SCIENCE BASED TARGETS

DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

# EVIDENCE SYNTHESIS REPORT PART 1: CARBON CREDITS

A synthesis of the relevant evidence on carbon credits submitted to the Science Based Targets initiative during the 2023 call for evidence on the effectiveness of environmental attribute certificates in corporate climate targets.

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# EXECUTIVE SUMMARY

In 2018, the International Panel on Climate Change (IPCC) published a report that laid forth a mandate to limit global warming to 1.5°C. It outlined the impact of unmitigated greenhouse gas emissions, detailing the stark contrast between 1.5°C and 2°C of warming. Since the report was released, we've witnessed dangerously high ocean temperatures, record-breaking wildfires and deadly flooding across the world. Such extreme weather events are no longer anomalous–they are expected, and they are worsening.

But the window of opportunity has not closed. It is true that each passing year has reduced the likelihood of limiting warming to 1.5°C, but all hope is not yet lost. We still have the potential to take ambitious measures to rapidly cut greenhouse gas emissions–and the private sector will have a crucial role to play in such efforts. Our collective efforts to stem the tide of global warming must include businesses from every sector and across every region setting emissions reduction targets aligned with reaching global net-zero no later than 2050.

That's where the Science Based Targets initiative (SBTi) plays a role. The SBTi enables companies and financial institutions to understand how much and how quickly they need to reduce their greenhouse gas (GHG) emissions to align with the latest climate science. We develop standards, tools and guidance that allow companies to set emission reduction targets in line with what is needed to keep global heating below catastrophic levels and reach net-zero by 2050 at the latest.

The SBTi Corporate Net-Zero Standard was first launched in October 2021 to address the growing need for a common, robust, science-based understanding of net-zero in the corporate sector. It provides guidance and tools for companies to set net-zero targets that lead to mitigation consistent with limiting warming to 1.5°C.

Since the launch of the Standard, there has been year-on-year growth in both net-zero target validations and commitments. As of July 2024, over 1000 companies have set SBTi-validated net-zero targets, with another 2300+ businesses committed to set net-zero targets in the near future.

Conducted in accordance with the Standard Operating Procedure (SOP) for Development of SBTi Standards, the Corporate Net-Zero Standard is now undergoing its first major revision. The revision process, detailed in the project Terms of Reference, includes exhaustive research, expert advisory, public consultation and pilot testing before finalizing Version 2.0 of the Corporate Net-Zero Standard in 2025.

The aims of the revision process include incorporating insights gained following the Standard's formal adoption in 2021, integrating insights gathered from the validation of 1000+ corporate net-zero targets, aligning with the latest scientific findings and emerging best practices and addressing a number of gaps within the existing frameworks.

As outlined in the SOP for Development of SBTi Standards, exhaustive research across multiple topics is already underway to inform revisions to the Corporate Net-Zero Standard.

This includes research that will inform potential changes in the eligible use of different types of environmental attribute certificates (EACs) in SBTi standards.

### Environmental attribute certificates

EACs encompass a diverse range of instruments that certify and communicate specific environmental or sustainability attributes of a given activity or commodity. By verifying that certain environmental standards or sustainability criteria have been met, these certificates enable companies to substantiate their environmental claims and support compliance with voluntary or regulatory schemes. They can also enhance transparency within the value chain.

Generally speaking, certificates used to enable climate-related claims by corporates can be classified into two broad categories:

1. **Instruments that convey the mitigation outcome(s) of an intervention:** These instruments, referred to herein as carbon credits, are used to measure and communicate the mitigation outcomes of an intervention. Carbon credits can be issued from a wide number of activities and are often measured in tonnes of carbon dioxide equivalent ($tCO_2e$). The main categories of activities that can issue carbon credits based on the type of mitigation outcome include emissions avoidance credits, emissions reductions credits and carbon removal/sequestration credits.

2. **Instruments that convey the climate-related performance of an activity:** These instruments are used to establish the emissions profile of an activity, such as the production or processing of a given commodity. The emissions profile can be established directly through the emissions intensity of the activity, or indirectly by conveying attributes that help determine the emissions profile of the activity. This could include whether the commodity was produced using zero-carbon technologies or from activities or areas that result in no deforestation and/or no conversion. Depending on the type of activity that issues the certificate, these instruments can be classified into the following, non-exhaustive categories: energy certificates (e.g., renewable energy certificates, renewable gas certificates, sustainable aviation fuel certificates and green hydrogen certificates), and commodity certificates (instruments that certify and convey sustainability information about the production process of different commodities, e.g. green steel).

### Call for evidence on the effectiveness of EACs in corporate climate targets

The SBTi issued a Call for Evidence on the Effectiveness of EACs in Corporate Climate Targets that remained open from September 21 to November 24, 2023 (SBTi, 2023). The open call was designed to solicit evidence from a wide range of stakeholders in response to eight research questions related to the two types of environmental attribute certificate listed above.

* *The Call for Evidence document referred to "emission reduction credits" as opposed to the more common "carbon credits" so as to exclude evidence submissions relating to carbon removal credits used for the purpose of neutralizing residual emissions, which were defined*

*as out of scope of this research.[1] However, the intention of the Call for Evidence was to also consider carbon credits that represent emissions avoidance.*

### Purpose of this report

The purpose of this report is to summarize the body of evidence submitted to the SBTi during the Call for Evidence period related to carbon credits that represent either emissions reductions or emissions avoidance.

The SBTi will issue separate reports in the future that cover the body of evidence that was submitted to the SBTi relating to the other types of EACs under investigation, including energy attribute certificates for electricity, other energy carrier certificates and commodity certificates conveying a specific emission factor.

### Methods

Across all EAC types, a total of 406 unique pieces of evidence were submitted via a survey form and 32 additional unique pieces of evidence were submitted via email. The SBTi has published a table compiling the evidence submitted and the aggregated survey response results of the 406 unique pieces of evidence submitted via the survey form.

The Call for Evidence survey invited respondents to provide evidence and their individual opinions about the relevance and findings. To ensure objective evaluation, the SBTi developed a standardized methodology to systematically review and assess the evidence submitted (see Annex B for further detail). The SBTi's examination of the evidence submitted was performed to summarize the findings in relation to the research questions and to provide additional credibility to the information submitted by the respondent.

This assessment methodology has been undertaken only for evidence that was submitted and tagged as relevant to emission reduction credits. The SBTi anticipates following the same process for evidence that was submitted to the SBTi and tagged as relevant to the other types of EACs (energy attribute certificates for electricity, other energy carrier certificates and certified commodities conveying a specific emission factor) at a later date.

The assessment methodology comprises five steps:

1. Initial evidence cleaning and categorization
2. Detailed evidence review
3. Categorization of evidence into final tiers and relevance levels
4. Evidence synthesis and report writing
5. Quality review

Each piece of evidence was first assigned a default tier based on the evidence type, whether it was published in a peer-reviewed journal, and whether it was published by a governmental entity. The tiers are not intended to strictly represent a hierarchy of quality, but are meant to aid general prioritization of evidence in terms of bias and relevance. Table 1 below shows the default tiers for each evidence type. The methodology is described in detail in Annex B.

[1] As specified in the September 2023 Call for Evidence document, this effort was not designed to examine the effectiveness of carbon removal credits for the purpose of neutralization of residual emissions. Evidence on removal activities will be considered for the development of more detailed requirements and guidance for neutralization of residual emissions for future revisions of the SBTi Corporate Net-Zero Standard.

*Table 1. Default evidence tiers. See Annex B for more details about the evidence type categorisation*

| Default tier | Evidence type | Peer- reviewed journal | Published by a gov. organization |
|---|---|---|---|
| A | Controlled research study | Yes | Any |
| | Law or regulation | No | Any |
| | Legal or regulatory analysis | Yes | Any |
| | Literature review | Yes | Any |
| B | Case study or example | Yes | Any |
| | Controlled research study | No | Any |
| | Legal or regulatory analysis | No | Yes |
| | Report or white paper | No | Yes |
| | Survey or poll | No | Any |
| C | Case study or example | No | Any |
| | Commentary | Any | Any |
| | Legal or regulatory analysis | No | No |
| | Literature review | No | Any |
| | News Coverage | No | Any |
| | Report or white paper | No | No |
| | Statistical information | No | Any |

## Evidence synthesis

There were 111 unique pieces of evidence that were submitted to the SBTi's Call for Evidence that submitters tagged as being relevant to emission reduction credits.

Following the methodology summarized in the above and described in detail in Annex B, the SBTi identified 71 pieces of evidence submitted to the SBTi were either relevant or partially relevant to both the research questions posed and to carbon credits that represent emissions reductions or emissions avoidance.

Within this report, the discussion of the evidence is split into three main themes. The first of the three themes discusses evidence related to the extent to which carbon credits deliver their intended mitigation outcomes, and whether there is an association between specific operating conditions and their effectiveness in delivering mitigation outcomes. The second theme discusses the evidence that considers the different ways in which companies can use

carbon credits and the corresponding implications for the net-zero transformation of sectors and for global efforts to increase climate mitigation finance. The third and final theme relates to the types of claims that may or may not be credibly used by companies purchasing and retiring carbon credits (reductions and avoidance) for different purposes.

For each theme, Table 2 summarizes key findings from the evidence synthesis. While the evidence submitted and assessed reveals some trends and provides insights into the themes described in this document, the findings should not be extrapolated or generalized beyond the specific conditions described in each of the individual pieces of evidence. The limitations section of this report outlines the rationale for this.

*Table 2. Summary of findings across themes and evidence tiers*

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| **Theme 1:**<br>**Mitigation outcomes and conditions for effectiveness**<br><br>**(Total number of relevant submission = 41)** | The empirical and observational evidence in Tiers A and B (those with less risk of bias or irrelevance) suggests that various types of carbon credits are ineffective in delivering their intended mitigation outcomes.<br><br>Evidence in Tier C (those with higher risk of bias or irrelevance) shows more mixed results.<br><br>There was no evidence submitted that identified characteristics or operating conditions associated with effective carbon credits and projects. |
| **Theme 2:**<br>**Corporate Use Cases for Carbon Credits and Implications for Net-Zero Aligned Transformation and Climate Finance**<br><br>**(Total number of relevant submission = 31)** | The evidence suggests that there could be clear risks to corporate use of carbon credits for the purpose of offsetting. This includes potential unintended effects of hindering the net-zero transformation and/or reducing climate finance.<br><br>BVCM and contribution claim approaches may represent preferable models for accelerating net-zero transformation and increasing climate finance. |
| **Theme 3:**<br>**Claims**<br><br>**(Total number of relevant submission = 19)** | All Tier A evidence challenge the legitimacy of offsetting claims, arguing that treating carbon credits as fungible with other sources, sinks, or reductions of emissions is inadvisable, illogical, or damaging to global mitigation goals.<br><br>Two of the three Tier B evidence submissions oppose offsetting claims and 10 of the 12 Tier C evidence submissions directly oppose offsetting claims, with the other two not taking a strong stance either way.<br><br>A number of evidence submissions highlight that the quantity and diversity of claims has created confusion amongst corporates and other actors. |

**Theme 1 (Mitigation Outcomes and Conditions for Effectiveness)** considered the insights that could be drawn from evidence regarding the effectiveness of emission reduction

credits to deliver mitigation outcomes and under which conditions they deliver their intended outcomes. In reviewing the evidence, the SBTi was particularly interested in the extent to which attributes such as additionality, permanence, accurate estimation of emissions and leakage impact the effectiveness of carbon credits.

There were 41 evidence submissions considered relevant or partially relevant to this theme. The empirical and observational evidence in Tiers A and B (those with less risk of bias or irrelevance) suggests that various types of carbon credits are ineffective in delivering their intended mitigation outcomes. Evidence in Tier C (those with higher risk of bias or irrelevance) shows more mixed results, with both the ineffectiveness and effectiveness of carbon credits in delivering mitigation outcomes being equally highlighted in the evidence.

Additionally, there was no evidence submitted that systematically identified features associated with actual credits or projects that do deliver their intended benefits in comparison with those that do not. In other words, the evidence does not identify characteristics or operating conditions associated with effective carbon credits and projects, but instead comments on and describes improvements needed overall.

Given the heterogeneity of carbon credits across various project types, methodologies and other conditions, the findings in this section should be understood as findings specific to the pieces of evidence submitted to SBTi and not generalized beyond this.

**Theme 2 (Corporate Use Cases for Carbon Credits and Implications for Net-Zero Aligned Transformation and Climate Finance)** considered the evidence regarding different ways in which companies can use carbon credits and the corresponding implications for the net-zero transformation of sectors and/or for global efforts to increase climate mitigation finance.

There were 31 evidence submissions considered relevant or partially relevant to this theme. In reviewing the evidence, the SBTi was particularly interested in understanding three-high level use cases: 1) offsetting, where companies purchase and retire carbon credits from activities that occur outside of their value chains as a substitute for reducing their own emissions (scopes 1–3); 2) insetting, where companies purchase and retire carbon credits that relate to activities that occur within their value chains; and 3) beyond value chain mitigation (BVCM), where companies purchase and retire carbon credits that relate to activities that occur beyond their value chains as a supplement to reducing their own emissions, and make either compensation or contribution BVCM claims relating to those actions (see the glossary for definitions).

The evidence submitted to the SBTi generally suggests that there could be clear risks to corporate use of carbon credits for the purpose of offsetting. This includes potential unintended effects of hindering the net-zero transformation and/or reducing climate finance. On the other hand, BVCM and contribution claim approaches may represent preferable models for accelerating net-zero transformation and increasing climate finance in that those efforts are beyond a company's efforts to reduce its own emissions.

**Theme 3 (Claims)** considered the evidence regarding the types of claims that may or may not be credibly used by companies purchasing and retiring emissions reductions credits for different purposes.

There were 19 evidence submissions considered relevant or partially relevant to this theme. The evidence received on this theme tended to address the following topics:

- A review of the types of claims that exist, without commenting on their appropriateness.
- Factors that could affect the validity of offsetting claims of unabated value chain emissions and carbon credits.
- Existing limitations, requirements or guidelines on claims according to voluntary and regulatory frameworks.
- Authors' opinions on which claims are and are not appropriate, and under what circumstances, with varying types of justification.

A number of evidence submissions highlight that the quantity and diversity of claims has created confusion amongst corporates and other actors. One evidence submission categorizes different types of claims including "non-offsetting claims", "contribution to a quantified GHG reduction or removal goal", "contribution to a global net-zero goal", "offsetting/compensatory claims", "offsetting/compensation claims backed by corresponding adjustments", and "offsetting/compensation claims not backed by corresponding adjustments". Another evidence submission highlights the diversity of claims being used by companies including "climate positive", "climate negative", "planet neutral", and "carbon positive/negative", all with potentially different meanings.

The evidence highlights the risk of claims which seek to convey that the purchase and retirement of carbon credits by companies somehow "offsets", "counterbalances" or "compensates for" unabated value chain emissions.

### Next steps

The SBTi will publish summary reports that relate to the other types of EACs in the scope of this research in due course.

The results of this research will be considered, along with other research outputs, in the revision of the SBTi Corporate Net-Zero Standard. This revision will be conducted in accordance with the Standard Operating Procedure (SOP) for Development of SBTi Standards, which includes public consultation, pilot testing, redrafting, review and approval by the Independent SBTi Technical Council and consideration and adoption by the SBTi board. The SBTi expects Version 2.0 of the Standard to be published in 2025.

# GLOSSARY

Please see the SBTi glossary for a list of key terms used across SBTi documents: https://sciencebasedtargets.org/glossary. Key definitions that are relevant to this document are set out in the table below.

*Table 3. Glossary*

| Term | Definition |
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| Abatement | Measures that companies take to prevent, reduce, or eliminate sources of GHG emissions within their value chain. |
| Abatement cost | The abatement cost is the unitary cost of an intervention that will reduce greenhouse gas emissions by one tonne of carbon dioxide equivalent (adapted from World Bank, 2023). |
| Achievement (of science-based targets) | The state of having met the required emissions reductions and other actions stated in a company's science-based target in the target year or earlier. |
| Additionality | Additionality is the extent to which something happens as a result of an intervention that would not have occurred in the absence of that intervention. Additionality is a defining concept of interventions quantified with consequential accounting, including carbon credit projects and programs. |
| Agriculture, forestry and other land use (AFOLU) | Common terminology in the scientific community for what is also called the land sector and forest, land and agriculture (FLAG) in the case of the SBTi. The AFOLU category combines the LULUCF (land use, land use change and forestry) and agriculture sectors. |
| Baseline emissions | The GHG Protocol for Project Accounting defines baseline emissions as "An estimate of GHG emissions, removals, or storage associated with a baseline scenario or derived using a performance standard" (GHG Protocol, 2005).<br><br>The GHG Protocol Corporate Accounting Standard highlights that the term "baseline emissions" (in the context of project-based accounting) should be differentiated from the term "base year emissions," which is mostly used in the context of inventory accounting. The term base year emissions focuses on a comparison of emissions over time, while a baseline is a hypothetical scenario for what GHG emissions would have been in the absence of a GHG reduction project or activity (GHG Protocol, 2005). |

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| Baseline parameters | Any parameter whose value or status can be monitored in order to validate assumptions about baseline emissions estimates or to help estimate baseline emissions (GHG Protocol, 2005). |
| Baseline procedures | Methods used to estimate baseline emissions. The GHG Protocol for Project Accounting presents two optional procedures: the project-specific procedure and the performance standard procedure (GHG Protocol, 2005). |
| Baseline scenario | The GHG Protocol for Project Accounting (i.e. for intervention or consequential accounting) defines a baseline scenario as: "A hypothetical description of what would have most likely occurred in the absence of any considerations about climate change mitigation" (GHG Protocol, 2005).<br><br>In the context of carbon credit generating projects, the determination of the baseline scenario outcome establishes whether a proposed project is additional (GHG Management Institute, 2022). |
| Base year (or base period) | In the context of inventory accounting, a base year refers to a historic datum (a specific year or, in the case of a base period, an average over multiple years) against which a company's emissions are tracked over time. |
| Base year emissions | In the context of inventory accounting, base year emissions refer to a company's scope 1, 2 and 3 emissions in a specific year against which a company's emissions are tracked over time. |
| Benefit sharing | Benefit sharing is the allocation of the proceeds from carbon credits to local stakeholders involved in a carbon credit project or program (Climate Focus, 2023). |
| Beyond value chain mitigation | Mitigation action or investments that fall outside a company's value chain, including activities that avoid or reduce GHG emissions, or remove and store GHGs from the atmosphere. |
| Book and claim chain of custody model | Chain of custody model in which the administrative record flow is not necessarily connected to the physical flow of material or product throughout the supply chain (GHG Protocol, 2022b). Commonly referred to as "unbundled certificates" to support claims. |
| Buffer pool | An approach for addressing non-permanence, in which to require that projects maintain adequate buffer reserves of non-tradable carbon offsets to cover unforeseen losses in carbon stocks. These non-tradable carbon offsets are pooled |

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| | into a commingled buffer pool with each project having its own buffer pool account (Mongabay, 2012). |
| Carbon credit | A carbon credit is a tradable unit that represents one metric tonne of avoided GHG emissions, reduced GHG emissions or GHG removals. |
| Carbon offset credit | A carbon credit is a tradable unit that represents one metric tonne of avoided GHG emissions, reduced GHG emissions or GHG removals. When a carbon credit is purchased and retired for offsetting purposes, it is sometimes referred to as a carbon offset credit. |
| Carbon inset credit | Quantified mitigation outcomes of projects or broader interventions which are credited for GHG claims to be transferred between entities, and which are generated from projects or interventions that reduce emissions or increase removals inside the reporting company's value chain. Credited GHG reductions or removal enhancements are quantified using project or intervention accounting methods, which quantify systemwide GHG impacts relative to a counterfactual baseline scenario or performance benchmark that represent the conditions most likely to occur in the absence of the mitigation project that generates the credit (GHG Protocol, 2022b). |
| Carbon credit (avoidance) | Emissions avoidance credits refer to certificates/tradeable units that represent one tonne of GHGs that are issued from activities that prevent potential future emissions compared to a counterfactual baseline scenario. The number of credits eligible for issuance in any given year results from comparing the emissions performance of an activity with the level of emissions in the counterfactual scenario in that year. For instance, a greenfield zero- or lower-carbon electricity project may generate carbon credits provided that, in the absence of revenue from the sale of carbon credits, a higher emissions alternative would have been built and operated instead. |
| Carbon credit (carbon removal and storage) | Carbon removal and storage credits refer to certificates/tradeable units that represent one tonne of GHGs that are removed and stored from the atmosphere, generated from activities that enhance the capture and storage of carbon dioxide from the atmosphere. For instance, biological or geological carbon sequestration may generate carbon credits by increasing carbon stocks in vegetation and soil (biological) or in geological structures provided that, in the absence of revenue from the sale of carbon credits, these sequestration activities would not have occurred. |

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| Carbon credit (emissions reduction) | Emissions reduction credits refer to certificates/tradeable units that represent one tonne of GHGs that are issued from activities that reduce greenhouse gas emissions compared to the emissions in a reference or base year. The number of credits eligible for issuance in any given year, result from comparing the emissions performance of an activity in a given year with the level of emissions in the base year. Examples of activities that generate emissions reduction credits include energy efficiency measures (e.g. in buildings or industrial processes) or switching from higher-carbon to lower-carbon fuels. |
| Chain of custody model | The general term to describe the process by which inputs and outputs and associated information are transferred, monitored and controlled as they move through each step in the relevant supply chain (ISO 2020) |
| Climate finance | The financial flows whose expected effect aims to reduce net greenhouse gas (GHG) emissions and/or to enhance resilience to the impacts of current and projected climate change (Kreibiehl et al., 2022). |
| Commodity certificates | Instruments that certify and convey sustainability information about the production process of different commodities. These certificates provide verified data on the environmental and/or social performance of a commodity in conformance with a specific sustainability standard. |
| Controlled blending chain of custody model | Chain of custody model in which materials or products with a set of specified characteristics are mixed according to certain criteria with materials or products without that set of characteristics resulting in a known proportion of the specified characteristics in the final output (GHG Protocol, 2022b). |
| Corporate climate abatement target | A company target to prevent, reduce, or eliminate sources of GHG emissions within its operations and wider value chain to a defined level by a defined future date compared to a historic base year of emissions inventory. |
| Counterfactual baseline | Carbon credits can be quantified through a baseline-and credit system that compares actual GHG emissions to a counterfactual baseline emissions scenario. The differences between actual and counterfactual emissions are accounted for as mitigation outcomes that would not have occurred in a business-as-usual scenario. This business-as-usual scenario is a counterfactual scenario that will not actually occur, but would have occurred in an alternative reality without the carbon credit-generating project or program. This makes the definition of conservative reference scenarios essential for the credibility of baselines (Climate Focus, 2022a). |

