Carbon Offset **Guide**

Securing Climate Benefit: A Guide to Using Carbon Credits

Second Edition

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HOW TO USE THIS GUIDE

You should use this guide in combination with www.OffsetGuide.org, which provides more detail on the topics covered in this guide. For example, the website expands on the following topics:

- Global warming potential and CO_2 equivalent
- Other environmental instruments used to claim avoided emissions
- Carbon crediting markets and programs
- What kinds of actors are typically involved in a project?
- What is the crediting project implementation cycle?
- Pros and con of credit purchasing options
- Add-on standards
- Conducting project due diligence when vetting crediting projects
- Are enhanced removal credits better than avoided emission credits?
- "Offsetting" vs. "mitigation contribution" claims
- The Paris Agreement and corresponding adjustments

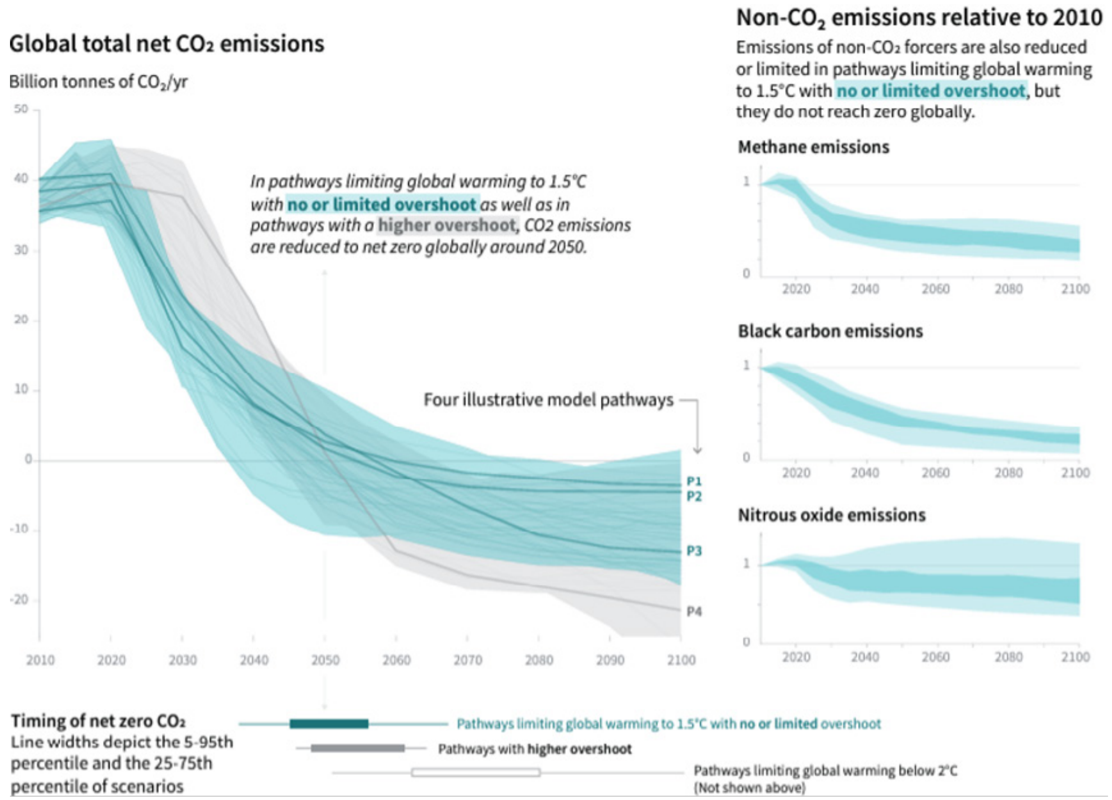
Internet links are provided throughout this PDF guide to access expanded and updated information. Links are presented as a clickable button ( ) at the end of each related section.

1. INTRODUCTION

According to the Intergovernmental Panel on Climate Change (IPCC), the world has until 2030 to cut human-caused carbon dioxide (CO_2) emissions in half (and cut other greenhouse gas emissions considerably) to maintain a 50% chance of avoiding the worst effects of climate change.[1] By 2050, CO_2 emissions will need to reach "net zero" – where emissions are in balance with removals[2] – to sustain this chance (Figure 1). Such reductions will require worldwide action by national and local governments, along with businesses and civil society.

The urgency is clear: companies and organizations will need to use every tool at their disposal to avoid emissions or enhance removals goals. "Carbon credits" are one such tool that – if used responsibly – can accelerate action to avert dangerous climate change.

Figure 1. Global total net CO_2 and non-CO_2 emissions



This guide is for companies and organizations seeking to understand carbon credits and how to use them in voluntary GHG reduction strategies. It may also be useful for individuals interested in using carbon credits to compensate for their personal emissions.

We begin, in Section 2, with an explanation of the basics of carbon credits, how to acquire them, and how they can (or should) be used in carbon management strategies. Section 3 addresses common criticisms of carbon credits. Section 4 clarifies the essential elements of carbon credit quality, explains how carbon credit certifiers try to ensure that quality, and includes basic questions prospective buyers can ask about quality. Section 5 describes strategies buyers can use to avoid lower-quality credits. Section 6 discusses ongoing debates related to the responsible use of carbon credits. This guide concludes with Section 7. Annex 1 provides a table identifying the relative risks inherent to different project types and Annex 2 defines a list of common terms related to carbon crediting.

Figure 1 source: IPCC, 2018: Summary for Policymakers

2. UNDERSTANDING CARBON CREDITS

Carbon credits are tradable instruments that convey a claim to either avoided GHG emissions or enhanced GHG removals. In this section, we define carbon credits, clarify the distinction between carbon credits and carbon offsets, and explain the basics of how carbon credits are generated, acquired, and used.

2.1 WHAT IS A CARBON CREDIT?

A carbon credit is a tradable instrument (typically a virtual certificate) that conveys a claim to avoided GHG emissions or to the enhanced removal of GHG from the atmosphere. Credits allow claims to be transferred from an entity that generated the avoided emissions or enhanced removals to a buyer. The buyer of a carbon credit can then "retire" it to count the avoided emissions or enhanced removals towards a climate change mitigation goal.

Carbon credits are certified by either governments or independent certification bodies (aka "carbon crediting programs"). A single credit is typically denominated as the equivalent of one metric tonne of CO_2 avoided or removed (see Box 1).

Box 1. Establishing a common denomination for different greenhouse gases

CO_2 is the most abundant GHG produced by human activities, and the most important pollutant to address for limiting dangerous climate change. However, human beings create and emit numerous other GHGs, most of which have a far greater heat-trapping effect, pound for pound, than CO_2. The most prevalent of these gases are methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), nitrogen trifluoride (NF_3), and sulfur hexafluoride (SF_6). Fully addressing climate change will require reducing emissions of all GHGs. Scientists and policymakers have established "global warming potentials" (GWPs) to express the heat-trapping effects of all GHGs in terms of CO_2-equivalents (annotated as "CO_2e"). GWPs are defined for different time horizons, to account for differences in the residence time of different gases in the atmosphere. By convention, all carbon credits certified under established standards are denominated using 100-year GWPs. This makes is easier to compare the effects of different GHGs and to denominate carbon credits in units of CO_2-equivalent avoided emissions or enhanced removals.

Learn more about GWPs here

Traditionally, carbon credits have been used for the purpose of carbon offsetting (the terms carbon offset credits, carbon offsets, offset credits, or simply offsets may be used interchangeably). Carbon offsetting is the practice of using avoided emissions or enhanced removals to compensate for GHG emissions. In carbon markets, for example, a buyer can secure and retire a carbon credit in lieu of directly reducing their own emissions. This works because, for the purpose of mitigating climate change, it does not matter where avoided emissions or enhanced removals occur – the effects are the same if an organization: (a) ceases an emission-causing activity; or (b) enables emissions to be avoided somewhere else in the world. Carbon credits were designed to make it easier and more cost-effective for organizations to pursue the second option.

Carbon credits are not always used to compensate for or offset emissions. In recent years, some parties have proposed using carbon credits simply to contribute to climate change mitigation, without any express compensation or offsetting claim. This way of using carbon credits is further discussed in Section 6.

Offsetting claims are only defensible if carbon credits are issued under a set of rigorous conditions. The degree to which these conditions are met defines the "quality" of the carbon credit. We define and explain these conditions – or "quality criteria" – in Section 6.

Although organizations sometimes use other kinds of instruments besides carbon credits to make GHG mitigation claims – such as "renewable energy credits" – these other instruments usually do not meet effective quality criteria.

Learn more about other instruments that may be used to claim avoided emissions like RECs, PPAs, Allowances, and EECs

2.2 CARBON CREDITING PROJECTS

Carbon credits can be produced by a variety of activities that avoid emissions or enhance carbon removal. In most cases, these activities are undertaken as discrete "projects." A carbon crediting project, for example, may involve:

- Renewable energy development (displacing fossil-fuel emissions from conventional power plants);
- The capture and destruction of high-potency GHGs like methane, N_2O, or HFCs; or
- Avoided deforestation (which can both avoid the emission of the carbon stored in trees, as well as remove additional carbon from the atmosphere as trees grow).

Projects can range in scale from very small (e.g., reducing a few hundred tonnes of CO_2e per year) to very large (e.g., millions of tonnes reduced per year). Carbon credits are also sometimes produced by large-scale "programs of activities,"[3] which aggregate together many similar small projects or coordinated efforts across entire jurisdictions (such as in the case of avoided deforestation).[4]

In many cases, carbon crediting projects produce social and environmental benefits beyond just avoided emissions or enhanced removals.

Depending on the project type, these "co-benefits" can include improvements to community employment opportunities; enhanced air or water quality; biodiversity and habitat conservation; improved energy access; and better access to community health and education services. Many carbon credit buyers seek projects that yield a broad range of benefits. Carbon credits can thus be part of a comprehensive strategy for corporate social responsibility, combining efforts to address climate change with contributions to other public goods.

One challenge is that the types of projects that make for higher-quality carbon credits tend to be those with the fewest co-benefits and vice versa (see Section 5.2.1).

What kinds of actors are typically involved in a project?

What is the crediting project implementation cycle?

2.3 CARBON CREDITING PROGRAMS

Carbon credits are not a simple commodity. As with many products whose quality is difficult for casual buyers to assess, standard-setting organizations have been established to provide quality assurance for carbon credits. These carbon crediting programs[5] range from international or governmental regulatory bodies – such as the UNFCCC Secretariat, which oversees an international carbon crediting program under Article 6.4 of the Paris Agreement – to independent non-governmental organizations (NGOs). Historically, governmental bodies certified carbon credits for regulatory purposes ("compliance programs"), while NGOs primarily served voluntary buyers ("independent programs"); more recently, both types of programs have begun to serve both types of markets (Table 1). Each carbon crediting program issues its own labelled "brand" of credit.

Crediting programs perform three basic functions:

(1) they develop and approve standards that set criteria for the quality of carbon credits;

(2) they review crediting projects against these standards (generally with the help of third-party auditors); and

(3) they operate registry systems that issue, transfer, and retire carbon credits.

More detail on how carbon crediting programs seek to ensure the quality of carbon credits (along with some of their limitations) can be found in Section 4 of this guide.

Villagers learn how to use bio-gas as a fuel source for cooking supplied by small-scale anaerobic digesters. Image credit: Sichuan Rural Poor-Household Biogas Development Programme

Learn more about carbon crediting markets and programs

Table 1. Examples of major carbon crediting programs

"Compliance" carbon crediting programs (run by governmental bodies)	Geographic Coverage	Label used for carbon credits
Article 6.4 of the Paris Agreement[6]	Global	Article 6.4 Emission Reduction Units (A6.4ERs)
California Compliance Offset Program	United States	Air Resources Board Carbon Offset Credit (ARBOC)
Korean Offsetting Program[7]	Global	Korean Offset Credit (KOC)
Regional Greenhouse Gas Initiative (RGGI)	Northeast United States	RGGI CO_2 Offset Allowance (ROA)
Australian Emission Reduction Fund (ERF)	Australia	Australian Carbon Credit Unit (ACCU)
"Independent" carbon crediting programs (run by NGOs)	**Geographic Coverage**	**Label used for carbon credits**
American Carbon Registry	Multiple countries	Emission Reduction Tonne (ERT)
Climate Action Reserve (CAR)	Multiple countries	Climate Reserve Tonne (CRT)
The Gold Standard	International	Verified Emission Reduction (VER)
Plan Vivo	International	Plan Vivo Certificate (PVC)
Verra - Verified Carbon Standard (VCS)	International	Verified Carbon Unit (VCU)

2.4 HOW TO ACQUIRE CARBON CREDITS

Although there are some trading exchanges that facilitate carbon credit transactions, most transactions occur "off-exchange", making price discovery difficult. The price of a carbon credit can range from under US$1 to well over US$500 (e.g., for advanced direct air capture removal credits). Prices tend to vary mostly by project type, with minor differences between carbon credit labels.[8]

Although carbon credit buyers do not need to be familiar with every carbon crediting program rule and procedure, they should have a basic understanding of how carbon credits are generated, transferred, and used. Purchasing options can depend on where in this "lifecycle" a buyer gets involved. In general, the earlier in the lifecycle, the better the nominal price and terms will be – but the greater the delivery risk and the longer it may take to actually receive carbon credits.

The basic lifecycle for carbon credits looks like the following:

1. Methodology development. Before avoided emissions or enhanced removals can be accepted for issuance of carbon credits, they must be shown to meet carbon credit quality criteria. This process requires a methodology that is specific to the type of crediting project generating the avoided emissions or enhanced removals. Most crediting programs have a library of approved methodologies covering a wide range of project types. However, project developers may also propose new methodologies for program approval and adoption.

Purchasing options: In rare cases, a prospective carbon credit buyer may sponsor the development of a methodology for a new project type that is not already eligible in existing crediting programs. This effort can be resource-intensive – and risky – but could make sense for organizations with a strong interest in a new type of project activity.

2. Project development, validation, and registration. A crediting project is designed by project developers, financed by investors, validated by an independent auditor, and registered with a crediting program. Official "registration" indicates that the project has been approved by the program and is eligible to start generating carbon credits after it begins operation (next step).

Purchasing options: Some carbon credit buyers directly invest in a crediting project in return for rights to (some portion of) the credits the project is able to generate.

Alternatively, a commonly used purchasing option is to contract directly with a project developer for delivery of carbon credits as they are issued. Such contracts generally take the form of "Emission Reduction Purchase Agreements" (ERPAs). An ERPA provides project developers with confidence that they will be able to sell a reliable volume of carbon credits. For buyers, the advantage is being able to lock in a price for carbon credits that is typically lower than market prices (in exchange for some delivery risk). ERPAs can be structured in numerous ways, including as option contracts.

3. Project implementation, verification, and carbon credit issuance. A crediting project is implemented, then monitored and periodically verified to determine the quantity of emissions it avoided. The length of time between verifications can vary, but is typically one year. A crediting program approves verification reports, and then issues carbon credits equal to the quantity of verified CO_2-equivalent avoided emissions or enhanced removals. Carbon credits are generally deposited into the project developer's account in a registry system administered by the crediting program.

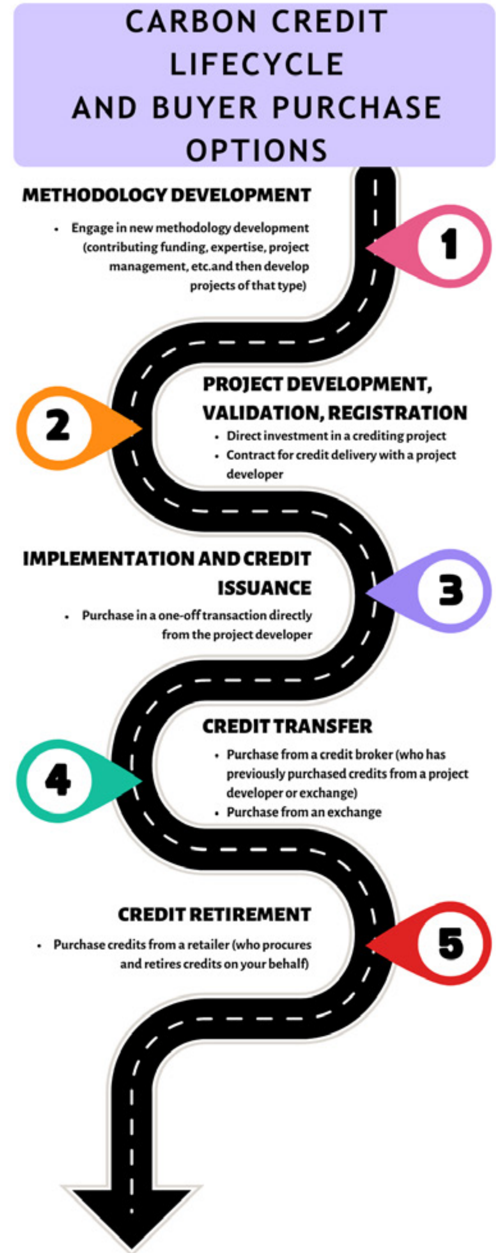
Purchasing options: In some cases, project developers may have unsold carbon credits for which they are seeking buyers. Purchasing directly from a project developer can avoid some transaction costs. However, projects with unsold credits (e.g., not contracted through an ERPA) may sometimes raise quality concerns (see **Section 4.1.2**).

