Securing Climate Benefit: A Guide to Using Carbon Offsets

AUTHORS

Derik Broekhoff
Michael Gillenwater
Tani Colbert-Sangree
Patrick Cage

ghg management institute

SEI Stockholm Environment Institute

ACKNOWLEDGEMENT

We are grateful to the High Tide Foundation for supporting the development of this guidance and the accompanying web resource. The mission of the High Tide Foundation is to have a significant, measureable impact on climate change mitigation.

ADDITIONAL ACKNOLEDGEMENTS

Thank you also to our many expert reviewers who helped to improve this guide. In particular, we thank Claire Carver (University of Colorado Boulder), Craig Ebert and Max DuBuisson (Climate Action Reserve), Barbara Haya (UC Berkeley), Anja Kollmus (Carbon Market Watch), Benjamin C Pierce (University of Pennsylvania), Lambert Schneider (Oeko Institute), Jerry Seager (Independent Expert), Mark Trexler (Climatographers), and Ruby Woodside (Second Nature).

Thank you to Amy Falcione from Big Picture Marketing for design templates. Thank you to Erika Barnett from GHGMI for formatting and design implementation for this guidance document and its companion website **offsetguide.org**. Thank you to Molly White for design assistance and for support in creating **offsetguide.org.**

Date of Publication: November 13, 2019

For an updated version of this guide, please see **OffsetGuide.org**

Please cite this document as *Broekhoff, D., Gillenwater, M., Colbert-Sangree, T., and Cage, P. 2019. "Securing Climate Benefit: A Guide to Using Carbon Offsets." Stockholm Environment Institute & Greenhouse Gas Management Institute. Offsetguide.org/pdf-download/*

TABLE OF CONTENTS

HOW TO USE THIS GUIDE 4

1. INTRODUCTION 5

2. UNDERSTANDING CARBON OFFSETS 6

- 2.1 What is a carbon offset? 6
- 2.2 Carbon offset projects 7
- 2.3 Carbon offset programs 8
- 2.4 How to acquire carbon offset credits 9
- 2.5 The role of offsets in carbon management strategies................13
  - 2.5.1 Achieving carbon neutrality 13
  - 2.5.2 Carbon offsets after 2020: The world under Paris 15

3. COMMON CRITICISMS OF CARBON OFFSETS....................................16

- 3.1 Concerns about how offset credits are used........................16
- 3.2 Concerns about carbon offset quality....................................17

4. WHAT MAKES A HIGH-QUALITY CARBON OFFSET?..........................18

- 4.1 Additionality 19
  - 4.1.1 How carbon offset programs address additionality 20
  - 4.1.2 Questions for buyers to ask about additionality 22
- 4.2 Avoiding overestimation...23
  - 4.2.1 How carbon offset programs address overestimation...24
  - 4.2.2 Questions for buyers to ask about overestimation..........25
- 4.3 Permanence 26
  - 4.3.1 How carbon offset programs address permanence........26
  - 4.3.2 Questions for buyers to ask about permanence 27
- 4.4 Exclusive claim to GHG Reductions 28
  - 4.4.1 How carbon offset programs address exclusive claims..29
  - 4.4.2 Questions for buyers to ask about ownership claims......29
- 4.5 Avoiding social and environmental harms 30
  - 4.5.1 How carbon offset programs address social and environmental harms 30
  - 4.5.2 Questions for buyers to ask about social and environmental harms...30

5. STATEGIES FOR AVOIDING LOWER-QUALITY OFFSET CREDITS ...32

- 5.1 Vetting offset projects...32
- 5.2 Sticking to lower-risk project types 32
- 5.3 “Discounting” offset purchases 33
- 5.4 Weaker methods: relying on price or vintage.............................. 34

ABOUT US 35

ANNEX 1: OFFSET PROJECT TYPES AND RELATIVE QUALITY RISK....36

REFERENCES..52

ENDNOTES...55

Title image credit: reforestation and restoration of degraded mangrove lands, sustainable livelihood and community development project in Myanmar.

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
- Comparing offset credits with green power and other environmental instruments and investments
- Common types of offset projects
- What carbon offset programs do
- How to acquire carbon offset credits
- Achieving carbon neutrality
- Air Travel & Climate
- Concerns about carbon offset quality
- Additionality
- Avoiding social and environmental harms
- How carbon offset programs address social and environmental harms
- Domestic or Foreign Projects
- Conducting project due diligence when vetting offset projects

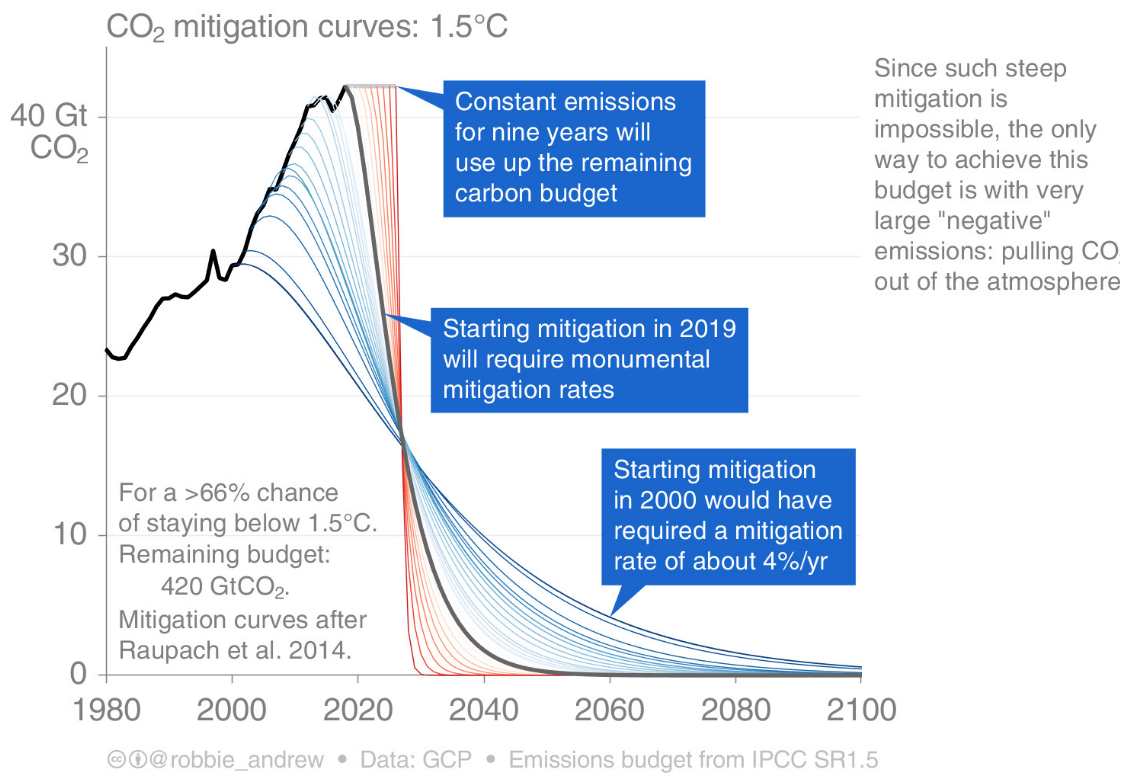
Internet links are provided throughout this PDF guide to access expanded and updated information. Links are presented as a clickable button ( ) at the end of each related section.

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. Such reductions will require worldwide action by national and local governments, along with businesses and civil society (Figure 1).

The urgency is clear: incremental steps to address greenhouse gas (GHG) emissions will not be enough. Companies and organizations will need to use every tool at their disposal to achieve emission reduction goals. "Carbon offsets" are one such tool that – if used responsibly – can accelerate action to avert dangerous climate change.

Figure 1. Required emission reduction rates for limiting global warming to 1.5°C



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

We begin, in Section 2, with an explanation of the basics of carbon offsets, how to acquire them, and how they can (or should) be used in carbon management strategies. Section 3 addresses common criticisms of carbon offsets. Section 4 clarifies the essential elements of carbon offset quality, explains how carbon offset 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 offset credits. This guide ends with Section 6, which provides links to further resources.