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| Decarbonization | The process by which countries, individuals or other entities aim to achieve zero fossil carbon existence. Typically refers to a reduction of the carbon emissions associated with electricity, industry and transport (IPCC, 2018). |
| Double claiming | A type of double counting in which the same emissions reduction or removal is claimed by two different entities towards achieving mitigation targets or goals. The double claiming of emissions reductions and removals often happens between a company's GHG inventory and the national inventory where that mitigation outcome occurred.<br><br>In the context of voluntary carbon markets, double claiming can occur between a country, jurisdiction or other entity that reports lower emissions or higher removals for the purpose of demonstrating achievement of a mitigation target or goal, and the entity retiring the carbon credit for the purpose of making a claim (adapted from ICVCM, 2022). |
| Double counting | A situation in which a single emissions reduction and/or removal is counted more than once towards achieving mitigation targets or goals (adapted from ICVCM, 2022).<br><br>Double counting may refer to a situation in which a quantity of GHG emissions is included in more than one organization's GHG inventory. This can occur across scopes (scope 1, 2 and 3) and within a single scope due to differing consolidation approaches, differing emissions calculation methodologies, and the intentional design of emissions accounting standards. |
| Permanence/Durability | The longevity of a carbon pool and the stability of its stocks, given the management and disturbance environment in which it occurs.<br><br>In the context of carbon credits, mitigation outcomes are permanent if they are guaranteed in perpetuity. Instead of issuing requirements for the indefinite future, carbon credit registries often use shorter time spans in light of practical constraints of insuring against reversals. The largest registries make use of buffer pools, which insure the permanence of sold credits against reversals. |
| Emission reductions | Measures that companies take to prevent, reduce, or eliminate sources of GHG emissions within their value chains, or measures that companies take to reduce emissions beyond their value chains compared to a historic baseline. |

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| Energy attribute certificates | A contractual instrument that conveys information (attributes) about a unit of energy, including the resource used to create the energy and the emissions associated with its production and use. EACs may also include information about the location of the facility that generated the unit of energy, when that facility began operations, and when the unit of energy was produced. Instruments that certify the production of renewable and/or low carbon energy (US EPA, 2024). |
| Environmental attribute certificate | Instrument that certifies and communicates the environmental and/or climate-related attributes associated with commodities, activities or projects. |
| Ex-ante assessment | Estimating future GHG effects of policies and actions (GHG Protocol, 2005).<br><br>A change (reduction or increase) in GHG emissions is calculated as the difference between the baseline and intervention (e.g. project or policy) emission estimates across the time series of the intervention. Estimates of both baseline and intervention emissions are a prediction of future performance under the baseline and intervention scenarios, respectively (GHG Management Institute, 2022). |
| Ex-post assessment | Estimating past GHG effects of policies and actions (GHG Protocol, 2005).<br><br>A change (reduction or increase) in GHG emissions is calculated as the difference between the baseline and intervention (e.g. project or policy) emissions estimates across the time series of the intervention.<br><br>For ex-post estimates only the baseline emissions are a prediction because actual data can be collected for the intervention scenario. As such, ex-post baseline emissions are a counterfactual (GHG Management Institute, 2022). |

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| Fungibility | Being of such a nature that one part or quantity may be replaced by another equal part or quantity in the satisfaction of an obligation.<br><br>In the context of offsetting, fungibility typically refers to the physical equivalence of unabated emissions and the mitigation outcomes with which they are being offset. Physical equivalence refers to the condition where different emissions reduction or sequestration activities are considered to have the same net effect on atmospheric greenhouse gas (GHG) concentrations. This implies that one unit of emissions reduced or sequestered through an offset project is considered equivalent to one unit of emissions produced, thus achieving a balance that maintains overall atmospheric GHG levels constant. |
| Identity preservation (IP) chain of custody model | Chain of custody model in which the materials or products originate from a single source and their specified characteristics are maintained throughout the supply chain (GHG Protocol, 2022b). |
| Intervention (or project or consequential) accounting | Accounting method that quantifies systemwide impacts of a specific action or intervention on GHG emissions and removals relative to a counterfactual baseline scenario that represent the conditions most likely to occur in the absence of the action or intervention (GHG Protocol, 2022b). |
| Inventory (or attributional) accounting | Inventory accounting, also known as attributional accounting, tracks GHG emissions and removals within a defined organizational and operational boundary over time. It is the primary method used by corporations and other organizations to report emissions from their operations and value chains (GHG Protocol, 2023). |
| Leakage | When a mitigation activity associated with a carbon crediting project or program displaces emission-creating activities outside the project or program boundary rather than halting them in actual terms. Leakage of GHG emissions can occur when mitigation activities: a) shift location (activity-shifting leakage); b) indirectly affect areas that are hydrologically connected (ecological leakage); c) impact the supply or demand of an emissions-intensive product or service (market leakage); or d) impact upstream or downstream emissions (upstream/downstream emissions leakage). |
| Mass balance chain of custody model | Chain of custody model in which materials or products with a set of specified characteristics are mixed according to defined criteria with materials or products without that set of characteristics (GHG Protocol, 2022b). |

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| Mitigation | A human intervention to reduce emissions or enhance the sinks of GHGs (IPCC, 2018). |
| Mitigation outcome | The IPCC defines mitigation as a human intervention to reduce emissions or enhance the sinks of GHGs (IPCC, 2018).<br><br>In the context of this report, and consistent with current practice, the term mitigation outcomes refers to human-induced activities that contribute to climate mitigation in one or more of the following ways: a) preventing the release of GHGs into the atmosphere compared to a counterfactual baseline scenario (avoided emissions), b) reducing the amount of GHGs previously released into the atmosphere from a given activity, usually compared to emissions from a given source in a reference or base year (emissions reductions), or c) removing and storing carbon from the atmosphere (carbon sequestration or carbon dioxide removal).<br><br>Article 6 of the Paris Agreement allows countries to sell and transfer emissions reductions and/or removals to other countries to achieve their nationally determined contributions (NDCs) thereby becoming Internationally Transferred Mitigation Outcomes (ITMOs). In June 2024, at the Bonn Climate Conference, national delegations reconvened formal negotiations on the design of UNFCCC carbon markets (Article 6), where it was agreed to postpone discussions on whether emission avoidance could qualify for crediting in Article 6.2 and 6.4 until 2028, while clarifying that emission avoidance is not currently permitted under Article 6. |
| Mitigation hierarchy | The mitigation hierarchy in the context of corporate climate action consists of a series of steps, in the following order of priority:<br>1) Avoid: measures taken by companies to avoid creating value chain emissions from the outset (e.g. manufacture of electric vehicles instead of internal combustion engines).<br>2) Reduce: measures taken by a company to reduce the intensity and/or extent of GHG impacts in the value chain that cannot be completely avoided (e.g. efficiency projects to reduce electricity usage of existing equipment).<br>3) Take responsibility for value chain emissions that continue to be released into the atmosphere by driving climate mitigation outside of the company's value chain (beyond value chain mitigation). It is expected that over time, and by 2050 at the latest, unabated emissions are counterbalanced |

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| | by permanent removal and storage of carbon from the atmosphere (neutralization of residual emissions). |
| Neutralization of residual emissions | Measures that companies take to counterbalance the climate impact of unabatable (i.e. residual) GHG emissions which are released into the atmosphere at and after net-zero target date through permanent removal and storage of $CO_2$ from the atmosphere. |
| Offsetting | The term offsetting refers to purchasing carbon credits from activities outside of a company's value chain as a substitute for abating emissions within its value chain. |
| REDD and REDD+ | Countries established the REDD+ framework to protect forests as part of the Paris Agreement. "REDD" stands for Reducing Emissions from Deforestation and forest Degradation in developing countries. The "+" stands for additional forest-related activities that protect the climate, namely sustainable management of forests and the conservation and enhancement of forest carbon stocks. Under the framework with these REDD+ activities, developing countries can receive results-based payments for emissions reductions when they reduce deforestation. |
| Science-based target | Corporate targets to mitigate GHG emissions that are in line with what the latest climate science says is necessary to meet the goals of the Paris Agreement – to pursue efforts to limit warming to 1.5°C. |
| Segregation chain of custody model | Chain of custody model in which specified characteristics of a material or product are maintained from the initial input to the final output (GHG Protocol, 2022b). |
| Vintage | The year in which the carbon emissions reduction or removal associated with a carbon credit or an environmental attribute certificate took place. Because the verification process can take two to three years from project/program inception, projects/programs may generate credits for already-reduced or removed emissions. In the context of scope 2 accounting, vintage reflects the date of energy generation from which the contractual instrument is derived (GHG Protocol, 2015). |

# INTRODUCTION

## Introduction to the SBTi

The Science Based Targets initiative (SBTi) is a corporate climate action organization that enables companies and financial institutions worldwide to play their part in combating the climate crisis.

The SBTi develops standards, tools and guidance that allow companies to set greenhouse gas emissions reduction targets in line with what is needed to keep global heating below catastrophic levels and reach net-zero by 2050 at the latest.

The SBTi is incorporated as a charity, with a subsidiary that hosts our target validation services. Our partners are CDP, the United Nations Global Compact, the We Mean Business Coalition (WMBC), World Resources Institute (WRI) and the World Wide Fund for Nature (WWF).

## About the SBTi's Corporate Net-Zero Standard

The SBTi Corporate Net-Zero Standard was launched in October 2021 to address the growing need for a common understanding of science-aligned net-zero targets in the corporate sector by providing guidance and tools for companies to set these targets. At the time of publication, the latest version of the SBTi Corporate Net-Zero Standard is V1.2, published in March 2024 (SBTi, 2024a).

Since the launch of the standard, there has been year-on-year growth in both net-zero target validations and commitments.

Over two years since its introduction, the SBTi is planning the first major revision to the Corporate Net-Zero Standard. In May 2024, the SBTi announced the timelines and process for this revision and published its Terms of Reference (SBTi, 2024b, SBTi, 2024c).

The revision process seeks to incorporate insights gained from the standard's adoption and target validation, ensure alignment with the latest scientific findings and emerging best practice, and address a number of gaps within the existing framework.

The SBTi has a number of research topics underway that represent inputs into the Corporate Net-Zero Standard revision process including research that will inform:

- Potential updates to the SBTi's scope 3 target-setting framework;
- How the SBTi could assess whether or not a company has achieved its target at the target date;
- Requirements around regular target validation cycles and progressive requirements for companies throughout the target lifetime;
- Potential changes in the eligible use of different types of environmental attribute certificates (EACs) in SBTi standards.

Please note that the outputs from research topics are just one input into SBTi standard development and drafting. The draft is then deliberated by expert groups, the SBTi Technical Council, and then open to any stakeholder who would like to provide feedback on the draft. A summary of how feedback is considered and decisions made into the final draft of the standard is transparently published by SBTi.

This revision of the Corporate Net-Zero Standard will be developed in accordance with the Standard Operating Procedure (SOP) for Development of SBTi Standards, which includes a public consultation followed by pilot testing and finalization of the Version 2.0 standard later in 2025 (SBTi, 2024d).

**The SBTi 2023 call for evidence on EACs**

As part of the SBTi's research into how it could assess whether or not a company has achieved its science-based target, the SBTi is exploring the role that environmental attribute certificates (EACs) currently play in corporate decarbonization strategies, and the impact that these certificates have had or may have, if any, to overall emission reduction goals.

As an input to this research effort, the SBTi issued an open Call for Evidence on the Effectiveness of Environmental Attribute Certificates in Corporate Climate Targets from September 21 to November 24, 2023 (SBTi, 2023).

The following types of environmental attribute certificate were defined as within the scope of the Call for Evidence:

- Energy attribute certificates for electricity
- Other energy carrier certificates, e.g. green hydrogen, green gas, sustainable aviation fuel certificates (SAFc)
- Emissions reduction credits
- Certified commodities conveying a specific emission factor, e.g. green steel

*As specified in the September 2023 Call for Evidence document, this effort was not designed to examine the effectiveness of carbon removal credits for the purpose of neutralization of residual emissions. Evidence on removal activities will be considered for the development of more detailed requirements and guidance for neutralization of residual emissions for future revisions of the SBTi Corporate Net-Zero Standard.*

The SBTi specified the types of evidence sought through the open call, including: empirical data and research studies, reports and white papers, statistical information, case studies and examples, surveys/polls and legal and regulatory analysis.

Respondents to the Call for Evidence were given the option to submit evidence via direct upload to a SurveyMonkey form, or by email to the SBTi. Each SurveyMonkey submission could include up to five pieces of evidence, but respondents were not limited in the number of times they could respond to the SurveyMonkey form. The content of the SurveyMonkey form can be found in Annex A of this report.

Respondents were asked to provide information about themselves (e.g. stakeholder category and contact information) and about the evidence (e.g. evidence type, potential

conflicts of interest inherent within the evidence, the perceived relevance of the evidence to the four types of certificates, and the perceived relevance of the evidence to a set of eight research questions).

Respondents that submitted evidence via the SurveyMonkey form were asked to indicate the position that the evidence supports (in their opinion) across each of the eight research questions:

1. What evidence exists about the effectiveness or ineffectiveness of environmental attribute certificates in delivering measurable emission reductions? (Response options: Effectiveness; Ineffectiveness; Not sure/Other)
2. What evidence supports or opposes a causal link between specific operating conditions (geographies, regulatory schemes, presence or absence of tracking mechanisms or registries, etc.) and the effectiveness of environmental attribute certificates to deliver emission reductions? Which conditions? (Response options: Supports; Opposes; Not sure/Other)
3. What regulatory safeguards and market infrastructure, if any, would need to be put in place for environmental attribute certificates to be effective and sustainable? (Response options: Regulatory and/or safeguards market infrastructure needed; No safeguards infrastructure needed; Not sure/Other)
4. What evidence supports or opposes the ability of environmental attribute certificates to accurately reflect and quantify emission reductions in the context of corporate climate abatement targets? (Response options: Supports; Opposes; Not sure/Other)
5. What evidence exists that uptake of attribute certificates leads to or hinders the transformation needed to reach climate stabilization? (Response options: Leads to transformation; Hinders transformation; Not sure/Other)
6. What specific evidence-based claims can and cannot be made when employing environmental attribute certificates to corporate decarbonization? (Open text box question)
7. Is there evidence that supports or undermines that the market value of this type of instrument is commensurate with the abatement costs of the underlying activity? (Response options: Supports; Undermines; Not sure/Other)
8. Is there evidence that shows that the use of these instruments (i.e. procurement of the attribute certificate) could contribute to scale-up of climate finance compared to alternative interventions? Or could it result in climate finance dilution? (Response options: Scale-up finance; Climate finance dilution; Not sure/Other)

Respondents also had the option to provide an explanation as to how and why the evidence they were submitting was relevant to the research questions, and to include a cover letter to accompany each piece of evidence.

The results of the SurveyMonkey submissions can be found online here.

**Overview of evidence review methodology**

The SBTi developed a methodology for the summary of evidence submitted as part of the Call for Evidence (see Annex B of this document). For each of the four categories of EAC listed above, the SBTi will publish a summary report which considers the evidence in the context of the research questions. Given the volume of material submitted, the SBTi is

assessing evidence related to the different types of EACs sequentially. This document is the summary report for evidence relevant to carbon credits (emissions avoidance and emissions reductions).

Please note, this report reflects the process established by SBTi and thus only reviews the papers submitted under the Call for Evidence on this topic. Although other evidence may be relevant, if it was not submitted to the SBTi under the Call for Evidence it was not reviewed in this report.

The motivation behind an open Call for Evidence was to solicit evidence from a wide range of stakeholders, including evidence that may not appear in a review of peer-reviewed literature. An open Call for Evidence serves to collect information from stakeholders who are interested in the topic and have the capacity to respond. Responses to this Call for Evidence therefore do not necessarily represent the full breadth of relevant evidence. Because of this limitation, the SBTi has also commissioned an independent third party to perform a systematic mapping of the scientific literature on the effectiveness of emission reduction credits in the context of corporate targets. The findings of the work will be publicly communicated along with this report.

### The purpose and structure of this report

The purpose of this report is to summarize the body of evidence submitted to the SBTi during the Call for Evidence period related to carbon credits that represent either emissions reductions or emissions avoidance. Evidence that was submitted and was relevant only to carbon removal credits was excluded from this analysis as it was considered out of scope of this research effort, as specified in the Call for Evidence document.

In publishing both the evidence submitted to the SBTi and this summary report, the SBTi seeks to contribute a valuable synthesis of submitted evidence on this important topic. Any corresponding updates to SBTi standards are subject to formal consideration and approval in line with the SBTi's Standard Operating Procedures and governance, including public consultation and approval by the SBTi Technical Council.

This summary report is organized into seven sections, in addition to a set of annexes:

1. **Introduction:** This section provides an overview of the SBTi, the Corporate Net-Zero Standard, the SBTi's research on EACs (including the Call for Evidence) and sets out the purpose and structure of this report.

2. **Definition of Environmental Attribute Certificates:** This section provides a definition of EACs and categorizes them into two broad categories: instruments that convey the mitigation outcome(s) of an intervention (more commonly referred to as carbon credits), and instruments that convey the climate-related performance of an activity (which includes energy certificates and commodity certificates).

3. **Evidence review methodology:** This section provides information on the Call for Evidence submissions across all types of EACs including the number of respondents

and the number of evidence submissions, and outlines the methodology for the review of evidence submitted to the SBTi under the Call for Evidence.

4. **Evidence synthesis:** This section summarizes the relevant evidence relating to carbon credits, organized into three broad themes that cover the eight research questions.

5. **Limitations:** This section highlights the limitations of the Call for Evidence process.

6. **Conclusion:** This section summarizes the insights from the review of evidence submitted to the SBTi that is relevant to carbon credits and the research questions posed by the SBTi.

7. **Next steps:** This short section highlights the next steps for the SBTi.

8. **Annexes:** The annexes include the Call for Evidence survey questions, additional detail on the methodology, information on the types of stakeholders that submitted evidence to the SBTi and a list of submitted evidence.

# DEFINITION OF ENVIRONMENTAL ATTRIBUTE CERTIFICATES

Environmental attribute certificates (EACs) encompass a diverse range of instruments that certify and communicate specific environmental or sustainability attributes of a given activity or commodity. By verifying that certain environmental standards or sustainability criteria have been met, these certificates enable companies to substantiate their environmental claims, support compliance with voluntary or regulatory schemes, and can enhance transparency within the value chain. Generally speaking, certificates used to enable climate-related claims by corporates can be classified into two broad categories:

### 1. Instruments that convey the mitigation outcome(s) of an intervention

These instruments, referred to herein as carbon credits, are used to measure and communicate the mitigation outcomes of an intervention. Carbon credits can be issued from a wide number of activities that represent different mitigation outcomes, often measured in tonnes of carbon dioxide equivalent ($tCO_2e$). The main categories of activities that can issue carbon credits based on the type of mitigation outcome include:

a) **Emissions avoidance credits:** Certificates issued from activities that prevent potential future emissions compared to a counterfactual baseline scenario. The number of credits eligible for issuance in any given year results from comparing the emissions performance of an activity with the level of emissions in the counterfactual scenario in that year. For instance, a greenfield zero- or lower-carbon electricity project may generate carbon credits provided that, in the absence of revenue from the sale of carbon credits, a higher emissions alternative would have been built and operated instead.

b) **Emission reductions credits:** Certificates issued from activities that reduce greenhouse gas emissions compared to the emissions in a reference or base year. The number of credits eligible for issuance in any given year, result from comparing the emissions performance of an activity in a given year with the level of emissions in the base year. Examples of activities that generate emission reduction credits include energy efficiency measures (e.g. in buildings or industrial processes) or switching from higher-carbon to lower-carbon fuels.

c) **Carbon removal/sequestration credits:** Certificates issued from activities that remove and store greenhouse gas emissions from the atmosphere. The number of carbon credits eligible for issuance in a given year is determined by measuring the increase in stored carbon as a result of the activity, compared to the baseline level of carbon stored before the activity began. Examples of biological carbon sequestration include restoring or enhancing natural carbon stocks or the sequestration of carbon in soil. Geological sequestration typically involves capturing carbon dioxide directly from the atmosphere and storing it in underground geological reservoirs or through mineral carbonation, where carbon dioxide is converted into stable mineral compounds.

Carbon credits can be generated from activities both within and beyond a company's value chain. Entities purchasing and retiring these credits might be involved directly in enabling the activities through project financing or other means, or they might simply procure the credits. This procurement can occur directly from project owners or through one or multiple intermediaries such as traders or brokers.

## 2. Instruments that convey the climate-related performance of an activity

These instruments are used to establish the emissions profile of an activity, such as the production or processing of a given commodity. The emissions profile can be established directly, through the emissions intensity of the activity, or indirectly, by conveying attributes that help determine the emissions profile of the activity, such as whether the commodity was produced using zero-carbon technologies or from activities or areas that result in no deforestation and/or no conversion. Depending on the type of activity that issues the certificate, these instruments can be classified into the following, non-exhaustive categories:

a) **Energy certificates:** The US Environmental Protection Agency defines energy attribute certificates as "*a contractual instrument that conveys information (attributes) about a unit of energy, including the resource used to create the energy and the emissions associated with its production and use. EACs may also include information about the location of the facility that generated the unit of energy, when that facility began operations, and when the unit of energy was produced.*" (US EPA, 2024). Some of the most commonly used energy certificates include:
   i) Renewable energy certificates;
   ii) Renewable gas certificates;
   iii) Sustainable aviation fuel certificates;
   iv) Green hydrogen certificates.

b) **Commodity certificates:** are instruments that certify and convey sustainability information about the production process of different commodities. These certificates provide verified data on the environmental and/or social performance of a commodity in conformance with a specific sustainability standard. There are a large number of standards and certification systems issuing certificates for various commodities. The Ecolabel Index currently tracks 456 ecolabels in 199 countries, and 25 industry sectors (Ecolabel Index, 2024). Commonly used labels certify sustainability and environmental information from different types of commodities, ranging from agricultural commodities to forestry commodities, to mining and metals, among many others.

Energy and commodity certificates are used in combination with different chains of custody models, ranging from those models that allow to trace the commodity through every step of the value chain (e.g. identity preservation or physical segregation models) to models where the environmental attributes are traded completely separately from the physical commodity (e.g. book and claim, controlled blending and mass balance models).

# EVIDENCE REVIEW METHODOLOGY

## Evidence submissions

Evidence was submitted by a total of 421 individuals in the Call for Evidence response period. Some evidence was submitted by more than one respondent and therefore the SBTi team had to de-duplicate evidence submissions. A total of 406 unique pieces of evidence were submitted via the SurveyMonkey form and 32 additional pieces of unique evidence were submitted via email. Evidence that was deemed ineligible due to the submitter being anonymous or sent to the SBTi outside of the Call for Evidence period is excluded from the SBTi's review.