4. Carbon credit transfer. After they are issued, carbon credits can be transferred into different accounts in a crediting program's registry. Transfers are usually undertaken as a result of a purchase or trade (i.e., after a purchase, carbon credits are transferred from the project developer's account into an account owned by the purchasers). Carbon credit buyers may then use the carbon credits by retiring them (see next step), hold them, or transfer them to other accounts. Carbon credits may change hands multiple times (getting transferred among multiple accounts) before they are ultimately retired and used.

Purchasing options: As with other commodities, numerous firms act as brokers for carbon credits. Brokers procure carbon credits and then transfer (or retire) them on clients' behalf. Brokers can make it easier to identify a mix of carbon credits from different project types, and facilitate large or small transactions. Some brokers sell carbon credits from projects they have invested in, in addition to projects developed by others. This practice may provide efficiencies in pricing, but it can affect the ability of the broker to be impartial about the credits they sell.

Another option is to purchase carbon credits on an exchange. There are multiple environmental commodity exchanges that list carbon credits for sale and work with registries to enable transfers. Purchasing carbon credits on an exchange can be relatively quick and easy, but it can be harder to obtain the information needed to evaluate the quality of these credits.

Figure 2. Carbon credit lifecycle and buyer purchase options at each stage



5. Carbon credit retirement. Carbon credits must be "retired" to use them and claim their associated avoided emissions or enhanced removals. Retirement occurs according to a process specified by each crediting program's registry. Once a carbon credit is retired, it cannot be transferred or used (meaning it is effectively taken out of circulation). (Note: some crediting programs use the term "cancellation" instead of "retirement." Functionally, they are the same, although "cancellation" more often refers to taking credits out of circulation without them being claimed or used.)

Purchasing options: For buyers looking to acquire only a small number of carbon credits (such as small companies or individuals), the most feasible option is to go through a retailer. Retailers can provide access to carbon credits from a range of different projects, and will provide at least basic information about those projects. In most cases, the retailer will maintain accounts on carbon credit program registries, and will retire carbon credits directly on a buyer's behalf.

Learn more about the pros and cons of each purchasing option

3. COMMON CRITICISMS OF CARBON CREDITS

Carbon credits are frequently criticized in the press and by some environmental advocates. Some observers object to "market-based" approaches for solving environmental problems and oppose carbon credits on that basis. Even those who are open to such approaches, however, often have reservations about carbon credits. Their concerns fall into two categories:

- How carbon credits are used
- The quality of carbon credits

Some criticisms are more valid than others, but many have at least some validity and are important for buyers of carbon credits to keep in mind.

3.1 CONCERNS ABOUT HOW CARBON CREDITS ARE USED

Examples of criticisms:

- "Carbon credits allow polluters to go on polluting" (i.e., they are a form of "greenwashing")
- "Carbon credits are not a long-term solution and can 'lock in' high-carbon infrastructure"
- "Carbon credits create an incentive to avoid regulating certain sectors and industries"

These kinds of criticisms are not so much about whether carbon credits are a valid form of climate change mitigation, but rather whether they create "perverse" incentives. Carbon credits were conceived of as a way to facilitate investment in cost-effective mitigation options that organizations would otherwise not be able to access. The temptation, however, can be for organizations to use carbon credits in lieu of making the investments needed to significantly reduce the emissions they have been allocated responsibility for (sometimes contrary to their stated commitments). The counterproductive result can be that they continue to pursue high-emitting activities – and invest in high-emitting equipment and facilities – effectively "locking in" higher emissions over the long run. Many observers advocate for treating carbon credits as a complement to aggressive internal climate action, not a primary means of mitigation.

Another possible perverse incentive created by carbon credits is to discourage needed regulation. Regulations that require GHG mitigation could deprive project developers of revenue from selling carbon credits, because any avoided emissions or enhanced removals would no longer be "additional" (see Section 4.1). Project developers may resist such regulatory changes. Regulation, however, is often a much more effective and comprehensive way to lower emissions across an economy. From a climate policy perspective, therefore, carbon credits have been viewed as an interim solution -- a way to accelerate action in the near term, but one that must ultimately (and explicitly) be replaced by more comprehensive policy action in the future.

3.2 CONCERNS ABOUT CARBON CREDIT QUALITY

Examples of criticisms:

- "Carbon credits do not represent valid GHG mitigation; if they are used as a substitute for real climate action, they only make climate change worse."
- "Carbon credit projects have adverse impacts on local communities and may make other environmental problems worse."

These criticisms are probably the most immediate concern for most carbon credit buyers. It would certainly be problematic if carbon credits are not what they purport to be, which is an exclusive claim to a full metric tonne of additional, permanent CO_2 mitigation (or its equivalent), without any adverse social or environmental impacts (see **section 4**). Unfortunately, despite the efforts of carbon crediting programs, a number of independent studies have identified serious problems with some types of carbon credits. For example, studies in the last decade of two international crediting program established under the Kyoto Protocol – the Clean Development Mechanism (CDM) and Joint Implementation (JI) – suggested that up to 60-70% of their carbon credits may not have represented valid avoided emissions or enhanced removals.[9] Other critiques have highlighted instances of carbon crediting projects that harmed local communities or resulted in broader environmental damage.[10] More recently, a 2024 survey of peer-reviewed analyses found that fewer than 16% of the credits issued to certain types of projects represent "real" greenhouse gas mitigation (i.e., meeting all criteria for a high-quality credit).[11] These critiques are troubling and should give pause to prospective buyers of carbon credits.

Some species, such as bamboo, may rapidly sequester carbon, but planting non-native or invasive species of plants can lead to damaging outcomes. Photo source: Misha FroLove/Bigstockphoto.com

However, buyers can employ a number of strategies to improve their likelihood of acquiring higher-quality credits. In **section 3**, we explain the essential elements of a "high-quality" carbon credit and indicate some basic questions buyers can ask to vet potential purchases. In **section 5**, we provide some general strategies for avoiding "low-quality" carbon credits.

4. WHAT MAKES A HIGHER-QUALITY CARBON CREDIT?

The central idea behind a carbon credit is that it can substitute for reductions that you, as a buyer, could have made to your own emissions. For this to be true, the world must be at least as well off when you use a carbon credit as it would have been if you had reduced your own emissions.[12] **When people talk about the "quality" of a carbon credit, they are referring to the level of confidence one can have that the use of the credit will fulfill this basic principle.**

This quality concept - **frequently referred to as "environmental integrity"** – sounds straightforward, but it is challenging to guarantee in practice.

A variety of terms are sometimes used to define quality criteria for carbon credits, including that avoided emissions or enhanced removals must be "real," "quantifiable," and "verifiable." Most of these terms have their origin in regulatory criteria established for air pollutant credits under the U.S. Clean Air Act (going back to 1977). However, these terms have distinct regulatory meanings under U.S. law that do not always translate meaningfully to carbon credits. The term "real," for example, has no commonly agreed definition across carbon credit programs and standards, and is often used as a vague catch-all.[13]

For this guide, therefore, we have distilled the essential elements of carbon credit quality down to five criteria. In short, higher-quality carbon credits are those associated with avoided emissions or enhanced removals that are:

- Additional
- Not overestimated
- Permanent
- Not claimed by another entity
- Not associated with significant social or environmental harms

Crediting programs were created with the intention of ensuring the quality of carbon credits (Section 2.3). In the remainder of this section, we describe the approaches crediting programs use to address the quality criteria listed above. As indicated in Section 3, however, many observers believe that crediting programs have a mixed track record. Part of the challenge is that carbon credit quality is not black and white. The multiple criteria involved – plus the fact that critical criteria like "additionality" are a matter of confidence rather than absolute truth (see below) – means that quality exists along a continuum.

Crediting programs, by contrast, are forced to make a binary decision: do they issue carbon credits or not? Most carbon crediting programs will say that every credit they issue is equally valid, but buyers should feel justified in questioning this assertion. Think of scoring the quality of a carbon credit on a 100-point scale. A crediting program may decide to issue credits to every project that exceeds a score of 50. But as a buyer, is a score of 51 really "good enough"?[14]

Astute buyers will understand this difficulty and actively seek out higher-quality carbon credits. For each quality criterion below, we highlight some questions that buyers can ask about specific crediting projects to better ascertain their relative quality. Even for sophisticated buyers, however, getting detailed answers to these questions may be difficult. Thus, in Section 5, we identify a range of strategies buyers can use to steer clear of lower-quality carbon credits and improve the chances of acquiring higher-quality credits.

Tree planting carbon crediting projects can provide many co-benefits to local communities. Image credit: The international small group and tree planting program.

4.1 ADDITIONALITY

Short version: To preserve environmental integrity, carbon credits must come from projects that are "additional." An additional project is one that would not have occurred without the incentive provided by carbon credit revenues.

Longer version: Additionality is the property of a project being additional and is typically assessed once by a crediting program when a proposed project is submitted for approval and registration.[15] A proposed project is additional if it will not take place without the expected revenue from selling carbon credits.

The additionality of a project is essential for the quality of carbon credits. If credits are issued to projects that are not additional, then purchasing those credits instead of reducing one's emissions will make climate change worse – because total emissions to the atmosphere would be lower if the purchaser had simply reduced their inventory emissions.

Evaluating whether crediting projects are additional can be deceptively difficult.[16] For example, sometimes a project's activities are required by law. Landfill operators, for example, may be required to install equipment that captures and destroys methane. In other cases, investments that avoid emissions will be made simply because they are profitable, without any consideration of the potential revenue from carbon credits. An investment in energy-saving lighting, for example, can pay for itself through avoided energy costs. Similarly, renewable energy technologies, like wind and solar, are often cost-competitive with fossil fuels without revenue from carbon credit sales. For a proposed project to be additional, the expectation of selling carbon credits must play a decisive ("make or break") role in the decision to implement it.

Additionality is a topic about which there is frequent misunderstanding. One commonly heard claim, for example, is that a project is additional if GHG emissions are lower than they would have been "in the absence of the project." This framing is incorrect because the question of additionality asks whether a proposed project came about because of the incentive from carbon credits. If we only compare a project to its absence, then we have ignored the real possibility that the proposed project would have been undertaken even in the absence of carbon credit revenue.

It is also common to hear discussion of different "kinds" of additionality, using terms like "financial additionality" or "regulatory additionality," as if these are distinct concepts. The only definition of additionality relevant to credit quality is the one presented here. Legal and financial considerations come into play when making determinations about additionality but are not separate definitional categories for what it means for a proposed project to be "additional."[17]

While additionality is the most essential criterion for assessing credit quality, its determination is inherently uncertain. Carbon crediting programs must make binary determinations of additionality to decide the eligibility of proposed projects for crediting (i.e., a proposed GHG project is either additional or it is not). In practice, determining whether a proposed project is additional requires comparing it to a hypothetical scenario without revenue from the sale of carbon credits. Such a scenario must be established using educated predictions (e.g., informed by factors such as future fuel, timber, or electricity prices). The determination can also fall prey to "information asymmetry," because only a project developer can say for sure whether the prospect of selling carbon credits was truly decisive - yet every project developer has an incentive to assert that it was decisive. Even though carbon crediting programs must still make a binary determination for administrative reasons, in light of these uncertainties, it is better to think of additionality in terms of risk: how likely is a project to be non-additional?

4.1.1 HOW CARBON CREDITING PROGRAMS ADDRESS ADDITIONALITY

Carbon crediting programs have developed two main approaches to determining the additionality of a project: "project-specific" and "standardized." Each of these approaches has strengths and weaknesses.

Project-specific approaches rely on an analysis of an individual project's characteristics and circumstances to determine whether it is additional. For example, they may involve:

- A demonstration that the proposed project activity is not legally required (or that non-enforcement of the legal requirements is widespread); and
- An "investment analysis" of whether the project is financially attractive in the absence of carbon credit revenues; and/or
- A "barriers analysis" demonstrating that the project faces (non-financial) barriers that do not apply to its alternatives;[18] and
- A "common practice analysis" demonstrating that the proposed project is not common practice or is distinct from similar types of activities that are common practice.

Project-specific approaches can be effective when applied rigorously but can also be time-consuming. Moreover, they often require subjective judgments (such as the evaluation of financial parameters or the identification of barriers) and strongly hinge on assumptions about the future (such as fuel prices for the next 7 years). It is often challenging for carbon crediting program staff and auditors to judge whether project developers are biasing these assumptions in their favor. Notwithstanding these concerns, project-specific approaches are applied to most projects under most carbon crediting programs.

"Standardized" approaches to determining additionality were developed in response to the perceived shortcomings of project-specific approaches. A standardized approach evaluates projects against a set of pre-defined eligibility criteria (e.g., performance benchmarks) that—in principle—distinguish additional from non-additional projects.[19] Standardized approaches require in-depth technical and economic analyses for each type of project to establish these eligibility criteria. When developed correctly, such criteria will make it unlikely that non-additional projects are eligible. The main advantage of the standardized approach is that, once these eligibility criteria are established, they can reduce the administrative burdens and subjectivity of making additionality determinations. Their main drawback is that they may be imprecise in addressing the atypical characteristics of individual projects within a given project type. Among the major independent (non-regulatory) carbon crediting programs, CAR has been the primary adopter of standardized approaches, although other programs (e.g. VCS, CDM) apply them to some project types.

For many project types, it can be difficult to define objective criteria that reliably screen out non-additional proposed projects, while not mistakenly excluding truly additional projects. Consequently, standardized approaches are available for a smaller set of project types. For example, CAR, which uses a standardized approach, has adopted a smaller number of methodologies (several of which are for the same project type, but tailored to different geographies and jurisdictions) compared to VCS and the Gold Standard, which incorporate over 200 project-specific methodologies applicable across the world.

In practice, carbon crediting programs can also apply approaches to determining additionality for some project types that blend elements of both project-specific and standardized methodologies.

Renewable energy carbon credit projects like this wind farm, must be highly scrutinized for their additionality and the role of potential carbon credit revenue incentivizing the project to occur. Image credit: Los Santos Wind Power Project.

Observations on Baselines and Additionality

No matter how quantitative and objective it appears, any additionality "test" or set of tests will create some number of false positives (i.e., proposed projects that are deemed additional despite the fact that they are not) and some number of false negatives (i.e., proposed projects that are deemed non-additional despite the fact that they are additional). The design of tests – and how they are implemented in practice – determines how much they will err on the side of false positives or false negatives. It is important to understand that while false positives and false negatives can be problematic from a policy perspective, only false positives undermine the environmental integrity of carbon credits. In other words, it is the false positives – carbon credits issued to truly non-additional projects – that lead to increases in emissions and therefore hamper climate protection goals.

Additionality tests can be cumbersome, time-consuming, and expensive. They are, however, necessary to ensure carbon credits have real value.