Fig. 1 source: Robbie Andrew (CICERO), http://folk.uio.no/roberan/t/global_mitigation_curves.shtml

2. UNDERSTANDING CARBON OFFSETS

The term "carbon offset" is shorthand for GHG emission reductions or removals that compensate for CO_2 emissions. In this section, we define carbon offsets, as well as explain the difference between offset credits, projects, and programs; detail how buyers can obtain offset credits; and describe how offset credits can (or should) be used in an organization's GHG management strategies.

2.1 WHAT IS A CARBON OFFSET?

The terms carbon offset and carbon offset credit (or simply "offset credit") are used interchangeably, though they can mean slightly different things. A carbon offset broadly refers to a reduction in GHG emissions – or an increase in carbon storage (e.g., through land restoration or the planting of trees) – that is used to compensate for emissions that occur elsewhere. A carbon offset credit is a transferable instrument certified by governments or independent certification bodies to represent an emission reduction of one metric tonne of CO_2, or an equivalent amount of other GHGs (see Box 1). The purchaser of an offset credit can "retire" it to claim the underlying reduction towards their own GHG reduction goals.

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"). This makes is easier to compare the effects of different GHGs and to denominate carbon offset credits in units of CO_2-equivalent emission reductions.

Learn more about GWP

The key concept is that offset credits are used to convey a net climate benefit from one entity to another. Because GHGs mix globally in the atmosphere, it does not matter where exactly they are reduced. From a climate change perspective, the effects are the same if an organization: (a) ceases an emission-causing activity; or (b) enables an equivalent emission-reducing activity somewhere else in the world. Carbon offsets are intended to make it easier and more cost-effective for organizations to pursue the second option.

As explained later in this guide, offset claims are only defensible under a set of rigorous conditions. Although organizations sometimes use other kinds of investments to make GHG reduction claims – such as the purchases of "renewable energy credits" – these other instruments usually do not meet the criteria for effective carbon offset claims.

How do I compare offset credits with green power and other environmental instruments and investments?

2.2 CARBON OFFSET PROJECTS

Carbon offset credits can be produced by a variety of activities that reduce GHG emissions or increase carbon sequestration. In most cases, these activities are undertaken as discrete "projects." A carbon offset 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 absorb additional carbon 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 offset 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]

What other types of offset projects are common?

In many cases, carbon offset projects produce social and environmental benefits beyond just GHG reductions. 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 offset credit buyers seek projects that yield a broad range of benefits. Carbon offsets 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 offsets tend to be those with the fewest co-benefits – and vice versa (see Section 5.2).

2.3 CARBON OFFSET PROGRAMS

Carbon offset 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 offsets. These carbon offset programs[5] range from international or governmental regulatory bodies – such as the United Nation's Clean Development Mechanism (CDM) Executive Board, which oversees carbon offsets under the Kyoto Protocol – to independent non-governmental organizations (NGOs). Historically, governmental bodies certified offset credits for regulatory purposes ("compliance programs"), while NGOs primarily served voluntary buyers ("voluntary programs"); more recently, both types of programs have begun to serve both types of markets (Table 1). Each carbon offset program issues its own labelled "brand" of credit.

Offset programs perform three basic functions: (1) they develop and approve standards that set criteria for the quality of carbon offset credits; (2) they review offset projects against these standards (generally with the help of third-party verifiers); and (3) they operate registry systems that issue, transfer, and retire offset credits.

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

This man trains two women in the use of small-scale anaerobic digesters that capture and destroy methane as a fuel source for cooking. Image credit: Sichuan Rural Poor-Household Biogas Development Programme

Learn more about what carbon offset programs do

Table 1. Examples of major carbon offset programs

"Compliance" carbon offset programs (run by governmental bodies)	Geographic Coverage	Label used for offset credits
Clean Development Mechanism (CDM)[6]	Developing countries	Certified Emission Reduction (CER)
California Compliance Offset Program	United States	Air Resources Board Offset Credit (ARBOC)
Joint Implementation (JI)[7]	Developing countries	Emission Reduction Unit (ERU)
Regional Greenhouse Gas Initiative (RGGI)	Northeast United States	RGGI CO_2 Offset Allowance (ROA)
Alberta Emission Offset Program (AEOP)	Alberta, Canada	Alberta Emissios Offset Credit (AEOC)
"Voluntary" carbon offset programs (run by NGOs)	**Geographic Coverage**	**Label used for offset credits**
American Carbon Registry	United States, some international	Emission Reduction Tonne (ERT)
Climate Action Reserve (CAR)	United States, Mexico	Climate Reserve Tonne (CRT)
The Gold Standard	International	Verified Emission Reduction (VER)
Plan Vivo	International	Plan Vivo Certificate (PVC)
The Verified Carbon Standard	International	Verified Carbon Unit (VCU)

2.4 HOW TO ACQUIRE CARBON OFFSET CREDITS

Although there are some trading exchanges that facilitate offset credit transactions, most transactions occur "off-exchange", making price discovery difficult. The price of an offset credit can range from under US$1 to well over US$35. Prices tend to vary mostly by project type, generally with small differences between offset credit labels.[8]

Although offset credit buyers do not need to be familiar with every carbon offset program rule and procedure, they should have a basic understanding of how carbon offset 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 offset credits.

The basic lifecycle for carbon offset credits looks like the following:

1. Methodology development. Before any GHG reductions can be certified for use as carbon offsets, they must be shown to meet carbon offset quality criteria. This process requires a methodology or protocol that is specific to the type of offset project generating the reductions. Most carbon offset 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 offset credit buyer may sponsor the development of a methodology for a new project type that is not already eligible in existing offset programs. This effort can be a 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. An offset project is designed by project developers, financed by investors, validated by an independent verifier, and registered with a carbon offset program. Official "registration" indicates that the project has been approved by the program and is eligible to start generating carbon offset credits after it begins operation (next step).

Purchasing options: Some offset credit buyers directly invest in an offset project in return for rights to (some portion of) the credits the project is able to generate. This approach can allow for deeper engagement and a fuller understanding of a project's strengths and weaknesses.

Alternatively, a commonly used purchasing option is to contract directly with a project developer for delivery of carbon offset 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 offset credits. For buyers, the advantage is being able to lock in a price for offset 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 offset credit issuance. An offset project is implemented, then monitored and periodically verified to determine the quantity of emission reductions it has generated. The length of time between verifications can vary, but is typically one year. A carbon offset program approves verification reports, and then issues a number of carbon offset credits equal to the quantity of verified CO_2-equivalent GHG reductions. Offset credits are generally deposited into the project developer's account in a registry system administered by the offset program.

Purchasing options: In some cases, project developers may have unsold offset 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. Offset credit transfer. After they are issued, carbon offset credits can be transferred into different accounts in an offset program's registry. Transfers are usually undertaken as a result of a purchase or trade (so, after a purchase, the offset credits will be transferred from the project developer's account into an account owned by the purchasers). Offset credit buyers may then use the offset credits by retiring them (see next step), hold them, or transfer them to other accounts. Offset 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 offset credits. Brokers procure offset credits and then transfer (or retire) them on clients' behalf. Brokers can make it easier to identify a mix of offset credits from different project types, and facilitate large or small transactions. Some brokers sell offset 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.