Respondents classified 206 pieces of evidence as relevant to energy attribute certificates for electricity, 159 pieces of evidence as relevant to other energy carrier certificates, 111 pieces of evidence as relevant to emissions reduction credits,[2] 43 pieces of evidence as relevant to certified commodities conveying a specific emission factor and 15 pieces of evidence as relevant to other unspecified types of EACs. Since some pieces of evidence were relevant to more than one type of EAC, the summed numbers in this paragraph do not equal the total unique pieces of evidence.

A table listing the eligible evidence submitted to the SBTi can be accessed here. Where the evidence submitted to the SBTi is protected by copyright the citation is provided and, where relevant, links to where the documents can be downloaded upon subscription and/or payment.

While the Call for Evidence SurveyMonkey respondents provided their own opinions about the relevance and findings of the evidence that they submitted, the SBTi developed a standardized methodology and assembled a panel of expert reviewers, comprising SBTi staff and external contractors, to systematically review and assess the evidence submitted. This more thorough examination was performed to summarize the findings of the evidence in relation to the research questions in a way that provides additional credibility to the information submitted by the respondent. Please note that the panel of expert reviewers described above is referred to as the "review panel" throughout this document.

The main steps taken by the review panel are outlined below and detailed in Annex B.

## Stakeholder type

The review panel performed quantitative stakeholder analysis to determine who responded to the Call for Evidence, to help understand how representative the body of evidence may be. Evidence was submitted by 421 individuals to the SBTi via the SurveyMonkey form. The survey respondents provided information about their organizational affiliation and the type of organization with which they are affiliated. The top three respondent stakeholder groups were businesses (196 individuals), industry or professional associations (58 individuals) and environmental or conservation groups (55 individuals). The results of this analysis can be found in Annex C.

[2] This includes carbon credits that represent emissions reductions and avoided emissions.

### SBTi assessment of evidence

While the Call for Evidence SurveyMonkey respondents provided their own opinions about the relevance and findings of the evidence that they submitted, the SBTi developed a standardized methodology to systematically review and assess the evidence submitted. This more thorough examination was performed to summarize the findings of the evidence in relation to the research questions in a way that provides additional credibility to the information submitted by the respondent.

This assessment methodology has been undertaken only for evidence that was submitted and tagged as relevant to emissions reduction credits. The SBTi anticipates following the same process for evidence that was submitted to the SBTi and tagged as relevant to the other types of EACs – energy attribute certificates for electricity, other energy carrier certificates and certified commodities conveying a specific emission factor.

The assessment methodology comprises five steps:

1. **Initial evidence cleaning and categorization** which was conducted by the SBTi research team and comprises:
    a. Data cleaning
    b. Revision of the evidence type classification
    c. Categorization of evidence by “general leaning”.
2. **Detailed evidence review** which was conducted by the review panel and comprises:
    a. Reading of the evidence and related information
    b. Categorization of evidence type
    c. Categorization of evidence based on its relevance to the research question
    d. Categorization of evidence according to the research question findings
    e. Determination of the risk of bias
    f. Identification and collation of additional useful information.
3. **Categorization of evidence into final tiers and relevance levels** which was conducted by the SBTi research team and comprises:
    a. Designation of evidence into tiers
    b. Designation of evidence according to overall relevance.
4. **Evidence synthesis and report writing** which was conducted by the SBTi research team and comprises:
    a. Final screening of review panel assessments
    b. Report writing.
5. **Quality review** which was conducted by the SBTi quality team and comprises:
    a. Ensuring that the strategic objectives of the research align with its outputs
    b. Conducting conflict of interest checks for authors, the review panel, and the review team
    c. Verifying scientific references and citations in the document
    d. Ensuring that proper research methodology and transparency is applied in the review process and ensuring fair, balanced information is provided
    a. Ensuring appropriate documentation, data handling procedures, and data privacy measures are followed.

The methodology is described in detail in Annex B.

# EVIDENCE SYNTHESIS

This section of the report focuses solely on the evidence submitted to the SBTi that relates to carbon credits (both emissions reductions and emissions avoidance credits). There were 111 unique pieces of evidence that were submitted to the SBTi under the Call for Evidence that submitters tagged as being relevant to emissions reduction credits.

Following the methodology summarized in the section above and described in detail in Annex B, the SBTi identified 71 pieces of evidence submitted to the SBTi were either relevant or partially relevant to both the research questions posed and to carbon credits that represent emissions reductions or emissions avoidance. This includes evidence that submitters thought was relevant in addition to one evidence submission not tagged by submitters as being relevant to emissions reduction credits but which references inset credits (Adjin, 2023). Please see Annex D which includes two tables – one which lists the evidence that was considered relevant or partially relevant, and a second which lists the evidence that was considered not to be relevant.

The discussion of this evidence is split into three main themes. The first of the three themes discusses the evidence submitted to SBTi to consider the extent to which carbon credits deliver their intended mitigation outcomes, and whether there is an association between specific operating conditions and their effectiveness in delivering mitigation outcomes. The discussion draws upon the evidence that was submitted to the SBTi that was considered relevant to the research questions one, two, three and four that were posed by the SBTi in the open Call for Evidence.

This second broad theme discusses the evidence submitted to SBTi to consider the different ways in which companies can use carbon credits and the corresponding implications for the net-zero transformation of sectors and for global efforts to increase climate mitigation finance. The discussion draws upon the evidence that was submitted to the SBTi that was considered relevant to research questions five, seven and eight.

The third and final theme relates to the types of claims that may or may not be credibly used by companies purchasing and retiring carbon credits (reductions and avoidance) for different purposes. The discussion draws upon the evidence that was submitted to the SBTi that was considered relevant to research question six.

Within each theme, the evidence is discussed according to three “tiers” (A, B and C). The methodology for categorizing the evidence into tiers is described in Annex B. The tiers are not intended to strictly represent a hierarchy of quality, but are meant to aid in general prioritization of evidence that is likely to be least subject to bias and most relevant to the research inquiry.

**Theme 1: Mitigation Outcomes and Conditions for Effectiveness**

This first theme explores the extent to which carbon credits (emissions reductions and avoidance) deliver their intended mitigation outcomes (i.e. does a carbon credit truly represent one $tCO_2e$ of emissions reductions or avoidance), and whether there is an

association between specific operating conditions and their effectiveness in delivering mitigation outcomes.

The discussion draws upon the evidence that was submitted to the SBTi that was considered relevant to:

- Research question one: What evidence exists about the effectiveness or ineffectiveness of environmental attribute certificates in delivering measurable emission reductions?
- Research question two: What evidence supports or opposes a causal link between specific operating conditions (geographies, regulatory schemes, presence or absence of tracking mechanisms or registries, etc.) and the effectiveness of environmental attribute certificates to deliver emission reductions? Which conditions?
- Research question three: What regulatory safeguards and market infrastructure, if any, would need to be put in place for environmental attribute certificates to be effective and sustainable?
- Research question four: What evidence supports or opposes the ability of environmental attribute certificates to accurately reflect and quantify emission reductions in the context of corporate climate abatement targets?

In reviewing the evidence, the SBTi was particularly interested in the extent to which attributes such as additionality, permanence, accurate estimation of emissions and leakage impact the effectiveness of carbon credits. These concepts are defined in the glossary of this report.

### Summary of results across all three tiers

The SBTi review panel identified 41 pieces of evidence that were relevant or partially relevant to this theme. 27% of relevant or partially relevant pieces of evidence were classified in Tiers A and B (n = 11), and the remaining 73% were classified in Tier C (n = 30).

Eight Tier A and Tier B evidence submissions that were considered relevant or partially relevant to this line of inquiry highlight the ineffectiveness of certain types of carbon credits under certain methodologies to varying degrees (Badgley et al., 2022a, Badgley et al., 2022b, West et al., 2020, West et al., 2023, Coffield et al., 2022, Probst et al., 2023, Haya et al., 2023 and Gill-Wiehl et al., 2023).

Just one Tier B evidence submission (Roopsind et al., 2019) points to the effectiveness of carbon credits, however it is specifically focused on the bilateral Norway-Guyana REDD+ programme which falls under the United Nations Framework Convention on Climate Change (UNFCCC) mechanism and does not result in the generation or sale of emissions reduction credits to companies.

It is not possible to determine a “general leaning” for two of the Tier A submissions – Edmonds et al. (2021) and Nabuurs et al. (2022) – since they reference, but do not explore, integrity issues to do with e.g. permanence, leakage and additionality.

11 Tier C evidence submissions can be interpreted as being generally supportive of the effectiveness of carbon credits. This includes four case studies that describe examples of

projects that have yielded mitigation outcomes and emphasize how the financial incentive from credit sales made them additional (International Dairy Foods Association, 2023; Anew Climate, 2023; Anew Climate, 2023b; Climate Impact Partners, n.d;), as well as opinion pieces or commentaries which highlight the need to scale climate finance towards particular activities such as forest protection and conservation and highlight the potential of carbon markets in doing so (FSC Indigenous Foundation, IPACC, Peoples Forest Partnership, Alianza Mesoamericana de Pueblas e Bosques, 2023; Everland, 2023; Miltenberger et al., 2021, Pauly et al., 2023, Tropical Forest Alliance and Proforest, 2023; oneshot.earth, 2023). One submission highlighted the success of California's Low Carbon Fuel Standard (Seymour, 2021).

11 Tier C evidence submissions highlight the ineffectiveness of certain types of carbon credits under certain methodologies to varying degrees (Calyx Global, 2023; Berk and Lungungu, 2020; Hurteau et al., 2008; Landholm et al., 2022; Rainforest Foundation UK, 2023; Cames et al., 2016; Lakhani, 2023; Blake, 2023; Elgin, 2020; Elgin, 2022; de Haldevang, 2021). Three of these evidence submissions focus specifically on REDD+ and acknowledge the potential for the mechanism to be effective but call for improvements across quality dimensions including additionality, accurate baselines, avoidance of leakage and double counting and permanence (Calyx Global, 2023; Berk and Lungungu, 2020; Rainforest Foundation UK, 2023).

In summary, 19 evidence submissions across the tiers highlight the ineffectiveness of certain types of carbon credits (Tier A = 5; Tier B = 3; Tier C = 11) while 12 can be interpreted as being generally supportive of the effectiveness of carbon credits (Tier A = 0; Tier B = 1; Tier C = 11).

One notable finding is that there are papers in this theme with directly opposing findings on the effectiveness of REDD+, based on different methodologies for analysis, with Roopsind et al. (2019), Everland (2023) and Pauly et al. (2023) supporting its effectiveness and several others raising concerns on its effectiveness, e.g. Probst et al. (2023), Haya et al. (2023), West et al. (2020), West et al. (2023); Calyx Global (2023), Berk and Lungungu (2020), and Rainforest Foundation UK (2023). This highlights the complexity in determining the effectiveness of REDD+ specifically. This is perhaps unsurprising, since REDD+ credits are generated based on a counterfactual baseline scenario of future deforestation, meaning there is inherent uncertainty associated with this type of credit.

In terms of whether there is an association between specific operating conditions and their effectiveness in delivering mitigation outcomes, there were no evidence submissions that systematically identify features associated with actual credits or projects that do deliver their intended benefits in comparison with those that do not. In other words, the evidence does not identify characteristics or operating conditions associated with effective carbon credits and projects, but instead comments on and describes improvements needed overall.

A number of recurrent themes emerged across evidence tiers as to how the integrity of voluntary carbon markets and carbon credit methodologies more specifically might be improved to ensure that carbon credits deliver emissions reductions, avoidance, and removals, including:

- Active monitoring and use of a dynamic baseline to account for factors that emerge within the project timeframe (Badgley et al., 2022b; Coffield et al., 2022; Gill-Wiehl et al., 2023; West et al., 2020);
- Larger buffer pools to ensure permanence for forestry projects (Badgley et al., 2022a) and jurisdictional level or nested-jurisdictional approaches (Tropical Forest Alliance and Proforest, 2023);
- Conservative methodologies and data source selections (Gill-Wiehl et al., 2023; Haya et al., 2023).
- Robust accounting provisions to avoid double counting of emissions reductions (Cames et al., 2016).
- Accounting methodologies to recognize the value of management actions that reduce the risk of carbon loss (Hurteau et al., 2008).

There were five Tier C evidence submissions that point to or themselves represent recent developments in terms of improving the integrity of voluntary carbon markets (Trove Research, 2023b; International Civil Aviation Organization, 2019; Oeko-Institut, WWF-US, EDF, 2022; The Carbon Credit Quality Initiative, 2023; Sky Harvest Carbon, 2022). For example, Trove Research highlights efforts by crediting programs to improve their methodologies, and the emergence of international integrity frameworks such as the Integrity Council for the Voluntary Carbon Market, the Carbon Credit Quality Initiative, the International Civil Aviation Organization's Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), as well as work at the European Commission.

In conclusion, and on balance, the evidence suggests that there is a need to improve the underlying methodologies to ensure that carbon credits accurately reflect the mitigation outcomes that they intend to deliver. Promisingly, however, there appears to be significant effort underway to address integrity issues of carbon credits across a number of dimensions including accurate quantification, additionality, permanence and leakage. It is important to emphasize that the evidence submitted to the SBTi covers a heterogeneous mix of carbon credit types, project activity types and crediting methodologies, which limits the extent to which generalizable conclusions can be drawn and thus there is a need to assess a wider body of evidence to interrogate this research area more robustly.

### Tier A evidence

The evidence in Tier A includes six peer-reviewed controlled research studies and a chapter from the Intergovernmental Panel on Climate Change Working Group III Sixth Assessment Report. Many of these sources highlighted methodological issues with crediting schemes that systematically incentivize over-crediting or overestimating emissions reductions or avoidance outcomes.

The six controlled research studies largely support the ineffectiveness of emissions reduction credits in delivering measurable mitigation outcomes under existing standards and quantification methodologies. Five of these research studies addressed voluntary REDD+ projects and California's forest carbon offsets program and found substantial over-crediting in these schemes: Badgley et al. (2022a), Badgley et al. (2022b), Coffield et al. (2022) and West et al. (2020), West et al. (2023).

Badgley et al. (2022a) examines the carbon offset regulation in force in the State of California where carbon can be sold to buyers for the purposes of offsetting their own emissions. The authors challenge the logic of offsetting fossil $CO_2$ emissions (which have effectively permanent atmospheric consequences) with carbon stored in forests which is inherently less durable due to socioeconomic and physical risks that can cause the re-release of carbon into the atmosphere. The authors highlight that the California Air Resources Board (CARB) has proposed a minimum storage duration of 100 years and developed a self-insurance mechanism called a buffer pool to ensure the durability of emissions reductions or removals. However, the study finds that 95% of the buffer pool dedicated to managing wildfire risk has already been depleted, and the portion dedicated to managing risk of disease and pests is highly vulnerable to a single disease, concluding that the mechanism is unlikely to be able to ensure 100-year permanence of issued credits (Badgley et al., 2022a).

Badgley et al. (2022b) also examines California's forest offsets program, and found that “nearly a third of credits analyzed do not reflect real climate benefits” (Badgley et al., 2022b). The authors quantify “systematic statistical and ecological shortcomings in California's forest offsets protocol” in which the “averaging together [of] dissimilar tree species across arbitrarily defined geographic regions allows – and, via adverse selection, may even encourage – offset projects that claim spurious, non-real carbon credits.” The authors conclude that the program’s design features largely resulted in over-crediting, and propose the use of remote sensing techniques to assess the additionality and durability of carbon offsetting projects. According to the authors, a robust, species-specific baseline for the forest offsets program would also need to be combined with active monitoring to detect problems that were not anticipated in the offset protocol design phase. The authors note that the study does not consider other potential issues around additionality, leakage or permanence (Badgley et al., 2022b).

On a similar note, Coffield et al. (2022) discuss the difference between static baselines for California’s forest offset projects and monitoring using geospatial data, demonstrating that there are significant differences in carbon accumulation rates. The assessment explores three distinct definitions of control groups which yield the same broad conclusions of lack of additionality. The authors propose the use of “remote sensing-based geospatial data products as components of large-scale carbon accounting and offset verification” to account for factors that undermine additionality claims relating to forest offset projects that use static baselines. The topic of permanence was described as beyond the scope of this study. However, the authors did note that “decreases in carbon accumulation in the past several years were also observed in non-project lands and coincide with increased disturbances like drought, fire, and the sudden oak death pathogen which could threaten project permanence over the full duration of the projects' lifetime” (Coffield et al. 2022).

West et al. (2020) find “no significant evidence that voluntary REDD+ projects in the Brazilian Amazon have mitigated forest loss” in their comparison of ex-ante crediting baselines with ex-post counterfactuals developed using the synthetic control method. The study demonstrates that using historic deforestation trends as baselines in REDD+ projects become problematic when deforestation rates change for political or economic reasons (West et al., 2020).

The authors highlight an alternative approach of using national or subnational (jurisdictional) baselines that are predefined, and periodically updated, by the government, alongside default carbon-stock values or a common carbon-density map – an approach which they state has the benefit of ensuring "consistency in the treatment of leakages and avoiding double-counting reductions". However, they also acknowledge that since national and sub-national baselines are typically based on historical data, they do not address the limitations of historical data for baseline development (they are "not any more likely to capture contemporaneous deforestation drivers and their dynamism"). The authors therefore suggest enhanced monitoring and baseline updates based on control areas that share similar characteristics as the REDD+ projects, potentially coupled with human–natural system models to explore alternative baseline scenarios and quantify the potential downside risks involved in conservation investments under dynamic patterns of land-use change. The authors recognize the impact of such enhancements on project development costs (West et al, 2020).

West et al. (2023) examined the effects of 26 REDD+ project sites in six countries on three continents using synthetic control methods for causal inference and the authors state that they found that most projects have not significantly reduced deforestation, and that for projects that did, reductions were substantially lower than claimed. The authors state that this "reflects differences between the project ex ante baselines and ex post counterfactuals according to observed deforestation in control areas." They argue that methodologies used to construct deforestation baselines for carbon offset interventions need urgent revisions to correctly attribute reduced deforestation to the projects, thus maintaining both incentives for forest conservation and the integrity of global carbon accounting (West et al., 2023).

Edmonds et al. (2021) considers the effect of the trading of mitigation outcomes by countries under Article 6 of the Paris Agreement – i.e. where countries with higher domestic marginal abatement costs cooperate with those with lower domestic marginal abatement costs to reduce emissions in other countries instead of domestically (Edmonds et al., 2021). Despite highlighting the potential benefits of trading of mitigation outcomes by countries, the authors also underscore the risk of creating rules that inadvertently, through indirect effects (e.g. leakage or double-counting), increase global emissions relative to independent implementation. The authors conclude that "the rule book needs to be written carefully… rulesets need to be tested in numerical simulation models before they are tested in the real world to avoid costly miscalculations" (Edmonds et al., 2021).

The submitted excerpt of the IPCC AR6 WGIII report was Chapter 7: Agriculture, Forestry and Other Land Uses (AFOLU). The chapter describes that AFOLU projects included within the Clean Development Mechanism (CDM), voluntary carbon standards, compliance markets, and reduced deforestation from official United Nations Framework Convention on Climate Change (UNFCCC) reports have delivered emissions reductions and offsets of at least 7.9 GT $CO_2$e from 2007 to 2018 (of which the voluntary market makes up 95 million t$CO_2$e). The chapter goes on to note that "ensuring good governance, accountability (e.g. enhanced monitoring and verification capacity), and the rule of law are crucial for implementing forest-based mitigation options". The authors also note that "there has not been a systematic assessment of the elements of project or programme design that lead to high levels of additionality" and acknowledge that "debate about the net carbon benefits of some projects continues" regarding permanence and leakage (Nabuurs et al., 2022).

## Tier B evidence

The evidence in Tier B consisted of four controlled research studies, including one peer-reviewed paper that was downgraded for partial relevance and three non-peer-reviewed studies, two of which, at the time of the evidence submission to the SBTi, were due to undergo peer review. The evidence in this group collectively assessed a broader swath of the voluntary carbon market across all major sectors and different carbon credit registries. These papers similarly found overall low effectiveness of carbon credits in delivering their intended outcomes. One additional theme that emerged from this tier was the differing mitigation outcomes between projects that are developed for the purpose of issuing emissions reduction or avoidance credits and programs developed by researchers, non-governmental organizations, or governments that used a similar field intervention but did not officially issue carbon credits.

Probst et al. (2023) synthesized empirical studies of over 2,000 offset projects across renewable energy, cookstoves, forestry and chemical processes and found that overall, "only 12% of the total volume of existing credits constitute real emissions reductions". Their results show differing achievement ratios between the four sectors examined: 0% for renewable energy, 0.4% for cookstoves, 25% for forestry and 27.5% for chemical processes. These findings address the additionality or non-additionality of these projects and the accuracy of the mitigation estimations by comparing the ex-ante baseline emissions and project emissions predictions against the ex-post counterfactual (real baseline) and realized carbon savings. The authors also compared offset projects (i.e. projects that generate credits for the voluntary carbon market that may be used for offsetting purposes) to what they term "field interventions" that do not generate credits and found that field interventions are more effective than offset credits at reducing emissions from cookstoves and forestry projects. The authors hypothesize that higher effectiveness of field interventions may be due to the fact that these interventions, in contrast to offset projects, are designed "to test the effectiveness of a particular intervention instead of maximising financial gains." Based on this analysis, the authors state that methodological improvements for offset projects are needed in order to better estimate the counterfactuals that credits rely on (Probst et al., 2023).

While not the focus of the study, Probst et al. (2023) also consider leakage and durability (or permanence) of offset projects. They highlight that within the forestry sector, around 25% of studies analyze leakage, 73% of which find no evidence of leakage and the rest "a mixed picture". With regards to assessing durability, the authors note the challenge with the short time periods of the analyses, where the studies in their sample analyze on average 6.5 years of intervention. In addition to the relatively short intervention study periods, almost none of the sectors considers the results post intervention: "the only exceptions are a few studies in the forestry sector (13% of all forestry-related studies), which tend to show that once payments run out, conservation effects are likely to be reversed" (Probst et al., 2023).

An analysis of five cookstove methodologies estimated that their sample of improved cookstove projects "is over-credited by 6.3 times" (Gill-Wiehl et al., 2023). The authors highlight that cookstove baselines constructed with project-led and national fuel consumption surveys can lead to abnormally high baseline and/or low consumption values since these calculations are susceptible to social desirability and recall biases whereby households may

want to present affluence and/or have challenges in estimating kilograms of fuel used (Gill-Wiehl et al., 2023).