4.1.2 QUESTIONS FOR BUYERS TO ASK ABOUT ADDITIONALITY

None of the program-administered screens for additionality are perfect. Some key questions to avoid credits from lower-quality projects include the following:

- *Did the project secure a buyer for carbon credits before implementation?* Given the risks and uncertainties of the carbon market, it is very rare for a project that truly needs carbon credit revenue to go forward without first securing buyers for most or all of the credits it expects to produce. Forward contracts generally take the form of "emission reduction purchase agreements" (ERPAs). If a project began implementation without an ERPA, its claims to additionality should be further examined.
- *How large is the project's carbon credit revenue stream compared to other revenue streams or cost savings achieved by the project?* Claims of additionality are often tenuous if carbon credit revenues constitute a small portion of a project's total revenues. For example, if 95% of the total revenues for a renewable energy project derive from electricity sales and only 5% are from carbon credit revenue, the project's additionality should be questioned.
- *Would the project cease to avoid emissions (or cease to remove GHGs from the atmosphere) if it did not continue to receive carbon credit revenues?* Even if a project's carbon credit revenue is comparable to (or greater than) other revenue streams, those other revenues may be sufficient to cover costs – meaning that the project may continue avoiding emissions (or removing GHGs) even if it stopped selling carbon credits. While such projects are not necessarily non-additional — the decision to implement the project, for example, may still have been based on the prospect of carbon credit sales – they may pose a higher risk of being non-additional.
- *If the project is not (currently) legally required, is there reason to believe that it is being undertaken in anticipation of future legal requirements (or to avoid triggering such requirements in the future)?* Programs may differ in the extent to which they examine prospective legal requirements. For example, a landfill gas flaring project may not be required by law, but

landfill owners may seek to implement such a project if they anticipate being mandated to control landfill emissions in the future (e.g., as the landfill grows to where it exceeds a regulatory size threshold). Thus, they could claim that the project is additional today, even though its implementation would be mandated in the (near) future.

4.2 AVOIDING OVERESTIMATION

Short version: Avoiding overestimation means the GHG emissions avoided or the removals that are enhanced by a mitigation project are quantified conservatively relative to a realistic baseline.

Long version: To avoid overestimation of a carbon crediting project's effects, the emissions avoided, or removals enhanced, by carbon crediting projects must not be exaggerated. Conservative quantification must ensure that it is unlikely too many credits will be issued to the project and must extend to both the project and baseline emissions. It typically demands that projects are monitored and that this data along with the quantified avoided emissions or enhanced removals are assured by accredited auditors before credit issuance. Overestimation can occur by inflating estimated baseline emissions and/or underestimating the project emissions including failures to account for a project's indirect effects on GHG emissions (i.e., leakage).

Suppose that, for every 50 additional tonnes of CO_2 emissions that are avoided by a crediting project, the project developer reports avoiding 100 tonnes, and 100 carbon credits are then issued to the project. Half of these credits would have no effect in mitigating climate change and using them instead of reducing inventory

Sometimes GHG reduction activities are required by law. Landfill operators in California, for instance, are required to install equipment that captures and destroys methane. Photo source: Panaramka/ Bigstockphoto.com

emissions would make climate change worse. Overestimation of avoided emissions can occur in several ways:

- *Overestimating baseline emissions.* The first – and most subtle – way carbon credits can be overestimated is if a project's baseline emissions are overestimated.[20] Baseline emissions are the reference against which avoided emissions are calculated, and are closely tied to additionality: they are the emissions that would have occurred in the absence of the expected revenue from selling issued credits.[21] Baselines are easier to determine for some types of projects than others. For a project that captures methane from a landfill and destroys it, the amount of methane that would have been emitted is generally the amount that is captured and destroyed plus methane that is not captured by the project (due to imperfect capture efficiency) as in the baseline scenario both sources of gas would have been emitted.[22] In contrast, there can be much greater uncertainty when estimating how many GHG emissions will be displaced on an electricity grid by a solar power project – leading to a greater risk of overestimation if estimation methods are not appropriately conservative.

- *Underestimating actual emissions*. Many kinds of carbon crediting projects avoid but do not eliminate GHG emissions. A project's avoidedemissions are quantified by comparing the actual (i.e., *ex post*) emissions that occur after the project is implemented against its predicted (i.e., *ex ante*) baseline emissions.[23] In the same way that baseline emissions can be overestimated, actual project emissions can be underestimated – with both contributing to an overestimation of avoided emissions by the project. For enhanced removal projects, this source of overestimation risk can result from overestimating actual removals caused by the project. Exaggerated estimates of the actual impact of a project can arise through measurement error. For example, determining the increase in the amount of carbon stored in trees from one year to the next is subject to measurement uncertainty and sampling errors, which can sometimes overstate actual carbon storage. Many standards address this by discounting measured quantities wherever significant uncertainties arise.
- *Failing to account for the indirect effects of a project on GHG emissions (aka "leakage").* To quantify avoided emissions, actual project and baseline emissions are determined for all sources affected by a project. Often, however, a project will have both intended and *unintended* effects on GHG emissions. If quantification methods fail to account for GHG emission increases caused by the project at some sources (even indirectly), then the total avoided emissions will be overestimated. Unintended increases in GHG emissions caused by a project outside of its recognized boundaries are referred to as "leakage." The classic example is a forest preservation project that ends up shifting the production of timber through deforestation to other areas.
- *Forward crediting.* Although rare, carbon credits may be issued for avoided emissions that a project developer expects to achieve in the future. Such "forward crediting" is usually problematic because it can lead to an over-issuance of carbon credits if a project fails to perform as expected.[24] It can also pose issues if future events (e.g., regulatory changes) lead to erroneous assumptions that inform the baseline emissions over the crediting period.

Finally, to control for these possible causes of overestimation, it is necessary to *monitor and verify ex post* a project's performance.[25] Measurement and data collection procedures – and calculations or estimates derived from these data – should be scientifically sound and methodologically robust. Furthermore, project monitoring data should be rigorously *verified*. Verification entails assessing the veracity of data provided by project developers, often through an audit of selected data samples. Crediting project developers have an incentive to report data that maximizes the number of carbon credits they can sell. Verification helps to assure that reported data are accurate and do not overstate avoided emissions or enhanced removals.

4.2.1 HOW CREDITING PROGRAMS ADDRESS OVERESTIMATION

Carbon crediting programs endeavor to ensure that avoided emissions are not overestimated by requiring the use of detailed quantification methods specified within approved project type-specific **methodologies**. In general, the quantification methods within a methodology include:

- *GHG accounting boundaries* which define the GHG sources and sinks to be considered in quantifying a project's baseline GHG emissions and the actual project GHG emissions.[26]
- *Baseline scenario determination and emission estimation methods* that prescribe how a project's baseline scenario is defined, including acceptable assumptions regarding baseline technologies and practices and provide instruction for quantifying the baseline emissions.

Forestry-based crediting projects have the potential to shift deforestation from the project location to unprotected areas causing project leakage to occur. Image credit: Biofilica Resex Rio Preto – Jacundá REDD+.

- *Quantifying actual project emissions methods* that prescribe how emissions associated with the implemented activities are calculated. These methods ensure there is functional equivalence between the baseline scenario and project (i.e., that the same level of service or quantity of goods results from both scenarios).
- *Monitoring requirements* that prescribe the data to be collected for quantifying the baseline emissions and the project emissions. These methods also specify how to conduct measurements, what kinds of estimates are acceptable, the calculation formulas that must be used, and how estimation uncertainties are assessed.[27]

Importantly, carbon crediting programs require verification by independent third-party auditors who check that projects have properly applied prescribed quantification methods (see Box 2). In most cases, carbon credits are only issued after GHGs have been avoided or removed, and verified.

Finally, crediting programs also limit the crediting periods during which projects can be issued credits for avoided emissions. Crediting periods are typically from 7 to 10 years, which is often shorter than the operational lifetime of a project's equipment. Programs generally allow crediting periods to be renewed (usually one or two times, depending on the project type), as long as a project remains eligible under its crediting program standard.[28]

Box 2. What do carbon credit project auditors do?

Third-party auditors (also referred to as verifiers) have two main responsibilities in the context of the operations of a carbon crediting program. First, they perform project validation, which entails confirming that a proposed project meets a program's eligibility criteria,

including the determination of additionality. Second, auditors conduct project verification, which entails confirming that project monitoring data was collected per a program's requirements, as well as reviewing calculations to confirm that the project's avoided emissions were estimated according to the approved methodology.[29] The verification process usually involves a site visit combined with auditing (or sampling) of monitoring data to confirm with "reasonable assurance" that the data are accurate.

Auditors are generally paid by project developers, which creates an inherent conflict of interest. To address this conflict of interest, most carbon crediting programs review auditing arrangements, require auditors to legally certify that they are free from conflicts of interest (beyond the auditing services contract), and limit the number of times that the same auditor can verify a single project or multiple projects for the same project developer. Programs also regularly audit the work of third-party auditors to assure their objectivity.

4.2.2 QUESTIONS FOR BUYERS TO ASK ABOUT OVERESTIMATION

Examining in detail how a project's avoided emissions were quantified can be difficult and time-consuming. However, two relatively straightforward questions can point to areas of potential risk:

- *Does the project apply any deviations from the methodology and if so, are the deviations appropriately justified?* Several carbon crediting programs allow projects to deviate from a methodology's requirements if the project developer can justify an alternative approach to program staff. Deviations are often temporary and typically involve situations where a project is not able to produce monitoring data according to prescribed methods but can estimate them using alternative methods. Programs will generally try to ensure that alternative methods are more conservative than what a methodology prescribes. Carbon credit buyers may nevertheless wish to review cases where a deviation was applied for and approved.
- *Are there any gaps or other discrepancies in project monitoring data, and have these discrepancies been properly explained and addressed?* Major crediting programs have rules and procedures to address gaps or discrepancies in project monitoring data (e.g., if a flow meter temporarily breaks down and fails to collect data for some time). Such instances should be transparently reported, along with methods to conservatively address them. If monitoring reports and relevant data are not available and easily accessible (usually online), this lack of transparency should raise concerns about overestimation.

4.3 PERMANENCE

Short version: Carbon credits must be associated with the *permanent* avoidance or permanent enhanced removal of GHG emissions. If a project that only temporarily stores carbon (e.g., by sequestering it in trees or soils) substitutes for activities that permanently lower carbon emissions (e.g. by reducing fossil fuel use), environmental integrity will be undermined.

Long version: One challenge with using carbon credits to compensate for CO_2 emissions is that the effects of CO_2 emissions are very long-lived. Most of the carbon in a tonne of CO_2 emitted today will – eventually – be removed from the atmosphere. However, around 25% remains in the atmosphere for hundreds to thousands of years.[30] To physically compensate for CO_2 emissions, carbon credits must be associated with avoided emissions or enhanced removals that are similarly permanent.

The problem is that the effects of some types of projects can be reversed. A "reversal" occurs if carbon stored by a project is later emitted, resulting in no cumulative change in atmospheric carbon over time. For many kinds of crediting projects, reversals are either physically impossible or extremely unlikely. The greatest risk occurs with projects that store carbon in reservoirs (like trees) that may be subject to future disturbances. The classic example is a forestry project that keeps carbon in trees and soils (and adds to those carbon stores over time, as the forest grows). If a fire later burns down the project's trees – or the trees are cut down to make way for new development – some, or all, of the carbon may be (re) emitted, leading to a reversal.

One common misunderstanding is that – for carbon credits – "permanent" means something less than hundreds or thousands of years. A standard convention, for example, is that carbon only needs to be kept out of the atmosphere for a few decades (e.g., 40 years) to be considered "permanent." Such compromises are frequently made in the context of carbon crediting programs seeking to balance technical requirements (i.e., storing carbon indefinitely) with practical constraints (i.e., realistically, crediting programs can provide only a finite guarantee). But, scientifically, anything less than a full guarantee against reversals into the indefinite future is not "permanent." Buyers of carbon credits subject to reversal risk should bear this in mind and recognize the potential liability that reversals could pose in the future – even after the minimum "permanence" period guaranteed by crediting programs. Strictly speaking, such credits do not fully offset fossil CO_2 emissions.

4.3.1 HOW CREDITING PROGRAMS ADDRESS PERMANENCE

Most carbon crediting programs have established "buffer reserves" to address the risk of project reversal.[31] Under this approach, a portion of carbon credits from multiple projects are set aside into a common buffer reserve (or "pool"), which functions as an insurance mechanism. Buffer reserve credits can be drawn upon to compensate for reversals from any project with reversal risk. If a reversal occurs, credits are retired or cancelled from the buffer reserve on behalf of the project's buyers. The number of credits a project must contribute to the buffer reserve is usually based on an assessment of the project's risk for reversals. Over finite time periods, this approach can fully cover catastrophic losses affecting individual projects, as long as the buffer reserve is sufficiently stocked with credits from projects across an entire program.

Carbon crediting programs also encourage – or require – projects to reduce the risk of reversals. Some programs, for example, allow lower buffer reserve contributions if project developers implement risk mitigation measures (such as forestry projects that implement fuel treatments, and the use of conservation easements or other legally binding restrictions on future land uses). Other programs make reversal risk mitigation a requirement for eligibility.

Buffer reserves can effectively compensate for reversals due to natural disturbance risks — such as fire, disease, or drought affecting forests and soils. However, they run into a "moral hazard" problem if used to compensate for human-caused reversals, such as intentional timber harvesting.[32] If a landowner faces no penalty for harvesting trees for their timber value, for example – because any reversals caused by harvesting would be compensated for out of a buffer reserve – then the landowner could face a strong incentive to harvest. This would be a classic example of an "uninsurable" risk that would quickly compromise the effectiveness of a buffer. Because of this, most crediting programs are careful to place the primary responsibility for compensating intentional reversals on project developers. However, not all crediting programs have equally credible mechanisms for enforcing these obligations. Some do so through legal contracts, for example, while others simply withhold future credit issuances – which may not be effective if a developer simply "walks away" from a project after an intentional reversal.

4.3.2 QUESTIONS FOR BUYERS TO ASK ABOUT PERMANENCE

No reversal risk can be insured against in perpetuity. Over the very long run, the chance of reversal for projects that store carbon in trees and soils approaches 100%. Buyers should keep this in mind when considering carbon credits from these kinds of projects. As a guideline, if your goal is strictly to offset GHG emissions, avoiding reversible GHG reductions altogether is the safest approach.

However, addressing emissions from agriculture, forestry, and land use is critically important for mitigating climate change globally – and these kinds of projects often have desirable co-benefits. If your primary goal is to contribute to mitigation efforts (not offset per se), then purchasing credits that are additional from these projects can be a great choice.

Assuming some risk of reversibility is acceptable, questions for buyers to consider include:

- *Does the project have a formal plan for managing and reducing reversal risks, and is this plan being followed?* Higher quality carbon sequestration projects will have management plans in place to lower the risk of reversals. These plans may cover physical measures like thinning or other treatments to reduce the risks of fire and disease in forests; financial management practices to reduce risk of project failure or bankruptcy; and/or easements, legal restrictions, or other measures to guard against over-harvesting or land conversion. Projects with strong plans, along with implementation and enforcement provisions, are likely to have higher quality carbon credits
- *How long is "permanence" guaranteed by the crediting program that issued the credits?* Crediting programs differ significantly in terms of the length of time that they will guarantee compensation for reversals. The majority do so only through the end of a project's lifetime, which under some programs may be as short as 10 years. Other programs offer a minimum guarantee of 100 years from the time a credit is issued. Crediting programs are not always transparent about what their minimum guarantee is, so it is worth inquiring either with project developers or directly with carbon crediting program staff. The longer the guarantee, the higher the relative quality of the carbon credits.

4.4 EXCLUSIVE CLAIMS

Short version: To preserve environmental integrity, carbon credits must convey an exclusive claim to avoided emissions or enhanced removals, and must not be counted or used more than once.

Long version: The use of carbon credits can make climate change worse – i.e., the atmosphere will see greater total emissions – if they allow more than one party to lay claim to the same avoided emissions or enhanced removals. For example, imagine that two different companies claim the same 100 tonnes worth of avoided CO_2 emissions. Together they would claim to have avoided 200 tonnes of emissions, but the actual change in emissions to the atmosphere relative to the baseline scenario would only be 100 tonnes. The climate would be worse off, compared to a situation where both companies were to each avoid 100 tonnes of emissions. "Double counting" like this can happen in three ways:[33]

- *Double issuance* occurs if more than one carbon credit is issued for the same avoided tonne of GHG emissions. For example, a carbon crediting program can mistakenly issue two credits to the same project for one tonne of avoided emissions. This rarely happens. A more likely scenario is that two different programs could issue credits to the same project, without realizing the project is "double registered" under both programs. Most crediting programs run checks to avoid this situation (though they are not always foolproof). Finally, a more subtle "double issuance" risk is that the same program, or multiple programs, could issue credits to two different projects, each of which claims to have avoided the same tonne of emissions. An example would be if both the producer and consumer of biofuels claim to have avoided the GHG emissions from combusting the same liters of fuel – and two different programs issue carbon credits separately to each project without realizing the overlap.
- *Double use* occurs if two different parties count the same carbon credit toward their GHG emission targets. Again, most carbon crediting programs have procedures to prevent this from happening. The most likely way for it to occur is for an unscrupulous seller to represent to a buyer that a credit was retired on their behalf, and then proceed to market the same credit to other buyers in the same fashion. To prevent this, carbon crediting programs must require that the purpose of any carbon credit retirement is clearly recorded in a registry system, that the beneficiaries of credit retirements are identified in the same registry, and that all of this information is publicly accessible. Across existing crediting programs, current practices related to this kind of information disclosure are somewhat mixed.
- *Double claiming* can happen if carbon credits are issued to a project for avoided emissions or enhanced removals that another entity (e.g., a government or private company) claims toward its own target. For example, double claiming would occur if an energy efficiency project obtained carbon credits for avoiding emissions at a power plant covered by an emission target. In this case, both the project and the power plant could claim the same avoided emissions if the project is issued carbon credits and the power plant claims to have caused the avoided emissions toward its target.[34] Double claiming associated with carbon credits is also a potentially significant issue under the Paris Agreement, an issue further discussed in **Section 6**.

