

Explainer · February 2025

Carbon offsets primer

This primer highlights that carbon offsets don't reduce emissions in principle and haven't provided climate benefits in practice. Other approaches to channelling climate finance can be implemented in their place.

Key points:

- Carbon offsetting refers to the use of a carbon credit – equivalent to one tonne of CO₂ or equivalent gases avoided, reduced or removed – by a country, company or individual to “cancel out” their emissions elsewhere.
- As offsets don't cause a net reduction in emissions, their use is not aligned with limiting warming to 1.5°C or 2°C and instead further delays emission cuts.
- Instead of providing an economically efficient way to spur mitigation, academic and investigative reports have shown that projects used for carbon offsetting have not delivered emissions reductions, causing emissions to increase overall.
- This is because most carbon offsets come from projects that aim to reduce or avoid emissions compared to if no project was put in place – which is very difficult to prove. Projects often overstate the quantity of offsets and there are risks that emission reductions are reversed or leak to other areas.
- Emissions avoidance and reduction offsets have no place in ambitious climate policies.
- In addition, carbon offset projects have often been linked to fraud and human rights abuse. Companies' use of carbon offsets carries reputational and litigation risks.
- While carbon offset schemes have often been promoted as a means to channel climate finance to developing countries and nations with large forested areas, there are viable alternatives. For example, companies can make climate contributions without claiming credits and revenue from taxes on wealth and fossil fuels could be directed towards climate action.
- On top of rapid and sustained mitigation efforts, the IPCC outlines a theoretical need for durable carbon removals to offset a very small amount of residual emissions and to balance out historical emissions after we reach net zero if we are to achieve climate targets. However, carbon removal faces various feasibility challenges and relying on its future use at scale is extremely risky and uncertain.
- Mitigation should always be the first priority. There are a broad range of cost-effective options for reducing emissions that have more potential once fully utilised.

What are carbon offsets?

Offsetting refers to the use of a credit – [equivalent to one tonne of CO₂ or equivalent gases avoided, reduced or removed](#) – by a country, company or individual to “cancel out” their emissions elsewhere. Once credits are used to counterbalance emissions they are retired and cannot be used again.

Carbon credits can be traded on two types of carbon markets: compliance and voluntary.

- **Compliance markets** are regulated by governments and involve emissions reductions that are mandated by law. Examples include cap-and-trade or emissions trading schemes (ETS), such as the EU ETS. Some of these compliance schemes [allow restricted use of offsets](#) to meet emissions reduction obligations.
- **The voluntary carbon market (VCM)** is largely unregulated and enables companies or individuals to use offsets to make emissions cuts where there is no legal obligation to do so. In 2023, the voluntary carbon market was reported to have a [transaction volume equivalent to trading 110.8 million tonnes of CO2 equivalent \(CO2e\)](#), worth USD 723 million.

As of the end of 2024, the majority of carbon credits issued were for [forestry and land use projects \(34.6%\)](#) and [renewable energy projects \(31.8%\)](#), followed by household and community projects, such as clean cookstove projects (12.4%).

A brief history of carbon offsetting

Carbon offsetting was first developed as a purely “[philanthropic exercise](#)”, according to Dr Mark Trexler, who the World Resources Institute hired to oversee the first land-based carbon offset scheme in 1988. “[No one ever thought that carbon offsets were going to save the world](#)”, Trexler told Carbon Brief in 2023.

Carbon offsetting was then introduced for use by countries under the Kyoto Protocol, to give them flexibility in meeting their binding emission reduction targets. Emissions could be traded under three mechanisms: [International Emissions Trading, the Clean Development Mechanism \(CDM\) and Joint Implementation](#).

In 2012, the Kyoto Protocol and associated carbon trading [started to fall apart](#), after which carbon offsets moved over to the largely unregulated VCM. Since then, a number of countries and regions have set out their own mechanisms for carbon trading and offsets.

The use of carbon offsetting is allowed under [Article 6 of the Paris Agreement](#), which relates to carbon trading. Countries are able to trade carbon credits bilaterally (Article 6.2) or via a new international carbon trading platform (Article 6.4). However, as there are [minimal transparency requirements and no real repercussions](#) for countries if they fail to abide by the rules, there is a risk Article 6 will result in the trading of low integrity credits and contribute to increased emissions.

The rationale behind offsetting does not align with the science

In theory, carbon offset schemes are assumed to be economically efficient, as they [enable emissions reductions to occur where they are cheapest](#).

For example, countries or companies struggling to meet their climate goals can pay for emissions reductions elsewhere where it is cheaper to do so. This could also channel financing for mitigation towards developing countries, where much of the ‘[low-hanging fruit](#)’ is located.

This means offsetting is [at best a zero-sum game](#) and by design does not reduce emissions. Done properly, offsets merely compensate for emissions growth in one setting by reducing emissions elsewhere. But research has shown that many offsets have not been carried out properly.