With regards to additionality, which the authors describe in the context of cookstoves as “a proportion of participating households who would likely have not used an efficient stove were it not for the offset program”, the authors point to just one relevant narrative case study in the published literature that found strong evidence for the additionality of the studied cookstove project. However, the authors’ own assessment of additionality was inconclusive and they identified this as an area for further research (Gill-Wiehl et al., 2023).

With regards to leakage (which can occur in the context of cookstoves when reduced use of firewood or charcoal by project households leads to increased fuel usage by non-project households), Gill-Wiehl et al. highlight that the default value of leakage in many methodologies is unjustified which represents a source of uncertainty, especially since “projects are not unbiased in their assessment as more leakage implies fewer credits” (Gill-Wiehl et al., 2023).

The authors therefore suggest that "eliminating the flexibility to use methods that are neither robust nor conservative could reduce over-crediting easily” and that methodologies should use “conservative literature-derived default values" in combination with more robust surveys to address biases, or directly monitor fuel use. However, the authors also highlight the general challenge that exists for project developers where the poor quality of carbon credits (as a result of inaccurate quantification techniques) means that prices are too low to improve the quality of credits to attract higher prices (Gill-Wiehl et al., 2023).

Haya et al. (2023), in a research study on four Verra REDD+ crediting methodologies, note how widespread and significant over-crediting is across all quality factors. The authors point to previously published studies that demonstrate that inaccurate baselines likely resulted in over-crediting of 92% (meaning that projects issued 13 times more credits than their climate benefit). In addition, forest carbon accounting methods used by project developers resulted in estimates 23% to 30% higher than the authors’ own estimates. They also found that average deductions for natural reversal risk were just 2% when they should, according to the authors, have been greater than 28%, translating into over-crediting of more than 36% from this factor alone. Leakage deductions were also much lower than those suggested in the academic literature. The authors conclude that “since over-crediting compounds across factors, only a very small fraction of credits likely represent real emissions reductions from Verra’s REDD+ projects” (Haya et al., 2023).

Haya et al. (2023) conclude that “REDD+ is ill-suited to the generation of carbon credits for use as offsets” and provide a number of specific recommendations for REDD+ credits to be effective and sustainable around ensuring additionality, accounting for leakage, dealing with carbon pool permanence and ensuring local community safeguards. These include “improving estimates of current natural risk, refining the process of choosing allometric and below ground biomass equations, applying deductions for international leakage and leakage from agricultural displacement, and requiring more rigorous assessment of safeguards compliance for all projects and especially those with greater risk.” The authors also recommend that Verra changes the auditing system to remove conflicts of interest of auditors, enforce the application of conservative methods for estimating impacts, create an

independent body to verify safeguard compliance and address grievances, require more appropriate assessment of safeguards compliance, and make changes to ensure that forest communities lead or fully participate in the design of projects that affect them (Haya et al., 2023).

In contrast, Roopsind et al. (2019) constructed a counterfactual times-series trajectory of annual tree cover loss using synthetic matching to quantify tree cover loss that would have occurred in the absence of the bilateral Norway–Guyana REDD+ program and found "strong evidence" that Guyana reduced deforestation and avoided GHG emissions over the project timeframe. It should be noted that the project being studied was under the UNFCCC mechanism and did not result in the generation or sale of emissions reduction credits to companies, unlike REDD+ projects on the voluntary carbon market. The analysis suggests that national REDD+ payments weakened the potential effect of increases in gold prices, an internationally traded commodity that is the primary deforestation driver in Guyana. The authors argue that the inclusion of Norway–Guyana REDD+ enabling activities in the bilateral agreement resulted in both regulatory and technological additionality that improved overall forest governance (Roopsind et al., 2019).

The authors state that leakage and permanence are challenging to quantify in the context of national REDD+. In the case of leakage this is due to its complexity and in finding direct causal links since the drivers of deforestation are often associated with global commodity trade and investment flows. To address leakage of deforestation outside the bounds of the REDD+ jurisdiction, they recommend a "multinational REDD+ approach across all of the Guiana Shield biome countries that includes political cooperation and harmonizes forest governance and deforestation regulations" (Roopsind et al., 2019).

### Tier C evidence

There were an additional 30 pieces of evidence in Tier C. This includes nine reports/white papers, five commentary or opinion pieces, five case studies, five pieces of news coverage, two controlled research studies which were downgraded due to risk of bias and/or partial relevance, two evidence submissions that are repositories of either case studies or peer-reviewed articles, one set of "factsheets" and one standard document.

Eleven evidence submissions can be interpreted as being generally supportive of the effectiveness of carbon credits (International Dairy Foods Association, 2023; Anew Climate, 2023a; Anew Climate, 2023b; Climate Impact Partners, n.d; FSC Indigenous Foundation, IPACC, Peoples Forest Partnership, Alianza Mesoamericana de Pueblas e Bosques, 2023; Everland, 2023; Miltenberger et al., 2021, Pauly et al. 2023, Tropical Forest Alliance and Proforest, 2023; oneshot.earth, 2023; Seymour, 2021).

All four of the case studies in this evidence tier describe examples of projects that have yielded mitigation outcomes. For example, International Dairy Foods Association (2023) describe how "demand for environmental attribute certificates (i.e. carbon/greenhouse gas offset credits) facilitate the execution of greenhouse gas (GHG) management projects that deliver high quality and durable flows of emissions reductions/removals" through anaerobic digestion systems at dairy processing sites. Other case studies on improved forest management (Anew Climate, 2023a), landfill methane destruction (Anew Climate, 2023b),

and rooftop solar in India (Climate Impact Partners, n.d.) similarly assert the effectiveness of these projects and how the financial incentive from credit sales made them additional. These case studies therefore emphasize the effectiveness of carbon credits. However, they are limited in that they are focused on individual case studies.

A commentary by Stillwater Associates considers how successful California's Low Carbon Fuel Standard (LCFS) has been. The LCFS is one of a group of programs in California designed to reduce GHG emissions in which entities that supply low-carbon intensity fuels generate credits that are then purchased by entities who generate deficits from producing or supplying high-carbon intensive fuels. The evidence submission suggests that the LCFS has been successful, with the program having generated credits representing a total reduction of 77.5 million $tCO_2e$ at the end of 2020, with GHG reductions occurring ahead of schedule (Seymour, 2021).

FSC Indigenous Foundation, IPACC, Peoples Forest Partnership, Alianza Mesoamericana de Pueblas e Bosques submitted an open letter representing Global South voices which argued that REDD+ projects provide one of the only proven avenues available to Global South communities to access the finance required to conserve and protect their environments and drive sustainable development for their communities that are shaped by their traditions and values. The authors acknowledge that "REDD+ methodologies are not perfect… but improvements are being continuously made based on scientific evidence. REDD+ carbon crediting programs must be given the opportunity and support to grow to their full potential as an important part of a market that prioritizes transparency and integrity." They state that "recent criticisms on the validity of REDD+ as a conservation mechanism have ignored these positive benefits and have put this critical source of finance at risk – ultimately putting the well-being of our communities at risk" (FSC Indigenous Foundation, IPACC, Peoples Forest Partnership, Alianza Mesoamericana de Pueblas e Bosques, 2023). This evidence therefore supports the potential effectiveness of REDD+ credits but acknowledges current challenges with REDD+ methodologies.

Everland (2023) completed a global study of 53 REDD+ projects across seven countries, in which the author compared REDD+ project baselines against the actual forest loss that occurred in the state containing the project. The author found that Verra REDD+ projects in the scope of the study delivered their intended mitigation outcomes. The authors challenge the findings of other studies (West et al., 2023, 2020) and suggest that there are flaws in the synthetic control method used by these authors (Everland, 2023).

Pauly et al. (2023) – a controlled research study that was downgraded in tier due to unclear risk of bias – analyzes 45 REDD+ projects representing 71% of verified avoided unplanned deforestation projects by area and 63% of total avoided unplanned deforestation verified emissions reductions, and compares the normalized baseline deforestation rates with actual jurisdiction-level forest loss between 2002–2022. Their findings demonstrate that REDD+ projects had an annual forest loss of 0.07±0.02%/year, a factor of ten lower than either baseline or observed jurisdiction-average forest loss, suggesting that at a systemic level, emissions reductions from the voluntary project-based REDD+ mechanism have been robust. The authors state that project monitoring and verification reports indicate that projects generally report negligible leakage across the sample. It is important to highlight that this study does not consider avoided planned deforestation REDD+ projects which generate

23.31% of all REDD+ annual emissions reductions. The authors highlight this as a further area for research (Pauly et al., 2023).

Tropical Forest Alliance and Proforest's 2023 report "Accelerating Progress for Nature, Climate and People at Scale: Companies' Roles and Action" does not explicitly explore the effectiveness of carbon credits but calls for companies to accelerate progress towards nature, climate and people goals by contributing to multi-stakeholder collaboration at landscape and jurisdictional scale, including through jurisdictional REDD+ (Tropical Forest Alliance and Proforest, 2023).

A 2023 opinion piece by oneshot.earth ("A Case for Pragmatism: Our Theory of Change") highlights the time value of carbon stating that "avoiding one tonne of carbon dioxide now is more important than removing one tonne of carbon dioxide in the future" since avoiding GHG emissions today stops the warming effects that it would have had for the time it takes to remove it in the future. The authors therefore call for investment in both removal and avoidance but do not specifically discuss the mechanisms under which avoidance or removal credits are effective (oneshot.earth, 2023).

Miltenberger et al. (2021) also argues in favor of the effectiveness of carbon credits broadly (not limited to a particular project type), whilst acknowledging the current challenges that exist. The authors argue that voluntary carbon markets demonstrate tremendous potential to bring "unprecedented levels of finance" to mitigation activities and that many of the current issues with the voluntary carbon market (such as additionality, permanence and inaccurate baselines) "will be made insignificant if not irrelevant due to the deluge of innovation and market participation we see in the space today." The publication promotes the benefits of carbon credits associated with shorter durations of permanence, claiming that they "present an opportunity to protect and expand carbon sinks, incentivize low or negative carbon production, and increase the flow of carbon from the atmosphere to short term and durable stocks" (Miltenberger et al., 2021).

Eleven evidence submissions highlight the ineffectiveness of certain types of carbon credits under certain methodologies to varying degrees (Calyx Global, 2023; Berk and Lungungu, 2020; Hurteau et al., 2008; Landholm et al., 2022; Rainforest Foundation UK, 2023; Cames et al., 2016; Lakhani, 2023; Blake, 2023; Elgin, 2020; Elgin, 2022; de Haldevang, 2021). Four of these evidence submissions focus specifically on REDD+ and acknowledge the potential for the mechanism to be effective but call for improvements across quality dimensions including additionality, accurate baselines, avoidance of leakage and double counting and permanence (Calyx Global, 2023; Berk and Lungungu, 2020; Rainforest Foundation UK, 2023).

Calyx Global's 2023 commentary piece entitled "Science vs. Everland: Who is correct on REDD?" critiques the Everland (2023) paper discussed above. Calyx Global assessed over 70 REDD+ projects using a range of geospatial data and methodological approaches to assess whether the project was overestimating its baseline and found results similar to West et al. (2023). Calyx Global provides a number of reasons for Everland coming to different conclusions including "faulty assumptions" and "drawing the wrong conclusions". The authors argue that while "the comparison of forest loss rates in a jurisdiction to those in project areas can be an interesting analysis… it is not a reasonable way to assess the

counterfactual baseline, i.e. “how much deforestation would occur in a particular area” without the REDD project.” The authors critique the Everland assumption that projects are located, on average, in areas that are representative of the entire jurisdiction with regards to deforestation risk, stating that this is often not the case and in fact projects are often in locations that have lower deforestation risk compared to other areas in the jurisdiction. Calyx Global quotes the West et al (2023) study which states: that there is a “tendency to locate projects in areas with low background deforestation”, noting that this “makes REDD+ projects appear more successful at reducing deforestation than they were” (West et al, 2023). Calyx Global also argues that Everland is “blaming the wrong actor” – i.e. that it is inappropriate to blame researchers that critique REDD+ methodologies for stemming the flow of finance to forest communities (Calyx Global, 2023).

Berk and Lungungu’s 2020 report explores the social impacts of the Mai Ndombe REDD+ program in the Democratic Republic of Congo (DRC) and highlight several concerning social issues including the lack of free, prior and informed consent, lack of grievance mechanisms, and – most relevant for this line of inquiry – that the interventions appear to have little impact on reducing deforestation and degradation, and in some cases even catalyzed forest loss (Berk and Lungungu, 2020).

A 2023 report by Rainforest Foundation UK suggests that jurisdictional REDD+ schemes – which were developed in an effort to overcome some of the evident shortcomings of project-level REDD+ – have their own problems and may risk creating non-meaningful credits at a much higher rate. The authors argue that while jurisdictional REDD+ advocates have promoted the jurisdictional approach as solving problems such as inflated baselines, leakage and over-crediting, “there are reasons to believe that this can also create new baseline problems, for example because of variations across very large areas. Whilst there might be a better link to regional or national forest-related policies, this in itself can be a problem: policies change according to the whims of governments and electorates, hence what might be true when a baseline is formulated might well not be true five years later.” The report cites a range of case studies including the Forest Carbon Partnership Facility emission reductions programme in Sangha and Likouala, Republic of Congo, and identifies issues associated with a lack of additionality, a lack of any likely impacts, inflated baselines and a lack of consultation with local communities (Rainforest Foundation UK, 2023).

Hurteau et al. (2008) highlights the importance of managing forests for carbon uptake and highlights that policies at the time were actually promoting avoidance of $CO_2$ release and stifling actions that would increase long-term carbon storage. The authors examined four of the largest wildfires in the United States in 2002 and found that prior thinning would have reduced $CO_2$ release from live tree biomass by 98%. They point to the fact that – at the time of publication which is more than 15 years ago now – carbon registry groups required that forest managers determine a baseline above which additional carbon stored counts as a carbon credit. The authors argue that this “one-size-fits-all methodology is fundamentally flawed, because it does not fully account for the effect of variation in stand structure and forest biomass on the risk of stand-replacing fire and albedo (i.e. the ratio of outgoing to incoming radiation).” They therefore call for carbon accounting methodologies to recognize the value of management actions that reduce the risk of carbon loss through stand-replacing fire (Hurteau et al., 2008).

Landholm et al. (2022) examines the role that carbon markets may play in unlocking the mitigation potential of nature-based solutions in the short and mid-term, both globally and at a country level. This paper does not assess the effectiveness of carbon credits. However, the authors note that issues related to permanence and additionality remain a source of concern limiting the development of agriculture carbon projects, noting that permanence is particularly challenging in the context of agriculture where practices can change quickly on an annual basis (Landholm et al., 2022).

Cames et al. (2016) considers the extent to which the Clean Development Mechanism (CDM) is additional. The CDM was a flexible mechanism defined in the Kyoto Protocol that allowed countries to fund GHG emissions reductions projects in other countries and claim the saved emissions as part of their own efforts to meet international emissions targets. The Kyoto Protocol expired in 2020 and therefore no new projects are being created under the CDM however there are still some CDM projects ongoing. The authors found that most energy-related project types under the CDM were unlikely to be additional whereas methane projects had a high likelihood of being additional; industrial gas projects were likely to be additional as long as the mitigation is not otherwise promoted or mandated through policies; and biomass power projects had a medium likelihood of being additional. In the case of cookstoves, the authors stated that they are likely to considerably over-estimate the emissions reductions due to a number of unrealistic assumptions and default values. The authors provided various recommendations to improve the environmental integrity of international crediting mechanisms including limiting the project types to those with high likelihood of delivering emissions reductions, reviewing methodologies systematically to address risks of over-crediting, and robust accounting provisions to avoid double counting of emissions reductions (Cames et al., 2016).

A more recent paper by Perspectives Climate Group which is primarily focused on the effectiveness of carbon market grievance mechanisms also highlights environmental-related concerns associated with the CDM including lack of additionality (mainly in large infrastructure projects), inflated baselines, and challenges around ensuring permanence, mainly in afforestation and reforestation projects (Perspectives Climate Group, 2023).

The news coverage in this tier consists of articles that highlight recent cases of emissions reduction, avoidance, and removals projects associated with credits that do not deliver the mitigation outcomes they claim to (Lakhani, 2023; Blake, 2023; Elgin, 2020; Elgin, 2022; de Haldevang, 2021).

Lakhani (2023), a *Guardian* news article, suggests that the “top carbon offset projects may not cut planet-heating emissions”. The *Guardian* and researchers from Corporate Accountability (a non-profit, transnational corporate watchdog) analyzed the top 50 emission offset projects and argued that, according to their criteria and classification system, 39 of the top 50 emission offset projects (78%) were categorized as “likely junk or worthless due to one or more fundamental failing that undermines its promised emission cuts” (Lakhani, 2023). Similarly, a *New Yorker* news article entitled “The Great Cash for Carbon Hustle” claims that millions of carbon credits generated by a project in Kariba Zimbabwe did not effectively prevent deforestation despite generating nearly USD 100 million in revenue from credit sales (Blake, 2023).

A Bloomberg news article, cites the CEO of a large timber company that sells carbon credits as saying “weak rules have created strong incentives for landowners to develop offset projects that don’t actually change the way forests are managed, and therefore do little to help the climate” (Elgin, 2022). A second Bloomberg article focuses on GreenTrees LLC, “a small company that says it combats climate change by reforesting thousands of acres of farmland along the lower Mississippi River.” The article states that “interviews with 17 participating landowners, as well as an examination of hundreds of pages of contracts and project documents, reveal that GreenTrees usually takes credit for trees that were already planted, or would have been planted anyway” (Elgin, 2020). This article therefore questions the additionality of these credits.

A third Bloomberg news article, focused on the Mexican government’s Sembrando Vida (Sowing Life) reforestation program which paid farmers to plant trees points to analysis of satellite images by the World Resources Institute that suggests that the program may have caused the loss of nearly 73,000 hectares of forest coverage in 2019, its first full year. The article states that in one village in Campeche, more than two-thirds of those farmers on the program had chopped down forest to be able to take part (de Haldevang, 2021).

There were five evidence submissions that focus more on the conditions under which carbon credits can be effective and/or highlight recommendations to improve their effectiveness (Trove Research, 2023; International Civil Aviation Organization, 2019; Oeko-Institut, WWF-US, EDF, 2022; The Carbon Credit Quality Initiative, 2023; Sky Harvest Carbon, 2022).

Trove Research’s first quarterly review of the state of integrity of the voluntary carbon market propose three dimensions of integrity: 1) emissions impact integrity (the amount of $CO_2e$ that has been reduced/removed); 2) implementation integrity (how the project reduced/removed that $CO_2e$) and; 3) usage integrity (how the credits are then reviewed and used). The quality dimensions they highlight for emissions impact integrity include additionality, quantification and permanence. The quality dimensions highlighted for implementation integrity include co-benefits, legal and ethical considerations and delivery risk. The quality dimensions highlighted for usage integrity include transparency/disclosure and double counting. Across these dimensions, the authors highlight efforts to address current issues with the market including efforts by crediting programs to improve their methodologies and the emergence of international integrity frameworks such as the Integrity Council for the Voluntary Carbon Market, the Carbon Credit Quality Initiative, the International Civil Aviation Organization’s Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), as well as the European Commission. They also highlight the emergence of guidance methodologies including the Tropical Forest Integrity Guide and the SBTi’s work on beyond value chain mitigation, as well as developments in the private sector including the origination of rating agencies such as Calyx Global, Sylvera, BeZero and Renoster, and Trove Research’s own “integrity assessment” solution (Trove Research, 2023a).

The International Civil Aviation Organization’s “CORSIA Emissions Unit Eligibility Criteria” (which was mentioned in the Trove Research paper above) was also submitted to the SBTi as evidence. This document lists 11 program design features that eligible offset programs should meet: clear methodologies and protocols, scope considerations (e.g. which sectors, project types, or geographic locations are covered), offset credit issuance and retirement

procedures, identification and tracking, legal nature and transfer of units, validation and verification procedures, program governance, transparency and public participation provisions, safeguards system, sustainable development criteria and avoidance of double counting, issuance and claiming (International Civil Aviation Organization, 2019).

Two evidence submissions relate to the Carbon Credit Quality Initiative (an initiative that was also mentioned in the Trove Research paper above), including the revised Carbon Credit Quality Initiative methodology (Oeko-Institut, WWF-US, EDF, 2022) as well as a series of Carbon Credit Quality Initiative "factsheets" that cover different carbon credit project types including efficient cookstoves, improved forest management and landfill gas utilization. The factsheets assess project types against a number of dimensions including additionality/ vulnerability, quantification methodologies, non-permanence, compatibility with net-zero and Sustainable Development Goal (SDG) impacts. For example, for landfill gas projects the factsheet suggests that additionality risks are low as the evaluation of investment analyses from registered projects shows that revenues from carbon credits have a high impact on clearing financial benchmarks and improving internal rates of return. In contrast, the avoided unplanned deforestation factsheet highlights material non-permanence risks (The Carbon Credit Quality Initiative, 2023).

Sky Harvest Carbon (2022) highlights the heterogeneity of different carbon credits, where "their values vary based on differentiable attributes like geography, technology, duration, and volume" which they argue puts an "onerous burden on buyers to tread carefully or pay-up for advisors to navigate the shifting and nuanced carbon markets". The authors therefore propose a new "yard stick" for carbon markets which includes the use of tonne-year accounting "to create high-quality equivalencies of projects with shorter durations by compensating with increases in volume. For example, a project that stores carbon dioxide for one year would require 100 tonnes of carbon dioxide to maintain the equivalency ratio equal to 100 tonne-years per credit". The authors also propose use of a discount rate representing the social cost of carbon applied consistently each year throughout the effective lifetime of the crediting project to account for the time value of carbon (where the authors state that carbon impact in the near-term is more valuable than carbon impact created over the long term). Based on this new "yard stick" the authors propose a new definition of a carbon credit: "A carbon credit is a permit or certificate to emit greenhouse gases equivalent to the global warming potential of one metric tonne of carbon dioxide and is generated by delivering the equivalent global warming potential of one metric tonne of carbon dioxide released into the atmosphere indefinitely, rounded to one thousandth of a tonne" (Sky Harvest Carbon, 2022).

There are two additional evidence submissions worth highlighting. Firstly, Carbon Market Watch's "Carbon Credit Tracker" which is a resource that they update that includes case studies, reports, news articles, and other publications describing specific climate mitigation projects which generate, or have generated, carbon credits (Carbon Market Watch, n.d.). Secondly, Berkeley Carbon Trading Project's "Repository of Articles on Offset Quality" which is a webpage hosting a repository of peer-reviewed articles and independent research institute reports that analyze the quality of offset projects and protocols (Berkeley Carbon Trading Project, n.d.). Given these evidence submissions contain many resources, these have not been reviewed in full by the SBTi, however they are still considered relevant to this line of inquiry.