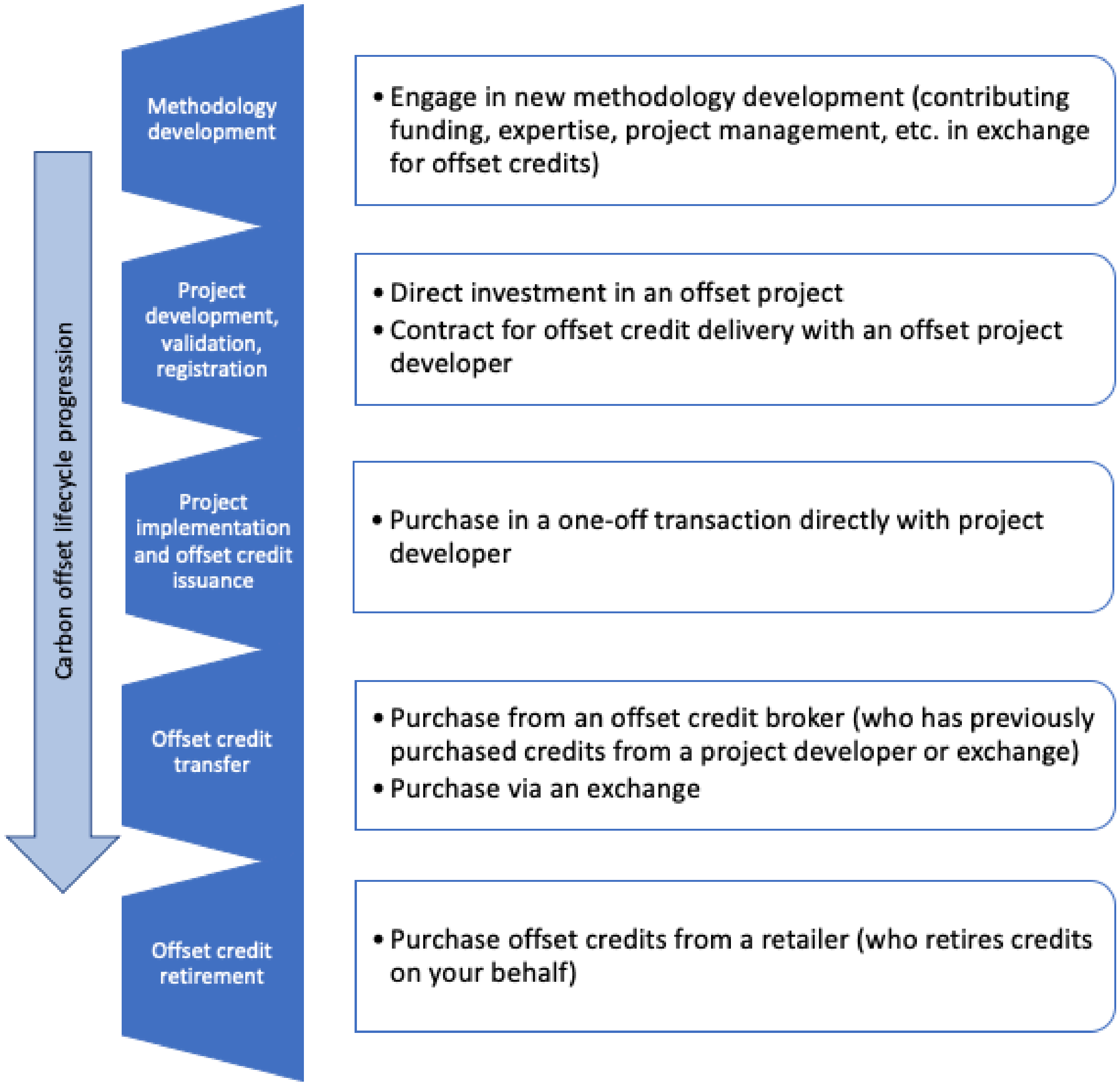
Another option is to purchase offset credits on an exchange. There are a number of environmental commodity exchanges – mostly in North America and Europe – that list carbon offset credits for sale and work with registries to enable transfers. Purchasing offset credits on an exchange can be relatively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

5. Offset credit retirement. Offset credit holders must "retire" carbon offset credits in order to use them and claim their associated GHG reductions towards a GHG reduction goal. Retirement occurs according to a process specified by each carbon offset program's registry. Once an offset credit is retired, it cannot be transferred or used (meaning it is effectively taken out of circulation).

Purchasing options: For buyers looking to acquire only a small number of offset credits (such as small companies or individuals), the most feasible option is to go through a retailer. Retailers can provide access to offset 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 offset program registries, and will retire offset credits directly on a buyer's behalf.

Learn more about how to acquire carbon offsest credits

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



2.5 THE ROLE OF OFFSETS IN CARBON MANAGEMENT STRATEGIES

In principle, carbon offset credits offer a convenient and cost-effective way to reduce GHG emissions. Often, this means offset credits are used to compensate for (or "offset") an organization's GHG emissions, in lieu of reducing those emissions directly. For example, since most organizations find it impractical to completely eliminate their carbon footprint using only internal measures, carbon offsets offer the only practical way to claim "carbon neutrality." If your organization pursues carbon neutrality, however, it should still seek to use carbon offsets sparingly (Section 2.5.1).

In the future, international policy efforts could make it more difficult for organizations to establish valid voluntary offset claims (see Section 2.5.2). This could change how most buyers approach the use of offset credits. Instead of offsetting GHG emissions, for example, credits may be used to indicate an organization's charitable contribution to external climate change mitigation efforts. One indication of this shift in thinking is the increasing use of the term "carbon credit" rather than "offset credit" to refer to the commodity being purchased. In this guide, we continue to use the term "offset credit" since the underlying principles involved remain the same.

2.5.1 ACHIEVING CARBON NEUTRALITY

Carbon neutrality refers to achieving a net carbon footprint of zero.[9] The term is often applied to an entire organization (or committed individual), but can also be applied to a product or activity (such as air travel). Since it is not possible for most organizations or individuals to completely eliminate all GHG emissions associated with their activities and products, carbon neutrality is typically premised on the idea of using external GHG reductions to balance emissions that cannot readily be eliminated. Carbon offset credits are the primary tool for achieving such reductions.

Carbon neutrality goals are growing in popularity, and on their face are highly ambitious. Achieving "net zero" emissions by 2050, for example, is increasingly seen as the benchmark for a "science-based" GHG reduction target.[10] One risk, however, is that carbon neutrality can mask what is ultimately required to avert climate change. Given their ease of use, it can be tempting to rely on carbon offsets as a primary means for meeting a carbon neutrality goal. In fact, as originally conceived, carbon offset credits were seen primarily as a way to lower the cost of meeting a particular GHG target, including carbon neutrality.

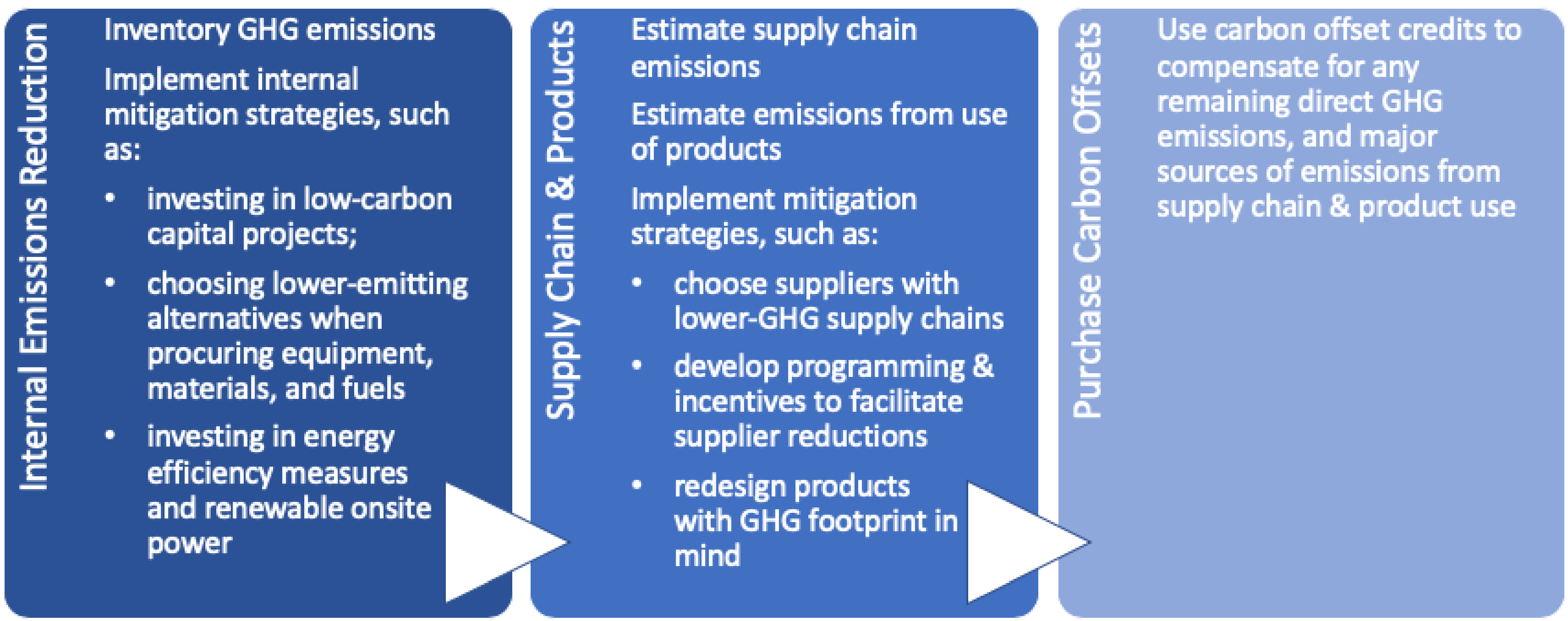
Under current circumstances, this approach to using carbon offsets would be a mistake. Collectively, all CO_2 emissions from burning fossil fuels must cease altogether well before the end of the century: there will be little room for anyone to "net out" their emissions using someone else's GHG reductions. Thus, although the idea of achieving zero net emissions is compelling and even necessary, the focus should be on reducing GHG emissions directly (and dramatically) in line with global mitigation goals. Arguably, organizations should only use carbon offsets on top of efforts to reduce their own emissions to near-zero by 2050.