4.4.1 HOW CREDITING PROGRAMS ADDRESS EXCLUSIVE CLAIMS

Carbon crediting programs apply several methods to ensure that credits convey an exclusive claim to avoided GHG emissions.

Double issuance is addressed primarily by:

- Ensuring that carbon credits are only issued after program approval of verification reports and other supporting documentation.
- Checking that the accounting boundaries used to quantify avoided GHG emissions or enhanced removals do not overlap with other projects.[35]
- Actively monitoring project registrations – including at other carbon crediting programs—to check that a project is not issued carbon credits by more than one program for the same avoided GHG emissions.

Double use is addressed primarily through registry systems that assign unique serial numbers to individual carbon credits, track their transfer and ownership, and record the purpose of their use and on whose behalf they were retired.[36]

Double claiming is addressed through:

- Restricting the eligibility of project types (e.g., excluding those that are known to be subject to GHG reduction mandates or competing claims); and/or
- In some cases, project developers are required to sign legal attestations asserting exclusive claims to credited avoided emissions or enhanced removals and agreeing to legally convey such claims to the buyers of carbon credits. (Programs may differ in their specific legal requirements.)

4.4.2 QUESTIONS FOR BUYERS TO ASK ABOUT EXCLUSIVE CLAIMS

Although carbon crediting programs generally have effective measures in place to prevent double counting, there are still some steps that carbon credit buyers can take to make sure they have an exclusive claim to the avoided emissions or enhanced removals for which the credits were issued. Key questions to ask include:

- *When carbon credits are retired, are the purpose and beneficiary of the retirement indicated in a carbon crediting program registry?* Buyers should ask to see proof of credit retirement on the relevant registry – including certificate numbers or a transaction ID that matches the quantity purchased – along with an identified purpose and the beneficiary of the retirement.
- *Were the carbon credits issued for avoiding offsite emissions?* Ownership claims are harder to police where they involve emissions that occur at sources not owned or controlled by the project developers. Claims to these avoided emissions are inherently riskier because there is always a chance that the entities who do own or control the sources may claim the avoided emissions themselves. Major carbon crediting programs generally try to prevent conflicting claims by having project owners legally attest to having an exclusive claim to credited avoided emissions. However, it can sometimes be difficult (if not impossible) to determine exactly where emissions are physically avoided (e.g., at unidentified electric power plants for demand side energy efficiency projects), making the truth of such attestations difficult to verify. Where risks of double claiming seem significant (for example, if avoided emissions occur in sectors with significant voluntary commitments or compliance obligations), buyers should avoid carbon credits from such projects.

4.5 AVOIDING SOCIAL AND ENVIRONMENTAL HARMS

Short version: To ensure that carbon credit transactions do not make people or the environment worse off, crediting projects must avoid causing any (new) social and environmental harms.

Long version: Some projects that avoid emissions or enhance removals can at the same time harm local communities or cause (non-climate related) environmental damage. Some project types have higher risks of causing harm (see risk tables which indicate where these issues could arise for different project types). For example, large-scale hydropower projects, such as those implemented or proposed to be implemented in Brazil through the CDM, can displace local populations, and cause the loss of valuable agricultural land and the loss of ecosystems (e.g., in the flooded reservoir above the hydropower dam). Forestry projects also have the potential to cause harm. For example, in many countries unresolved land tenure issues can result in social harm if communities lose access to forestland, also forestry projects may maximize timber production and CO_2 sequestration but this could reduce the forest's diversity and lead to the degradation of the other ecosystem benefits.

To broadly uphold the principle of environmental integrity, potential harm must be prevented or minimized. At a minimum, projects should demonstrate compliance with all legal requirements in the jurisdiction where they are located. In many cases, however, additional reviews and safeguards may be necessary to guard against negative social and environmental outcomes.

4.5.1 HOW CARBON CREDITING PROGRAMS ADDRESS SOCIAL AND ENVIRONMENTAL HARMS

Carbon crediting programs generally have environmental and social safeguard policies designed to reduce the risk of any detrimental effects from registered projects. Nearly all require (and verify) that projects comply with applicable legal requirements. Most crediting programs also require local stakeholder consultations as part of the project approval process and have established grievance mechanisms to address complaints related to projects after implementation. Crediting programs may guard against the risks of harm presented by specific project types by excluding these riskier project types from the program. Crediting programs may also require risk assessment and reporting by project developers. Finally, some programs – like the Gold Standard – actively require that projects demonstrate social and environmental co-benefits (and not just avoid harm), as well as monitor and report on these benefits.

There are several "add-on" certification schemes focused on the social and environmental impacts of carbon crediting projects. Organizations like the Climate, Community, and Biodiversity Alliance (CCBA) and SOCIALCARBON, for example, certify the added co-benefits achieved by crediting projects (but do not otherwise address credit quality).

Visit our page on add-on standards to learn more

Carbon credits were originally conceived as a means to not only provide avoided emissions benefits but also co-benefits to the communities in the vicinity of crediting projects. Co-benefits from the implementation of a crediting project improve social, economic, and/or ecological outcomes. For example, co-benefits can include improving community employment opportunities, air and/or water quality, biodiversity, biological habitat conservation, energy access, or access to community health and education services.

When deciding between crediting projects to buy credits from, if you are confident in the environmental integrity of each project, then the co-benefits can be a distinguishing factor. If buying credits from a clean cookstove project, you should also be supporting a project that reduces the amount of purchased fuel as it enables more efficient use of fuel. This outcome can save households money as well as reduce air pollutant health impacts from inefficient indoor fuel combustion. As a buyer, it is useful to know your prioritization for these project characteristics – do you want to associate your organization with a project that conserves wilderness or financially benefits communities? Do you want to find a project with a connection to your business operations, products, or supply chain? Carbon credit purchases can represent a public relations risk if seen as 'buying out' of the problem of addressing climate change instead of reducing internal emissions. However, there is also risk related to a project's potential to cause social or environmental harm. By supporting projects with high co-benefits, you can turn this aspect of risk into a positive attribute. Unsurprisingly, projects with high co-benefits typically correspond with higher credit prices.

4.5.2 QUESTIONS FOR BUYERS TO ASK ABOUT SOCIAL AND ENVIRONMENTAL HARMS

Asking the following questions can help reduce the risk of purchasing carbon credits from harmful projects:

- *Before implementation, did the project developers engage and consult with local stakeholders potentially affected by the project?* Stakeholder consultation can be particularly important in developing countries, where there are often fewer regulatory safeguards. If stakeholder outreach was not undertaken, this failure should raise concerns, though the seriousness may depend on the type of project involved and where it is located. Some types of projects pose fewer risks to local communities than others.

Agriculture-based carbon credit projects can create job opportunities through increased management intensity. Image credit: The international small group and tree planting program.

- *Has the project received any program or third-party certifications affirming its environmental or social co-benefits?* Generally, such certifications (e.g., from the CCBA; SOCIALCARBON; or crediting programs themselves) can provide added assurance that a project will not cause harm and ensure that project developers have considered the concerns of local stakeholders. Projects that have not received any co-benefit certification do not necessarily pose a high risk of harm, but it may be useful to inquire with project developers about why they did not seek certification if it was an option.
- *What has the project done to minimize risks and reduce potential harm?* Where there is a significant risk, it is crucially important to understand a project's specific circumstances, how it has addressed potential risks and the concerns of local stakeholders, and what mechanisms it has in place to both avoid harm and compensate for any harm that does occur. The CCBS, for example, requires ongoing community impact monitoring associated with forestry projects. A project's documentation that is publicly accessible from the crediting program's registry, should provide information to answer this question. If not, you should reach out to the project developer directly.

5. STRATEGIES TO AVOID LOWER-QUALITY CARBON CREDITS

As the prior sections make clear, carbon credits are not a typical commodity. Although crediting programs provide some assurance, purchasing higher-quality carbon credits is not as simple as buying any "certified" credit issued by a crediting program. Some credit buyers can invest the time and resources to research and discover good projects and procure higher-quality credits. For many (if not most) buyers, that approach is not realistic. In this section, we describe – and assess the pros and cons of – some strategies for steering clear of lower-quality carbon credits. These include:

Less reliable methods

- Buying credits issued by recognized crediting programs
- Avoiding cheaper credits
- Avoiding older credit "vintages"
- Making up for lower-quality by "discounting" or "over-buying"

More reliable methods

- Sticking to lower risk project types
- Buying credits from trusted exchanges or retailers
- Buying credits from projects certified against independently assessed, higher-quality methodologies

Most reliable methods

- Buying credits from projects rated highly by independent rating services
- Vetting crediting projects directly

5.1 LESS RELIABLE METHODS

A few "quick and easy" approaches can be used to provide at least some assurance of avoiding lower-quality or less credible carbon credits. These include the following.

5.1.1 BUYING CREDITS ISSUED BY RECOGNIZED CREDITING PROGRAMS

Over the years, several independent organizations and initiatives have been established to evaluate and accredit carbon crediting programs. In some cases, these organizations were formed to provide greater assurance for voluntary buyers, by assessing and recognizing crediting programs that meet defined standards for governance, oversight, and standards development. In other cases, regulatory bodies – like the International Civil Aviation Organization (ICAO) – have developed standards for recognizing crediting programs that are eligible to serve the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

Examples:

ICROA

Established: 2008

The International Carbon Reduction and Offset Alliance (ICROA) is an industry trade group established to promote best practices within the voluntary carbon market. Purchasing credits from ICROA endorsed crediting programs can offer buyers the assurance that thresholds for program operations and management have been met. ICROA requirements include: demonstration of a program's independence from conflict of interest, markets, and project developers; effective governance practices; the use of a registry tracking system; public availability of information and transparency of procedures; the use of third-party auditors to review individual projects as well as procedures for auditor oversight; the use of carbon crediting principles to inform standard requirements; the consideration of stakeholder views through the program's development and operation; and a requirement that each program surpasses a scale threshold of listed projects (>2) and issued credits (>100,000tCO_2e).

Green-e

Established: 2008

Serving mainly North American buyers, the Green-e Climate program provides "independent oversight of marketing and sales, [so that] buyers can be sure they are getting what they paid for."[37] Green-e has endorsed four carbon crediting programs to date for which credits may be eligible for the Green-e Climate label including the Gold Standard, VCS, CAR, and ACR. The Green-e label conveys chain-of-custody certification for the carbon credit – meaning that the credit's chain of custody pathway from project implementation and credit issuance to the project developer via a registry system, through any transactions between intermediary credit brokers, traders, or exchanges, to the ultimate use and retirement of the credit in the registry tracking system has been recorded accurately and supports the exclusive claim of the credit by the buyer.

CORSIA

Established: 2016

The International Civil Aviation Organization (ICAO) proposed a goal to achieve carbon neutral growth in international aviation beyond 2020 in 2010. In 2016 it began development of a market-based mechanism – the CORSIA – to realize this goal. The CORSIA program[38] identifies existing carbon crediting programs from which airlines may source carbon credits to comply with carbon neutral growth requirements. However, in some cases CORSIA also further restricts eligibility of credits to those derived from approved project types or methodologies (see Buying credits from projects certified against independently assessed, higher-quality methodologies).

Pros: These kinds of recognition programs help to distinguish crediting programs with credible standards and governance systems from those that may be less reliable. For example, they typically ensure that recognized crediting programs are free from conflicts of interest, e.g., they do not certify and then directly sell credits to buyers.

Cons: Even within established crediting programs, there can be significant variations in quality among different project types (and even between specific registered projects). Buying carbon credits from a recognized program helps to avoid serious credibility challenges, but is not a guarantee of buying higher-quality credits.

5.1.2 AVOIDING CHEAPER CREDITS

In many markets, "cheap" is often synonymous with "lower-quality." Very cheap carbon credits can indeed be a sign of lower-quality, especially for newer projects. If a project is selling carbon credits for a price below US$1-2 per tonne (i.e., close to the transaction cost of getting a project developed, registered, and verified) then the case for additionality is probably weak; it can be hard to argue that the project truly depended on carbon credit revenue for its implementation. However, some carbon project types with high environmental integrity can avoid GHG emissions or enhance removals at relatively low cost (e.g., some types of industrial gas destruction).

The inverse argument – that higher prices correlate with higher quality – is not reliably true either. Truly additional crediting projects will have a higher intrinsic cost for avoided GHG emissions or enhanced removals and will therefore need to charge a higher price for carbon credits to be financially viable. However, there is nothing to prevent non-additional projects from also charging high prices, assuming they can find a gullible buyer. These projects may end up crowding out projects with higher actual costs.

Pros: Purchasing more expensive credits may mean a higher likelihood of additionality, as well as higher scores on other criteria like quantification, permanence, and avoidance of social and environmental harms.

Cons: Looking only for higher-priced carbon credits (without looking at other variables) is not a guarantee of higher quality.

5.1.3 AVOIDING OLDER CREDIT "VINTAGES"

The "vintage" of a carbon credit can refer either to the year in which it was issued, or the year in which its associated avoided GHG emissions or enhanced removals occurred (for some kinds of carbon credit projects, there can be a significant lag between the emissions impact and issuance, because of longer verification cycles, e.g., with forestry projects). Older issuance vintages may present a quality concern where the following conditions are true:

- The carbon credits under consideration have remained unsold for a long time; and/or
- The carbon credits are being sold directly by the project developer, where the developer:
  - » Did not contract with a dedicated carbon credit buyer upfront (e.g., under an ERPA); and/or
  - » Has carried forward a significant number of unsold carbon credits; and
  - » Has continued to operate the carbon project for several years despite the lack of carbon credit sales.

Pros: Avoiding the purchase of older credit vintages can avoid cases where credits were obviously lower-quality to begin with. It may also help to ensure that your purchase is driving new efforts to avoid emissions or enhance removals. (Even if an old project was high-quality to begin with, if it is now complete or near completion, or it has succeeded for years without selling some credits, then buying unsold credits may not contribute to addressing climate change beyond merely supporting a "sunk" benefit of the project.)

Cons: The vintage of a carbon credit does not by itself indicate anything about its quality.

5.1.4 MAKING UP FOR LOWER-QUALITY BY "DISCOUNTING" OR "OVER-BUYING"

One strategy to address quality risks is to simply retire extra carbon credits. For example, to compensate for 100 tonnes of CO_2 emissions, a buyer could purchase and retire 200 carbon credits from a range of different projects. This approach is commonly referred to as "discounting."[39]

Although this strategy does not address quality directly, it hedges against the risk that some carbon credits may be associated with avoided emissions or enhanced removals that are non-additional, over-estimated, non-permanent, or claimed by others. It may also help buyers focus on reducing their inventory emissions, since it effectively increases the cost of offsetting.

Pros: Discounting or "over-buying" credits can help make up for deficits in quality across a portfolio of carbon credits and project types. It can be particularly useful where the recognized quality deficit relates to overestimation. For example, if you know that a project was issued twice as many credits as it should have been, then purchasing and retiring two credits for every tonne of claimed mitigation could be an effective strategy.

Cons: While discounting can be part of a responsible strategy for using carbon credits, it should not be done in the absence of other methods to assess quality and avoid lower-quality credits. Doubling the purchase of non-additional credits still means that 100% of your purchases are non-additional!

5.2 MORE RELIABLE METHODS

The following approaches for avoiding lower-quality carbon credits can be more effective. However, they are not a guarantee against lower-quality and should still be pursued carefully and with attention to specific details.

5.2.1 STICKING TO LOWER RISK PROJECT TYPES

Although many kinds of projects can avoid emissions or enhance removals, some types of projects have a harder time meeting essential quality criteria than others. Industrial gas destruction projects typically have clear additionality, for example: as long as they are not required by law, there are few if any reasons to undertake them aside from generating carbon credits.[40] For many renewable energy projects, on the other hand, careful scrutiny is required to determine whether the prospect of carbon credit sales played a decisive role in their implementation (and even with such scrutiny, it can be hard to be certain – as they are often on the margin of viability with energy sales revenue alone).