## Theme 2: Corporate Use Cases for Carbon Credits and Implications for Net-Zero Aligned Transformation and Climate Finance

This second theme analyzes the evidence submitted to SBTi to consider the different ways in which companies can use carbon credits and the corresponding implications for the net-zero transformation of sectors and for global efforts to increase climate mitigation finance.

The discussion draws upon the evidence that was submitted to the SBTi that was considered relevant to:

- Research question five: What evidence exists that uptake of attribute certificates leads to or hinders the transformation needed to reach climate stabilization?
- Research question seven: Is there evidence that supports or undermines that the market value of this type of instrument is commensurate with the abatement costs of the underlying activity?
- Research question eight: Is there evidence that shows that the use of these instruments could contribute to scale-up of climate finance compared to alternative interventions, or could it result in climate finance dilution?

In reviewing the evidence, the SBTi was particularly interested in understanding it with regards to three high-level use cases:

1. **Offsetting:** Companies can purchase and retire carbon credits from activities that occur outside the company's value chain to offset its own emissions (scopes 1–3). Under an offsetting approach, the carbon credit is purchased and retired as a substitute for reducing the company's own emission. SBTi standards do not support the use of carbon credits in this way – stating that carbon credits from mitigation activities outside of a company's value chain cannot be used towards achievement of near- or long-term abatement targets.

2. **Insetting:** A company can purchase and retire carbon credits that relate to activities that occur within its value chain – this is sometimes referred to as "insetting". A company might choose to do this as a mechanism to channel finance to value chain partners and to ensure that unique claims to the GHG reductions or removals from activities in the value chain will not be sold or transferred to third parties via carbon credits.[3] The SBTi Corporate Net-Zero Standard does not specifically reference insetting (largely due to the lack of consensus on the definition and best practice application of insetting) but the SBTi Corporate Net-Zero Standard Road Test Workshop 2 document (published in 2021) states that companies should only include emissions reductions or removals from "insetting" projects that use a corporate accounting approach and are wholly contained within their supply chains, or include only the portion of a "partially included" project that is within their supply chain and linked directly to sourcing (SBTi, 2021).

[3] Note that complexity arises when accounting for the mitigation outcomes associated with purchased carbon credits (which are quantified using intervention or project accounting methods) in a company's scope 3 inventory (which under GHG Protocol must be quantified using inventory accounting methods).

3. **Beyond value chain mitigation:** Companies can purchase and retire carbon credits that relate to activities that occur beyond a company's value chain as a supplement to reducing their own emissions – this is what the SBTi defines as "beyond value chain mitigation" or BVCM. The SBTi Corporate Net-Zero Standard recommends that companies deliver BVCM by taking action or making investments outside their own value chains to mitigate GHG emissions in addition to their near-term and long-term science-based targets. Companies can claim BVCM activities and outcomes either with compensation claims or contribution claims – where compensation claims seek to convey a "netting out" or "counterbalancing" of unabated value chain emissions with BVCM outcomes, and where contribution claims seek to convey a contribution to global climate mitigation efforts or even the efforts of a country (SBTi, 2024e).

It is important to highlight that there is interdependence between this line of inquiry and the results of theme 1 which focuses on the supply-side of the equation (whether a carbon credit effectively delivers mitigation outcomes) – i.e. regardless of the use case, their ability to accelerate sectoral net-zero transformation and/or increase climate mitigation finance is dependent on their ability to effectively deliver mitigation outcomes. For this reason, only evidence that addresses how carbon credits are used by companies is discussed within this section.

### Summary of results across all three tiers

The review panel identified 31 pieces of evidence that were relevant or partially relevant to this theme. 19% of relevant or partially relevant pieces of evidence were classified in Tiers A and B (n = six), and the remaining 81% were classified in Tier C (n = 25).

The four Tier A evidence submissions that were considered relevant or partially relevant to this line of inquiry all indicate significant risks associated with the corporate use of carbon credits as offsets. One paper points to a number of principled critiques of offsetting in the wider literature – citing papers which argue that offsetting provides a license to pollute and diminishes a company's responsibilities to reduce their own emissions (Trouwloon et al., 2023). A separate paper points to literature that challenges the premises that the climate benefits associated with carbon credits are equivalent to the emissions that the credits are used to offset (Badgley et al., 2022a). A third paper states that "mitigation within AFOLU is occasionally and wrongly perceived as an opportunity for inaction within other sectors" (Nabuurs et al., 2022).

The one controlled research study in Tier A does suggest that there could be cost savings as a result of the trading of mitigation outcomes by countries under Article 6 of the Paris Agreement; however, it does not consider the impacts of companies trading mitigation outcomes. As mentioned previously, this paper does underscore that there is a risk that trading increases global emissions due to leakage and/or double counting and concludes that "rulesets need to be tested in numerical simulation models before they are tested in the real world to avoid costly miscalculations" (Edmonds et al., 2021).

In Tier A, only Trouwloon et al. (2023) considers corporate use of carbon credits under BVCM – a use case which the authors recommend in contrast to an offsetting use case (Trouwloon et al., 2023).

There were only two relevant evidence submissions designated to Tier B – one non-peer-reviewed controlled research study and one survey. The survey, which was submitted by the World Business Council for Sustainable Development (WBCSD), represents the opinions of company respondents, of which 96% stated that EACs amplified decarbonization efforts rather than hindered them, and 36% stated that environmental attribute certificates enabled them to deploy more capital into decarbonization than they would have otherwise (WBCSD, 2023). However, the survey question referred to heterogeneous types of EAC and therefore it is unclear in the extent to which evidence-based conclusions can be drawn with regards to carbon credits under different use cases.

The controlled research study in Tier B was primarily focused on the supply-side of the equation (and is thus discussed primarily in theme 1 above). However, the authors did take strong opposition to offsetting and instead called for the financing of the protection and restoration of forests through different mechanisms, including BVCM (Haya et al., 2023).

There were 25 relevant or partially relevant submissions in Tier C. Five pieces of Tier C evidence argue that the private sector's use of carbon credits as offsets has the potential to accelerate net-zero transformation and/or increase climate finance. For example, Ballentine (2023) argues in an opinion piece that by not giving recognition to companies for financing of mitigation outside of their inventories, the GHG Protocol and SBTi "disincentivize even interventions that result in significant climate impact per dollar of corporate investment … which lead[s] to highly inefficient use of corporate budgets and suboptimal climate outcomes" (Ballentine, 2023).

Ten of the Tier C evidence submissions indicate that the private sector's use of carbon credits as offsets has the potential to hinder net-zero transformation and/or decrease climate finance. For example, Cullenward et al. (2023) raise five main issues with offsetting: 1) inaccurate quantification of mitigation outcomes; 2) issues with fungibility of avoided emissions credits and corporate emissions; 3) issues with durability and permanence of carbon credits; 4) misleading claims associated with carbon credit use; and 5) the risk of double-counting (Cullenward et al., 2023).

Six Tier C evidence submissions highlight preferable alternatives to offsetting – either explicitly referencing BVCM or describing the approach of making a contribution claim more specifically. For example, the United Nations High-Level Expert Group on the Net-Zero Emissions Commitments of Non-State Entities (HLEG) suggest that high-integrity carbon credits are a useful mechanism for deployment of climate finance, in particular for helping developing countries to decarbonize, but that credits should only be used for beyond value chain mitigation, rather than as offsets (HLEG, 2022).

Four of the Tier C evidence submissions refer to insetting and explicitly reference carbon credits or similar types of certificates, three of which highlight their potential role in accelerating scope 3 decarbonization. Abatable and the International Platform for Insetting highlight that the lack of standardized best practice guidance on this topic represents a barrier to action and that "the future verification of 'inset credits' as a commodity remains a

topic for debate" (Abatable and the International Platform for Insetting, 2023). NewClimate Institute and Carbon Market Watch (2023) highlight integrity risks with insetting.

In conclusion, seven evidence submissions across the three tiers could be interpreted to be more supportive of corporate offsetting (Tier A = 1; Tier B = 1; Tier C = 5). However, many of these submissions have limitations either because a) the paper does not look at trading between companies but is focused instead on voluntary cooperation between countries under Article 6 of the Paris Agreement; b) it is a survey with a relatively small sample size representing opinions of companies and with questions that were not specific to carbon credits, rather to EACs as a broader category; c) because they represent opinion pieces; or d) because they assume significant increases in the price of carbon credits and assume that corporates' decisions to invest in mitigation is purely cost-efficiency driven.

On the other hand, 14 evidence submissions across the three tiers are explicitly critical of corporate offsetting (Tier A = 3; Tier B = 1; Tier C = 10), eight of which explicitly reference BVCM and/or the contribution approach as a preferable model which can increase mitigation outcomes and climate finance (Tier A = 1; Tier B = 1; Tier C = 6). However, there are also limitations inherent in some of these papers in that they often represent opinions or cite other literature that may represent opinions, rather than quantitatively assessing different scenarios on the corporate use of carbon credits.

Only Tier C evidence considers the role of carbon credits for the purposes of insetting and is generally supportive of insetting, with the exception of NewClimate Institute and Carbon Market Watch (2023). This suggests that there is a need for more academic research on this topic.

Considering the full body of evidence relevant to this inquiry, there are clear risks to corporate use of carbon credits for the purpose of offsetting, with the potential unintended effect of hindering the net-zero transformation and/or reducing climate finance. On the other hand, BVCM and contribution approaches may represent preferable models for accelerating net-zero transformation and increasing climate finance. However, there is a need to assess a wider body of evidence to interrogate this research area more thoroughly. In particular, there is a clear need for further research into and standardization of insetting as a corporate practice, where carbon credits originate from within a company's value chain.

### Tier A evidence

The evidence in Tier A includes two peer-reviewed controlled research studies, one peer-reviewed literature review and a chapter from the Intergovernmental Panel on Climate Change Working Group III Sixth Assessment Report.

There is just one Tier A evidence submission – Trouwloon et al. (2023) – which focused solely on the different ways in which carbon credits are or could be used by companies and the impact on sectoral transformation and/or climate finance. There were other pieces of evidence that were at least partially relevant and are also discussed below.

Trouwloon et al. (2023) review the nascent literature on corporate climate claims relying on the use of voluntary carbon credits. The authors state that "investments in mitigation projects

driven by the desire to generate carbon credits have real-world advantages for the countries and communities that benefit from well-designed carbon projects and programs that would otherwise not be implemented". However, the authors also highlight several "principled critique[s]" of offsetting, pointing to literature that argues offsetting GHG emissions provides a cheap license to continue polluting beyond the timeframe needed to achieve net-zero globally, diminishing companies' responsibilities to reduce their own emissions (a phenomenon known as the "collective sacrifice concern"). For this reason, the authors propose that companies should purchase and retire carbon credits for the purpose of beyond value chain mitigation, over and above their efforts to decarbonize their own value chains (Trouwloon et al., 2023).

A controlled research study by Edmonds et al. considers the effect of the trading of mitigation outcomes by countries under Article 6 of the Paris Agreement – i.e. where countries with higher domestic marginal abatement costs cooperate with those with lower domestic marginal abatement costs to reduce emissions in other countries instead of domestically (Edmonds et al., 2021). Given the focus on countries, the study does not directly address the research question; however, the insights and methodology are potentially transferable to the context of corporate climate targets. The authors simulate a reference and three alternative scenarios to analyze two primary research questions: What are the potential cost savings from full cooperation in implementing the NDCs? And if the cost savings were reinvested in additional ambition, how much additional emissions mitigation could be enabled?

The scenario analysis suggests that Article 6 holds substantial potential to either lower the costs of achieving country Nationally Determined Contributions (NDCs) and/or increase their ambition in the first contribution period through economic efficiency gains if cost savings are reinvested into mitigation. The analysis shows that lower-cost mitigation opportunities associated with nature-based solutions broaden the scope of opportunities available to enhance ambition in the first NDC contribution period. However, the authors note that there are limits to the amount of land available for nature-based solutions to offset fossil fuel-based emissions (Edmonds et al., 2021).

As mentioned in the previous section of this report, this paper also highlights that there is a risk that indirect effects of trading (e.g. leakage or double-counting) increase global emissions relative to independent implementation and thus "the rule book needs to be written carefully … rulesets need to be tested in numerical simulation models before they are tested in the real world to avoid costly miscalculations" (Edmonds et al., 2021).

One controlled research study is more focused on the supply-side in that it examines California's forest carbon offsets program buffer pool; however, it also highlights literature that challenges the premise that the climate benefits associated with carbon credits are equivalent to the emissions that the credits are used to offset (Badgley et al., 2022a). This is therefore a useful source when considering an offsetting use case in which an emissions reduction in a company's own value chain is substituted for an emissions reduction beyond the value chain. The authors cite numerous papers that challenge this "equivalency claim", for example where projects credit non-additional, business-as-usual activities (Cames et al., 2016; Haya et al., 2023; Schneider, 2009; Calel et al., 2021); where projects cause emissions to shift or "leak" to other jurisdictions, rather than decrease net emissions on a

global basis (Aukland et al., 2003; Schwartzman et al., 2021); and where the baseline scenarios against which credits are issued represent realistic and credible counterfactuals (Badgley et al., 2022b; Schneider and Kollmuss, 2015; Schneider, 2011; West et al., 2020).

In the IPCC AR6, WG III chapter on AFOLU, Nabuurs et al. (2022) emphasize the critical role of the AFOLU sector in stabilizing global temperatures, and highlight that the AFOLU sector offers significant near-term mitigation potential at relatively low cost. However, the authors demonstrate that the AFOLU sector "cannot compensate for delayed emissions reductions in other sectors" and argue that "mitigation within AFOLU is occasionally and wrongly perceived as an opportunity for inaction within other sectors" (Nabuurs et al., 2022).

### Tier B evidence

The evidence in Tier B included one non-peer-reviewed controlled research study and one survey.

Just one evidence submission in Tier B – the results of a 2023 WBCSD survey of companies – considers the substitution effect that occurs when carbon credits are used as offsets and suggests that their use can accelerate net-zero transformation and increase climate finance. Of the 38 survey respondents, 96% stated that EACs amplified decarbonization efforts rather than hindered them, and 36% stated that environmental attribute certificates enabled them to deploy more capital into decarbonization than they would have otherwise (WBCSD, 2023). However, it is important to highlight that this survey represents the opinions of respondents rather than evidence that supports a conclusion. Moreover, since the survey question posed does not distinguish between different types of EACs (which range from renewable energy certificates, green gas certificates, green steel certificates and carbon credits, etc.), it is unclear in the extent to which it is possible to draw out conclusions specifically for carbon credits.

One evidence submission in this Tier – Haya et al. (2023), which is a non-peer-reviewed controlled research study – suggests that certain types of carbon credits could hinder the transformation needed to reach climate stabilization. While this paper was primarily focused on the supply-side (and is thus discussed in theme 1), it states that "offsets, even if they could work perfectly, would not reduce the concentration of greenhouse gasses in the atmosphere but would mainly move where the emissions occur", and that "REDD+ is not designed to address the most important commercial drivers of deforestation" (Haya et al., 2023).

Instead, the authors suggest other actions – beyond offsetting – that private actors should instead take to help reduce tropical deforestation including reducing demand-side drivers of deforestation, supporting forest plans designed by Indigenous and forest communities, funding of "contributions to global mitigation" (i.e. beyond value chain mitigation coupled with a contribution rather than a compensation claim), debt-relief, fair share climate finance, and focusing on the largest driver of climate change (fossil fuels). The paper concludes that "we must direct our attention and actions to the underlying causes of deforestation and work to reverse the local, national, and international policies that promote them" (Haya et al, 2023).

### Tier C evidence

There were an additional 25 pieces of evidence in Tier C. This includes 19 reports/white papers, two commentary/opinion pieces, one literature review, one news coverage, one guidance document and one survey/ poll that was downgraded due to the limited sample size.

Five pieces of Tier C evidence argue that the private sector's use of carbon credits as offsets has the potential to accelerate net-zero transformation and/or increase climate finance under certain conditions.

Ballentine (2023) (a peer-reviewed commentary/opinion piece) questions whether well-meaning environmental stakeholders and institutions are undercutting the contributions that companies can make to fighting climate change. He argues that elements of the corporate climate accountability system – such as the Greenhouse Gas Protocol (GHG Protocol) and the SBTi – lead to significant mis-allocations and constraints on corporate climate spend and reduces the potential climate change-mitigating impact of crucial private capital (Ballentine, 2023).

Ballentine suggests that "it is axiomatic in climate science that a ton of GHGs reduced, avoided, or removed has the same climate value regardless of where that action occurred, who was responsible for the intervention, or whose emissions were impacted." The author argues that "directing corporate climate spend to emissions reductions outside of inventories is at best not incentivized and often discouraged – irrespective of the fundamental climate science that a ton is a ton" and questions whether this "quasi-regulatory hierarchy get[s] the most decarbonization impact from the significant – but finite – amount of corporate climate investment." Ballentine concludes that by not giving recognition to companies for their financing of mitigation outside of their inventories, the GHG Protocol and SBTi "disincentivize even interventions that result in significant climate impact per dollar of corporate investment … which lead[s] to highly inefficient use of corporate budgets and suboptimal climate outcomes" (Ballentine, 2023).

The Voluntary Carbon Market Integrity Initiative (VCMI) & MSCI Carbon Markets' white paper entitled "Using carbon credits to meet corporate climate targets" presents the analysis that underpins the rationale for the VCMI Beta Scope 3 Flexibility Claim (which was also submitted to the SBTi as evidence and is categorized in this tier) that would allow companies to substitute abatement of scope 3 emissions for carbon credit purchase (i.e. allowing them to offset their emissions) until 2035 (VCMI & MSCI, 2023 and VCMI, 2023). While their analysis implies that individual companies would reduce their deployment of climate finance – since carbon credits are typically lower cost than internal abatement options in many sectors – they argue that allowing flexibility to offset scope 3 emissions would encourage more firms to adopt climate targets. They state that "if companies are allowed to use carbon credits to meet 50% of their total emissions gap (scope 1, 2 and 3) we could expect to see around 1,000 more companies setting ambitious climate targets", creating demand for carbon credits representing 640 million $tCO_2e$ today and 2.2 $GtCO_2e$ in 2030, driving USD 19 billion of climate finance today and USD 65 billion in 2030, assuming a carbon price of USD 30/$tCO_2e$ (VCMI & MSCI, 2023). This analysis therefore makes the assumption that companies make decisions where to fund mitigation purely based on the marginal cost of

abatement and does not consider wider factors that inform corporate decision-making including, for example, management of climate transition and physical risks and/or investor and customer demand.

The MSCI Carbon Markets and VCMI analysis also assumes that carbon prices will rise significantly – to USD 30/$tCO_2e$. For context, a Forest Trends' Ecosystem Marketplace (2022) report states that the global weighted average price of a carbon credit across project types was just USD 4.00 in 2021, with prices ranging from an average of USD 1.18/$tCO_2e$ for transportation projects up to USD 8.81/$tCO_2e$ for agriculture projects (Forest Trends' Ecosystem Marketplace, 2022). However, Trove Research (2023a) shows a gradual downward momentum in carbon credit prices in the first quarter of 2023 (Trove Research, 2023a).

Barreto et al.'s study of carbon offsets and renewable energy certificates to meet Boston's mandate for carbon neutrality by 2050 highlights the moral hazard risk whereby offsets could allow their users to simply "pay for their sins" but states that offsets can also work to internalize the cost of carbon, "providing a financial signal which can help incentivize further direct emissions reductions" (Barreto et al., 2018). They propose that "if Boston's offset program was designed such that the offset expense was paid by the same entities (sectors, departments, actors) who are responsible for generating emissions, then offsets can be an effective accelerator of internal direct emissions reductions, because the more direct actions these entities take to reduce emissions, the fewer offsets they will need to purchase." They state that for this to be effective, however, the cost of offsets should appropriately reflect the "true" cost of emissions to society which they argue is not guaranteed in voluntary markets with limited demand and limited willingness to pay (Barreto et al., 2018).

Verra (2023) submitted the results of a survey that was drafted based on learnings from Verra's Scope 3 Initiative and the research questions posed in the SBTi Call for Evidence. Nine individuals fully completed the survey, and an additional five partially completed the survey. As a result of this small sample size, this evidence was downgraded from the default Tier B to Tier C. Question four of their survey is most relevant to this research theme, where 69% of respondents agreed that excluding the use of environmental attribute certificates to achieve science-based targets hinders efforts to stabilize the climate (Verra, 2023). As with the WBCSD survey mentioned above, this survey represents the opinions of respondents rather than evidence that supports a conclusion, and the survey question posed does not distinguish between different types of EACs – which range from renewable energy certificates, green gas certificates, green steel certificates and carbon credits, etc.

Fourteen submissions indicate that the private sector's use of carbon credits as offsets has the potential to hinder net-zero transformation and/or decrease climate finance.

Cullenward et al., 2023 propose that carbon offsetting as an approach is not fit for purpose in a world where governments and companies are seeking to stabilize planetary temperatures instead of supporting modest emission cuts. The authors raise five main issues with offsetting: 1) inaccurate quantification of mitigation outcomes; 2) issues with fungibility of avoided emissions credits and corporate emissions; 3) issues with durability and permanence of carbon credits; 4) misleading claims associated with carbon credit use; and 5) the risk of double-counting (Cullenward et al., 2023).

A number of reports/white papers authored by Carbon Market Watch were submitted to the SBTi and are aligned with the positions set out in Cullenward et al. (2023). For example, in their 2022 paper “Flights of Fancy: Preventing European airlines from making far-fetched climate claims”, Carbon Market Watch analyzed the action or investments that eight major European airlines were taking outside their value chains and report that nearly all airlines rely on relatively cheap forestry projects in developing countries that are unsuitable for offsetting fossil fuel emissions due to the non-permanence of carbon storage. They argued that, as it stands, “CORSIA will cover a very small fraction (less than 10%) of total aviation emissions and is unlikely to have any meaningful effect to address the sector’s climate impacts” (Carbon Market Watch, 2022a).

Carbon Market Watch also analyzed the carbon neutrality claims on 15 products in a Belgian supermarket in 2023 and argued that advertising products as carbon-neutral through the use of offsets is misleading and will contribute to an increase in greenhouse gas emissions (Carbon Market Watch, 2023a). Carbon Market Watch also published a report/white paper that looks at 18 carbon neutral fossil fuel claims by oil and gas majors that relate to liquefied natural gas (LNG) cargoes and oil and condensate shipments, arguing that “relying primarily on carbon credits to ‘offset’ a product’s/service’s emissions – let alone claiming carbon neutrality by doing so – is also problematic due to the flawed logic of ‘tonne-for-tonne’ offsetting, which encourages business-as-usual activities”. They argue “that by solely purchasing carbon credits to erroneously claim their products are carbon neutral, fossil fuel firms are doing a disservice to climate action and conservation efforts" (Carbon Market Watch, 2021).