A basic strategy would look like the following (Figure 3):

- Inventory your company's GHG emissions.[11]
- Implement internal mitigation strategies in line with global goals (for example, halving CO_2 emissions by 2030, and achieving net-zero emissions by 2050).
- Reduce supply chain emissions, such as by selecting suppliers with lower-GHG supply chains, and emissions from the use of consumer products, such as by designing energy-efficient products.
- Use carbon offset credits to cover any remaining GHG emissions from sources your organization owns or controls, and if possible, from your supply chain and product use.

Achieving carbon neutrality

Figure 3. Steps to achieving carbon neutrality



2.5.2 CARBON OFFSETS AFTER 2020: THE WORLD UNDER PARIS

The practice of carbon offsetting has arisen in a world where far too little is being done to address climate change. At a global level, relatively few organizations have taken meaningful action to reduce GHG emissions. As a result, for companies committed to taking action, it has not been hard to find low-cost carbon offsets. The potential supply of GHG reductions is huge, because there are so many sources of GHG emissions that face no legal or economic incentives to reduce.

The 2015 Paris Agreement could change this. For the first time, nearly every country in the world has identified explicit actions (i.e., “contributions”) they agree to make to reduce GHG emissions and adapt to climate change. This approach is a major change from the Kyoto Protocol, where only industrialized countries committed to reduce emissions. Under Kyoto, offsetting was an explicit and prominent strategy: industrialized countries could fund offset projects in developing countries, providing them with needed investment and promoting sustainable development. In exchange, industrialized countries could more cheaply meet their obligations, by claiming the reductions achieved by these projects. Developing countries benefited from such an exchange, because they faced no obligations themselves and therefore gave nothing up in allowing emission reductions to be “transferred.”

The Paris Agreement complicates this older picture considerably. The fact that every country has agreed to reduce emissions means there will be fewer opportunities for additional reductions – i.e., reductions that go beyond what countries have pledged (and would otherwise not happen in the absence of a carbon offset market - see Section 4.1). This does not mean the end of carbon offsetting. In fact, Article 6 of the Paris Agreement explicitly recognizes the possibility for international cooperation through the transfer of emission reductions. However, if a country allows an emission reduction to be claimed by another party (either another country or some other entity), it should no longer be able to count the reduction towards its own GHG target. The Paris Agreement has language expressly prohibiting such “double counting” among countries.

Currently, it is envisioned that double counting will be avoided through “robust” accounting methods (the language used in Article 6). Specifically, if a country transfers an emission reduction, it will adjust its GHG balance sheets so that the reduction is not counted toward its pledged “contribution,” while a country receiving the transfer can apply the reduction to its own GHG balance sheet.[12] Similar accounting will likely be done for emission reductions funded by the international aviation industry, which has pledged to offset any increase in its GHG emissions after 2020.[13] In principle, the same methods could be applied to backstop claims for carbon offset credits purchased by private voluntary buyers.

Players in the voluntary carbon offset market are still sorting out what this will all mean. [14] Whatever happens, the criteria for what makes a quality credit will not change. In the remainder of this guide, we highlight some common concerns about carbon offset credits, explain the essential criteria for a “high quality” offset credit, and indicate what buyers can do to avoid lower-quality credits.

Air travel and climate

3. COMMON CRITICISMS OF CARBON OFFSETS

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

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

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

3.1 CONCERNS ABOUT HOW OFFSET CREDITS ARE USED

Examples of criticisms:

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

These kinds of criticisms are not so much about whether carbon offsets are a valid form of climate change mitigation, but rather whether they create “perverse” incentives. Carbon offsets were conceived 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 offset credits to achieve all (or large parts) of their GHG reduction goals, rather than make the investments needed to significantly reduce their own carbon footprint. 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. This concern is the primary reason that many observers advocate for treating carbon offsets as a complement to aggressive internal climate action, not a primary means of mitigation.

Another possible perverse incentive created by carbon offsets is to discourage needed regulation.[15] Regulations that require GHG reductions could deprive project developers of revenue from selling offset credits, because the reductions would no longer be “additional” (see Section 4.1). Project developers would likely resist such regulatory changes. From a climate policy perspective, therefore, carbon offsets 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 OFFSET QUALITY

Examples of criticisms:

- "Carbon offset 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 offset projects have adverse impacts on local communities and may make other environmental problems worse."

These criticisms are probably the most immediate concern for most offset credit buyers. Carbon offset credits are of little use in mitigating climate change if they are not a valid substitute for an organization's own internal GHG reductions. Unfortunately, despite the efforts of carbon offset programs, a number of independent studies have identified serious problems with some carbon offset credits. For example, studies of the world's two largest offset programs – the Clean Development Mechanism (CDM) and Joint Implementation (JI), both administered by the United Nations under the Kyoto Protocol – suggest that up to 60-70% of their offset credits may not represent valid GHG reductions.[16] Other critiques have highlighted instances of carbon offset projects that harmed local communities or resulted in broader environmental damage.[17] An official report commissioned by the United Nations in 2012 catalogued many of the CDM's shortcomings and identified areas of potential improvement.[18]

These critiques are troubling and should give pause to prospective buyers of offset credits. Major carbon offset programs, however, have responded to at least some of the concerns raised by these studies.[19] These responses include amending quantification methodologies to prevent over-estimation of GHG reductions,[20] as well as reconsidering the eligibility of certain project types.[21] Nevertheless, it is still wise to approach the carbon offset market with healthy scepticism.

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

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

Concerns about carbon offset quality

4. WHAT MAKES A HIGH-QUALITY CARBON OFFSET?

The central idea behind a carbon offset is that it can substitute for GHG emission reductions that an organization would have made on its own. For this to be true, the world must be at least as well off when you use a carbon offset credit as it would have been if you had reduced your own carbon footprint.[22] **When people talk about the “quality” of a carbon offset credit, they are referring to the level of confidence one can have that the use of the credit will fulfil this basic principle.**

This concept- **frequently referred to as preserving "environmental integrity"**- sounds straightforward, but it is challenging to guarantee in practice. Quality has two main components. First and foremost, a quality offset credit must represent at least one metric tonne of additional, permanent, and otherwise unclaimed CO_2 emission reductions or removals. Second, a quality offset credit should come from activities that do not significantly contribute to social or environmental harms.