When a project used to offset emissions elsewhere lacks environmental integrity (i.e. does not represent real emission reductions), it leads to an [overall increase](#) in emissions. Indeed, assessments of past carbon offset projects over decades have shown that [many projects have failed to deliver the emissions reductions](#) they promised.

Offsetting is not a valid solution as countries and companies need to achieve [deep emission reductions now](#). Keeping warming to 1.5°C requires [achieving net zero emissions by 2050](#), meaning CO2 emissions must [fall steeply from the 41.6 billion tonnes](#) estimated in 2024.

The use of carbon credits not only delays emission cuts, but can cause continued investment into non-1.5°C aligned technologies and business models, which could [lock in those practices for decades](#). The UK Climate Change Committee, which advises the UK on climate change policy, writes that the purchase of offsets to enable the use of high-emitting technology “[would in the long run lead to higher emissions than if funds used for 'offsetting' were used to invest in low-carbon technology.](#)”

Current reliance on offsets has increased emissions

A systematic review of carbon offset projects comprising a fifth of all carbon offsets issued to date, published in November 2024, estimates that “[that less than 16% of the carbon credits issued to the investigated projects constitute real emission reductions.](#)” The remaining 84% did not constitute real emissions reductions – thereby instead resulting in the release of 812 million tonnes of emissions, equivalent to “[more than annual German CO2 emissions](#)”.

Another investigation conducted by The Guardian and Corporate Accountability in 2023 found that 39 of the 50 offset projects that have sold the most credits [likely did not result in the emissions reductions they claimed](#), and the others were either problematic or could not be assessed due to lack of information.

In addition, a 2024 assessment of over 4,000 carbon credit projects conducted by US investment company MSCI rated [47% as low-integrity](#), meaning they did not meet most environmental and social criteria.

Offsets used under compliance mechanisms have shown similar results. A 2015 study by the Stockholm Environment Institute on the environmental integrity of offsets issued under the Kyoto Protocol’s Joint Implementation mechanism suggests that they enabled global GHG emissions to be about [600 million tonnes CO2e higher](#) than they would have been if countries had met their emissions targets domestically.

Similarly, a 2016 study found that 73% of the potential supply of 2013–2020 credits used under the Clean Development Mechanism (CDM) offered [a low likelihood that emission reductions are additional and not overestimated](#). A separate assessment of clean cookstove projects under the CDM, which replaced traditional stoves with more efficient ones, suggests that these may “[fail to realize expected carbon reductions or anticipated health and climate cobenefits](#)”.

Government offset schemes have also shown limited emissions reductions. For example, a review of 182 projects focused on native forest regeneration, from which the Australian government has purchased USD 204 million worth of credits, [were found to have negligible impact](#).

Few offsets are truly additional

Almost all carbon credits issued to date have been for the [avoidance or reduction of carbon emissions](#). Only around 3% of credits in the VCM in 2023 were for the [removal of carbon emissions](#). The additionality of emissions avoidance or reduction projects is difficult to verify as it requires the development of counterfactual scenarios to demonstrate that emissions reductions only took [place due to the incentive from the carbon credit revenue generated](#).

Research has shown that it is likely that many projects would have occurred without carbon credit revenue. For example, given that renewable energy technologies are now cheaper than fossil fuels in most countries, [hundreds of millions of tonnes of credits from renewable energy projects that are currently traded are likely not additional](#). A review of 1,350 wind farms across India found [52% of these projects would have been built without additional income from CDM credits](#), misallocating scarce resources and likely leading to increased global emissions.

Renewable energy projects are now so unlikely to be additional that many of the largest VCM registries, like Verra and Gold Standard, [no longer allow these projects](#). However, it is still possible to purchase renewable energy credits: A Bloomberg report found that in 2021 [“one third of the carbon offsets purchased from the 100 highest-selling projects were tied to renewable energy”](#).

As of February 2025, all [grid-connected renewable energy](#) project methodologies assessed by the carbon offset governance body, the Integrity Council for the Voluntary Carbon Market (ICVCM), had their applications for [the Core Carbon Principles label](#) rejected because they lacked additionality.

Offset quantities are frequently overestimated

Similarly, projects that issue credits based on reducing or avoiding deforestation or forest degradation are challenging to verify, as these require demonstrating that existing forests would have been cut down or degraded at higher rates if the project was not funded. Forestry offset credits have been continuously exposed for [fraudulent business practices](#), such as inflating the baseline rates of how much deforestation would have occurred in the absence of the project to generate more credits, [taking credit for trees that were already planted](#) and selling offsets for preserving forests that were [not in danger](#) of being harvested.