NewClimate Institute and Carbon Market Watch’s 2023 annual Corporate Climate Responsibility Monitor report assesses the climate strategies of 24 major global companies and points to the increasing number of court cases highlighting legal risks associated with offsetting and the move away from offsetting claims such as “carbon neutrality” by certification standards. The authors argue that the prices of carbon credits in voluntary markets are too low to create a meaningful incentive for the corporate buyers of those credits to make operational changes to reduce their own value chain emissions. They state: “Buyers paid an average USD 3/t$CO_2$e for voluntary offset credits in 2018, with the 99-percentile upper range outliers at a price of USD 16/t$CO_2$e, substantially less than the carbon price range of USD 40–80/t$CO_2$e which the High-Level Commission on Carbon Prices found to be consistent with the Paris Agreement 1.5˚C temperature goal” (NewClimate Institute and Carbon Market Watch, 2023).

Carbon Market Watch’s 2023 report entitled “Secretive Intermediaries: Are carbon markets really financing climate action?” argues that intermediaries’ fees “diverts the flow of funds away from climate action and towards financial go-betweens”, and that the opacity of these intermediary fees “distorts the picture of how much finance is actually being channelled to mitigation projects” (Carbon Market Watch, 2023b). Similarly, Healy et al. (2023) analyzed benefit sharing in a sample covering a range of carbon crediting programs and project types and found that “in most cases revenues [from carbon credit sales] are mostly shared with project implementers and that it is thus unclear whether and to what degree this includes actual benefit sharing beyond refunding incurred costs” (Healy et al., 2023).

NewClimate Institute and Carbon Market Watch therefore propose an alternative model for companies to actively take responsibility for unabated emissions without claiming to neutralize them, known as the contribution approach, which they argue “avoids many of the pitfalls associated with offsetting” (NewClimate Institute and Carbon Market Watch, 2023). The contribution approach described here is synonymous with the SBTi’s BVCM approach whereby companies make contributions rather than compensation claims, over and above reducing their own emissions in line with science.

Fearnehough et al. (2020) explore a range of potential new models for voluntary carbon markets including the contribution approach. The authors suggest that under this new model voluntary carbon markets could help overcome barriers in nascent technologies and sectors, fostering the development and reducing the costs of inaccessible mitigation options that are beyond the reach of what host countries can feasibly deliver – so called “high-hanging fruits”. They also highlight the potential to provide incentives for countries to enhance the ambition of their NDCs by targeting voluntary carbon market finance at those countries with Paris Agreement compatible NDC targets (Fearnehough et al., 2020).

The BVCM and contribution claim model is also supported by a number of other Tier C evidence submissions, including Broekhoff (2022) (a report/white paper) which argues that “Use of carbon credits cannot reduce the impact of an emitting activity. Carbon credits are more accurately viewed as a contribution to mitigation activities (such as reforestation) that are supplementary to direct decarbonization efforts, not a compensatory measure.” Broekhoff argues that the “consensus view” is that use of carbon credits is appropriate only in the context of following a “mitigation hierarchy” that recognizes the need to comprehensively and directly reduce emissions in line with the 1.5°C global goal through both the reduction of fossil fuel emissions and large-scale reforestation (not either/or). Moreover, Broekhoff highlights inherent uncertainties related to additionality and quantification, and challenges with permanence and double claiming. Broekhoff concludes, “it is best to treat carbon credits as a means of channeling investment into climate change mitigation activities, not as a failsafe way to compensate for a given source of emissions” (Broekhoff, 2022).

The United Nations High-Level Expert Group on the Net-Zero Emissions Commitments of Non-State Entities (HLEG) (2022) also supports the BVCM use case of carbon credits. In their report/white paper, “Integrity Matters: Net Zero Commitments by Businesses, Financial Institutions, Cities and Regions”, the authors suggest that high-integrity carbon credits are a useful mechanism for deployment of climate finance, in particular for helping developing countries to decarbonize, but that credits should only be used for beyond value chain mitigation, rather than as offsets (HLEG, 2022).

The authors of the Tropical Forest Credit Integrity (TFCI) Guide (2023) (which was classified as a report/white paper) also support the use of carbon credits for BVCM. They highlight that finance specifically directed toward forests is less than 1% of the total needed to meet the international goal of halting and reversing deforestation by 2030 and emphasize the critical role that companies can play in providing the finance necessary to keep these forests standing. While some of the organizations that author the TFCI Guide are focused on voluntary carbon markets as a central strategy for financing tropical forest protection, others focus on non-market-based finance. However, they all agree that to provide transparency

and ensure that carbon credits transacted are a complement to and not a substitute for company decarbonization, companies must publicly commit to a science-based target validated by SBTi or equivalent, and the mitigation hierarchy should be a guidepost for prioritizing their actions (TFCI, 2023).

In fact, the Tropical Forest Alliance and Proforest (2023) highlight that several civil society organizations working with companies taking landscape-scale action have recommended that the SBTi should require, reward or incentivize companies to take BVCM action, considering the necessity to bring down GHG emissions in the forest, land and agriculture sector (Tropical Forest Alliance and Proforest, 2023).

Four evidence submissions discuss the potential for carbon credits as insets in accelerating net-zero transformation and/or increasing climate finance under certain conditions. There were other evidence submissions which referred to insetting approaches but did not specifically reference carbon credits or alternative types of mitigation certificates and thus are not discussed herein.

GoodShipping and Routescanner's "Route $CO_2$ Zero: A step-by-step guide to decarbonise your scope 3 emissions" report argues that insetting using book and claim approaches empowers cargo owners and freight forwarders to make an immediate climate impact by decarbonizing their scope 3 emissions from transportation. The paper does not provide evidence for the effectiveness of insetting, but suggests a three-step process for this approach (GoodShipping and Routescanner, n.d.).

A 2023 newspaper article was also submitted to the SBTi which discusses how Norden, a Danish ship owner and operator, planned to issue carbon inset tokens with the aim of supporting the decarbonization of customer supply chains. In this article, Norden states that "every token guarantees complete ownership to the buyer and provides full transparency and chain-of-custody with regards to the biofuel interventions, emission calculations, assurance and risks mitigations" (Adjin, 2023).

Abatable and the International Platform for Insetting published a paper in 2023 entitled "Addressing Scope 3 – how insetting can be scaled to tackle supply chain emissions" in which they define insetting projects as interventions along a company's value chain that are designed to generate greenhouse gas emissions reductions and carbon storage, and at the same time create positive impacts for communities, landscapes and ecosystems. The authors argue that the "practice provides companies with an avenue to drive carbon reductions and removals within their supply chains and harmonise their operations with the ecosystems they depend upon" (Abatable and the International Platform for Insetting, 2023).

The report presents the findings of 20 qualitative interviews with project developers and broader industry stakeholders on insetting and the practice's associated opportunities and challenges. They find that resources such as the GHG Protocol, SBTi, Gold Standard's Scope 3 Value Chain Interventions Guidance and Verra's Scope 3 Program are not uniformly aligned on the definition of insetting, which was identified by interviewees as a key barrier. Interviewees also highlighted that the potential for use of carbon credits in the context of insetting is creating further confusion in the marketplace given their more common use for offsetting purposes. The authors therefore argue that "the future verification of 'inset credits'

as a commodity remains a topic for debate" (Abatable and the International Platform for Insetting, 2023).

The authors also highlight the lack of consensus on where the geographical boundaries for insetting should lie, with interviewees selectively arguing that they should be at the farm, regional, or national level. The report calls for better standards, guidance, and collaboration to improve boundary setting and traceability for insetting activities, and for the development of registries, whether those used in the voluntary carbon market or dedicated insetting ones to support with tracking emissions and co-claiming and avoiding double counting. The authors conclude that, "as guidance develops, conservative claims of BVCM rather than Scope 3 reductions or removals are advisable" (Abatable and the International Platform for Insetting, 2023).

Conversely, NewClimate Institute and Carbon Market Watch (2023) argue that the insetting measures that were identified in their assessment of company climate strategies "amount de facto to the unregulated offsetting of emissions, usually through biological carbon dioxide removals within the value chain". They claim that "this illegitimate concept has gained considerable traction over the past year, and its potential to significantly undermine corporate strategies is already being realised" (NewClimate Institute and Carbon Market Watch, 2023).

Finally, there were three evidence submissions worth highlighting which challenge the premise that companies are using carbon credits to delay action to address their value chain emissions (Forest Trends' Ecosystem Marketplace, 2023; Sylvera, 2023 and Trove Research, 2023b), which implies that they are either using them for the purposes of BVCM or insetting as opposed to offsetting.

The Forest Trends' Ecosystem Marketplace (2023) report/white paper – "All in on Climate: The Role of Carbon Credits in Corporate Climate Strategies" – argues there is limited evidence to suggest that carbon credits are being used by companies to delay or avoid meaningful action on climate. The paper presents an assessment of corporate disclosures to CDP in 2022 and Ecosystem Marketplace's proprietary voluntary carbon market dataset to compare companies that purchased voluntary carbon credits versus companies that do not. The authors claim that companies that purchase carbon credits are 3.4 times more likely to have an approved science-based climate target than companies that do not engage in carbon markets, and three times more likely to include scope 3 emissions in their climate targets. They reported that the median voluntary buyer of carbon credits spent three times more on emissions reductions activities[4] (USD 1,338,557 versus USD 447,220, respectively) and one and a half to two times more per $tCO_2e$ emitted (scopes 1 and 2) than the typical non-buyer. This analysis thus indicates a correlation between companies in the dataset setting science-based targets and purchasing carbon credits (Forest Trends' Ecosystem Marketplace, 2023). It might therefore be that these companies are purchasing carbon credits for the purposes of BVCM or insetting rather than offsetting.

[4] It is understood that this refers to scope 1, 2 and 3 emissions reduction activities as reported by companies in the CDP questionnaire.

There are however a number of data limitations in this study which present challenges in drawing conclusions. Indeed, the authors note that the CDP dataset underpinning this analysis is "an incomplete accounting of voluntary carbon credit purchases" (Forest Trends' Ecosystem Marketplace, 2023). Furthermore, the CDP data is self-reported by companies and therefore it is not clear whether companies are counting their carbon credit purchases towards the delivery of their science-based targets or their reported spend on emissions reduction activities.

The authors also do not specify whether the carbon credits that companies reported to have purchased were retired by them or not (i.e. they may have been purchased and are being held for future retirement or purchased with the intention of selling them onto a second buyer). The analysis is based on 768 companies that reported purchases of 121.2 million carbon credits in 2021, which represents 23% of carbon credit transactions in that year (which Forest Trends' Ecosystem Marketplace reports as 518.3 million). The paper does not include information on the remaining buyers of carbon credits, which may or may not be setting science-based targets and/or making progress in reducing their value chain emissions.[5]

In a similar vein, Sylvera's 2023 report "Carbon Credits: Permission to Pollute, or Pivotal for Progress?" also analyzes CDP data to test the "common belief that companies purchase carbon credits or 'offsets' in order to avoid taking real action to cut greenhouse gas emissions". The authors analyzed the scope 1 and 2 emissions data and carbon credit purchase data of 102 large businesses across a range of sectors, spanning nine years (2013–2021). They found that 50% of these companies used carbon credits. They reported that on average, the 51 companies in the dataset that buy carbon credits are simultaneously cutting their scope 1 and 2 emissions by 6.2% per year while the 51 companies that don't use carbon credits are cutting emissions by only 3.4% per year. The authors clarify that the "figures represent reductions in actual emissions – not net emissions – meaning that a company's use of carbon credits does not directly impact these numbers." They therefore conclude that "investment in carbon credits coincides with an almost 2x rate of emission reductions" (Sylvera, 2023).

Again, the authors of this paper highlight the data limitations, for example that the data does not include scope 3 emissions and that they had to use scope 2 market-based data where location-based data was not available. Despite these limitations, the authors suggest that this study demonstrates that "investment in carbon credits doesn't stop companies from taking meaningful climate action" and they emphasize that companies should follow the mitigation hierarchy by prioritizing reducing emissions and then sourcing the highest quality credits (Sylvera, 2023).

A third paper presents a similar analysis – "Corporate emission performance and the use of carbon credits" by Trove Research. The authors state that "companies that are material users of carbon credits decarbonise twice as fast as those that do not use carbon credits." This is based on a sample of 4,156 companies, where "material users of carbon credits" is

[5] Climate Focus reports 159 million carbon credit retirements in 2021 (Climate Focus, 2022) and therefore if the 121.2 million carbon credit purchases by the companies covered in the Forest Trends' Ecosystem Marketplace refers to retirements then their assessment covers approximately 76% of global voluntary carbon credit retirement in that year. While it is unclear, the analysis seems to imply that it refers to purchases of carbon credits as opposed to retirements.

defined as companies who have used at least 100 $tCO_2e$ of credits and at least 5% of their scope 1 and 2 emissions, of which there are 351 companies in the sample. The authors argue that "these findings refute the assertion that companies voluntarily buying carbon credits are creating a 'license to pollute'" and that in fact, the voluntary purchase of carbon credits "provides companies an incentive to accelerate their emission reductions… [which is] likely, in part, to be because when purchasing credits, companies voluntarily attach a price to their emissions" (Trove Research, 2023b).

**Theme 3: Claims**

This theme considers the evidence relating to claims to discuss the types of claims that may or may not be credibly used by companies purchasing and retiring emissions reductions credits for different purposes. This section therefore relates to research question six posed in the SBTi's open Call for Evidence: "What specific evidence-based claims can and cannot be made when employing environmental attribute certificates to corporate decarbonization?"

It is worth highlighting that this is a rapidly evolving space with increasing examples of public efforts to regulate corporate climate claims through both law and softer regulatory instruments such as guidance from consumer, competition and financial authorities. There have been notable developments in 2024 since the Call for Evidence submission period closed and therefore these important, but recent, developments are not discussed within this report.

### Summary of results across all three tiers

The SBTi identified 19 pieces of evidence that were relevant or partially relevant to this research question. 37% of relevant or partially relevant pieces of evidence were classified in Tiers A and B (n = 7), and the remaining 63% were classified in Tier C (n = 12).

The evidence base that addresses this theme was more limited than the other themes. Research question six is worded to invite more subjective types of submissions, which is reflected in the types and quantities of evidence that can provide a direct answer; for example, there are no controlled research studies addressed by this research question. Where submitted publications did directly address claims related to corporate decarbonization, they were often opinion pieces or addressed the types of justifications and data that are used to substantiate claims. The evidence received on this theme tended to address the following topics:

- A review of the types of claims that exist, without commenting on their appropriateness.
- Factors that could affect the validity of offsetting claims, e.g. the fungibility (i.e. the physical equivalence) of unabated value chain emissions and carbon credits.
- Existing limitations, requirements, or guidelines on claims according to voluntary and regulatory frameworks.
- Authors' opinions on what claims are and are not appropriate, and under what circumstances, with varying types of justification.

It is clear from this body of evidence regarding the theme of claims, similarly to the previous section, that the effectiveness of carbon credits at delivering mitigation outcomes is a prerequisite for addressing this question.

All four Tier A evidence challenge the legitimacy of offsetting claims, arguing that treating carbon credits as fungible with other sources, sinks, or reductions of emissions is inadvisable, illogical, or damaging to global mitigation goals. Two of the three Tier B evidence submissions oppose offsetting claims (the third Tier B evidence submission does not comment on the appropriateness of different types of claims but mentions the differing definitions of net-zero and carbon neutrality). 10 of the 12 Tier C evidence submissions directly oppose offsetting claims, with the other two (Verra, 2023 and Abatable and the International Platform for Insetting, 2023) not taking a strong stance either way.

Nine out of the 19 evidence submissions explicitly support the use of contribution claims over offsetting/ compensation/counterbalancing claims (Tier A = 1; Tier B = 1; Tier C = 7).

This limited set of evidence also suggests that there is some confusion and disagreement about the meaning of terms used surrounding claims, most notably in the meaning and common understanding of the definition of "carbon neutrality" claims (Trouwloon et al., 2023; Acampora, 2023; Carbon Market Watch, 2023a; Abatable and the International Platform for Insetting, 2023).

Finally, Trouwloon et al. highlight two key areas for further research. They emphasize the need to "improve the scientific understanding around many of the concepts used when formulating corporate climate claims, including through a better understanding of the socio-political contexts in which they are manifest and a better translation into criteria that indicate when such concepts are used robustly". They also highlight the need to "improve our scientific understanding of the behavioral implications of the use of carbon credits in corporate climate claims" (Trouwloon et al., 2023).

### Tier A evidence

There are four relevant or partially relevant evidence submissions in Tier A including one peer-reviewed literature review, one controlled research study, one law or regulation, and a chapter from the IPCC AR6 WG III report.

The most relevant submission in this tier is Trouwloon et al. (2023), a literature review that focuses on three key dimensions of corporate climate claims as related to carbon credits: 1) the intended use of carbon credits: offsetting versus non-offsetting claims; 2) the framing and meaning of headline terms: net-zero versus carbon neutral claims; and 3) the status of the claim: future aspirational commitments (ex-ante) versus stated achievements (ex-post). The authors perform a literature review and propose an analytical framework for categorizing corporate climate claims. The review highlights greenwashing risks associated with misleading corporate climate claims, as well as increasing litigation and liability risks, as indicated by the growing number of corporate social responsibility (CSR)-related claims in the United States and Europe. In particular, the authors note the risks associated with carbon neutrality claims which may be "particularly likely to mislead because many consumers fail to understand the nature of offsetting and thus inaccurately estimate the

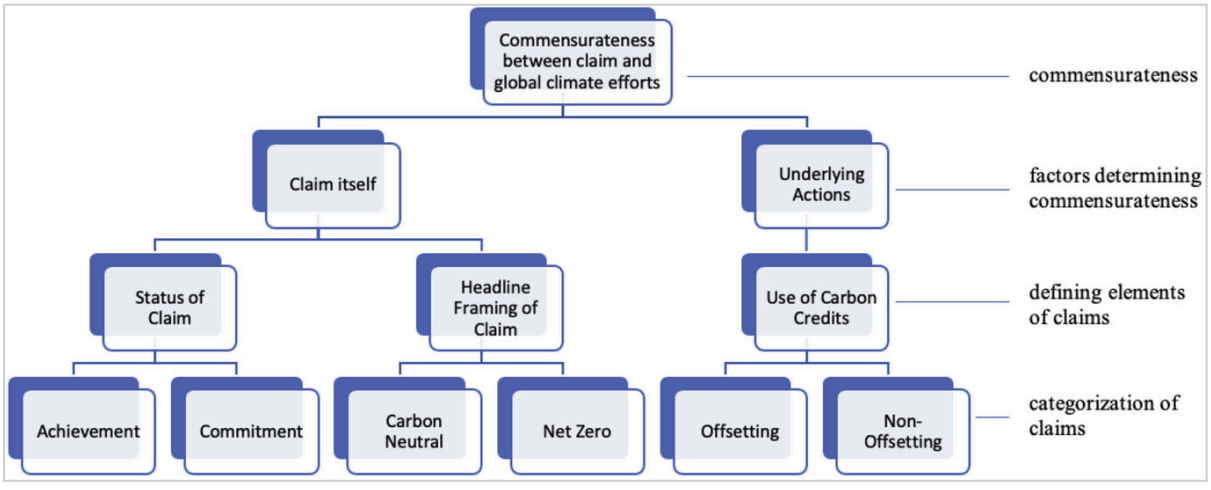
impact of carbon offsetting on the total carbon footprint of their purchases" (Trouwloon et al., 2023).

The findings "underscored the importance of transparency around the use of carbon credits" and related claims in several dimensions including commitment (ex-ante) versus achievement (ex-post); details of the actions underlying a claim; and whether carbon credits are used for offsetting or non-offsetting (i.e. contribution claim) purposes. The analysis also presupposes that the claims being discussed "are underpinned by high quality voluntary carbon credits that are permanent, additional and managed to minimize leakage."

As mentioned in theme two, Trouwloon et al. propose that companies should purchase and retire high quality carbon credits (i.e. permanent, additional and managed to minimize leakage) for the purpose of beyond value chain mitigation, over and above their efforts to decarbonize their own value chains. In terms of the claims that can then be made based upon the company's purchase and retirement of high quality carbon credits, there is some diversity. The authors describe a number of different types of claims including "non-offsetting claims", "contribution to a quantified GHG reduction or removal goal", "contribution to a global net-zero goal", "offsetting/compensatory claims", "offsetting/compensation claims backed by corresponding adjustments", and "offsetting/compensation claims not backed by corresponding adjustments". The authors argue that contribution claims avoid many of the pitfalls and risks that come with offsetting and are thus preferable over compensatory claims. Despite this, they highlight that "there is, as of yet, no consensus on what it means for a corporate claim to accurately reflect its contribution to global climate mitigation, nor is it well understood how claims can be governed to ensure that they are commensurate with global climate mitigation efforts" (Trouwloon et al., 2023).

The authors propose a categorization of corporate climate claims and their defining elements, as shown in Figure 1 below.

*Figure 1: Proposed categorization of corporate climate claims and their defining elements (Trouwloon et al., 2023)*




Trouwloon et al. highlight two key areas for further research. Firstly, they emphasize the need to "improve the scientific understanding around many of the concepts used when

formulating corporate climate claims, including through a better understanding of the socio-political contexts in which they are manifest and a better translation into criteria that indicate when such concepts are used robustly". Secondly, they highlight the need to "improve our scientific understanding of the behavioral implications of the use of carbon credits in corporate climate claims" (Trouwloon et al., 2023).

Badgley et al. (2022a), is, as mentioned above, mainly focused on the supply-side but highlights literature that challenges the premise that the climate benefits associated with carbon credits are equivalent to the emissions that the credits are used to offset (Badgley et al., 2022a). This therefore can be interpreted as critical of offsetting or compensatory claims associated with carbon credits that represent emissions reductions or avoidance.

Nabuurs et al. (2022), which is a chapter from the IPCC AR6 WG III report, also mentions the lack of equivalence of emissions reductions associated with land-related emissions reductions and emitted GHGs from other (industrial) sources, stating that at a systematic level emission reductions associated with "AFOLU [agriculture, forestry and other land use] simply cannot compensate for mitigation shortfalls in other sectors." How this translates down to compensation at the individual level of a corporation is not addressed in this evidence. The authors also note the importance of "robust measurement, reporting and verification processes [...] to prevent misleading assumptions or claims on mitigation" (Nabuurs et al., 2022).