Perhaps the easiest way to reduce the risk of buying lower-quality carbon credits is to restrict purchases to credits that come from lower-risk project types. Annex 1 provides an overview of the relative quality risks associated with common types of carbon crediting projects.

There are two potential drawbacks to this approach. First, as Annex 1 indicates, there are only a handful of project types that have low environmental integrity risks as a class. Second, the kinds of projects that can most easily meet environmental integrity requirements tend to be projects that offer the least in terms of environmental and social co-benefits – and vice versa. Often, a buyer must choose between a project type with lower-quality risks and one with greater co-benefits. A project that avoids N_2O emissions at a nitric acid plant, for example, will generally be highly additional, easy to quantify, will pose no ownership or permanence concerns, and will not cause social or environmental harms – but it will do little to enhance people's livelihoods or otherwise improve the environment. An agroforestry project that sequesters carbon in trees across many small farms, on the other hand, may yield a multitude of local benefits – but its GHG impact will be harder to quantify, and the carbon stored in trees may not be permanent. These kinds of trade-offs can be observed in Annex 1, which also identifies project types that offer the greatest potential for social and environmental co-benefits.

Pros: Sticking to project types that have a lower risk for quality deficits (e.g., because they typically are additional, are easier to quantify, and do not pose permanence, double counting, or social and environmental harm concerns) can be a relatively easy way to avoid lower-quality carbon credits.

Cons: Lower risk is not the same thing as a guarantee of quality. The standards and methodologies used to certify projects may still be important. Furthermore, limiting purchases to lower risk project categories may exclude many valuable mitigation activities, including those with social and environmental co-benefits.

5.2.2 BUYING CREDITS FROM TRUSTED EXCHANGES OR RETAILERS

As discussed in Section 2.4, a common way to purchase carbon credits is through a retailer or an exchange. Many of these services exist primarily to facilitate transactions and provide market liquidity, without necessarily making any representations about the quality of credits transacted (e.g., beyond indicating their origin and the standards against which they were issued). However, many retailers – and some carbon credit exchanges – market themselves as only providing high-quality credits. Procuring carbon credits from a trustworthy "high-quality" retailer or exchange is one way to avoid lower-quality credits.

The main challenge with this approach is ascertaining how trustworthy the service is and what their methods are for selecting higher-quality credits. One way to do this is to inquire about which of the various approaches described by this guide they themselves follow. For example, are they simply acquiring carbon credits issued under independently recognized crediting programs (Section 5.1.1) – which may not be a reliable guarantee of quality? Or are they only making credits available from specific projects that are rated highly by an independent rating service (Section 5.3.1)?

Pros: Sticking to a reliable retailer or exchange for acquiring carbon credits can be a relatively easy way to avoid lower-quality credits, provided the retailer or exchange does a good job themselves of selecting for higher-quality.

Cons: This approach still requires care to determine the relative trustworthiness of the retailer or exchange and to evaluate the criteria they use to select higher-quality carbon credits.

5.2.3 BUYING CREDITS FROM PROJECTS CERTIFIED AGAINST INDEPENDENTLY ASSESSED, HIGHER-QUALITY METHODOLOGIES

A relatively recent development in the voluntary carbon market is the establishment of initiatives that independently assess both (1) crediting programs and their governance (like the initiatives described in Section 5.1.1); and (2) the relative rigor and quality of individual methodologies used by these crediting programs to register projects and issue credits. These initiatives identify not just credible programs, but also which of the methodologies used by these programs tend to be higher-quality. Projects that follow more stringent methodologies, for example, stand a greater chance of clearing a high bar for quality.

Two prominent examples of these initiatives are the Integrity Council for the Voluntary Carbon Market (IC-VCM) and the Carbon Credit Quality Initiative (CCQI). The goal of the IC-VCM is to identify specific project categories (crediting program and project type combinations) that meet a threshold for quality (or "integrity," as defined by the IC-VCM). The CCQI rates individual methodologies on a five-point scale, indicating how they compare both within and across crediting programs (which in some cases also considers differences in crediting program governance and procedures).

As indicted in Section 5.1.1, ICAO is also selective about the specific methodologies that are eligible for use under CORSIA. However, ICAO's decisions to exclude methodologies are typically based on policy considerations, not an explicit assessment of their quality deficits. The primary hurdle for eligibility under CORSIA is meeting programmatic requirements and it is therefore not strictly comparable to the ICVCM or CCQI initiatives.

Examples:

iC THE INTEGRITY COUNCIL FOR THE VOLUNTARY CARBON MARKET

Established: 2024 (still under development)

The IC-VCM was established as an independent governance body for the voluntary carbon market, initiated by carbon market stakeholders and leaders in climate finance. It has identified "Core Carbon Principles" (CCPs) that define quality thresholds for specific combinations of crediting programs and carbon credit methodologies. The IC-VCM is in the process of assessing crediting programs' approved methodologies against the CCPs, initially targeting the methodologies that comprise the largest share of credits in the voluntary market. The assessment will determine which methodologies meet the CCP quality thresholds and can therefore be labeled as high-quality.

CCQI Carbon Credit Quality Initiative

Established: 2021

The CCQI is an initiative founded and managed by three non-profit organizations: the Environmental Defense Fund (EDF), the

World Wildlife Fund (WWF), and Oeko Institute. The CCQI evaluates crediting programs and individual methodologies and assigns quality rating scores specific to each methodology (see CCQI FAQ for more info). The CCQI has made its methodology publicly available online and publishes the results of scores which are integrated into an online scoring tool. The tool guides users to select the type of project they are interested in, the crediting program, the country of implementation, the timing of the avoided emissions or enhanced removals, and the specific methodology that was selected. Each of these factors can potentially result in different scores based upon the assessment CCQI experts have conducted.

Pros: These initiatives allow buyers to identify carbon credits issued under more rigorous standards and methodologies, thus reducing the risk that the credits will be of lower-quality. This may be a more reliable approach than, for example, sticking to lower risk project types (Section 5.2.1), because even within a project category, the methodologies used by crediting programs can be more or less stringent. Moreover, higher-quality methodologies can help guard against poor-quality carbon credits even for project types with higher inherent risk, thus expanding the pool of potentially "safe" carbon credits.

Cons: Rating credits at the methodology (or program and methodology) level may still be a blunt way to discriminate between higher- and lower-quality credits. There is a still a risk of "bad" (lower-quality) projects being certified under higher-quality methodologies. Conversely, it is often still possible to find high-quality projects registered under lower-rated methodologies. Truly understanding the relative quality of carbon credits may require project-level reviews, which these initiatives do not provide.

5.3 MOST RELIABLE METHODS

The following approaches for avoiding lower-quality carbon credits are the most effective. These approaches rely upon quality assessment by actors with significant technical expertise. Still, these methods are not a guarantee against lower-quality and should be pursued carefully and with attention to specific details.

5.3.1 BUYING CREDITS FROM PROJECTS RATED HIGHLY BY INDEPENDENT RATING SERVICES

Carbon credit rating services that rate the quality of individual projects are relatively new to the voluntary carbon market. In line with this guide's presentation of how to think about carbon credit quality (Section 4), existing services typically provide nuanced ratings that distinguish relative quality on a sliding scale, often across different criteria and quality dimensions (e.g., additionality, quantification, permanence, exclusive claims, and avoidance of social and environmental harms).

In practice what these services do is interrogate projects in line with (some version of) the recommendations found in Section 5.3.2. Some rating services offer bespoke ratings for individual clients.[41] Others may team up with specific platforms to make their ratings available, such as the Salesforce Net Zero Marketplace or Allied Offsets which host ratings from three credit rating companies (for some listed projects). In 2023, Carbon Market Watch published a review of existing services and how they conduct their ratings. However, (when this page was published in 2024) all such services were operated as for-profit companies that typically do not divulge the details of their rating methods, nor do they typically make their ratings publicly available.

Pros: Relying on individual project ratings, conducted by a rigorous and reliable rating service, is probably the strongest way to avoid lower-quality carbon credits (short of conducting one's own project-level due diligence). Such ratings can help buyers avoid lower-quality projects that may slip through the standards and vetting processes of carbon crediting programs, and provide a more nuanced approach to assessing carbon credit quality than simply looking at methodology-level reviews. Looking at project-level ratings is perhaps the only reliable way to discover individual higher-quality projects in "higher risk" categories (see Annex 1).

Cons: Most rating services are operated by for-profit companies who treat their procedures as confidential intellectual property. Buyers therefore need to pay for these services, which can add to cost, and in some cases the rating methods may still not be transparent. In addition, as the Carbon Market Watch report referenced above makes clear, different services sometimes attach markedly different scores to the same projects. Some discretion may therefore still be warranted in relying on any particular service provider.

5.3.2 VETTING PROJECTS DIRECTLY

Buyers can ask basic questions about crediting projects that may help screen out lower-quality options. In most cases, project developers and carbon credit owners should be forthcoming with answers to such questions (if they are not, it is a red flag). The level of effort required to investigate a crediting project can vary, depending on a buyer's resources and the type of project involved. One option is to engage the services of consultants or trusted retailers to examine projects. It is often a good idea to work with someone who has a detailed understanding of the sectors or project types being considered, which in some cases could involve enlisting multiple experts. For more sophisticated buyers with the resources to perform this due diligence, we offer guidance to conduct crediting project "due diligence" for each quality criteria as well as a sample case study.

Conducting crediting project due diligence

Pros: For buyers with time, resources, and expertise, vetting crediting projects can provide deep and direct insight into their merits and relative quality. As with using carbon credit rating services, this approach can help to avoid lower-quality projects, and to discover individual higher-quality projects within "higher risk" categories. It may be the only way to discover such projects if they have not been rated by a rating service.

Cons: Vetting projects directly requires time, expertise, and resources, and may be infeasible for many buyers. It may also be an inefficient way to discover higher-quality credits for buyers interested primarily in "common" project types already assessed by rating services.

6. WHAT DOES IT MEAN TO USE CARBON CREDITS RESPONSIBLY?

When first proposed in the late 1980s, carbon credits were conceived as a tool to reduce the cost of meeting a particular GHG inventory reduction goal. Actors who might face a regulatory obligation to reduce emissions – power plant owners in an emissions trading (or cap-and-trade) system, for example – could "offset" their emissions by acquiring carbon credits from emission sources not facing an obligation, rather than make more costly investments to reduce emissions at their own facilities. Since, to mitigate climate change, it does not matter where in the world GHG emissions are reduced, this arrangement (in principle) would allow for greater flexibility and lower overall costs. Lower compliance costs would, in turn, allow for setting more aggressive reduction targets – leading to higher ambition and more emission reductions globally.

When companies began voluntarily committing to reduce their emissions, the role of carbon credits was initially viewed in the same way. That is, a company could commit to becoming "carbon neutral" not by fully eliminating its allocated inventory emissions, but instead by using carbon credits to more cost-effectively achieve that goal. Theoretically, a company would reduce its own allocated emissions (e.g., scopes 1-3) if it could do so for less than the cost of a carbon credit, but otherwise would rely on carbon credits to achieve its target.

This model of voluntary offsetting, however, has faced criticism. As section 3 of this guide indicates, a prevalent concern about carbon credits is that companies may "over-rely" on them instead of achieving inventory emission reductions. That is, the temptation is for companies to use carbon credits to achieve a substantial portion of their GHG reduction goals, rather than make investments to mitigate emissions from their own operations. Multiple environmental groups and standard-setting organizations have argued that users of carbon credits should instead follow a "mitigation hierarchy"[42] under which they prioritize climate action as follows:

1. Take steps to substantially reduce one's own allocated inventory emissions – for example, reduce emissions in line with what would be required if, collectively, the world were to follow a pathway to net zero emissions by the middle of the century.
2. Use carbon credits only to offset any remaining emissions.

When various actors speak of "responsible use" of carbon credits, they typically mean following some version of this mitigation hierarchy.[43] The Voluntary Carbon Market Integrity Initiative (VCMI), for example, was launched in 2021 with the express purpose of recognizing companies following this approach. The Science-Based Targets initiative (SBTi) has likewise, since its inception in 2013, focused on step 1 in the hierarchy, and only in 2021 began to contemplate a role for carbon credits with the initiation of its Net Zero standard.

The tension between these two approaches (least-cost achievement of a reduction goal vs. following a mitigation hierarchy) arises largely from different understandings about what companies claim to be doing – or what they should be doing – to address climate change.

For example, many stakeholders interpret a "carbon neutrality" claim as implying a focus on reducing one's own allocated inventory emissions. Indeed, many consumers may interpret "neutrality" or "net zero" claims as equivalent to having an actual carbon footprint of zero. Using carbon credits as a primary (or even substantial) means to make such a claim may therefore be seen as misleading. A "carbon neutral" airplane flight is not the same as a "carbon free" flight (e.g., powered entirely by renewable fuels) – and companies could be criticized for implying such an equivalence. In other words, people often interpret a "neutrality" claim as something other than a simple least-cost mitigation exercise.

Similarly, under SBTi's model, many stakeholders argue that the primary purpose of voluntary climate action (i.e., what they should be doing) is not to reduce emissions wherever they may occur (e.g., at the lowest cost), but to devote resources to decarbonizing a company's own allocated inventory emissions, even if it is costly to do so. In that context, using carbon credits is not relevant or appropriate. Using carbon credits to (nominally) achieve a goal defined with respect to a company's allocated inventory emissions would again lead to misleading claims ("the company said it would do X, but instead it did Y") – and would diverge from what a company should be doing. Under SBTi's approach (and other "net zero" frameworks), carbon credits may only be used to fulfill ancillary objectives, such as "neutralizing" (with enhanced removals) any emissions that remain after targets are achieved, or to achieve mitigation above and beyond any targeted reductions in allocated emissions (i.e., what SBTi refers to as "beyond value chain mitigation").

Debates about responsible use are far from resolved. For example, what happens if a company is unable to meet the targets defined for its own allocated emissions? Should it simply declare failure, or is using carbon credits to "make up the difference" still acceptable? If companies focus only on reducing their own allocated inventory emissions, which may be costly to mitigate, won't that mean less overall climate action? How can we get companies to both decarbonize their own operations and provide sorely needed financing (e.g., through carbon credits) for broader climate change mitigation throughout the world?

Different initiatives are proposing different answers to these questions – or are still working through them. Meanwhile, the current emphasis on a mitigation hierarchy has engendered a parallel debate, on whether use of carbon credits should emphasize enhanced removals over avoided emissions.

Are enhanced removal credits "better" than avoided emission credits?

"Offsetting" vs. "mitigation contribution" claims

The Paris Agreement and corresponding adjustments

6. CONCLUSION

Recent years have seen a surge in interest in carbon credits, and this is a good sign. It suggests public attention to climate change is growing, at a time when action to address it is more urgent than ever. As we make clear in this guide, carbon credits are far from a perfect tool. If used carelessly, carbon credits could slow progress on climate change and amount to little more than greenwashing. However, when high quality credits are used responsibly, they can accelerate action on climate change beyond the slow pace that has so far been set and enabled through government policies.

There is a general consensus that using carbon credits responsibly requires, first, a strong plan for reducing one's own GHG emissions. Simply buying credits instead of taking more direct and aggressive action – flying less, for example, or investing in improving the energy efficacy of your buildings, equipment, and vehicles – is not defensible given the strong need for aggressive action in all areas of human activity.

Responsible use also requires spending time to understand and seek out higher-quality credits. Carbon credit programs provide a necessary level of quality assurance for the credits they issue and you should avoid carbon credits that have not been certified by an established program. But, whether this assurance is sufficient is another question. As explained in **section 4**, whether a carbon credit has "environmental integrity" is not a binary question. Quality exists along a continuum defined by the level of confidence one has in a crediting project's additionality (first and foremost), as well as its quantification, permanence, exclusive claim to avoided emissions or enhanced removals, and avoidance of social and environmental harms. The issuance of a carbon credit signifies – or should signify – that a project meets a minimum quality threshold. However, crediting programs do not have spotless track records. You should not equate meeting a minimum threshold with high confidence in environmental integrity. It is important to understand the projects you are buying from, ask questions about key quality criteria (like whether a project has other revenue streams), and stick to project types that are more likely to fulfill basic quality requirements (as indicated in **Annex 1**).