A variety of terms are frequently used to define quality criteria for carbon offsets, including that associated GHG reductions 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 offsets. The term “real,” for example, has no commonly agreed definition across carbon offset programs and standards, and is often used as a vague catch-all. [23]

For this guide, therefore, we have distilled the essential elements of carbon offset quality down to five criteria. In short, quality carbon offset credits must be associated with GHG reductions or removals that are:

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

Carbon offset programs were created with the intention of ensuring the quality of carbon offset credits (Section 2.3). In the remainder of this section, we describe the approaches carbon offset programs use to address the quality criteria listed above. As indicated in Section 3, however, many observers believe that carbon offset programs have a mixed track record. Part of the challenge is that offset 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. Carbon offset programs, by contrast, are forced to make a binary decision: do they issue an offset credit or not? Most carbon offset 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 an offset on a 100-point scale. A carbon offset program may decide to issue credits for every GHG reduction that exceeds a score of 50. But as a buyer, is a score of 51 really “good enough”?[24]

Astute buyers will understand this difficulty and actively seek out higher quality offset credits. For each offset quality criterion below, we highlight some questions that buyers can ask about specific offset 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 offset credits and improve the chances of acquiring higher-quality credits.

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

4.1 ADDITIONALITY

GHG reductions are additional if they would not have occurred in the absence of a market for offset credits. If the reductions would have happened anyway – i.e., without any prospect for project owners to sell carbon offset credits – then they are not additional. Additionality is essential for the quality of carbon offset credits – if their associated GHG reductions are not additional, then purchasing offset credits in lieu of reducing your own emissions will make climate change worse.

Evaluating whether GHG reductions are additional can be deceptively difficult. The challenge is that GHG-reducing activities occur all the time.[25] Sometimes this is because the activities are required by law. Landfill operators in California, for example, are required to install equipment that captures and destroys methane. In other cases, investments that reduce emissions are made simply because they are profitable, without any consideration of carbon offset 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 increasingly cost competitive with fossil fuels, without revenue from carbon offset sales. For an activity or project to be additional, the possibility to sell carbon offset 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 can be considered additional if GHG emissions are lower than they would have been "in the absence of the project." This is incorrect. If a project would have been pursued without the sale of carbon offset credits, it is not additional, even if it reduces emissions below what they would have been in the project's absence. 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. In fact, the only definition of additionality relevant to offset quality is the one presented here. Legal and financial considerations come into play when making determinations about additionality, but are not separate benchmarks for what it means for GHG reductions to be "additional."

Furthermore, while additionality is the most essential ingredient of carbon offset quality, its determination is subjective. Additionality is frequently talked about in binary terms: a GHG reduction is either additional or it is not. In practice, however, determining whether an activity is additional requires comparing it to a scenario without revenue from the sale of carbon offsets. Such a scenario is inherently unknowable, and must be determined using educated predictions (such as about future fuel, timber, or electricity prices). The determination can also fall prey to "information asymmetry": only a project developer can say whether the prospect of selling carbon offset credits was truly decisive, but regardless of the truth, every project developer has an incentive to argue that it was. **In light of these uncertainties, it best to think of additionality in terms of risk: how likely is a project to be additional?**

Additionality

4.1.1 HOW CARBON OFFSET PROGRAMS ADDRESS ADDITIONALITY

Carbon offset 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.

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

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 wide-spread); and
- An "investment analysis" of whether the project is financially attractive in the absence of offset credit revenues; and/or
- A "barriers analysis" demonstrating that at least one alternative to the project would not be prevented by (non-financial) implementation barriers (e.g., social, institutional, or technical barriers); 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 in the evaluation of financial parameters or the identification of barriers) and strongly hinge on uncertain assumptions about the future (such as fuel prices). It is often challenging for offset program staff and verifiers to judge whether project developers are biasing these assumptions in their favor. All voluntary carbon offset programs rely heavily on project-specific approaches, except for the Climate Action Reserve (CAR).

"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-determined eligibility criteria (e.g., performance benchmarks that—in principle—distinguish additional from non-additional projects). Standardized approaches require upfront analysis to establish these eligibility criteria. Their main advantages are that they can reduce the administrative burdens of making additionality determinations, and they reduce elements of subjectivity in assessing projects. Their main drawback is that they may be imprecise in distinguishing additional and non-additional projects. Of the major voluntary carbon offset programs, the CAR has been the primary adopter of standardized approaches,[26] although other programs (e.g. VCS) apply them to some project types.

For many project types, it can be difficult to define objective criteria that reliably screen out non-additional 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 less than 20 protocols, in contrast to the VCS and Gold Standard, which incorporate over 200 project-specific methodologies/protocols.

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 lower quality projects include the following:

- Did the project secure a buyer for offset credits before implementation? Given the risks and uncertainties of the carbon market, it is rare for a project that truly needs offset credit revenue to go forward without first securing buyers for some or all of the credits it expects to produce. Forward contracts generally take the form of "emission reduction purchase agreements" (ERPAs). Although there are exceptions, if a project began implementation without an ERPA, its claims to additionality should be further examined.
- How large is the project's offset credit revenue stream compared to other revenue streams or cost savings achieved by the project? Claims of additionality are often tenuous if carbon offset 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 offset credit revenue, the project's additionality should be questioned.
- Would the project cease reducing emissions if it did not continue to receive carbon offset revenues? Even if a project's offset 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 reducing emissions even if it stopped selling carbon offset 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 offset sales – they may pose a higher risk of being non-additional.

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

- 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 currently required by law, but landfill owners may seek to implement such a project anyway 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 it would be implemented anyway in the (near) future.

4.2 AVOIDING OVERESTIMATION

Suppose that, for every 50 additional tonnes of CO_2 that are reduced by an offset project, the project developer reports reducing 100 tonnes, and 100 offset credits are then issued to the project. Half of these credits would have no effect in mitigating climate change, and using them in lieu of reducing your own emissions would make climate change worse. Overestimation of GHG reductions can occur in several ways:

- Overestimating baseline emissions. The first – and most subtle – way GHG reductions can be overestimated is if a project's baseline emissions are overestimated. Baseline emissions are the reference against which GHG reductions are calculated, and are closely tied to additionality: they are the emissions that would have occurred in the absence of demand for offset credits.[27] 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 equal to the amount that is captured and destroyed.[28] 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 greater risk of overestimation if methods are not appropriately conservative.
- Underestimating actual emissions. Many kinds of carbon offset projects reduce, but do not eliminate, GHG emissions. A project's GHG reductions are quantified by comparing the actual emissions that occur after the project is implemented to its predicted baseline emissions. In the same way that baseline emissions can be overestimated, actual emissions can be underestimated – with both contributing to an overestimation of GHG reductions. One way actual emissions can end up underestimated is through measurement error. For example, determining the increase in the amount of carbon stored in trees in any given year is subject to measurement uncertainty, and sampling errors can lead to overestimating carbon sequestration (the equivalent of underestimating GHG emissions).
- Failing to account for the indirect effects of a project on GHG emissions (aka "leakage"). To quantify GHG reductions, actual and baseline emissions are determined for sources (or sinks) 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 net GHG reductions will be overestimated. Unintended increases in GHG emissions caused by a project outside of its boundaries are referred to as "leakage." The classic example is a forest preservation project that avoids the emissions caused by clearing one parcel of forest, but ends up shifting the production of timber through deforestation to other areas.
- Forward crediting. Although rare, offset credits may be issued for GHG reductions 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 offset credits if a project fails to perform as expected.[29] It can also pose issues if future events (e.g., regulatory changes) lead to additionality or emission reduction ownership concerns.

Finally, to control for all these possible causes of overestimation, it is important to monitor and verify a project's performance.[30] It is important for measurement and data collection procedures – and for any calculations or estimates derived from these data – to be scientifically sound and methodologically robust. Furthermore, it is important for project monitoring data to be rigorously verified. Verification entails assessing the veracity of data provided by project developers, often through an audit of selected data samples. Carbon offset project developers have an incentive to report data that maximize the number of carbon offset credits they can sell. Verification helps to assure that reported data are accurate and do not overstate GHG emission reductions.