One of the world’s leading carbon credit certifiers, Verra, [overstated the threat of deforestation by 400% on average](#), according to one analysis. As a result, more than 90% of its carbon forest offsets [“do not represent genuine carbon reductions”](#). A 2023 investigation into an avoided deforestation project in Zimbabwe that generated 42 million carbon credits [found that only 15 million of these generated a legitimate avoided emission](#) due to inflated baselines. EU countries have also been exposed for [overstating logging targets](#) in order to pocket additional carbon credits, worth 120 million tonnes of CO₂e.

Academic papers highlight that emissions reduction efforts from [deforestation and forest degradation \(REDD\) projects](#) and [California’s forest offset programmes](#) have not reduced

deforestation. A review into a type of credit called Improved Forest Management offsets, which have produced 11% of all voluntary offsets to date, found that issuance of these credits [deviates from scientific understanding and risks significantly overestimating the amount of carbon removed](#).

Nature-based offsets pose risk of reversal and leakage

Another key issue for nature-based offsets lies in the foundational – and incorrect – assumption of offsetting: that all emissions are equivalent and fungible – meaning they are mutually interchangeable. However, releasing a tonne of carbon from fossil fuels cannot be exactly offset by taking up one tonne of carbon by planting a forest. The carbon released from fossil fuels was stored for millions of years under the earth in a stable form – while the carbon taken up in the forest will – at best – be stored for decades, until the trees begin to degrade. So while storing carbon in nature could help to delay warming in the near term, nature-based carbon credits [should not be treated as equivalent to fossil fuel emissions](#).

Some types of carbon credits, particularly those that are nature-based, also lack permanence. They risk the premature release of carbon back into the atmosphere due to natural or human-caused events, for example via wildfires or clearing of forests. A report on avoided deforestation projects in Cambodia used satellite imagery to show that four years later, [half of these areas had been cleared](#). In 2021, the Los Angeles Times reported that a forest carbon offset project in California continued to sell credits [even after many trees burnt down in wildfires](#).

Additionally, offset projects that aim to reduce or avoid emissions in one area may instead simply cause emissions to increase or ‘leak’ to another area to compensate. A 2023 review of nature-based offsets shows that “[leakage is vastly underestimated](#) in practice and argu[es] that current efforts to improve accounting methods are unlikely to deliver the accuracy required.”

Poor quality credits are oversupplied

So many credits with a low likelihood of achieving actual emissions reductions have been issued that there is an oversupply in the market. According to the Berkley Carbon Trading Project, there is currently a surplus of [829 million credits on the VCM, just counting those from the four top carbon registries](#). As a result of being oversupplied, credits are priced far too low to reflect the true cost of carbon,¹ which means it is much cheaper for companies and countries to purchase ‘junk’ credits than to reduce their emissions.

For example, the 20 companies retiring the most offsets from the VCM over 2020–2023 predominantly sourced low-quality, cheap offsets, [87% of which “carry a high risk of not providing real and additional emissions reductions”](#), according to researchers analysing VCM activity. Most of these offsets came from forest conservation and renewable energy projects. Purchasers come from a range of sectors, including automotive, aviation, oil and gas, consumer goods, and transport and logistics firms, all of which have access to meaningful – albeit more expensive – decarbonisation activities within their own supply chains.

¹ Offsets on the VCM are currently priced [at USD 1-10 \(as of February 2025\)](#). The 2017 Report of the High-Level Commission on Carbon Prices estimated that carbon prices should be [USD 40-80 by 2020 and USD 50-100 by 2030](#) to be consistent with achieving Paris Agreement temperature goals. Other studies estimate that the real cost of carbon is much higher – around [USD 185 per tonne of CO₂](#).

Offset projects have resulted in fraud and human rights abuse

In addition to not delivering promised emissions reductions, offset projects have been linked to [human rights abuse](#) and [land conflicts](#) that can [push Indigenous People and local communities off their land](#). Often offset projects are purportedly designed to benefit local communities, however, at times this money is pocketed by intermediaries and project developers, many of which [commit fraud](#), for example by exaggerating the baseline risk of deforestation, to [entitle themselves to more funding](#).

Due to the complicated way in which carbon emissions are accounted for, there are ways for countries and companies to misuse accounting tricks to their benefit. A large concern is that misalignment of carbon accounting schemes [could mean that carbon credits are double counted](#), i.e. emission reductions are used by the country that developed the credit as well as the country that purchased the credit. This is being discussed as part of negotiations for the use of carbon trading under the Paris Agreement.

Offsetting claims have resulted in litigation risks

Misleading claims about the outcomes of using carbon offsets are increasingly leading to reputational and legal risks for companies, reflecting that courts agree that carbon offsets fail to act as a climate solution. For example, in 2023, a regional German court ruled that advertising claims of climate neutrality from the use of offsets by airline company Eurowings were [misleading and breached German law](#). Similar lawsuits have been [taking place](#) around the world, causing companies to abandon carbon neutrality and net zero claims associated with the use of offsets.