Finally, voluntarily using carbon credits may be a valid way to accelerate climate action, but buyers should never neglect the need for ambitious governmental policy responses. Using high quality carbon credits to make a claim of carbon neutrality – even a highly defensible claim – is a detriment to climate action if it distracts companies, customers, and other stakeholders from pushing for stronger regulation and carbon pricing policies. Voluntary action cannot supersede policy action! Coordination between voluntary actors and governments will be essential for ensuring a strong collective response to climate change. Carbon credits should be seen as one element of this collective response, not a solution by themselves.

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ANNEX 1: CREDITING PROJECT TYPES AND RELATIVE QUALITY RISKS

Some types of crediting projects have an easier time meeting essential carbon credit quality criteria than others. In the following tables, we distinguish between "lower risk" project types, where individual projects will frequently meet all carbon credit quality criteria, and other project types, where more caution is often necessary. For each project type, we indicate in the tables whether meeting a particular criterion could be relatively difficult and may therefore be of particular concern when considering a carbon credit purchase. In Tables 3-5, if a cell is left blank, then the quality criterion is not a major concern for that project type.

Table 2. Relative carbon credit quality risk for different project types

Lower risk	Medium risk	Higher risk
• CO_2 usage • Methane destruction (w/o utilization) • N_2O avoidance from nitric acid production • N_2O – adipic acid* • Ozone-depleting substance (ODS) destruction • Direct air carbon capture and storage • Enhanced weathering	• Methane capture and utilization • Methane avoidance • Energy distribution • Energy efficiency, household demand side • PFCs & SF_6 avoidance/ reuse • Renewable energy, small scale	• Agriculture • Biomass energy • Cement production • Energy efficiency, industrial demand side • Energy efficiency -- supply side • Forestry & land use • Fossil fuel switching • Fugitive gas capture or avoidance • Low-carbon transportation measures • Renewable energy, large scale

* Studies have found potential concerns with N_2O avoidance projects at adipic acid plants. In principle, however, these could be lower risk projects if appropriate methodologies are applied.

Table 3. Lower risk project types

Project Type	Sub-types Included	Additionality	Quantification & Leakage	Other (Ownership/ Double Counting, Permanence)	Co-benefits/ Harms
CO_2 usage	Use of CO_2 from biomass or industrial tail gases to replace fossil or mineral CO_2 in industrial applications				
Methane destruction	Coalmine ventilation air methane (VAM) destruction				Harms: Could be seen as supporting coal industry and therefore not a project type consistent with long-term climate goals.
	Landfill gas flaring	Varies by location. Projects are likely additional in most parts of the developing world. In developed countries, including the United States, some projects are pursued to avoid triggering compliance requirements.	Some potential for baseline uncertainties (e.g., how much methane would have been generated in the absence of a project), but most are addressed through program quantification & eligibility rules.		Benefit: May reduce odor issues for communities near landfills.

Project Type	Sub-types Included	Additionality	Quantification & Leakage	Other (Ownership/ Double Counting, Permanence)	Co-benefits/ Harms
N_2O avoidance from nitric acid production	Various process improvements in nitric acid production		The baseline can be overestimated, as N_2O measurement is technically complex.		Harms: Could be seen as supporting the manufacture of synthetic fertilizer and therefore not consistent with long-term climate goals
N_2O destruction in adipic acid production	Destruction or reuse/ recycling of N_2O by-product from adipic acid production		Studies have found evidence of plants increasing their acid production to generate more N_2O to destroy for carbon credits. Current methodologies may correct for this tendency.		
Destruction of ozone depleting substances (ODS)	Collection and destruction of ODS used in insulating foams and refrigeration equipment		Some uncertainties may exist regarding baseline emission rates (e.g., how quickly ODS would leak if reused in old equipment). The high GWP for ODS gases can amplify quantification errors.		Benefit: Destruction of ODS helps to accelerate recovery of stratospheric ozone.

Project Type	Sub-types Included	Additionality	Quantification & Leakage	Other (Ownership/ Double Counting, Permanence)	Co-benefits/ Harms
Direct air carbon capture and storage	Spreading finely ground olivine or basalt over farmland or seawater or in use for landscaping			Must use well-selected, designed, and managed carbon capture and storage sites to reduce non-permanence risk.	If Enhanced Oil Recovery (EOR) is involved in the process there may be some concerns relating to the production of oil.
Enhanced weathering	Spreading finely ground olivine or basalt over farmland or seawater or in use for landscaping				Benefits: can be used as replacement for synthetic fertilizers to promote crop yields, can reduce ocean acidification. Harms: may cause soil contamination and disturb ecosystems, risks relating to increased mining. Potential human health risks from grinding minerals to very fine sizes.

Table 4. Medium risk project types

Project Type	Sub-types Included	Additionality	Quantification	Other (Ownership/ Double Counting, Permanence)	Co-benefits / Harms
Methane capture and utilization for energy	Coal mine methane, coal bed methane	Carbon credit revenue can make up a large portion of return on capital investment; however, technical hurdles for these projects are no longer substantial and there are significant levels of business-as-usual methane usage at mines in some countries.	Some projects may incentivize increased drainage of methane, leading to more methane destroyed than would have been released in the baseline. Most methodologies control for this, however. Where methane is utilized for energy generation, some uncertainties can arise regarding the baseline for displaced emissions.	Ownership: Projects that generate energy using captured methane may result in indirect avoided emissions (e.g., at grid-connected power plants).	Benefits: May have air pollution benefits if captured methane is used to displace coal. Harms: Could be seen as supporting coal industry and therefore not a project type consistent with long-term climate goals.
	Livestock methane, manure management, biogas utilization	For some projects in some locations, it is important to evaluate whether other revenue streams and funding sources would enable implementation without carbon revenues.	Some potential for baseline uncertainties, but most can be addressed through quantification & eligibility rules. Where methane is utilized for energy generation, some uncertainties can arise regarding the baseline for displaced emissions.	Ownership: Projects that generate energy using captured methane may result in indirect avoided emissions (e.g., at grid-connected power plants).	Benefits: Crediting projects at industrial livestock operations may mitigate local environmental impacts. Similarly, biodigesters can provide energy families use for cooking, saving money on fuel and reducing the sanitary issues associated with burning of animal and human waste. A lower dependence on firewood due to biogas use reduces fuel wood use.

Project Type	Sub-types Included	Additionality	Quantification	Other (Ownership/ Double Counting, Permanence)	Co-benefits / Harms
Methane capture and utilization for energy (cont.)	Other (waste water, industrial solid waste methane capture & utilization)	Regulatory drivers should be examined for many of these projects. For some projects in some locations, it is important to evaluate whether other revenue streams and funding sources would enable implementation without carbon revenues.	Some potential for baseline uncertainties, but most can be addressed through quantification and eligibility rules. Where methane is utilized for energy generation, some uncertainties can arise regarding the baseline for displaced emissions.	Ownership: Projects that generate energy using captured methane may result in indirect avoided emissions (e.g., at grid-connected power plants).	Benefit: May reduce odor issues for communities near facilities.
	Landfill gas utilization (for energy, electricity)	Varies by location. Projects are likely additional in most parts of the developing world. In developed countries, including the United States, some projects are pursued to avoid triggering compliance requirements, and projects that generate energy can be economical without carbon revenue.	Some potential for baseline uncertainties (e.g., how much methane would have been generated in the absence of a project), but most are addressed through program quantification & eligibility rules. Where methane is utilized for energy generation, some uncertainties can arise regarding the baseline for displaced emissions.	Ownership: Projects that generate energy using captured methane may result in indirect avoided emissions (e.g., at grid-connected power plants).	Benefit: May reduce odor issues for communities near landfills.

Project Type	Sub-types Included	Additionality	Quantification	Other (Ownership/ Double Counting, Permanence)	Co-benefits / Harms
Methane emission avoidance	Composting; aerobic treatment of waste or wastewater; palm oil waste management / utilization	For composting and aerobic waste treatment, compliance drivers should be carefully examined. For some projects in some locations, it is important to evaluate whether other revenue streams and funding sources would enable implementation without carbon revenues.	Some potential for baseline uncertainties, but most can be addressed through quantification & eligibility rules. If palm oil (or other) waste is used for energy generation, uncertainties can arise regarding the baseline for displaced emissions.	Ownership: Projects that generate energy (e.g., from palm oil waste) may result in indirect avoided emissions (e.g., at grid-connected power plants).	Benefits: Composting projects help reduce food waste, promote the environmental and health benefits of organic farming and reduce fossil-based fertilizer demand.
Energy distribution	District heating, connection of isolated grids, microgrid development, other	Additionality may be unclear in many cases; projects may be capital intensive and it may not be clear that carbon revenues would be decisive for investment decisions.	May be some uncertainty about baseline emissions that are avoided through the project; quantification methodologies will generally address this concern with sufficient conservativeness.	Ownership/double counting: Often results in indirect avoided emissions. Where distribution displaces electricity applications (e.g., fewer space heaters used as a result of a district heating project), electricity generators could double count avoided emissions.	Benefits: Can lead to significant air quality benefits where displacing inefficient distributed combustion (e.g., in home coal or peat stoves). Connecting isolated grids or microgrid development, provides more reliable energy access.

Project Type	Sub-types Included	Additionality	Quantification	Other (Ownership/ Double Counting, Permanence)	Co-benefits / Harms
Energy efficiency, household demand side	Improved cookstoves		Significant uncertainty and potential for over-crediting due to approaches used to estimate reduction in biomass fuel used due to improved stoves, fraction of non-renewable biomass (i.e., emissions associated with land-use change impacts), emission factors for wood-fuel used in baseline, inclusion of "suppressed demand" for fossil fuels, and underestimation of stove abandonment or stove stacking.	Permanence: Where project includes accounting for avoided deforestation (i.e., increase in forest carbon stocks due to decreased use of biomass), carbon storage could be reversed.	Benefits: Can lead to significant air quality benefits where replacing inefficient distributed combustion (e.g., in home wood, coal, charcoal or peat stoves) and therefore significant health benefits for families using improved cookstoves. Can lead to creation of new employment through market for stoves. Can reduce time and expenditures on fuel by rural families.
	More efficient lighting, insulation, & appliances; HVAC systems; air conditioning; street lighting; water pumping and purification; etc.	For some projects, it may be hard to show that carbon revenues were a decisive factor, e.g. where energy cost savings exceed carbon credit revenues. In many places, improved efficiency is already common practice with national and local support schemes.	Often there can be uncertainty about avoided baseline emissions, actual adoption rates for new equipment, and/or baseline usage patterns. Baselines are sometimes linked to estimates of "suppressed demand" for fossil fuels, which run the risk of overestimating baseline emissions.	Ownership/double counting: Energy efficiency measures will often lead to indirect avoided emissions, meaning greater potential for double counting.	Benefits: Can lead to cost savings for end users, and meaningful public health improvements for communities and families in low income areas.

Project Type	Sub-types Included	Additionality	Quantification	Other (Ownership/ Double Counting, Permanence)	Co-benefits / Harms
PFC & SF_6 avoidance & reuse	PFC & SF_6 emission avoidance; SF_6 capture & re-use	Additionality depends on specific project activity and facilities involved. In some contexts, measures for avoiding emissions may be cost-effective without carbon revenues. In addition, PFCs and SF_6 are increasingly being regulated by governments, and so some projects could be mandated in some jurisdictions. Some projects may be pursued in anticipation of these regulations, prior to them taking effect.			

Project Type	Sub-types Included	Additionality	Quantification	Other (Ownership/ Double Counting, Permanence)	Co-benefits/ Harms
Renewable energy, small scale (under 15 MW)	Electricity generation from small-scale (run of river) hydropower plants	Can face greater investment hurdles than large hydro projects, but it is often not clear whether carbon revenues would materially affect investment decisions	May be some uncertainty about baseline emissions avoided by the project; quantification methodologies will generally (though not always) address this concern conservatively.	Ownership/double counting: If grid-connected or otherwise displacing fossil fuel energy, these projects will result in indirect avoided emissions; electricity generators could double count the avoided emissions. If Renewable Energy Credits (RECs) or Guarantees of Origin (GoOs) are also sold from the project, then another entity may functionally double count the avoided emissions.	Benefits: Reduced air pollution where fossil generation is displaced. Rural electrification. Harms: Displaced ecosystem services and communities that relied on previous river resources (this is less of a concern for smaller projects).
	Electricity generation from solar, wind, geothermal, other renewable power sources	For many of these projects, it is not clear that carbon revenues can decisively influence investment decisions.	May be some uncertainty about baseline emissions avoided by the project; quantification methodologies will generally (though not always) address conservatively.	Ownership/double counting: If grid-connected or otherwise displacing fossil fuel energy, these projects will result in indirect avoided emissions; electricity generators could double count the avoided emissions. If RECs or GoOs are also sold from project, then another entity may functionally double count the avoided emissions.	Benefits: Reduced air pollution where fossil generation is displaced. Rural electrification.
	Gasification and/or combustion of municipal solid waste	For many of these projects, it is not clear that carbon revenues can decisively influence investment decisions.	Potential uncertainties related to baseline methane emissions avoided by the project. Potential uncertainties related to displaced energy emissions (similar to other renewable energy projects).	Ownership/double counting: If grid-connected or otherwise displacing fossil fuel energy, these projects will result in indirect avoided emissions; electricity generators could double count avoided emissions. If RECs or GoOs are also sold from project then another entity may functionally double count the avoided emissions.	Benefits: Better local solid waste management. Harm: Air pollution, if advanced emission controls are not part of project.

Table 5. Higher risk project types

Project Type	Sub-types Included	Additionality	Quantification	Other (Ownership/ Double Counting, Permanence	Co-benefits/ Harms
Agriculture	Low-till/no-till soil carbon sequestration; use of biochar	Additionality is context-specific. In the U.S., for example, low-till/ no-till is increasingly common practice. Frequently, for individual landowners, carbon revenues for these project types are too low to play a decisive role in changing practice. Programmatic approaches (where many landowners are aggregated together under a single project) are more likely to be additional.	Quantification of net avoided emissions or enhaced removals in biological systems are inherently more uncertain than for many other project types; diverse and uncontrolled implementation environments make measurement, monitoring, and verification more difficult. Leakage risk can be a significant issue for tillage projects (to the extent crop yields are affected).	Permanence: Risk of reversal (i.e., non-permanent enhanced removals) is a concern for all carbon storage projects.	Benefits: Both biochar and tillage projects can enhance soil productivity and reduce erosion, increasing farmers' yields and reducing impact on aquatic ecosystems.
	Rice cultivation methane avoidance, improved fertilizer management, etc.	Improved fertilizer management can often pay for itself (without carbon revenue), although barriers may prevent efficient investments in some cases. Conversely, carbon revenues for these project types (rice methane, nutrient management) are often too low to play a decisive role in changing practice. Programmatic approaches (where many landowners are aggregated together under a single project) are more likely to be additional.	Quantification of net avoided emissions in biological systems is inherently more uncertain than for many other project types; diverse and uncontrolled implementation environments make measurement, monitoring, and verification more difficult. Leakage risk can be a significant issue to the extent crop yields are affected (shifting production to lands where mitigation actions are not practiced).		Benefits: Improved fertilizer management can help reduce nutrient runoff. Harms: Effects of alternative rice cultivation methods may vary depending on context. (In California, for example, reduced flooding of fields may negatively impact waterfowl habitat.)

Project Type	Sub-types Included	Additionality	Quantification	Other (Ownership/ Double Counting, Permanence)	Co-benefits/ Harms
Biomass energy	Industrial waste: Bagasse power, palm oil solid waste, black liquor, forest residues, sawmill waste, industrial waste, biodiesel from waste oil	Regulatory incentives frequently make biomass power competitive with fossil fuels, even without carbon revenues. Some studies have questioned the application of barrier and investment analyses to assess the additionality of these projects.	Some risk of exaggerated claims of avoided methane emissions associated with anaerobic decay of biomass.	Ownership/double counting: Often results in indirect avoided emissions; other energy suppliers or electricity generators could double count avoided emissions.	Benefits: Supports the beneficial use of waste from agricultural industries, diverting waste from landfills and providing revenue in return for environmental benefit. A source of renewable and environmentally-improved energy by generating electricity from waste. Accordingly, creates more sustainable patterns of production.
	Agricultural farm residue, forest residue, and dedicated energy crop	Regulatory incentives frequently make biomass power competitive with fossil fuels, even without carbon revenues. Some studies have questioned the application of barrier and investment analyses to assess the additionality of these projects.	Significant risks of over-crediting concern due to lack of assessment of land use, as well as direct and indirect land use change from collection of biomass feedstocks (leakage risk). Some methodologies may better address these concerns than others.	Ownership/double counting: Often results in indirect avoided emissions; other energy suppliers or electricity generators could double count avoided emissions.	Benefits: Promotes renewable energy development. If land-use risks are properly dealt with, creates more sustainable patterns of production. Harms: Risks competing with other land-uses, primarily agriculture for food and reforestation/ afforestation.