Forestry-based offset 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+.

4.2.1 HOW CARBON OFFSET PROGRAMS ADDRESS OVERESTIMATION

Carbon offset programs try to ensure that GHG reductions are not overestimated by requiring the use of detailed quantification methods specific to individual project types. In general, these methods prescribe:

- GHG accounting boundaries that define the GHG sources and sinks that must be considered in quantifying a project's baseline and actual GHG emissions. [31]
- Baseline emission estimation methods that prescribe how a project's baseline scenario is defined, including acceptable assumptions regarding baseline technologies and practices.
- Monitoring requirements that prescribe the data to be collected for predicting baseline emissions and quantifying a project's actual emissions. These methods also specify how to conduct measurements, what kinds of estimates are acceptable, and what calculation formulas must be used. [32]

Importantly, carbon offset programs require verification by independent, third-party verifiers, who check that projects have properly applied prescribed quantification methods (see Box 2). In most cases, offset credits are only issued after GHG reductions or removals have already occurred and been verified.

Finally, offset programs also limit the crediting periods during which projects can generate creditable GHG reductions. Crediting periods are typically from 7 to 10 years, which is often shorter than the operational lifetime of a project's equipment. Programs generally allow crediting periods to be renewed (usually one or two times, depending on project type), as long as a project remains eligible under its standard. [33]

Box 2. What do carbon offset project verifiers do?

Third-party verifiers have two main responsibilities in the context of a carbon offset program. First, they perform project validation, which entails confirming that a proposed project meets a program's eligibility criteria. Second, verifiers conduct project verification, which entails confirming that project monitoring data was collected in accordance with a program's requirements, as well as reviewing calculations to confirm that the project's GHG reductions were estimated according to the approved methodology/protocol.[34] 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.

Verifiers are generally paid by project developers, which creates a conflict of interest. To reduce the risk of bias, most carbon offset programs review verification arrangements, require verifiers to legally certify that they are free of conflicts, and limit the number of times that the same verifier can verify a project. Programs also regularly audit the work of verifiers to ensure their objectivity.

4.2.2 QUESTIONS FOR BUYERS TO ASK ABOUT OVERESTIMATION

Examining in detail how a project's GHG reductions 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 protocol/methodology and appropriately justify these deviations? Several carbon offset programs allow projects to deviate from a protocol'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 is able to estimate them using alternative methods. Programs will generally try to ensure that alternative methods are more conservative than what a protocol prescribes. Offset 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 carbon offset programs have rules and procedures to address gaps or discrepancies in project monitoring data (for example, if a flow meter temporarily breaks down and fails to collect data for a period of time). Such instances should be transparently reported, along with methods to 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

One challenge with using carbon offsets 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.[35] To compensate for this, offset credits must be associated with GHG reductions that are similarly permanent. If a GHG reduction or removal is "reversed" (i.e., GHGs are subsequently emitted so that no net reduction occurs),[36] then it no longer serves a compensatory function.

For most kinds of carbon offset projects, reversals are either physically impossible or extremely unlikely.[37] The greatest risk occurs with projects that store carbon in "leaky" reservoirs. 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). Such a project will reduce CO_2 emissions – and increase removals – if the trees would have been cut down otherwise. But, if a fire later burns down the project's trees, some or all of the carbon may be (re)emitted, leading to a reversal.

One common misunderstanding is that – for carbon offsets – "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 100 years (or less, in some cases) to be considered "permanent." Such compromises are frequently made in the context of carbon offset programs seeking to balance technical requirements with the practical constraints of insuring against reversals. But, scientifically, anything less than a full guarantee against reversals into the indefinite future is not "permanent."

4.3.1 HOW CARBON OFFSET PROGRAMS ADDRESS PERMANENCE

Most carbon offset programs have established "buffer reserves" to address the risk of GHG reductions being reversed. [38] Under this approach, offset credits from individual projects are set aside into a common buffer reserve (or "pool"), which functions as an insurance mechanism. Reserved credits can be drawn upon to compensate for reversals from any project. 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 offset 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 fuel treatments, and the use of conservation easements or other legally binding restrictions on land use). 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 present a "moral hazard" problem if used to compensate for human-caused reversals, such as intentional timber harvesting. [39] If a landowner faces no penalty for harvesting trees for their timber value, for example – because any reversals caused by harvesting would be compensated out of a buffer reserve – then the landowner could face a strong incentive to harvest. Offset programs approach this issue in different ways. Some programs use buffer reserves only to compensate for natural disturbances, and impose contractual obligations on landowners to compensate for any “avoidable” reversals (including reversals due to negligence or willful intent). Others will cover such reversals using buffer reserves, but will not issue further offset credits to a project until the reversal is remedied.

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 offset credits from these kinds of projects. As a rule of thumb, 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 representing additional GHG reductions 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 offset credits.
- How long is “permanence” guaranteed by the offset program that issued the credits? Offset 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. Offset programs are not always transparent about what their minimum guarantee is, so it is worth inquiring either with project proponents or directly with program staff. The longer the guarantee, the higher the relative quality of the offset credits.

4.4 EXCLUSIVE CLAIM TO GHG REDUCTIONS

Carbon offset credits must convey an exclusive claim to GHG reductions. Imagine if two different companies laid claim to the same 100 tonnes worth of CO_2 reductions. Together they would claim a total of 200 tonnes of reductions, but the actual reduction would only be 100 tonnes. Again, climate change would be made worse, compared to a situation where both companies simply reduced 100 tonnes of their own emissions. This type of "double counting" can happen in three ways:[40]

- **Double issuance** occurs if more than one offset credit is issued for the same GHG reduction. For example, a carbon offset program can mistakenly issue two credits to the same project for one tonne of CO_2-equivalent reductions. More likely, however, is that a program issues credits to two different projects, each of which claims the same reduction. An example would be if both the producer and consumer of biofuels claim GHG reductions associated with using the same liters of fuel – and a program issues offset credits to both of them without realizing the overlap. Established carbon offset programs are generally good at avoiding this error within their system, but a somewhat greater risk is that two different programs issue offset credits for these kinds of overlapping claims (not realizing that another program has recognized the same reductions).
- **Double use** occurs if two different parties count the same offset credit towards their GHG reduction claims. Again, most carbon offset programs have procedures to prevent this from happening. The most likely way for it to occur is for an unscrupulous seller to represent to multiple buyers that the credit was retired on their behalf. To avoid such fraud, it is essential for carbon offset programs to require that the purpose of any offset credit retirement is clearly recorded in their registry systems – including on whose behalf the retirement was made.
- **Double claiming** can happen if offset credits are issued to a project, but another entity (e.g., a government or private company) then counts the same GHG reductions towards its own GHG reduction goal. For example, double claiming would occur if an energy efficiency project obtains offset credits for reducing emissions at a power plant covered by a (regulatory or voluntary) emission reduction target. In this case, both the project and the power plant would claim the same reduction: the project through offset credits, and the power plant, through a reduction of emissions relative to its target. Such overlapping claims must be carefully avoided. As described in Section 2.5.2, a potentially significant double claiming issue could arise under the Paris Agreement. Specifically, unless governments agree not to count an offset project's GHG reductions towards their national mitigation targets, the reductions will effectively be double claimed.

4.4.1 HOW CARBON OFFSET PROGRAMS ADDRESS EXCLUSIVE CLAIMS

Carbon offset programs apply a number of methods to ensure that offset credits convey an exclusive claim to GHG reductions.

Double issuance is avoided primarily by:

- Ensuring that offset credits are only issued after program approval of emission reduction verification reports and other supporting documentation;
- Checking that the accounting boundaries used to quantify GHG reductions for different projects do not overlap
- Actively monitoring project registrations – including at other programs—to check that a project is not issued credits by more than one program for the same emission reductions[41]

Double use is avoided primarily through registry systems that assign unique serial numbers to individual offset credits, track their transfer and ownership, and record the purpose of their use and retirement.[42]

Double claiming is avoided though:

- Restricting the eligibility of project types (e.g., excluding those are known to be subject to GHG reduction mandates or competing claims); and/or
- Requiring project developers to sign legal attestations asserting exclusive claims to any credited emission reductions, and agreeing to legally convey such claims to the buyers of offset credits.

