit are used interchangeably although they mean different things.

- A carbon offset refers to a reduction in greenhouse gas (GHG) emissions – or an increase in carbon storage (e.g., through land restoration or the planting of trees) – that is used to compensate for emissions that occur elsewhere.

- A carbon offset credit is a transferable instrument certified by governments or independent certification bodies to represent an **emission reduction of one metric tonne of CO2, or an equivalent amount of other GHGs.**

— The purchaser of an offset credit can "retire" it to claim the underlying reduction towards their own GHG reduction goals.

— Carbon offset credits can be produced by a variety of activities (termed "projects") that reduce GHG emissions or increase carbon sequestration. Examples include:

- Avoided deforestation (which avoids release of CO_2 stored in trees and will lead to more CO_2 absorption as trees grow)
- Capture and destruction of potent GHGs before they are released into atmosphere
- Renewable energy development

— Offset projects often produce additional environmental and social benefits beyond just GHG reduction, such as job creation, enhanced air or water quality, improved energy access, biodiversity conservation.

— In 2020, companies purchased more than 93 million carbon offset credits, equivalent to the pollution from 20 million cars in a year. That's a 33% increase over 2019, according to BloombergNEF. The market is poised to grow sharply in the coming years as heavy emitters such as Royal Dutch Shell, Delta Airlines and JetBlue Airways have vowed to negate pollution by acquiring more carbon offsets.

Offsets in Practice

— There are two types of markets for carbon offset credits, **compliance** and **voluntary**.

- In the compliance market (e.g. EU Emissions Trading Scheme) companies, governments, or other entities buy credits in order to comply with mandatory caps on the total amount of carbon dioxide they are allowed to emit
- Voluntary market demand comes from individuals, companies and organisations seeking to meet net-zero goals
- Compliance offset market credits may in some instances be purchased by voluntary, non-regulated entities, but voluntary offset market credits, unless explicitly accepted into the compliance regime, are not allowed to fulfil compliance market demand

— Projects can be aggregated together under a coordinated effort, which results in "**programs**". Programs serve 3 functions: 1) set standards of criteria for the quality of credits, 2) review projects against these standards, 3) operate registry systems to issue, transfer and retire credits.

— Programs range from international or governmental regulatory bodies (e.g. California Compliance Offset Program) to independent NGOs (e.g. The Verified Carbon Standard). Historically, governmental bodies certified offset credits for regulatory purposes (compliance programs), while NGOs primarily served voluntary buyers (voluntary programs).

— There are some trading exchanges for offset credit transactions, however most occur off-exchange, making price discovery difficult. The price of a voluntary offset credit can range from under US$1 to well over US$35. Prices tend to vary mostly by project type, generally with small differences between offset credit labels.

— The lifecycle of carbon offset credits follows these basic steps, with buyers potentially being involved at all stages:

1. **Methodology development**, specific to the type of offset project generating the reductions. Most programs have a library of approved methodologies covering wide range of project types.
2. **Project development, validation, registration:** projects are designed by developers, financed by investors, validated by independent a verifier and registered with a carbon offset program. Official "registration" indicates that the project has been approved by the program and is eligible to start generating carbon offset credits after it begins operation. Some offset credit buyers invest in a project in return for a portion of the credits the project generates in future. An alternative way of buyers getting involved at this stage is through an "Emission Reduction Purchase Agreements" (ERPAs), essentially an offtake agreement that provides security of buyers for the developer, and allows buyers to lock in a price that is typically lower than market prices.

3. **Project implementation, verification, and offset credit issuance:** once up and running, the project is periodically verified to determine the quantity of emission reductions it has generated. A carbon offset program approves verification reports, and then issues a number of carbon offset credits equal to the quantity of verified CO2-equivalent GHG reductions.

4. **Offset credit transfer:** after they are issued, carbon offset credits can be transferred into different accounts in an offset program's registry, usually when a buyer purchases these credits. Buyers can use credits by retiring them (next step), holding them, or selling them on. As with other commodities, numerous firms act as brokers for carbon offset credits. Another option is to purchase offset credits on an exchange. There are a number of environmental commodity exchanges – mostly in North America and Europe – that list carbon offset credits for sale and work with registries to enable transfers.

5. **Credit retirement:** offset credit holders must "retire" carbon offset credits in order to use them and claim their credits associated GHG reductions towards a GHG reduction goal. Retirement occurs according to a process specified by each carbon offset program's registry. Once an offset credit is retired, it cannot be transferred or used (meaning it is effectively taken out of circulation). For buyers looking to acquire only a small number of offset credits (such as small companies or individuals), the most feasible option is to go through a retailer, who provides access to wide range of projects, maintains accounts with program registries, and can retire credits on buyer's behalf.