Project Type	Sub-types Included	Additionality	Quantification	Other (Ownership/ Double Counting, Permanence)	Co-benefits/ Harms
Cement production	Use of blended cements, process and efficiency improvements	Choice of cement blends is often determined by institutional purchasing or compliance requirements over which carbon revenues have little influence; higher-blend cements are also often cheaper than standard blends. Additionality for these projects may therefore hinge upon non-financial factors that are more difficult to prove.			
Energy efficiency, industrial demand side	Various forms of Industrial energy use efficiency	Many industrial efficiency projects pay for themselves and are common practice. Carbon revenues are often small relative to energy cost savings, so are seldom a decisive factor in pursuing a project.		Ownership/double counting: Energy efficiency measures will often lead to indirect avoided emissions, meaning greater potential for double counting of avoided emissions.	Benefits: Increasing industrial energy efficiency decreases the lifecycle emissions – and environmental impact – of products. These projects contribute to private sector participation in decarbonization.

Project Type	Sub-types Included	Additionality	Quantification	Other (Ownership/ Double Counting, Permanence)	Co-benefits/ Harms
Energy efficiency – supply side	Waste heat/ gas recovery; combined heat and power projects; improving energy conversion efficiency at boilers, power plants, etc.	Carbon revenues are often small relative to energy cost savings, so are seldom a decisive factor in pursuing a project. Projects are also common practice in many (though not all) countries and sectors. Some studies have questioned the application of barrier and investment analyses to assess the additionality of these projects.	Baseline determination can be complicated and site-specific. In existing facilities, it can be difficult to assess the actual use of waste heat in the baseline. In new projects, there are high uncertainties in modelling baseline waste heat production. Baselines under some methodologies for supply-side efficiency projects have been set too high, resulting in over-crediting.	Ownership/double counting: Projects that displace emissions at other sources (e.g., on electricity grid) will lead to indirect avoided emissions, meaning greater potential for double counting.	Harms: Financially supporting energy efficiency improvements in fossil burning energy systems may slow the transition to low-carbon energy systems.
Forestry and land use	Afforestation & reforestation; avoided deforestation; improved forest management; agroforestry; avoided conversion of high-carbon soils	Frequent challenges in determining baseline activity, which may be highly site-specific. Since the baseline determines how much carbon storage is additional, this makes additionality uncertain. In addition, timber and land-use values often exceed carbon revenue value, making it difficult in some cases to determine whether carbon revenues were decisive in changing baseline activities.	There are frequently significant baseline uncertainties for these project types. In addition, diverse and uncontrolled implementation environments make measurement, monitoring, and verification more difficult for these projects. Significant leakage risk can occur from displacement of harvesting or land-use development (i.e., reduced harvest in one area can cause an increase elsewhere)	Permanence: Risk of reversal (i.e., non-permanent enhanced removals) is a concern for all carbon storage projects.	Benefits: Forests provide a range of ecosystem services that forest sector crediting projects can maintain and expand. These may include increased local livelihoods, maintaining ecosystems and biodiversity, local farm productivity (pollination and precipitation services), limiting runoff, and water filtration.

Project Type	Sub-types Included	Additionality	Quantification	Other (Ownership/ Double Counting, Permanence)	Co-benefits/ Harms
Forestry and land use (cont.)					Avoided conversion of grasslands can yield significant environmental benefits beyond carbon storage, such as preserving landscapes and biodiversity. Harms: Poorly-designed forestry projects that do not sufficiently engage local communities and indigenous peoples can have major negative impacts, including livelihood restrictions and even community displacement.
Fossil fuel switching	Switch from coal to natural gas in boilers or power generation; use of natural gas as a transportation fuel	Carbon revenues are often a small component of total project revenues, so are seldom a decisive factor in pursuing a project. Studies have identified significant uncertainties in assessment of investment barriers to fuel switching, and point to new natural gas projects becoming increasingly common practice and non-additional.	Failure to account for upstream emissions from fossil fuel extraction & transport (e.g., methane leaks at well-head or in transmission & distribution) can lead to over-crediting.		Harms: Supporting adoption or continued use of fossil fuels may slow the transition to low-carbon energy systems. Widespread use of natural gas is incompatible with the temperature goals of the Paris Agreement.

Project Type	Sub-types Included	Additionality	Quantification	Other (Ownership/ Double Counting, Permanence)	Co-benefits/ Harms
Fugitive gases	Waste gas recovery from oil & gas production or other industrial operations; leak prevention in natural gas transmission & distribution systems; other fugitive gas prevention and recovery	Many fugitive avoided emission activities are cost-effective without carbon revenues; the financial value of preventing fugitive emissions (e.g., in terms of reduced fuel losses) often exceeds the carbon revenue value, so carbon revenues are seldom a decisive factor in pursuing a project.	Where waste gas quantities are directly measured, quantification concerns are low. Fugitive emissions, however, can be hard to detect and quantify, creating uncertainties about the effects of leak prevention activities.		Harms: Supporting adoption or continued use of fossil fuels may slow the transition to low-carbon energy systems. Widespread use of natural gas is incompatible with the temperature goals of the Paris Agreement.
Renewable energy, large scale	Geothermal; solar; mixed renewables; tidal energy; other	Unconventional renewables face greater financial hurdles than other technologies, and thus are more likely to be additional. However, carbon revenues are often a small component of total project revenues, so are seldom a decisive factor in pursuing a project.	May be some uncertainty about baseline emissions avoided by the project; quantification methodologies will generally (though not always) address conservatively.	Ownership/double counting: Projects that displace emissions at other sources (e.g., on electricity grid) will lead to indirect avoided emissions, meaning greater potential for double counting.	Benefits: Reduced air pollution where fossil generation is displaced.

Project Type	Sub-types Included	Additionality	Quantification	Other (Ownership/ Double Counting, Permanence)	Co-benefits/ Harms
Renewable energy, large scale (cont.)	Hydropower and wind projects	Common practice in many countries Carbon revenues are often a small component of total project revenues, so are seldom a decisive factor in pursuing a project. Studies have found documented concerns related to additionality assessment in large-scale hydro and wind projects.	May be some uncertainty about avoided baseline emissions; quantification methodologies will generally (though not always) address conservatively. Some studies have identified issues with quantification methodologies for hydro projects, particularly when methane emissions (from plant material that is buried in the dam reservoir) are omitted, leading to over-crediting .	Ownership/double counting: Projects that displace emissions at other sources (e.g., on electricity grid) will lead to indirect avoided emissions, meaning greater potential for double counting.	Harms: Some large-scale hydropower projects have well-documented negative social and environmental impacts. These projects can displace local communities and indigenous peoples, degrade forests, harm biodiversity and affect aquatic life and existing food sources for populations.
Low-carbon transportation measures	Public transportation improvements, mode shifting, vehicular fuel efficiency improvements, vehicle scrapping or retirement	In general, the mitigation cost of transportation projects ($/ tonne CO_2 avoided) is well above historical prices for carbon credits, calling into question whether credit revenues decisively incentivize projects. For transport efficiency projects, fuel cost savings often (substantially) exceed carbon revenues from avoided emissions, raising similar questions about additionality.	High levels of uncertainty in quantifying avoided emissions from public transportation, mode shifting, and vehicle scrapping/ retirement projects. Reasonable quantification certainty for efficiency upgrades (notwithstanding baseline/additionality concerns).		Benefits: Avoided emissions transportation projects can improve air-quality and the health of those living nearby as well as increase urban livability.

The terms listed below have been adapted from the Integrity Council for the Voluntary Carbon Market (ICVCM) Core Carbon Principles Assessment Framework and Procedure -- Part 5 -- Definitions (available here).

TERM	DEFINITION
Additionality	"Additionality" is the property of a project being "additional." An additional project is one that would not have occurred without the incentive provided by carbon credit revenues.
Auditor	An independent third-party entity that is accredited to perform validation and/or verification audits of crediting projects. Synonyms include verification and validation bodies (VVB), validators, and verifiers.
Avoided emissions	The negative change in greenhouse gas emissions caused by an intervention relative to the intervention's baseline scenario.
Baseline scenario	A scenario describing the activities, practices, and/or technologies that would have been adopted – and the associated emissions or removals that would have occurred – in the absence of an intervention (e.g., the incentive provided by carbon credits). If a project is not additional (i.e., it would have been undertaken regardless of carbon credit revenues), then the baseline scenario and project are (in principle) the same.
Cancellation	The permanent removal of a carbon credit in an electronic registry. Typically, cancellation "nullifies" the credit, such that no party can claim its associated avoided emissions or enhanced removals. This may be done, for example, to compensate for reversals or excess credit issuances, or for the purpose of re-issuing carbon credits for the same avoided emissions or enhanced removals under a different carbon crediting program. In some cases, however, "cancellation" is use synonymously with credit "retirement."

TERM	DEFINITION
Carbon credit	A tradable financial instrument that is issued by a carbon crediting program, representing avoided GHG emissions or enhanced removals, equivalent to one metric tonne of carbon dioxide equivalent. Carbon credits are typically serialised, issued, tracked, and retired or administratively cancelled by means of an electronic registry operated by an administrative body, such as a carbon crediting program.
Carbon crediting program	A standard-setting organization that registers crediting projects and issues carbon credits.
Carbon dioxide equivalent	The basic unit of carbon accounting. A metric used to compare the emissions from various greenhouse gases on the basis of their global-warming potential (GWP), by converting amounts of other gases to the equivalent amount of carbon dioxide with the same GWP. Abbreviated to tCO_2e for metric tonne carbon dioxide equivalent.
Corresponding adjustment	An accounting entry applied in the context of Article 6 of the Paris Agreement to account for the international transfer of mitigation outcomes and prevent double counting of avoided emissions or enhanced removals.
Crediting period	The period in which a crediting project can be issued carbon credits for the emissions it avoids or the removals it causes. Crediting periods are often shorter than the lifetime of a project, meaning some avoided emissions or enhanced removals may not be credited.

TERM	DEFINITION
Crediting project	An activity that avoids emissions or enhances removals, relative to the activity's baseline scenario, and seeks registration and issuance of carbon credits under a carbon crediting program. Although most such activities take the form of discrete "projects," they can also include large-scale programs or even policy interventions implemented across jurisdictions (as in the case of jurisdiction-level crediting of avoided deforestation measures). Synonyms include mitigation activity and offset project. This guide uses "crediting project" as a shorthand for all such activities and interventions.
Double counting	A situation in which a tCO_2e of avoided emission or enhanced removal is counted more than once toward achieving mitigation targets or goals. Double counting can occur through double issuance, double use, and double claiming.
Double issuance	A type of double counting in which more than one carbon credit is issued for the same avoided emissions or enhanced removals (and credits are not cancelled accordingly, e.g., to affect a transfer of a credit from one registry to another).
Double use	A situation in which a single carbon credit is claimed more than once toward achieving mitigation targets or goals. This can happen, for example, if an unscrupulous seller retires a carbon credit on behalf of more than one buyer.
Enhanced removals	The positive change in greenhouse gas removals caused by an intervention relative to the intervention's baseline scenario.
Ex ante carbon credits	Carbon credits that are issued for ***projected*** avoided emissions or enhanced removals, before they occur and are verified. Some crediting programs issue ex ante credits as a distinct type of credit, which may then be converted to ex post credits after avoided emissions or enhanced removals have been monitored and verified.

TERM	DEFINITION
Ex post carbon credits	Carbon credits that are issued ***after*** avoided emissions or enhanced removals achieved by a crediting project occur and have been monitored and verified.
Greenhouse gases (GHG)	Gases, both naturally occurring and anthropogenic, that trap heat in the atmosphere. The primary anthropogenic GHGs tracked in national inventories include carbon dioxide, methane, and nitrous oxide.
Issuance	The instruction by the relevant authority in a carbon crediting program to create and serialize a specified quantity of carbon credits in a registry account.
Leakage	An unintentional increase in emissions or decrease in removals caused by an intervention, relative to the intervention's baseline scenario, which typically occurs at sources or sinks physically separate from the location where the intervention is implemented. For example, leakage can occur due to a shift in where emissions occur due to market responses, changes in human activity near a project, or changes in physical processes.
Materiality	An auditing concept applied by auditors in validation and verification engagements to label the significance of identified errors, omissions, misstatements, or the aggregation of these, in the quantification of avoided emissions or enhanced removals from a crediting project. "Immaterial" findings by auditors are deemed insufficiently significant to affect their verification decisions.
Methodology	A methodology defines the GHG accounting rules and requirements for implementing, monitoring, reporting, and verifying crediting projects. Methodologies are approved by crediting programs for specific project types and define project eligibility conditions along with methods for determining additionality, setting the baseline, and quantifying baseline and project emissions. The term "protocol" is used interchangeably with methodology.

TERM	DEFINITION
Mitigation contribution	The act of retiring carbon credits for the purpose of claiming to have enabled avoided emissions or enhanced removals, without making any compensation claims. This contrasts with "offsetting," where the express purpose of retirement is to compensate for an entity's emissions.
Offsetting	The compensation of an entity's greenhouse gas emissions (within its allocational GHG (i.e., inventory) accounting boundaries) by retiring an equivalent amount of carbon credits.
Permanence	A criterion for the environmental integrity of carbon credits, stipulating that the avoided emissions or enhanced removals associated with a carbon credit must endure for at least long as an emission of CO_2 will elevate atmospheric CO_2 levels (i.e., for thousands of years, or in effect, "permanently"). For some types of mitigation projects – e.g., those that store carbon in forests – this is not practically achievable, since for these activities there is significant risk of reversal (see separate definition). Most carbon crediting programs therefore require that carbon is stored for a minimum duration (e.g., several decades) and – in some cases – refer to "durability" rather than "permanence."
Project developer	In this guide, the project developer refers to the legal entity requesting the registration of a crediting project and issuance of carbon credits. The crediting project developer may be a public or private entity. Synonyms include project proponent and mitigation activity proponent. Note that sometimes the project developer may be distinct from the entity submitting a project for registration. If this occurs, the registering entity is referred to as the project proponent and is distinct from the project developer.
Registry	An information technology system used by carbon crediting programs to: (1) register, track, and make publicly available information on carbon crediting projects; and (2) issue carbon credits, enable the transfer of carbon credits between different accounts, and cancel or retire them.

TERM	DEFINITION
Retirement	The permanent removal of a carbon credit in a registry for the purpose of claiming the associated avoided emissions or enhanced removals toward compliance requirements or voluntary goals.
Reversal	For a crediting project that enhances or preserves carbon stocks in reservoirs (see enhanced removals), the occurrence of an event in which some or all of the additional increment in stocks resulting from the crediting project are subsequently released to the atmosphere. Reversals can, for example, occur due to natural processes, such as wildfires, or anthropogenic drivers, such as timber harvest or land conversion.
Social and environmental safeguards	Policies, standards, and operational procedures designed to identify, prevent, and mitigate adverse social and environmental impacts that may arise from the implementation of mitigation activities.
Validation	The process by which auditors confirm that a crediting project meets all eligibility criteria for registering with a crediting program.
Verification	The process by which auditors confirm that a crediting project has been properly monitored, and that avoided emissions or enhanced removals achieved by the crediting project have been properly quantified in accordance with crediting program rules and standards.
Vintage	The “vintage” of a carbon credit can refer either to the year in which it was issued, or the year in which associated avoided emissions of enhanced removals occurred (for some kinds of crediting projects, there can be a significant lag between the latter and the former, because of longer verification cycles, e.g., with forestry projects).