Offset programs are still deliberating on how to reconcile competing claims for GHG reductions that are covered by countries' climate action pledges under the Paris Agreement (see Section 2.5.2).

4.4.2 QUESTIONS FOR BUYERS TO ASK ABOUT OWNERSHIP CLAIMS

Although carbon offset programs generally have effective measures in place to assure that the emission reductions are not double counted, there are still some steps that credit buyers should take to make sure they have an exclusive claim to emission reductions. Key questions to ask include:

- When offset credits are retired, is the purpose of the retirement clearly indicated in a carbon offset program registry? Buyers should ask to see proof of offset credit retirement on the relevant registry – including certificate numbers or a transaction ID that match the quantity purchased – along with a clearly identified purpose and the beneficiary of the retirement.
- Were the offset credits issued for indirect emission reductions? Ownership claims are harder to police where they involve indirect emission reductions (i.e., reductions that occur at sources not owned or controlled by the project owners). Claims to these emission reductions are inherently riskier because there is always a chance that the entities who do own or control the sources may claim the reductions as well. Major carbon offset programs generally try to prevent conflicting claims by having project owners legally attest to having an exclusive claim to credited reductions. However, it can be difficult (if not impossible) to determine exactly where indirect reductions occur, making the truth of such attestations difficult to verify. Where risks of double claiming seem significant (for example, if GHG reductions occur in sectors with significant voluntary commitments or regulatory obligations), buyers should avoid offset credits associated with indirect reductions (e.g., from projects that displace fossil fuel emissions on an electricity grid).

4.5 AVOIDING SOCIAL AND ENVIRONMENTAL HARMS

Finally, for a project to produce high quality offset credits, it should not significantly contribute to social and environmental harms. For example, a project should demonstrate it complies with all legal requirements in the jurisdiction where it is located. Depending on the type of project and the jurisdiction where it is located, however, additional reviews and safeguards may be necessary to guard against negative outcomes unrelated to GHG emissions.

Avoiding social and environmental harms

4.5.1 HOW CARBON OFFSET PROGRAMS ADDRESS SOCIAL AND ENVIRONMENTAL HARM

Carbon offset 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 are in compliance with applicable legal requirements. Most offset programs also require local stakeholder consultations as part of the project approval process, and have established grievance mechanisms to address complaints about projects after implementation. Finally, some programs actively require that projects demonstrate social and environmental co-benefits (and not just avoid harms), as well as monitor and report on these benefits.

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

How carbon offset programs address social and environmental harms

4.5.2 QUESTIONS FOR BUYERS TO ASK ABOUT SOCIAL AND ENVIRONMENTAL HARMS

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

- Prior to 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.
- 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 offset programs themselves) can provide added assurance that a project will not cause harm and ensure that project developers have taken into account the concerns

of local stakeholders. Projects that have not received any co-benefit certification do not necessarily pose a high risk of harms, 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? Annex 1 (also available at offsetguide.org) contains a list of general project types and identifies those for which the risk of social or environmental harms may be significant. Where there is 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 harms and compensate for them if they occur. The CCBS, for example, requires ongoing community impact monitoring associated with forestry projects.

Domestic or foreign projects

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

5. STRATEGIES FOR AVOIDING LOWER-QUALITY OFFSET CREDITS

As the prior sections make clear, carbon offset credits are not a typical commodity. Although carbon offset programs provide some assurance, purchasing high quality offset credits is not as simple as buying any "certified" credit issued by an offset program. It is common to tell credit buyers to "do their homework," and indeed such advice is appropriate for organizations with the time and resources to do so. In this section, we describe both thorough and simpler strategies for steering clear of lower-quality offset credits.

5.1 VETTING OFFSET PROJECTS

As indicated in the prior section, buyers can ask basic questions about offset projects that may help screen out lower quality options. In most cases, project developers and offset credit owners should be forthcoming with answers to such questions (if they are not, it is a red flag). For more sophisticated buyers or those with more resources, a fuller list of offset project "due diligence" questions can be applied.

How do I conduct more rigorous project due diligence?

One option is to engage the services of consultants or trusted retailers to examine projects, navigate different options, and put together a portfolio of offset credits that meet a buyer's goals (with respect to location, project type, offset quality, and co-benefits, for example). 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.

5.2 STICKING TO LOWER-RISK PROJECT TYPES

Although many kinds of projects can deliver GHG reductions, some types of projects have a harder time meeting essential carbon offset criteria than others. It is generally easy to show that industrial gas destruction projects are additional, 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.[43] 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 – they are often on the margin of viability with energy sales revenue alone).

Perhaps the easiest way to reduce the risk of buying low-quality offset credits is to restrict purchases to credits that come from lower-risk project types. Annex 1 (also available at offsetguide.org) provides an overview of the relative offset quality risks associated with common types of carbon offset 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.

5.3 "DISCOUNTING" OFFSET PURCHASES

One strategy to address quality risks is to simply retire extra offset credits. For example, to compensate for 100 tonnes of CO_2 emissions, a buyer could purchase and retire 200 offset credits from a range of different projects. This approach is commonly referred to as "discounting."[44]

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

While discounting can be part of a responsible strategy for using carbon offsets, it should not be done in the absence of other methods to check for offset quality. Doubling the purchase of non-additional GHG reductions still contributes nothing to climate change mitigation!

Clean cookstoves reduce CO_2 through more efficient fuel usage while reducing indoor air pollution and providing financial savings to residents. Image (left) credit: Proyecto Mirador Enhanced Distribution of Improved Cookstoves in Latin America.

5.4 WEAKER METHODS: RELYING ON PRICE OR VINTAGE

In many markets, "cheap" is often synonymous with "low quality." Very cheap offset credits can indeed be a sign of low quality, especially for newer projects. If a project is selling offset 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 offset credit revenue for its implementation. However, some offset project types with high environmental integrity can produce GHG reductions at relatively low cost (e.g., industrial N_2O destruction or avoidance projects).

The inverse argument – that higher prices correlate with higher quality – is not reliably true either. Truly additional offset projects will have a higher intrinsic cost for generating GHG reductions, and will therefore need to charge a higher price for offset 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. Looking only for higher-priced offset credits (without looking at other variables) is therefore not a wise strategy.

The "vintage" of an offset credit can refer either to the year in which it was issued, or the year in which its associated GHG reduction occurred (for some kinds of offset projects, there can be a significant lag between the latter and the former, because of longer verification cycles, e.g., with forestry projects). The vintage of an offset credit does not necessarily indicate anything about its quality.

However, older *issuance* vintages may present a quality concern where the following conditions are true:

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

STOCKHOLM ENVIRONMENT INSTITUTE

(SEI) is an independent, international non-profit research institute bridging science and policy for sustainable development.

THE GREENHOUSE GAS MANAGEMENT INSTITUTE

(GHGMI) is an international non-profit organization providing expertise, training material, and courses to support a global community of experts with the highest standards of professional practice in measuring, accounting, auditing, and managing greenhouse gas emissions; meeting the needs of governments, corporations, and organizations large and small.

We welcome your questions or any feedback you have about this guide. Please see www.offsetguide.org for updated guidance.

You may email GHGMI at info@ghginstitute.org

ANNEX 1: OFFSET PROJECT TYPES AND RELATIVE QUALITY RISKS

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

Table 2. Relative offset quality risk for different project types

Lower risk	Medium risk	Higher risk
• CO_2 usage	• Methane capture and utilization	• Agriculture
• Methane destruction (w/o utilization)	• Methane avoidance	• Biomass energy
• N_2O avoidance from nitric acid production	• Energy distribution	• Cement production
• N_2O – adipic acid*	• Energy efficiency, household demand side	• Energy efficiency, industrial demand side
• Ozone-depleting substance (ODS) destruction	• PFCs & SF_6 avoidance/ reuse	• Energy efficiency -- supply side
	• Renewable energy, small scale	• 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 N2O 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 CO2 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 regulatory 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 offset 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.