Quality of Offsets

— Common criticisms of carbon offsets fall into two categories.

- How credits are used: these kinds of criticisms are not so much about whether carbon offsets are a valid form of climate change mitigation, but rather whether they create "perverse" incentives, i.e., organisations use credits to achieve all or most of their GHG reduction goal, rather than investing in structural solutions to reduce their carbon footprint.

- Quality of credits: these criticisms are probably the most immediate concern for most offset credit buyers. Studies have identified serious problems with some carbon offset credits. For example, studies of the world's two largest offset programs – the Clean Development Mechanism (CDM) and Joint Implementation (JI), both administered by the United Nations under the Kyoto Protocol – suggest that up to 60-70% of their offset credits may not represent valid GHG reductions. Other critiques have highlighted instances of carbon offset projects that harmed local communities or resulted in broader environmental damage.

— What makes a high-quality carbon offset? At a high level, the world must be at least as well off when you use a carbon offset credit as it would have been if you had reduced your own carbon footprint. When people talk about the "quality" of a carbon offset credit, they are referring to the level of confidence one can have that the use of the credit will fulfil this basic principle. However, the challenge is that quality is not black and white, and critical criteria like "additionality" are more about confidence that absolute truth.

— Quality can be distilled into five main criteria. Quality offsets should be associated with carbon reductions or removals that are:

- **Additional:** GHG reductions are additional if they would not have occurred in the absence of a market for offset credits. **If GHG reductions are not additional, then purchasing offset credits in lieu of reducing your own emissions will**

effectively make climate change worse. Evaluating additionality is difficult, because GHG-reducing activities occur all the time. Sometimes this is because the activities are required by law (e.g. landfill operators in California must use equipment to capture methane) or because investments to reduce emissions are simply profitable (e.g. renewable energy technologies, like wind and solar, are increasingly cost competitive with fossil fuels, without revenue from carbon offset sales).

- **Not overestimated:** overestimation can occur in several ways.
  - Overestimation of baseline emissions (i.e. the emissions that would have occurred in the absence of demand for offset credits). Sometimes this can be simple, e.g. methane released by a landfill site, but other times more complex, e.g. GHG emissions displaced by solar power project replacing non-renewable sources.
  - A project's GHG reductions are quantified by comparing the actual emissions that occur after the project is implemented to its predicted baseline emissions. Underestimating the former would also lead to overestimation in GHG reductions.
  - Failing to account for the indirect effects of a project on GHG emissions (i.e. "leakage"). The classic example is a forest preservation project that avoids the emissions caused by clearing one parcel of forest, but ends up shifting the production of timber through deforestation to other areas.

It is important to note that developers have an incentive to report data that maximises the number of credits they can sell. Verification helps assure reporting data is accurate and not overstated. Also offset programs often limit the crediting periods during which projects can generate creditable GHG reductions. Crediting periods are typically from 7 to 10 years, which is often shorter than the operational lifetime of a project's equipment.

- **Permanent:** clearly if a GHG reduction or removal is "reversed" (i.e., GHGs are subsequently emitted so that no net reduction occurs), then it no longer serves a compensatory function. The classic example is a forestry project that is eventually cut down in future if no longer protected, or if a fire later burns down the project's trees. In reality, "permanent" does not mean forever. In the world of offsets, a standard convention is that carbon needs to be kept out of the atmosphere for 100 years to be considered "permanent". The most common mitigant of this risk is the establishment of "buffer reserves", which are credits from projects being set aside as an insurance mechanism. If reversal occurs, these credits are retired or cancelled to compensate. The amount of buffer required will be based on risk of reversal occurring.
- **Not claimed by another entity:** double-counting can happen in three ways.
  - Double issuance: a program mistakenly issuing two credits to same project for 1T of CO2 (less likely), a program mistakenly issuing credits to two projects that each claims same reduction (also increasingly less likely), or two programs issuing credits for overlapping claims (perhaps greatest risk).
  - Double use: most likely way for this to occur is if a seller represents to multiple buyers that a credit was retired on their behalf.
  - Double claiming: double claiming would occur if an energy efficiency project obtains offset credits for reducing emissions at a power plant covered by an emission reduction target. In this case, both the project and the power plant would claim the same reduction; the project through offset credits, and the power plant through a reduction of emissions relative to its target.
- **Not associated with significant social or environmental harms:** project should demonstrate it complies with all legal requirements in the jurisdiction where it is located. Depending on the type of project and the jurisdiction where it is located, however,

additional reviews and safeguards may be necessary to guard against negative outcomes unrelated to GHG emissions.