There are alternative ways to fund climate action

Despite often [providing little funding for project implementers](#) on the ground, carbon crediting schemes have been promoted as a means to channel much needed climate financing towards developing countries, particularly for the protection of nature which is critically underfunded. However, there are other channels better suited to delivering climate finance.

Businesses can contribute to emissions reductions and other climate projects without claiming carbon credits. NewClimate Institute suggests that companies can do this by setting an internal carbon price and using this to support climate initiatives outside their own value chains. This resulting 'climate contribution' represents "a financial commitment [that is a complement – and in no way an alternative](#) – to directly reducing one's own climate footprint."

The offsetting industry has helped shape a narrative around the scarcity of funding. In reality, the issue is less about the amount of money available and more about how it is distributed and who decides. In 2022, Global North countries spent almost [80 times more](#) on [fossil fuel subsidies](#) than the USD 31.5 billion they provided in [grant-based climate finance](#) in the Global South. Research by Oil Change International suggests that over [USD 5.3 trillion a year could be generated](#) by rich countries ending public finance for fossil fuels and implementing fossil fuel and higher weather taxes, among other approaches.

Removals may play a very small role in limiting warming

Alongside emissions reduction and avoidance, offset projects also include a very small proportion of carbon removals – [around 3% of offsets](#) in the VCM in 2023. As we have already emitted too much, all modelled pathways limiting warming to 1.5°C or 2°C in the most recent Intergovernmental Panel on Climate Change (IPCC) reports [include the removal and storage](#) of some level of carbon from the atmosphere – highlighting a theoretical need for carbon removal in the future.²

However, in reality, carbon removal implementation faces a number of issues and relying on the feasibility of future large-scale carbon removal is [incredibly risky and uncertain](#). Scientists caution that it may be impossible to remove carbon at the billions-of-tonnes scale outlined in modelling pathways to return warming to 1.5°C or 2°C. Technological approaches to removals are [currently unproven at scale](#) and face significant implementation challenges. These approaches are, and will likely remain, very expensive (currently [much higher than the cost of most mitigation options](#)).

Similar technology used predominantly by oil and gas companies to capture carbon from the source of emissions (carbon capture and storage) has been [slow to develop, with a history of “unmet expectations”](#), according to a 2023 International Energy Agency report. Even if it can be made to work at scale, this technology [perpetuates the burning of fossil fuels](#).³

This reiterates the need to implement readily available mitigation approaches and pursue deep, rapid emissions cuts now.

The way forward: untangling offsets from the science

The use of offsets is not aligned with the scientific need to lower emissions and avert warming beyond safe levels. They do not durably remove carbon and instead provide a cheap way to allow companies and countries to continue emitting in line with business as usual instead of investing in meaningful mitigation measures.

Based on an analysis of 20 voluntary carbon offset registries for credits retired between January 2020 and December 2022, the top users of carbon offsets were fossil-fuel producers, car makers and tech firms. Companies such as [Shell, Volkswagen and Chevron](#) – the three largest purchasers of carbon credits – have routes to decarbonisation. A study that examined how carbon offsetting was used in four major oil companies’ net zero strategies found that [none had plans to transition away from fossil fuels](#).

Ultimately, offsetting has done more harm than good for overall emissions reductions. The VCM has failed to deliver real impact and [continues to have integrity issues](#). The use of carbon offsets by companies and countries should continue to be closely scrutinised. Emissions avoidance and reduction offsets [have no place in ambitious climate policies](#).

² The IPCC sets out two purposes for which removals should be reserved: to cancel out the residual emissions of very few ‘hard-to-abate’ activities and to remove some of the excess CO₂ we have emitted historically to improve our chances of staying within the [carbon budget](#), which research suggests will be exceeded in 6–10 years. Like emissions avoidance and reduction offsets, carbon removals have no place in company strategies as a lever to compensate for their own avoidable emissions.

³ While the technology used is very similar, carbon removal captures differs in that it captures diffuse CO₂ emissions from the atmosphere, while carbon capture and storage (CCS) is used to [capture emissions from the point source of an emitting process](#).

Mitigation should always be the first course of action – and should always be prioritised over carbon removal. These tested routes to limiting warming (for example, the implementation of solar, wind, battery storage and energy efficiency improvements) are also [more cost-effective](#). There are a broad range of mitigation options that are not yet fully utilised.

Support for the restoration of degraded ecosystems and the protection of biodiversity, alongside other mitigation efforts and the theoretical need to incentivise real, permanent carbon removal, does not have to be serviced by a market mechanism in the buying and selling of carbon credits. Instead, funding can be sourced outside of carbon offset revenue, such as via public financing, including revenue generated from wealth and fossil fuel taxation, and company climate contributions. Direct and targeted support should, in particular, be provided for countries with high forest cover and developing countries.