Alexeew, J., Bergset, L., Meyer, K., Petersen, J., Schneider, L. and Unger, C. (2010). An analysis of the relationship between the additionality of CDM projects and their contribution to sustainable development. International Environmental Agreements: Politics, Law and Economics, 10(3). 233–48. DOI: 10.1007/s10784-010-9121-y

Cames, M., Harthan, R. O., Fussler, J., Lazarus, M., Lee, C. M., Erickson, P. and Spalding-Fecher, R. (2016). How Additional Is the Clean Development Mechanism? Analysis of the Application of Current Tools and Proposed Alternatives. CLIMA.B.3/SERl2013/0026r. Prepared for DG Clima by Oko-Institut, INFRAS, Stockholm Environment Institute (SEI), Berlin. https://ec.europa.eu/clima/sites/clima/files/ets/docs/clean_dev_mechanism_en.pdf

Dufrasne, G. (2018). The Clean Development Mechanism: Local Impacts of a Global System. Carbon Market Watch. https://carbonmarketwatch.org/wp-content/uploads/2018/10/CMW-THE-CLEAN-DEVELOPMENT-MECHANISM-LOCAL-IMPACTS-OF-A-GLOBAL-SYSTEM-FINAL-SPREAD-WEB.pdf

Gillenwater, M. (2012). What is wrong with ‘real’ carbon credits? Greenhouse Gas Measurement and Management, 2(4). 167–70. DOI: 10.1080/20430779.2013.781879

Gillenwater, M. and Seres, S. (2011). The Clean Development Mechanism: a review of the first international crediting programme. Greenhouse Gas Measurement and Management, 1(3–4). 179–203. DOI: 10.1080/20430779.2011.647014

Haya, B. and Parekh, P. (2011). Hydropower in the CDM: Examining Additionality and Criteria for Sustainability. ERG-11-01. Energy and Resources Group, University of California Berkeley, Berkeley, CA. http://erg.berkeley.edu/working_paper/index.shtml

International Carbon Reduction & Offset Alliance (2019). ICROA’s position on scaling private sector voluntary action post-2020. , July 2019. https://www.icroa.org/resources/Documents/ICROA_Voluntary_Action_Post_2020_Position_Paper_July_2019.pdf

IPCC (2018). Global Warming of 1.5 °C. Intergovernmental Panel on Climate Change. http://www.ipcc.ch/report/sr15/

Joos, F., Roth, R., Fuglestvedt, J. S., Peters, G. P., Enting, I. G., et al. (2013). Carbon dioxide and climate impulse response functions for the computation of greenhouse gas metrics: a multi-model analysis. Atmospheric Chemistry and Physics, 13(5). 2793–2825. DOI: https://doi.org/10.5194/acp-13-2793-2013

Kartha, S., Caney, S., Dubash, N. K. and Muttitt, G. (2018). Whose carbon is burnable? Equity considerations in the allocation of a “right to extract”. Climatic Change, 150. DOI: 10.1007/s10584-018-2209-z

Kollmuss, A. and Lazarus, M. (2010). Industrial N_2O Projects Under the CDM: The Case of Nitric Acid Production. SEI Working Paper WP-US-1007. Stockholm Environment Institute - U.S. Center. http://www.sei-international.org/publications?pid=1636

Kollmuss, A., Schneider, L. and Zhezherin, V. (2015). Has Joint Implementation Reduced GHG Emissions? Lessons Learned for the Design of Carbon Market Mechanisms. http://sei-us.org/publications/id/550

Kolstad, C., Urama, K., Broome, J., Bruvoll, A., Cariño-Olvera, M., et al. (2014). Chapter 3: Social, economic and ethical concepts and methods. In Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Edenhofer, O., Pichs-Madruga, R., and Sokona, Y. (eds). Cambridge University Press, Cambridge, UK, and New York. 173–248. https://www.ipcc.ch/report/ar5/wg3/

Kreibich, N. and Obergassel, W. (2019). The Voluntary Carbon Market: What May Be Its Future Role and Potential Contributions to Ambition Raising? German Emissions Trading Authority (DEHSt) at the German Environment Agency. https://epub.wupperinst.org/frontdoor/deliver/index/docId/7396/file/7396_Carbon_Market.pdf

Lazarus, M., Erickson, P. and Spalding-Fecher, R. (2012). Transitioning Away from Large-Scale Power Projects: A Simple and Effective Fix for the CDM? SEI Policy Brief. Stockholm Environment Institute - U.S. Center, Seattle, WA. http://www.sei-international.org/publications?pid=2204

Murray, B. C., Galik, C. S., Mitchell, S. and Cottle, P. (2012). Alternative Approaches to Addressing the Risk of Non-Permanence in Afforestation and Reforestation Projects under the Clean Development Mechanism. Nicholas Institute for Environmental Policy Solutions, Duke University

Offset Quality Initiative (2008). Ensuring Offset Quality: Integrating High Quality Greenhouse Gas Offsets into American Cap-and-Trade Policy. The Climate Trust, Pew Center on Global Climate Change, California Climate Action Registry, Environmental Resources Trust, Greenhouse Gas Management Institute and The Climate Group. https://ghginstitute.org/wp-content/uploads/2010/01/OQI_Ensuring_Offset_Quality_Exec_Sum_Jul08.pdf

Ruthner, L., Johnson, M., Chatterjee, B., Lazarus, M., Fujiwara, N., Egenhofer, C., du Monceau, T. and Brohe, A. (2011). Study on the Integrity of the Clean Development Mechanism (CDM). AEA Technology for the EU Commission

Schneider, L. (2009). Assessing the additionality of CDM projects: practical experiences and lessons learned. Climate Policy, 9(3). 242–54. DOI: 10.3763/cpol.2008.0533

Schneider, L., Broekhoff, D., Mealey, T. and Soparkar, I. (2019). Avoiding Double Counting for CORSIA. Carbon Mechanisms Review, no. 3. 19–25.

Schneider, L., Duan, M., Stavins, R., Kizzier, K., Broekhoff, D., et al. (2019). Double counting and the Paris Agreement rulebook. Science, 366(6462). 180–83.

Schneider, L., Kollmuss, A. and Lazarus, M. (2015). Addressing the risk of double counting emission reductions under the UNFCCC. Climatic Change, 131(4). 473–86. DOI: 10.1007/s10584-015-1398-y

Schneider, L. and La Hoz Theuer, S. (2019). Environmental integrity of international carbon market mechanisms under the Paris Agreement. Climate Policy, 19(3). 386–400. DOI: 10.1080/14693062.2018.1521332

Schneider, L., Lazarus, M. and Kollmuss, A. (2010). Industrial N_2O Projects Under the CDM: Adipic Acid - A Case of Carbon Leakage? SEI-US Working Paper WP-US-1006. Stockholm Environment Institute - U.S. Center, Somerville, MA. http://www.sei-international.org/publications?pid=1621

Spalding-Fecher, R., Achanta, A. N., Erickson, P., Haites, E., Lazarus, M., Pahuja, N., Pandey, N., Seres, S. and Tewari, R. (2012). Assessing the Impact of the Clean Development Mechanism. http://www.cdmpolicydialogue.org/research/1030_impact.pdf

Trexler, M. C. (2019). Fixing Carbon credits: Today's Carbon credit Standards Undermine the Environmental Integrity of Carbon Markets; We Can Do (Much!) Better. The Climatographers. https://climatographer.com/wp-content/uploads/2019/10/2019-Trexler_Fixing-Carbon-Offsets.pdf

Trexler, M. and Schendler, A. (2015). Science-Based Carbon Targets for the Corporate World: The Ultimate Sustainability Commitment, or a Costly Distraction? Journal of Industrial Ecology. n/a-n/a. DOI: 10.1111/jiec.12311

Voluntary Carbon Market Working Group (2019). Envisioning the voluntary carbon market post-2020. , June 2019. https://www.goldstandard.org/sites/default/files/documents/2019_06_envisioning_the_vcm_statement_consultation_0.pdf

Wara, M. and Victor, D. G. (2008). A Realistic Policy on International Carbon credits. Program on Energy and Sustainable Development Working Paper, 74. Stanford University, Stanford, CA. http://pesd.stanford.edu/publications/a_realistic_policy_on_international_carbon_offsets/

Warnecke, C., Schneider, L., Day, T., Theuer, S. L. H. and Fearnehough, H. (2019). Robust eligibility criteria essential for new global scheme to offset aviation emissions. Nature Climate Change, 9(3). 218. DOI: 10.1038/s41558-019-0415-y

Warnecke, C., Wartmann, S., Höhne, N. and Blok, K. (2014). Beyond pure offsetting: Assessing options to generate Net-Mitigation-Effects in carbon market mechanisms. Energy Policy, 68. 413–22. DOI: 10.1016/j.enpol.2014.01.032

ENDNOTES

1 Under the Paris Agreement, the international community has established a goal of limiting global warming to "well below 2°C" by the 2100, and to pursue efforts to limit warming to 1.5°C. In a 2018 report, the IPCC summarized current modeling of what will be required to achieve the latter goal, noting that very substantial CO_2 reductions will be required by 2030. See: IPCC (2018)..

2 CO_2 can be removed from the atmosphere through natural sequestration (e.g., in trees, soil, or the ocean) or through artificial means (e.g., using direct-air capture technologies, which are still in their infancy).

3 Such "programs" were pioneered under the Kyoto Protocol's Clean Development Mechanism; see here.

4 See, for example, Verra's framework for Jurisdictional and Nested REDD+ programs. (REDD stands for "reduced emissions from deforestation and forest degradation".)

5 The terms "standard" or "registry" are sometimes used when referring to crediting programs. However, a comprehensive carbon credit program will consist of more than just a standard and a registry.

6 Article 6.4 will allow projects to transition from the Clean Development Mechanism (CDM) if they meet all required conditions as set by Parties to the Paris Agreement. Read more here.

7 The Korean Offset Program allows the use of CERs generated from CDM projects.

8 In general, price discrepancies among programs arise only when one program serves a captive market with strong demand that other programs may not serve, such as the regulatory cap-and-trade market in California.

9 The primary concern is that a large number of carbon credits come from energy sector projects that have significant sources of other revenue besides carbon credits, suggesting that they would have happened anyway and do not represent additional mitigation. Other identified issues include concerns about over-estimation of avoided emissions, e.g., for industrial gas destruction and other project types (Alexeew et al. 2010; Cames et al. 2016; Gillenwater and Seres 2011; Haya and Parekh 2011; Kollmuss et al. 2015; Kollmuss and Lazarus 2010; Lazarus et al. 2012; Ruthner et al. 2011; Schneider 2009; Schneider et al. 2010; Spalding-Fecher et al. 2012)

10 See, for example, Dufrasne (2018) as well as here.

11 See Spalding-Fecher et al. (2012).

12 This condition applies to GHG emissions, as well as to other social and environmental impacts. If global GHG emissions would be no greater as a result of using a carbon credit instead of reducing your own emissions, then the credit is said to preserve "environmental integrity" (Schneider and La Hoz Theuer 2019). However, it is also important that crediting projects do not cause significant social or (non-climate) environmental harm. Both are important for carbon credit quality.

13 See Gillenwater (2012).

14 For an in-depth discussion of these ideas, see Trexler (2019).

15 In most cases, additionality is assessed only once, when an activity is submitted to a crediting program for approval. Conceptually, one could think of some projects as becoming "non-additional" in the future – e.g., if, in the absence of carbon credit revenue, the same activity would have instead been implemented at a later point in time than proposed by the project developer. Typically, however, crediting programs address this possibility through reassessment of the activity's baseline (effectively, ceasing credit issuance to the activity, because the activity and its baseline are determined to be identical at a future date) rather than formally determining that an existing project was never additional in the first place.

16 See Gillenwater (2011).

17 However, crediting programs typically define baseline scenarios under the presumption that project interventions are additional.

18 In addition to identifying non-financial barriers preventing a project's implementation, a barriers analysis should also address whether expected revenue from the sale of carbon credits is likely to enable the project developers to overcome the barrier(s). For example, if a project enables a dedicated staff person to spend more time educating and building trust with a community to overcome social barriers preventing the adoption of a new clean cookstove that differs from those typically used in a community. A barrier may exist, but it must be eliminated by credit revenue if it is to be used to determine additionality for a project. In this example, the new stove adoption or use rate must be increased resulting from the additional education the staff person is able to engage in resulting from credit revenues.

19 Standardized additionality approaches can use "positive lists" (lists of defined technologies or practices that are deemed additional without further evaluation) or a set of technical specifications and other criteria that a project must meet to be determined to be eligible (for example landfill gas collection and destruction, occurring at a sanitary landfill must be below a certain size threshold and gas collection can not be required by law).

20 For projects that enhance the removal of carbon, this baseline concern is flipped as the risk of overestimating the impact of a project would results from underestimating the baseline's rate of carbon removal.

21 Again, a common misconception is that the baseline for a project represents what would have happened "in the absence of the project." However, it is essential to evaluate whether a proposed project is itself the baseline (i.e., is not additional), and therefore will avoid no emissions.

22 Assuming that the project is additional and that the project itself does not affect the rate of methane generation at the landfill – for example, by creating a "bioreactor" landfill.

23 For more information on the baseline concept and terminology see here.

24 See, for example, Offset Quality Initiative (2008).

25 This process may include collecting and verifying data needed to estimate a project's baseline emissions.

26 Some of these sources and sinks may be treated as "leakage" effects and accounted for in supplemental calculations.

27 Most quantification methods prescribe a combination of project-specific data collection, along with the use of conservative defaults or estimates where data collection is impractical.

28 Renewal under some programs may also involve requirements to update the baseline scenario, and therefore reconsider additionality determination.

29 Carbon crediting programs can differ in their approach to third party auditing (often referring to as validation and verification). Some programs, like CAR, combine validation with the first verification of a project and do not make a formal distinction between the two functions. Others require validation and verification as separate steps (and some, like the CDM, require separate auditors for each step to avoid conflicts of interest – since positive validation could lead to a more lucrative verification contract).

30 Technically, the individual molecules of CO_2 emitted may cycle back and forth between the atmosphere and terrestrial reservoirs multiple times, but atmospheric concentrations of CO_2 will remain elevated by an amount equal to about 25% of the original mass emitted after 1,000 years (Joos et al. 2013).

31 The CDM is alone in issuing "temporary credits" for reversible enhanced removals. Under this approach, carbon credits issued for these enhanced removals expire after a predefined period (up to 30 years) and must be replaced with other avoided emission credits. This approach effectively guarantees permanence if it is enforced (whether the CDM's administrative structures will be maintained in the future is an open question). However, it has faced significant hurdles, not least because it puts the onus for ensuring permanence on carbon credit buyers. As a result, buyers have been far less willing to pay for these credits, and the market for them has been largely non-existent.

32 See Murray et al. (2012).

33 See Schneider et al. (2015) for a fuller explanation of double counting issues with carbon credits.

34 Note that it is not double claiming for the power plant to report its physical GHG emissions to the atmosphere (that would include any changes caused by the project), but this is different from the difference between the project and its baseline scenario that may result in credit issuance.

35 Procedures may include requiring project developers to sign legal attestations stipulating that they will not request issuance of carbon credits for avoided emissions or enhanced removals from more than one program (unless they are effectively "transferring" credits from one program to another).

36 Some third-party programs, like Green-e Climate, provide checks on credit retirement steps for retail credit buyers. However, in most cases, this adds little value in terms of assurance beyond what carbon crediting programs already make available to any buyer in terms of retirement certification. In practice, programs do not always clearly indicate the purpose and beneficiaries of credit retirements.

37 https://www.green-e.org/programs/climate

38 For more information regarding how the CORSIA program functions see [this report.]

39 Technically, "discounting" refers to issuing fewer credits to a project than the avoided emissions or enhanced removals it achieved, but it is often used more broadly to refer to any approach that effectively uses more than a 1:1 ratio of carbon credits to compensate for tCO_2e emissions. It has also been proposed as an approach for use in regulatory carbon markets; for example, see Warnecke et al. (2014).

40 While additionality is not usually a concern, it may be in some cases (e.g., where most industry players, or a particular actor, have already agreed to voluntarily mitigate emissions). Furthermore, some kinds of industrial gas projects have issues with baseline estimation and overestimation of avoided emissions.

41 Joppa, L., Luers, A., Willmott, E., Friedmann, S. J., Hamburg, S. P. and Broze, R. (2021). Microsoft's million-tonne CO_2-removal purchase — lessons for net zero. Nature, 597(7878). 629–32. DOI:10.1038/d41586-021-02606-3.

42 The formal definition of a "mitigation hierarchy" was first introduced in the context of biodiversity conservation efforts – e.g., see https://doi.org/10.1093/biosci/biy029. The notion that users of carbon credits should reduce their own inventory emissions before offsetting has been a longstanding convention in voluntary carbon markets, but more recently has been given more formal expression as a "mitigation hierarchy."

43 "Responsible use" also involves using high-quality carbon credits, but the main principle is avoiding excessive use. Avoiding heavy reliance on carbon credits is sometimes seen as a way to mitigate the risk that carbon credits may be of low quality.

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