Types of Offset Projects

The market for valid carbon offset project types has grown significantly in recent years in line with rising demand. New project types have emerged recently through innovation, while others (such as renewable energy) have declined as they no longer meet the additionality criteria required of high quality offset projects.

— **Forestry:** relies on the simple conversion of CO_2 into wood and fruit through photosynthesis. Within forestry, there are four primary categories: reforestation which restocks existing forests that have been depleted, afforestation which is process of creating new forests in areas that have not been forested previously, agroforestry which intentionally integrated trees into agricultural areas, and improved forest management which tries to increase carbon stored in forests through techniques such as increasing average age of trees.

— **Soil sequestration:** through photosynthesis, plants assimilate carbon, which is then consumed by animals or added to the soil as residue when plants die and decompose. The long-term conversion of grassland and forestland to cropland and grazing lands has resulted in historic losses of soil carbon sequestration. However, there is significant potential for reversing this trend through restoration of degraded soils and widespread adoption of regenerative soil conservation practices, which can also help improve water quality and increase crop yield.

— **Renewable energy:** these offsets support the production of renewable energy and reduce demand for non-renewable energy sources. However as renewable energy technologies have become increasingly cost competitive in recent years, these offsets have come under scrutiny for their additionality given these projects likely would have occurred anyway (just makes financial sense).

— **Waste to energy**: mainly supporting projects that capture methane produced by landfills and animal waste, which can then be converted to electricity. There are similar concerns about additionality here, as regulations increasingly require methane capture.

— **Direct air capture:** process of filtering air, chemically capturing CO_2 and storing this CO_2 deep underground permanently. As today's methods are highly energy intensive, this technique relies on being supplied by renewable energy for it to actually be net negative.

— **Community projects:** these projects often help to introduce energy-efficient methods or technology to undeveloped communities around the world. Examples include providing clean water to communities (so they stop burning firewood to boil water) and distributing cooking stoves that replace traditional cooking methods like burning wood and charcoal for cooking.

— **Biochar:** this refers to the process of heating agricultural and forestry waste in the absence of oxygen, which produces biochar, a stable solid rich in carbon. This can then be returned to soil as an additive that can help to reduce reliance on fertilizers, while helping to bind and retain water and nutrients. According to some projects, one ton of biochar removes c. 3 tonnes of CO_2.

Case Study: Challenge of Additionality

It was recently reported that The Nature Conservancy, one of the top sellers of offset credits derived through forest conservation in the US, is reviewing its internal policies after a Bloomberg investigation revealed the group was taking credit for preserving trees in no danger of destruction. For forest offsets, the difference between the existing trees and the theoretical trees in the baseline scenario determines the amount of carbon credits that get to be sold. However lax rules have allowed developed to make unrealistic claims about the numbers of trees that might be cut down if not conserved (the baseline scenario), therefore increasing the difference and in turn, the number of offsets that can be sold. This is a good example of how challenging it can be to determine additionality.

Developers argue that in the absence of converting to an offset project and selling credits, while unlikely, it is theoretically possible that the land changes hands (owner faces financial difficulty for example) and the new owner may clear the forest. But preventing unlikely clearing that might happen only decades from now is a small climate benefit compared to the grandiose claims being sold. Companies are buying the right to claim they've reduced hundreds of thousands of tons of emissions today.

Case Study: Microsoft

Microsoft made headlines in January 2020 following its commitment to achieving net-zero by 2030 and by going one step further in announcing that by 2050 it intends to remove from the environment all the carbon the company has emitted either directly or by electrical consumption since it was founded in 1975. To achieve the latter goal, the company expects to employ a portfolio of negative emission technologies (NET) likely including afforestation and reforestation, soil carbon sequestration, bioenergy with carbon capture and storage (BECCs), and direct air capture (DAC). To further these efforts, the company has launched a new Climate Innovation Fund, which will invest $1B over the next four years in new technology development. Given the current state of technology however, it has initially focused on nature-based solutions, announcing in January 2021 that it has purchased the removal of 1.3 million metric tons of carbon from 15 suppliers across 26 projects around the world. 99% of these offsets represent nature-based solutions (mainly forestry, some soil), with less than 0.5% in engineering-based solutions. The full portfolio of offsets is available here.

Conclusion

Many governments, corporates and private organisations have set carbon neutral goals and net zero commitments. Investing in carbon offsets is often a necessary step to achieving these goals and commitments in the short-term as they fund vital activities and direct capital to critical projects. However, carbon offsets should not be deemed as a license to continue practices that are harmful to the environment. The journey to net zero is not without its challenges and this space will continue to evolve as additional participants, including regulators, step in.

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