Annex 1 of the European Sustainability Reporting Standards (ESRS) contains sustainability reporting requirements for companies subject to the Corporate Sustainability Reporting Directive (CSRD). The regulation requires separate reporting of carbon credits from GHG emission reduction targets. While acknowledging that "Financing GHG emission reduction projects outside the undertaking's value chain through purchasing carbon credits that fulfill high-quality standards can be a useful contribution towards mitigating climate change," the regulation prohibits the use of these instruments to offset corporate emissions or as a means to reach corporate emissions reduction targets under the ESRS. This regulation sets limits on the claims of regulated organizations, which includes companies listed in an EU-regulated market with at least 500 employees and non-EU companies with at least EUR 150 million of turnover in the European Union (European Commission, 2023).

### Tier B evidence

The three evidence submissions in Tier B include one controlled research study, one survey/poll, and a draft guidance document. These pieces of evidence address similar themes as evidence in Tier A regarding the lack of equivalence between certain types of carbon credits and certain emissions sources, as well as claims guidance and prohibitions.

Regarding the comparison of mitigation outcomes from credits versus other emissions, Haya et al. (2023) find that "REDD+ credits should not be traded with, or treated as equivalent to, fossil fuel emissions" due to the risk of reversal, uncertainty in baselines, and uncertainty in leakage impacts. This would preclude the use of these instruments from offsetting claims in that the concept underlying offsetting claims is that "a metric ton is a metric ton".

The draft GHG Protocol Land Sector and Removals Guidance, similar to the ESRS, prohibits the use of carbon credits (including emissions reduction credits) to substantiate claims relating to a corporation's GHG emissions targets. The draft guidance states that a reporting company shall deduct its value chain emissions reductions or removals associated with the sale of credits that are used by the buyers as offsets from the reporting company's GHG target accounting to avoid double counting of credits used as offsets or compensation, and that companies shall use the emissions and removals values adjusted for sold credits when accounting for progress toward a target (GHG Protocol, 2022a; GHG Protocol, 2022b). While the GHG Protocol Guidance is not a binding legal or regulatory requirement, it is the widely used, de-facto standard for GHG emissions inventory calculation and reporting.

Acampora (2023) present the results of interviews with companies and consultancies working in the agri-food industry around carbon neutrality. The paper does not comment on the appropriateness of different types of claims involving the use of carbon credits but mention the differing definitions of net-zero and carbon neutrality, highlighting the boundary of the claim ("a specific product or service instead of encompassing the whole organization"); coverage of different emissions scopes; required ambition of emission reductions; and use of carbon credits. The authors also note that "companies are struggling to find a common definition and understanding of [the] carbon neutrality process" (Acampora, 2023).

### Tier C evidence

There were an additional 12 pieces of relevant or partially relevant evidence in Tier C. This includes 10 reports or white papers, one survey, and one commentary/opinion piece.

Cullenward (2023) distinguishes between physical equivalence claims and economic equivalence claims, which are "based on normative, non-physical choices like economic discounting or arbitrary time horizons". The paper explains the difference between these types of claims and explains that compensatory claims, such as offsetting claims or neutralization claims, "contribute to the Paris Agreement's global temperature stabilisation goal only when they are based on physical equivalence," i.e. duration of storage commensurate to duration of the effect of emissions (Cullenward, 2023).

Several of the white papers come from Carbon Market Watch and criticize the claims made by airlines (Carbon Market Watch, 2022a), the 2022 FIFA World Cup (Carbon Market Watch, 2022b), grocery store products (Carbon Market Watch, 2023), and oil and gas majors (Carbon Market Watch, 2021). The first of these papers, Carbon Market Watch (2022a), identifies lack of transparency, low cost of credits, low quality of credits, and incomplete emissions accounting as the factors that undermine the quality of airlines' offsetting and carbon neutral claims. Carbon Market Watch argues that "no carbon neutrality claim can be credible without the utmost being done to reduce all emissions that can be reduced" before using carbon credits and similarly identifies likely issues with the quality (additionality and quantity of emissions reductions) of the carbon credits that are used for the 2022 FIFA World Cup's carbon neutrality claim (Carbon Market Watch, 2022b). Carbon Market Watch (2023) identifies legal and regulatory risks associated with carbon neutrality claims and notes that the "wide range of terminology makes it difficult for consumers to understand what is the real impact of a product on the climate." The paper on fossil fuel carbon neutrality claims raises, in addition to the factors mentioned in their airlines publication, the mismatch in timeframe of

impact between impermanent biological $CO_2$ storage associated with some types of carbon credits and long-lived $CO_2$ emitted from burning fossil fuels (Carbon Market Watch, 2021).

Broekhoff (2022) is an expert report from a senior scientist at Stockholm Environment Institute that provides the authors view on whether KLM Royal Dutch Airlines may validly claim that the $CO_2$ emissions of passenger aviation are reliably compensated through the purchase and use of carbon credits from a reforestation project. Broekhoff argues that if a consumer decides to fly, it would be misleading to suggest that purchasing carbon credits is equivalent in its impact to not flying when considering the need for all sectors to decarbonize in line with a science-based pathway, and thus it would not be valid to make a compensation claim. Broekhoff argues that a compensatory or "counterbalancing" claim can only be valid if certain logical conditions are met. Firstly, the author suggests that the mitigation associated with the carbon credit must be additional (which he notes is "deceptively difficult and subject to inherent uncertainty" due to the use of counterfactual baseline scenarios). Secondly, the mitigation must not be overestimated. Thirdly, the mitigation must be permanent since the effects of carbon emissions are typically long-lived. Fourth, the mitigation must be exclusively claimed (i.e. so it is not double counted by multiple parties towards targets). Finally, it must avoid social and environmental harms, which he notes is not directly related to the counterbalancing value of a carbon credit but is essential to ensure avoidance of undesirable consequences. Broekhoff therefore argues that "carbon credits are more accurately viewed as a contribution to mitigation activities (such as reforestation) that are supplementary to direct decarbonization efforts, not a compensatory measure" (Broekhoff, 2022).

Broekhoff's perspective is mirrored in NewClimate Institute and Carbon Market Watch's 2023 Corporate Climate which claims there is a "strengthening consensus that there is a limited role for offsetting in credible corporate climate strategies", and that instead "climate contributions without neutralisation claims can provide a transparent, constructive and ambitious approach to take responsibility for unabated emissions" (NewClimate Institute and Carbon Market Watch, 2023).

One white paper presents in detail several potential models of the use of carbon credits under the Paris Agreement, under which countries have nationally determined contributions (NDCs) to reduce their greenhouse gas emissions (Fearnehough et al., 2020). The paper considers the risks that the voluntary corporate use of these credits could pose to disincentivizing national governments from increasing the ambition of their NDCs. One factor in these risks is the type of claim used by the entity that retires the credits: neutralization (offset) vs. contribution claims. The authors briefly mention insights from their engagement process, including "concerns that offsetting can give customers a misleading impression that their purchasing decisions lead to fewer, or zero, emissions actually released into the atmosphere in the production of the product or service they are buying." The paper highlights how the types of corporate claims that carbon credits are used to substantiate have implications for global climate mitigation efforts (Fearnehough et al., 2020).

Cullenward et al. (2023) also highlight the risk of double counting emissions reductions or removal efforts between entities purchasing carbon credits and national governments' NDCs. Additionally, the authors explain that netting $CO_2$ emissions using carbon credits "is physically inaccurate if the carbon credit is non-additional or based on non-durable storage."

They suggest that “the only practical response is to stop making offsetting claims altogether” when using carbon credits (Cullenward et al. 2023).

Three pieces of Tier C evidence mention confusion among corporations and consumers about the meaning of key terms used in corporate claims involving carbon credits. In reviewing product carbon neutrality marketing, Carbon Market Watch (2023) found not only carbon neutral, $CO_2$ neutral, and climate neutral, but also “climate positive, climate negative, planet neutral, [and] carbon positive/negative”, all with potentially different meanings. Verra’s survey of its project and working group members demonstrated confusion in the meaning of the term “environmental attribute certificate” itself, with respondents understanding the phrase variously to refer to carbon credits, insets and supply chain interventions, and renewable energy certificates (Verra, 2023). Similarly, Abatable and the International Platform for Insetting (2023) highlight confusion with claims – “from a corporate claims perspective, the boundary of where an in-value chain (scope 3 emissions reduction or removal) claim stops and a Beyond Value Chain Mitigation (BVCM) claim starts is blurry”. As such, the authors recommend that companies should be “conservative with insetting claims to avoid accusations of greenwashing, while also proactively communicating about their insetting projects to further build the business case for insetting and share key learnings and challenges with their peers” (Abatable and the International Platform for Insetting, 2023).

The United Nations High-Level Expert Group on the Net Zero Emissions Commitments of Non-State Entities state that businesses should make investments beyond their value chain, “including the purchase and retirement of high-integrity carbon credits, but these credits cannot be used to meet non-state actors’ interim decarbonisation targets” (HLEG, 2022).

# LIMITATIONS

There are a number of limitations associated with the SBTi's Call for Evidence on the role of EACs in corporate climate targets which are described within this section of the report.

While an open Call for Evidence allows a wide range of stakeholders to submit evidence, including evidence that may not appear in a review of peer-reviewed literature, there are limitations in such a process. Firstly, the respondents to the Call for Evidence do not necessarily reflect the full breadth of stakeholders with experience, knowledge and insights that are relevant to the field of research. Indeed, 95 of the 421 SurveyMonkey form respondents were from businesses while just four respondents represented academic or research institutions, five represented community groups and just two represented ethnic, cultural or religious groups (see Annex C for more information on the respondents).

The literature discussed within the results section of this summary report only includes 71 pieces of evidence that were submitted to the SBTi during the Call for Evidence period between September and November 2023.[6] This is therefore a relatively small sample of evidence. Evidence that might be relevant to this research inquiry that was not submitted was not included in the scope of this report. It is therefore unclear how representative these results are of the entire universe of relevant evidence. All conclusions drawn from this body of evidence are therefore necessarily partial and suggestive.

There are other limitations which arise from the way in which the SBTi's Call for Evidence document was defined. For example the document referred to "emission reduction credits" as opposed to the more common "carbon credits" which may have limited broad understanding and reach of the call. The reason for referring to emissions reduction credits as opposed to carbon credits was to exclude evidence submissions relating to carbon removals credits used for the purpose of neutralizing residual emissions, which were defined as out of scope of this research. Since there is a distinction between emissions reductions and emissions avoidance credits that was not clarified in the Call for Evidence document, it may be that submitters did not submit evidence that is relevant to emissions avoidance credits, despite this being of interest to the SBTi under this line of inquiry.

Similarly, the SBTi received feedback that the scope of the Call for Evidence was unclear. The SBTi stated that "Environmental attribute certificates explored in this Call for Evidence include instruments that may be potentially eligible in abatement targets, including scope 1, 2 and 3 emissions." Since the SBTi Glossary defines abatement as "measures that companies take to prevent, reduce, or eliminate sources of GHG emissions within their value chain", the SBTi is aware of at least one respondent that chose not to submit evidence on the effectiveness of carbon credits as offsets (where they relate to mitigation outcomes that occur outside of the company's value chain).

Three of the eight research questions posed by the SBTi focused on the extent to which use of carbon credits by companies could accelerate or hinder transformation and increase or decrease climate finance – research questions five, seven and eight. However, these

[6] While evidence submitters deemed 111 evidence submissions as relevant to carbon credits, only 71 were considered relevant by the SBTi review panel.

research questions could have been framed more clearly to elicit the submission of evidence that focuses on the substitution effect that occurs when a company purchases and retires a carbon credit as an offset instead of reducing its own emissions.

Another limitation which may have reduced the amount of evidence submitted is that the Call for Evidence document requested that submitters not include copyrighted, confidential, paywalled, and sensitive information. In particular, this may have reduced the amount of peer reviewed literature that was received, and, in turn the heterogeneity of stakeholders submitting evidence. Given the volume of peer-reviewed literature that was behind a paywall, the SBTi made a decision to include the discussion of this evidence in this report, despite having stated this evidence would be considered ineligible in the Call for Evidence document.

This is a rapidly evolving area of research and therefore it is important to acknowledge that this report does not include any literature that was published after the closing of the Call for Evidence in 2023. Some evidence that was submitted was also in the peer review process and at the time of the publication of this report has now been published as a peer reviewed paper. However, the SBTi was focused on only the papers that were submitted during the call and therefore these papers would have been classified in a lower tier.

Another challenge in synthesizing the evidence is the heterogeneity of different carbon credit types and methodologies referenced in the evidence submitted to the SBTi and therefore it is challenging to generalize the findings.

# CONCLUSION

Across all three themes it is clear that more research is needed on the effectiveness of the use of carbon credits (emissions avoidance and reduction) by companies under different use cases. This is in part due to the limitations described above, including the small sample of evidence and the heterogeneity of types of carbon credits and methodologies that exist. However, the Call for Evidence did highlight insights that are useful and merit greater discovery.

Theme 1 (Mitigation Outcomes and Conditions for Effectiveness) considered the insights that could be drawn from the evidence with regards to the effectiveness of emissions reduction credits to deliver mitigation outcomes and under which conditions they deliver their intended outcomes. The limited selection of empirical and observational evidence in Tiers A and B suggests that various types of carbon credits are ineffective in delivering their intended mitigation outcomes. Evidence in Tier C, which represents findings with a higher risk of bias or less relevance, shows more mixed results. A key limitation was the generalizability of findings given the heterogeneity of different types of carbon credits and methodologies for quantifying mitigation outcomes associated with these credits. As such it is clear that a more comprehensive evidence base would need to be reviewed in order to have more conclusive results.

Theme 2 (Corporate Use Cases for Carbon Credits and Implications for Net-Zero Aligned Transformation and Climate Finance) considered the insights that could be drawn from the evidence with regards to the different ways in which companies can use carbon credits and the corresponding implications for the net-zero transformation of sectors and/or for global efforts to increase climate mitigation finance. The evidence submitted to the SBTi generally suggests that there could be clear risks to corporate use of carbon credits for the purpose of offsetting, with the potential unintended effect of hindering the net-zero transformation and/or reducing climate finance. On the other hand, BVCM and contribution approaches may represent preferable models for accelerating net-zero transformation and increasing climate finance in that those efforts are over and above a company's efforts to reduce its own emissions. However, as with Theme 1, there is a clear need to assess a wider body of evidence to interrogate this research area more thoroughly. In particular, there is a clear need for further research into and standardization of insetting as a corporate practice, where carbon credits originate from within a company's value chain.

Theme 3 (Claims) considered the insights that could be drawn from the evidence with regards to the types of claims that may or may not be credibly used by companies purchasing and retiring emissions reductions credits for different purposes. A number of evidence submissions highlight that the plethora and diversity of claims has created confusion. The vast majority of evidence submissions (84%) argue that treating carbon credits as fungible with other sources, sinks, or reductions of emissions is inadvisable, illogical, or damaging to global mitigation goals, with the other submissions not providing a strong view. Around half of the evidence submissions explicitly support the use of contribution claims over offsetting/compensation/ counterbalancing claims.

# NEXT STEPS

As mentioned, the purpose of this report is to summarize the body of evidence submitted to the SBTi during the Call for Evidence period related to carbon credits that represent either emissions reductions or emissions avoidance. The SBTi will publish summary reports that relate to the other types of EACs – energy attribute certificates for electricity, other energy carrier certificates, certified commodities conveying a specific emission factor – in the scope of this research in due course.

The results of this research will be considered, along with other research outputs, in the revision of the SBTi Corporate Net-Zero Standard. In May 2024, the SBTi announced the timelines and process for this revision and published its Terms of Reference (SBTi, 2024b, SBTi, 2024c).

This revision of the Corporate Net-Zero Standard will be developed in accordance with the Standard Operating Procedure (SOP) for Development of SBTi Standards, which includes public consultation, pilot testing, redrafting, review and approval by the Independent SBTi Technical Council and consideration and adoption by the SBTi board. The SBTi expects the Version 2.0 standard to be published later in 2025 (SBTi, 2024d).

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# ANNEX A: CALL FOR EVIDENCE ONLINE SUBMISSION FORM

A SurveyMonkey form was used to collect evidence. The questions in this form are included below.

It is worth highlighting that the Call for Evidence document also stated that, “In accordance with the SBTi Research Ethics Guidelines, contributors to this Call for Evidence shall include information regarding conflicts of interest. An actual conflict of interest in information submitted as evidence can be defined as a situation in which an individual or organization has interests in the outcome of such information that may lead to a personal or professional advantage and that might therefore compromise the integrity of the data provided. For example, if data provided as evidence is funded by an entity who may have interests in a particular set of outcomes. A perceived conflict of interest refers to a situation where an individual or organization providing or presenting evidence is seen as having a potential bias or vested interest that could influence their objectivity or the integrity of the evidence they provide. If an individual or organization wishes to submit a piece of evidence which they authored, please review the SBTi Competing Interest Guidelines.”

**About the submitter (provide once per survey response)**

Your name: _____
Your email address (not published): _____
Organizational affiliation: _____
Type of organization: _____

Provide a brief description of the organization(s) and your individual role within that organization (if this submission is associated with an organization) and/or provide a brief description of your individual background (if this submission is not associated with an organization): _____

Indicate how many pieces of evidence you are submitting (you may provide up to five times per survey response) _____

**Submitting evidence**

Title your evidence submission: _____

Identify the types of attribute certificate to which your evidence applies. (Select all that apply)
What type of evidence is this? (See types of acceptable evidence above; select one)

Disclose any conflict of interest, e.g. whether the research was supported by a non-public funding source: _____

Upload a cover letter (optional). You can use this to explain how the evidence responds to the research questions, describe the kind of position the evidence supports, and provide any additional context.

Upload the evidence as a PDF, DOC, DOCX, PNG, JPG or JPEG file; or send the evidence as an attachment to callforevidence@sciencebasedtargets.org.

Is the evidence relevant to the research questions?

1. What evidence exists about the effectiveness or ineffectiveness of environmental attribute certificates in delivering measurable emission reductions?
2. What evidence supports or opposes a causal link between specific operating conditions (geographies, regulatory schemes, presence or absence of tracking mechanisms or registries, etc.) and the effectiveness of environmental attribute certificates to deliver corporate emission reductions? Which conditions?
3. What regulatory safeguards and market infrastructure, if any, would need to be put in place for environmental attribute certificates to be effective and sustainable?
4. What evidence supports or opposes the ability of environmental attribute certificates to accurately reflect and quantify emission reductions in the context of corporate climate abatement targets?
5. What evidence exists that uptake of attribute certificates leads to or hinders the transformation needed to reach climate stabilization?
6. What specific evidence-based claims can and cannot be made when employing environmental attribute certificates to corporate decarbonization?
7. Is there evidence that supports or undermines that the market value of this type of instrument is commensurate with the abatement costs of the underlying activity?
8. Is there evidence that shows that the use of these instruments (i.e. procurement of the attribute certificate) could contribute to scale-up of climate finance compared to alternative interventions? Or could it result in climate finance dilution?

For each of the above questions, please indicate the following:

*Table 4. Call for Evidence survey questions relating to the research questions*

| Question number | The evidence is relevant to this research question | What position does this piece of evidence support regarding this question? | Please explain (1000 characters). If you need more space, elaborate in the cover letter. |
|---|---|---|---|
| Notes | Select one | Select one. Only appears if previous question is “Relevant” or “Not sure” | 200 word open text field. Only appears if previous question is checked |
| 1 | • Relevant<br>• Irrelevant<br>• Not sure | • Effectiveness<br>• Ineffectiveness<br>• Not sure/Other | Your response |
| 2 | • Relevant<br>• Irrelevant<br>• Not sure | • Supports<br>• Opposes<br>• Not sure/Other | Your response |

| | | | |
|---|---|---|---|
| 3 | ● Relevant<br>● Irrelevant<br>● Not sure | ● Regulatory and/or safeguards market infrastructure needed<br>● No safeguards infrastructure needed<br>● Not sure/Other | Your response |
| 4 | ● Relevant<br>● Irrelevant<br>● Not sure | ● Supports<br>● Opposes<br>● Not sure/Other | Your response |
| 5 | ● Relevant<br>● Irrelevant<br>● Not sure | ● Leads to transformation<br>● Hinders transformation<br>● Not sure/Other | Your response |
| 6 | ● Relevant<br>● Irrelevant<br>● Not sure | N/A | Your response |
| 7 | ● Relevant<br>● Irrelevant<br>● Not sure | ● Supports<br>● Undermines<br>● Not sure/Other | Your response |
| 8 | ● Relevant<br>● Irrelevant<br>● Not sure | ● Scale-up finance<br>● Climate finance dilution<br>● Not sure/Other | Your response |

**Permissions and acknowledgements**

For each of the following, please provide a response:

1. May we contact you to request clarification about your submission?
2. I confirm that, to the best of my knowledge, the information I am submitting to this Call for Evidence is true and accurate; or that any inaccuracies or errors have been identified.
3. I confirm that, to the best of my knowledge, there are no legal restrictions on the publication and distribution of the information I am submitting to this Call for Evidence.
4. I acknowledge that the SBTi may quote my submission in the summary report, with or without attribution to me and/or my organization(s).

**Click “done” to finalize submission**

# ANNEX B: DETAILED METHODOLOGY

**Call for Evidence scope and structure**

The SBTi issued an open Call for Evidence on the Effectiveness of Environmental Attribute Certificates in Corporate Climate Targets from September 21 to November 24, 2023.

The following types of environmental attribute certificate were defined as within the scope of the Call for Evidence:

- Energy attribute certificates for electricity
- Other energy carrier certificates, e.g. green hydrogen, green gas, sustainable aviation fuel certificates (SAFc)
- Emissions reduction credits
- Certified commodities conveying a specific emission factor, e.g. green steel

The SBTi specified the types of evidence sought through the open call, including: empirical data and research studies, reports and white papers, statistical information, case studies and examples, surveys/polls and legal and regulatory analysis.

Respondents to the Call for Evidence were given the option to submit evidence via direct upload to a SurveyMonkey form, or by email to the SBTi. Each SurveyMonkey submission could include up to five pieces of evidence, but respondents were not limited in the number of times they could respond to the SurveyMonkey form. The content of the SurveyMonkey form can be found in Annex A of this report.

Respondents were asked to provide information about themselves (e.g. stakeholder category and contact information) and about the evidence (e.g. evidence type, potential conflicts of interest inherent within the evidence, the perceived relevance of the evidence to the four types of certificates, and the perceived relevance of the evidence to a set of eight research questions).