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 offset 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 protocols 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 emission reductions (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 emission reductions (e.g., at grid-connected power plants).	Benefits: Offset 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 & 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 emission reductions (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 regulatory 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 emission reductions (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, regulatory 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 baseline for displaced emissions.	Ownership: Projects that generate energy (e.g., from palm oil waste) may result in indirect emission reductions (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 is not clear that carbon revenues would be decisive for investment decisions.	May be some uncertainty about avoided baseline emissions; quantification protocols will generally address this concern with sufficient conservativeness.	Ownership/double counting: Often results in indirect emission reductions. Where distribution displaces electricity applications (e.g., fewer space heaters used as a result of a district heating project), electricity generators could double count reductions.	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 with 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 offset 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 emission reductions, 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 reducing 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 avoided baseline emissions; quantification protocols 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 emission reductions; electricity generators could double count reductions. If RECs or GoOs are also sold from project then another entity may functionally double count reduction.	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 avoided baseline emissions; quantification protocols 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 emission reductions; electricity generators could double count reductions. If RECs or GoOs are also sold from project, then another entity may functionally double count reduction.	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 methane emissions avoided in baseline. 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 emission reductions; electricity generators could double count reductions. If RECs or GoOs are also sold from project then another entity may functionally double count reduction..	Benefits: Better local solid waste management. Harm: Air pollution, if advanced emission controls 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 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 GHG reductions 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 for tillage projects (to the extent crop yields are affected).	Permanence: Risk of reversal (i.e., non-permanent reductions) 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 GHG reductions 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 emission reductions; other energy suppliers or electricity generators could double count reductions.	Benefits: Supports a 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 protocols may better address these concerns than others.	Ownership/double counting: Often results in indirect emission reductions; other energy suppliers or electricity generators could double count reductions.	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 regulatory 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 emission reductions, meaning greater potential for double counting.	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 protocols 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 emission reductions, 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 reductions) is a concern for all carbon storage projects.	Benefits: Forests provide a range of ecosystem services that forest sector offset 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 emission reduction 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 avoided baseline emissions; quantification protocols 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 emission reductions, 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 protocols 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 emission reductions, 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 CO2 reduced) is well above current and historical prices for carbon offsets, calling into question whether carbon revenues can be a decisive factor in incentivizing these 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: Transportation emissions reduction projects can improve air quality and the health of those living nearby as well as increase urban liveability.

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. CLlMA.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 offsets? 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 offset 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 Offsets: Today's Carbon Offset 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 Offsets. 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, soils, 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 offset programs. However, a comprehensive carbon offset program will consist of more than just a standard and a registry.

6 Although the CDM has functioned primarily as a regulatory program under the Kyoto Protocol, it now also caters to voluntary purchasers.

7 Like the CDM, "Joint Implementation" is a separate offset program established under the Kyoto Protocol; the CDM applies only to developing countries, while JI is used in developed countries.

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 Similar terms, like "climate neutral" or "net zero" are largely synonymous.

10 See, for example, https://sciencebasedtargets.org/step-by-step-guide/

11 Scope 2 emissions for your corporate inventory should be estimated using grid average emission factors (e.g., kg CO2/kWh), also referred to as the location based method. Application of a zero emission factor, based on green power purchasing claims (i.e., the market based method), generally lacks environmental integrity and is inconsistent with good practice in environmental accounting. For further information see https://scope2openletter.wordpress.com/

12 This kind of "double-entry bookkeeping" is referred to in international negotiations as "corresponding adjustments." Detailed rules for how corresponding adjustments will be implemented are still being negotiated – see Schneider et al. (2019).

13 The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), established in 2016, is expected to demand anywhere from 1.6 to 3.7 billion offset credits between 2021 and 2035 – see Warnecke et al. (2019). On the subject of avoiding double counting, see Schneider, Broekhoff, et al. (2019).

14 See, for example, Kreibich and Obergassel (2019) as well as ICROA (2019) and Voluntary Carbon Market Working Group (2019).

15 See Wara and Victor (2008).

16 The primary concern is that a large number of offset credits come from energy sector projects that have significant sources of other revenue besides offset credits, suggesting that they would have happened anyway and do not represent additional mitigation. Other identified issues include concerns about over-estimation of emission reductions, 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)

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

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

19 Although most critical studies of carbon offsets have focused on the CDM and JI because of their high profile, many of the same issues are likely to arise in other programs as well. For some programs – like Verra (i.e., VCS) and the Gold Standard – this is because they incorporate CDM methodologies by reference, so there is substantial overlap in the kinds of projects they certify. In other cases, programs have used CDM methodologies as a starting point in developing their own standards. Although a number of programs have followed approaches that differ from the CDM, no program should be considered categorically free of all concerns about offset quality.

20 The CDM Executive Board, for example, adopted amendments and clarifications to its methodology for destruction of HFC-23 emissions to address demonstrated concerns about over-production of this gas purely for the purpose of producing more offset credits. Such projects are now disallowed. However, similar concerns for other project types – e.g., N_2O abatement at adipic acid plants – have not been fully addressed.

21 Verra and the Gold Standard, for example, have solicited public input on whether to exclude from eligibility clean energy projects in wealthy and middle-income countries, on the grounds that these projects have a low likelihood of being additional.

22 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 offset 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 offset projects do not cause significant social or (non-climate) environmental harms. Both are important for offset quality.

23 See Gillenwater (2012).

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

25 Again, see Trexler (2019).

26 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 eligible (for example: landfill gas collection and destruction, occurring at a sanitary landfill that is below a certain size threshold, where gas collection is not required by law, etc.).*

27 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 generate no emission reductions.

28 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.

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

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

31 Some of these sources and sinks may be treated as "leakage" effects and addressed in supplemental calculations.

32 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.

33 Renewal under some programs may also involve an updated

34 Carbon offset programs can differ in their approach to 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 verifiers for each to avoid conflicts of interest – since a positive validation could lead to a more lucrative verification contract).

35 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).

36 Technically, a "reversal" occurs if – at any point in the future – the rate of GHG emissions accelerates so that it is higher than would have occurred if the project had never happened. For example, protecting a parcel of forest from deforestation prevents 100 tonnes of carbon from being released to the atmosphere (reducing emissions by 100 tonnes). Fifty years later, however, the parcel is burned down, emitting all the carbon. The rate of emissions in year 50 is accelerated, because without the project, the 100 tonnes of carbon would not have been present to be burned. Net GHG reductions over 50 years are zero, because the additional emissions cancel out the prior reductions.

37 Unless a project involves carbon storage of some kind (e.g., sequestering carbon in trees), a reversal of emission reductions is highly unlikely. In theory, however, reversals can occur in other circumstances. A hypothetical example would be where a solar panel and battery storage system is used to provide electricity to a building, allowing it to operate off the grid (and avoiding grid-based electricity emissions); however, the solar panel fails and a backup diesel generator is brought in to provide power instead, causing more emissions than would have occurred without the project. Such circumstances will be rare, but for *some project types, it may be worth evaluating whether these types of risks exist.*

38 The CDM is alone in issuing "temporary credits" for reversible GHG reductions. Under this approach, offset credits issued for these reductions expire after a predefined period (up to 30 years) and must be replaced with other emission reductions. 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 offset 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.

39 See Murray et al. (2012).

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

41 Procedures may include requiring project developers to sign legal attestations stipulating that they will not request issuance of offset credits for emission reductions from more than one program (unless they are effectively "transferring" credits from one program to another).

42 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 beyond what carbon offset programs already make available to any buyer in terms of retirement certification.

43 While additionality is not usually a concern, some kinds of industrial gas projects do have issues with baseline estimation and overestimation of reductions.

44 Technically, "discounting" refers to issuing fewer credits to a project than the GHG reductions it achieved, but it is often used more broadly to refer to any approach that effectively uses more GHG reductions to offset fewer GHG emissions. It has also been proposed as an approach to be used in regulatory carbon markets; for example, see Warnecke et al. (2014).

Image (next page) courtesy of High Tide Foundation