Respondents that submitted evidence via the SurveyMonkey form were asked to indicate the position that the evidence supports (in their opinion) across each of the eight research questions below:

1. What evidence exists about the effectiveness or ineffectiveness of environmental attribute certificates in delivering measurable emission reductions? (Response options: Effectiveness; Ineffectiveness; Not sure/Other)
2. What evidence supports or opposes a causal link between specific operating conditions (geographies, regulatory schemes, presence or absence of tracking mechanisms or registries, etc.) and the effectiveness of environmental attribute certificates to deliver emission reductions? Which conditions? (Response options: Supports; Opposes; Not sure/Other)
3. What regulatory safeguards and market infrastructure, if any, would need to be put in place for environmental attribute certificates to be effective and sustainable? (Response options: Regulatory and/or safeguards market infrastructure needed; No safeguards infrastructure needed; Not sure/Other)

4. What evidence supports or opposes the ability of environmental attribute certificates to accurately reflect and quantify emission reductions in the context of corporate climate abatement targets? (Response options: Supports; Opposes; Not sure/Other)
5. What evidence exists that uptake of attribute certificates leads to or hinders the transformation needed to reach climate stabilization? (Response options: Leads to transformation; Hinders transformation; Not sure/Other)
6. What specific evidence-based claims can and cannot be made when employing environmental attribute certificates to corporate decarbonization? (Open text box question)
7. Is there evidence that supports or undermines that the market value of this type of instrument is commensurate with the abatement costs of the underlying activity? (Response options: Supports; Undermines; Not sure/Other)
8. Is there evidence that shows that the use of these instruments (i.e. procurement of the attribute certificate) could contribute to scale-up of climate finance compared to alternative interventions? Or could it result in climate finance dilution? (Response options: Scale-up finance; Climate finance dilution; Not sure/Other)

Respondents also had the option to provide an explanation as to how and why the evidence they were submitting was relevant to the research questions, and to include a cover letter to accompany each piece of evidence.

**Evidence submissions – data input**

Evidence was submitted by a total of 421 individuals in the Call for Evidence response period. Some evidence was submitted by more than one respondent and therefore the SBTi team had to de-duplicate evidence submissions. A total of 406 unique pieces of evidence were submitted via the SurveyMonkey form and 32 additional pieces of unique evidence were submitted via email. Evidence that was deemed ineligible, for example if the submitter was anonymous or it was sent to the SBTi outside of the Call for Evidence period, is excluded from the SBTi's review.

Respondents classified 206 pieces of evidence as relevant to energy attribute certificates for electricity, 159 pieces of evidence as relevant to other energy carrier certificates, 111 pieces of evidence as relevant to emission reduction credits,[7] 43 pieces of evidence as relevant to certified commodities conveying a specific emission factor and 15 pieces of evidence as relevant to other unspecified types of EACs. Since some pieces of evidence were relevant to more than one type of EAC, the summed numbers in this paragraph do not equal the total unique pieces of evidence.

A table listing the eligible evidence submitted to the SBTi and the evidence which is not available online in the links provided in the table can be accessed here. Where the evidence submitted to the SBTi is protected by copyright the citation is provided and, where relevant, links to where the documents can be downloaded upon subscription and/or payment.

[7] This includes carbon credits that represent emissions reductions and avoided emissions.

### SBTi assessment of evidence

While the Call for Evidence SurveyMonkey respondents provided their own opinions about the relevance and findings of the evidence that they submitted, the SBTi developed a standardized methodology to systematically review and assess the evidence submitted. This more thorough examination was performed to summarize the findings of the evidence in relation to the research questions in a way that provides additional credibility to the information submitted by the respondent.

This assessment methodology has been undertaken only for evidence that was submitted and tagged as relevant to emission reduction credits. The SBTi anticipates following the same process for evidence that was submitted to the SBTi and tagged as relevant to the other types of EACs – energy attribute certificates for electricity, other energy carrier certificates and certified commodities conveying a specific emission factor.

The assessment methodology comprises five steps:

1. **Initial evidence cleaning and categorization** which was conducted by the SBTi research team and comprises:
    a. Data cleaning
    b. Revision of the evidence type classification
    c. Categorization of evidence by “general leaning”.
2. **Detailed evidence review** which was conducted by the review panel and comprises:
    a. Reading of the evidence and related information
    b. Categorization of evidence type
    c. Categorization of evidence based on its relevance to the research question
    d. Categorization of evidence according to the research question findings
    e. Determination of the risk of bias
    f. Identification and collation of additional useful information.
3. **Categorization of evidence into final tiers and relevance levels** which was conducted by the SBTi research team and comprises:
    a. Designation of evidence into tiers
    b. Designation of evidence according to overall relevance.
4. **Evidence synthesis and report writing** which was conducted by the SBTi research team and comprises:
    a. Final screening of review panel assessments
    b. Report writing.
5. **Quality review** which was conducted by the SBTi quality team and comprises:
    a. Ensuring that the strategic objectives of the research align with its outputs
    b. Conducting conflict of interest checks for authors, the review panel, and the review team
    c. Verifying scientific references and citations in the document
    d. Ensuring that proper research methodology and transparency is applied in the review process and ensuring fair, balanced information is provided
    e. Ensuring appropriate documentation, data handling procedures, and data privacy measures are followed.

## Assessment step 1: Initial evidence cleaning and categorization

This first step of the assessment methodology includes data cleaning, revision of the evidence type classification, categorization of evidence into “default tiers” and categorization of evidence by its “general leaning”. This phase of the assessment was conducted by the SBTi research staff that authored this report.

### 1.1 Data cleaning

The SBTi team collated the SurveyMonkey form submissions and the email submission data into a spreadsheet.

Each evidence submission was then screened against the eligibility requirements defined in the Call for Evidence. The Call for Evidence defined the following types of evidence that would be considered ineligible:

- Standalone submissions of anecdotal evidence, individual expert opinions or testimonials, or opinion pieces, as well as social media posts, unverified internet sources and biased or commercial sources will not be considered as acceptable evidence. Other unacceptable types of evidence include copyrighted, confidential or sensitive materials.
- Information that is behind paywalls, subscription barriers, or other access restrictions that may limit its availability.

Despite the inclusion of these eligibility requirements, there were a number of submissions that were copyrighted, marked as confidential or were behind paywalls or subscription barriers. Where the SBTi was not given permission to publish copyrighted, confidential or paywalled evidence, the citation of the evidence is provided only (see the full evidence list here).

Given the volume of peer-reviewed literature that was behind a paywall, the SBTi made a decision to include the discussion of this evidence in this report, despite having stated this evidence would be considered ineligible. Similarly, the SBTi chose to include published opinion pieces where they were considered relevant to the research questions.

The Call for Evidence also specified that anonymous submissions will not be considered and therefore evidence was considered ineligible where submitters did not complete their identification details. Evidence submitted by individuals via the SurveyMonkey that did not agree to the terms of the submission, and evidence that was submitted outside of the Call for Evidence period were also excluded.

Evidence was also considered ineligible where submissions were clearly marked as test submissions or where there was no evidence attached to the SurveyMonkey submission.

Each piece of eligible evidence was then reviewed to retrieve basic bibliographic information and to identify unique evidence, since several pieces of evidence were submitted more than once.

### 1.2 Revision of “evidence type” characterization

The next step was to refine the classification options for evidence type for each piece of evidence to aid the overall review process based on initial review of the responses received.

Table 5 below shows the revised categorization that was applied to evidence types, based upon the categorization originally provided by the evidence submitters according to the response options provided in the Call for Evidence survey.

The final categorization scheme included the introduction of the categories “Law or regulation”, “Controlled research study”, “Commentary or opinion” and “Literature review”; and removal of the “Empirical data or research study” category. Evidence that was submitted as “empirical data or research study” was recategorized by reviewers into the final categorization scheme, including “Statistical information”.

This categorization was developed after an initial review of the evidence submitted, in order to improve the granularity with which evidence was described and to facilitate the review process. For example, the original evidence types in the SurveyMonkey included the broad categories “Empirical data or research study”, but it was decided that empirical data alone, in the absence of a research study, would have a different default tier than a research study.

The SBTi identified during the review process that each submission of a piece of evidence might contain multiple nested types of evidence. For example, a white paper could contain a table that presents statistical information, which itself is derived from one or multiple controlled research studies. For these cases, each piece of evidence was classified as its overall type. Where one evidence file submitted to the SBTi contains multiple separate publications, they were disaggregated and classified and reviewed separately.

*Table 5. Categorization of evidence type*

| Category | Definition |
|---|---|
| Report or white paper | An informative publication, containing data, observations, and/or policy proposals, that is not published in the academic literature. |
| Case study or example | A publication describing a case or “a number of cases of an intervention and outcome, with no comparison against a control group” (Bilotta et al., 2014). |
| Legal or regulatory analysis | A document that contains recommendations for policy or regulation or an assessment of the actual or expected impacts of a specific policy or regulation. This category includes policy or regulation proposals from the government authority that have not yet, and may not yet, be enacted into law. |

| | |
|---|---|
| Statistical information | "Data that has been recorded, classified, organized, related, or interpreted within a framework so that meaning emerges" (Statistics Canada, 2021). This category excludes statistical information derived from other types of evidence, such as from a survey or poll, or a controlled research study; these are categorized under those types. |
| Survey or poll | Results of a survey or poll that was not conducted as part of a controlled research study. |
| Law or regulation | Legal document that describes a statute, regulation, or ordinance that has been enacted into law. |
| Controlled research study[8] | A document presenting an inquiry undertaken to understand the effects of an intervention. This category may include randomized controlled trials, modeling studies, and observational studies. |
| News coverage[8] | Press releases, news releases, and/or pieces of journalism related to events. This category does not include opinion articles. |
| Commentary[8] | A publication where one or more authors express their subjective viewpoints, which may be informed by data or research. This category includes commentary articles published in peer-reviewed academic literature. |
| Literature review[8] | A critical, comprehensive evaluation of existing research on a specific topic. Reviews and meta-analyses published in peer-reviewed academic literature are included in this category. It may also include non-peer-reviewed publications. |

### 1.3 Categorization of evidence by "general leaning"

As mentioned, respondents that submitted evidence via the SurveyMonkey form were asked to indicate whether the evidence that they submitted was (in their opinion) relevant or not to each of the eight research questions. They could also specify that they were "not sure" whether it was relevant or not. Respondents also stated the position that the evidence supports (in their opinion) across each of the eight research questions.

The following research questions had three survey response options which could generally be classified as "supportive of the EAC", "unsupportive of the EAC", and "not sure":

- Research question one: What evidence exists about the effectiveness or ineffectiveness of environmental attribute certificates in delivering measurable emission reductions? (Response options: Effectiveness; Ineffectiveness; Not sure/Other)
- Research question four: What evidence supports or opposes the ability of environmental attribute certificates to accurately reflect and quantify emissions reductions in the context of corporate climate abatement targets? (Response options: Supports; Opposes; Not sure/Other)

- Research question five: What evidence exists that uptake of attribute certificates leads to or hinders the transformation needed to reach climate stabilization? (Response options: Leads to transformation; Hinders transformation; Not sure/Other)
- Research question eight: Is there evidence that shows that the use of these instruments (i.e. procurement of the attribute certificate) could contribute to scale-up of climate finance compared to alternative interventions? Or could it result in climate finance dilution? (Response options: Scale-up finance; Climate finance dilution; Not sure/Other)

Research question two and three were not relevant for assessing the general leaning of evidence since they relate to the operating conditions under which EACs can be effective; research question six was not relevant because it did not have categorical response options; and research question seven was not relevant on the basis that it relates to cost, not mitigation effectiveness directly.

As such, the survey submission results for research questions one, four, five and eight were used to define the "general leaning" of each unique piece of evidence – i.e., whether it was relevant to the research questions and supportive or unsupportive of the EAC.

If a piece of evidence was submitted by just one respondent then their survey response determined the "general leaning" alone. However, for pieces of evidence that were submitted by multiple respondents, the number of "supportive of the EAC", "unsupportive of the EAC", and "not sure" classifications for that piece of evidence were tallied up from all respondents across research questions one, four, five and eight.

The general leaning of each piece of evidence was then based on the following categorization:

- The evidence was categorized with a general leaning of "Other" where all respondents classified the evidence as irrelevant to all of research questions one, four, five and eight.
- The evidence was categorized with a general leaning of "Supportive" where at least 75% of classifications are, according to submitters, supportive of the EAC.
- The evidence was categorized with a general leaning of "Unsupportive" where at least 75% of classifications are, according to submitters, unsupportive of the EAC.
- The evidence was categorized with a general leaning of "Mixed" where none of the above conditions were met.

### Assessment step 2: Detailed evidence review

This second step of the assessment methodology comprises the following steps:

- Reading of the evidence and related information
- Categorization of evidence type
- Categorization of evidence based on its relevance to the research question
- Categorization of evidence according to the research question findings
- Determination of the risk of bias
- Identification and collation of additional useful information

This phase of the assessment was conducted by a panel of seven reviewers (SBTi staff members or contractors). Members of the review panel attested that they had no conflict of interest that would affect their review of each piece of evidence; specifically, reviewers were precluded from reviewing a piece of evidence if the reviewer or an organization with which they are affiliated was an author or contributor to the publication, or if they or the organization with which they are affiliated submitted that piece of evidence to the Call for Evidence to avoid potential conflict of interest.

The evidence to be reviewed was split among the seven reviewers according to their areas of expertise, and with an effort to ensure that each reviewer reviewed a mix of evidence types and a mix of evidence according to its general leaning (as described in step 1.3 above). This was done to avoid the bias that could be introduced if, for example, all of one evidence type was reviewed by a single individual.

This stage of the methodology that is described below, and was conducted by members of the review panel, was first tested on a subset of evidence and refined based on reviewer feedback. All reviewers reviewed a test piece of evidence and discussed and resolved areas of disagreement in order to mitigate differences between reviewers' application of the methodology.

### 2.1 Reading of evidence and the related submission information

The first step was for each member of the review panel to read the evidence that was assigned to them for review. Where the submitter of the evidence indicated that only a section of the evidence was relevant, the reviewers read just this section. The reviewer also reviewed the supporting information – the survey response(s) and, where relevant, the cover letter(s), that related to that evidence submission.

### 2.2 Categorization of the evidence type

For each piece of evidence, the review panel categorized each piece of evidence according to the evidence types listed in Table 3 above. The categorization of the evidence according to the submitters was used to inform this, but it was ultimately down to the review panel to assign the final evidence type categorization. This information was input into a GoogleForm by the review panel members.

As part of this categorization, the review panel also indicated (in the GoogleForm) whether the evidence was peer-reviewed and published in a journal, or a preprint for a peer-reviewed journal, and/or whether it was published by a government agency.

### 2.3 Categorization of evidence based on its relevance to the research question

For each piece of evidence, the review panel categorized each piece of evidence as "relevant", "partially relevant" and "not relevant" to each research question in the context of carbon credits. The categorization of the evidence according to the submitters was used to inform this, but it was ultimately down to the review panel to assign the final categorization of relevance.

## 2.4 Categorization of evidence according to the research question findings

For each piece of evidence, the review panel considered the conclusions that can be drawn from the evidence in relation to each of the eight research questions (except research question six which was an open text question). For example, for research question one on the effectiveness or ineffectiveness of environmental attribute certificates in delivering measurable emission reductions, the review panel stated whether (in their opinion) the evidence supports their a) effectiveness, b) ineffectiveness, c) not sure/other. The responses provided by the evidence submitters were available to the reviewers as contextual information, but it was ultimately down to the review panel to draw conclusions from the evidence. The review panel members were able to provide information in an open text box to justify their response.

## 2.5 Determination of the risk of bias

Members of the review panel characterized the risk of bias in each piece of evidence – that is, the risk that a bias in the design of the inquiry affected the findings of the evidence. This characterization was only related to the evidence itself and did not consider the risk of bias relating to the submitter(s) of the evidence or risk of a biased body of evidence due to the format of an open call for evidence (although submitters were asked to declare any potential conflicts of interest through the survey). The reviewers selected from the following options to categorize each piece of evidence:

- Low/no apparent risk of bias
- Unclear/potential risk of bias
- Clear/high risk of bias

Examples of unclear or potential bias include:

- It was unclear how the observations being compared in an observational study were selected, and they may have been cherry-picked.
- The study was funded or conducted by an entity that appears to have a conflict of interest regarding the results of the study, and the authors have not included a conflict of interest statement.
- Statistical information compared two figures that were generated from different studies with different methodologies or other material characteristics, where the effect of these differences on the comparison was not apparent.

Examples of clear or high risk of bias include:

- An observational study did not account for obvious confounding variables between two groups or observations, such as observations situated in different regulatory, ecological, or economic contexts.
- An observational study drew conclusions based on a sample size that is insufficient to demonstrate statistical significance.
- A survey or poll had responses from a biased sample of the population, in relation to the topics and conclusions.
- Statistical information compared two figures that were generated from different studies with different methodologies or other material characteristics, where the effect of these differences on the comparison was apparent.
- Credible claims have been made that the study is fraudulent.

The review panel members used their expert judgment when deciding whether there were any additional features of the evidence that would mitigate any potential or clear risk of bias.

### 2.6 Identification and collation of additional useful information

In addition, the review panel also had the option to pull out additional relevant information from the evidence into the GoogleForm so as to aid the synthesis and report writing process, including information on:

- The type or types of emissions reduction credits referenced in the evidence;
- Whether the evidence addressed the supply-side of carbon markets, the demand-side, or both;
- Whether the evidence addressed voluntary markets, compliance markets, or both;
- The generalizability across industries that purchase carbon credits, industries that issue credits, types of credits, geographies, and crediting methodologies and standards;
- Whether the reviewer agreed or disagreed with how the authors of the evidence drew the conclusions based on the data and information they had.

## Assessment step 3: Categorization of evidence into final tiers and relevance levels

The information submitted by the review panel was collated into a spreadsheet and used to categorize each piece of evidence according to its risk of bias and overall relevance to the research questions and carbon credits specifically. This part of the assessment was completed by the SBTi research team (the authors of this report).

This part of the assessment methodology draws from the quality of evidence framework proposed by Bilotta et al. (2014). Bilotta et al. apply best practice from the medical field to environmental decision-making, identifying three main domains that influence the quality of evidence: the risk of bias, the relevance of the evidence to the area of interest, and the chance of random error.

While the approach of Bilotta et al. was designed for meta-analysis of research studies, the SBTi research team extended the approach, broadening it to be applicable to the much broader range of evidence types that were submitted to the Call for Evidence. The third domain, chance of random error, was not considered for this assessment because the vast majority of evidence was not suited for assessing or discerning this information in that they were not controlled studies of the effects of an intervention. Therefore the SBTi condensed from the original three to two main factors that influence the quality of evidence: risk of bias and relevance.

### 3.1 Designation of evidence into tiers

Each piece of evidence was first assigned a default tier based on the evidence type, whether it was published in a peer-reviewed journal, and whether it was published by a governmental entity. These tiers are not intended to strictly represent a hierarchy of quality, but are meant

to aid in general prioritization of evidence that is likely to be least subject to bias and most relevant to this research inquiry. Table 6 below shows the default tiers for each combination.

Individual evidence was then reviewed and the tier could be adjusted if issues were detected in either of the two domains. Each domain could result in one adjustment, and severe or multiple issues could result in two adjustments due to any domain. Where the type of evidence was not listed in the table, the default tier was manually assigned and validated by another reviewer. Furthermore, certain publications from international organizations (e.g. IPCC reports) are reviewed by experts according to well documented review protocols. These documents, although not published in peer-reviewed journals, were initially classified into Tier A.

Note that generalizability is not a factor in determining placement into the tiers but is relevant for examining the entire body of evidence and how generalizable it is overall to the EACs of interest.

*Table 6. Default evidence tiers*

| Evidence type | Definition | Peer-reviewed journal | Published by a gov. organization | Default tier | Notes |
|---|---|---|---|---|---|
| Case study or example | A publication describing a case or "a number of cases of an intervention and outcome, with no comparison against a control group" (Bilotta et al. (2014)). | Yes | Any | B | |
| | | No | | C | |
| Commentary | A publication where one or more authors express their subjective viewpoints, which may be informed by data or research. This category includes commentary articles published in peer-reviewed academic literature. | Any | Any | C | |
| Controlled research study | A document presenting an inquiry undertaken to understand the effects of an intervention. This category may include randomized controlled trials, modeling studies, and observational studies. | Yes | Any | A | |
| | | No | | B | |
| Law or regulation | Legal document that describes a statute, regulation, or ordinance that has been enacted into law. | Yes | Any | N/A | |
| | | No | | A | |
| Legal or regulatory analysis | A document that contains recommendations for policy or regulation or an assessment of the actual or expected impacts of | Yes | Any | A | |
| | | No | Yes | B | |

| | | | | | |
|---|---|---|---|---|---|
| | a specific policy or regulation. This category includes policy or regulation proposals from the government authority that have not yet, and may not yet, be enacted into law. | | No | C | |
| Literature review | A critical, comprehensive evaluation of existing research on a specific topic. Reviews and meta-analyses published in peer-reviewed academic literature are included in this category. It may also include non-peer-reviewed publications. | Yes | Any | A | |
| | | No | | C | |
| News coverage | Press releases, news releases, and/or pieces of journalism related to events. This category does not include opinion articles. | Yes | Any | N/A | |
| | | No | | C | |
| Report or white paper | An informative publication, containing data, observations, and/or policy proposals, that is not published in the academic literature. | Yes | Any | N/A | |
| | | No | Yes | B | |
| | | | No | C | |
| Statistical information | “Data that has been recorded, classified, organized, related, or interpreted within a framework so that meaning emerges” (Statistics Canada, 2021). This category excludes statistical information derived from other types of evidence, such as from a survey or poll, or a controlled research study; these shall be categorized under those types. | Yes | Any | N/A | Would be categorized in another evidence type |
| | | No | Any | C | |
| Survey or poll | Results of a survey or poll that was not conducted as part of a controlled research study. | Yes | Any | N/A | Would be categorized in another evidence type |
| | | No | | B | |

## 3.2 Designation of evidence according to overall relevance

In assessment step 2.3, the review panel categorized each piece of evidence as “relevant”, “partially relevant” and “not relevant” to each research question in the context of carbon credits.

The next step was then to determine the overall relevance of each piece of evidence across all eight research questions. Each piece of evidence was initially assumed to be “relevant”. Evidence could then be downgraded to an overall relevance rating of “partially relevant” or “not relevant” if it was considered “partially relevant” or “not relevant” by the review panel for all eight of the research questions (in the context of carbon credits). One downgrade level, i.e. from relevant to partially relevant, could be imposed for reasons such as: the evidence discusses issues with removal credits that may be applicable to avoided emissions credits or emissions reduction credits; the evidence discusses the use of emissions reduction credits for the purposes of compliance with regulations where the conclusions may be applicable to voluntary use by companies.

Two downgrade levels, i.e. from “relevant” to “not relevant”, could be imposed for reasons such as: the evidence is not related to emissions or climate, or the evidence is not relevant to any of the research questions.

## Assessment step 4: Evidence synthesis and report writing

### 4.1 Final screening of review panel assessments

The report authors performed a final screening of review panel assessments for consistency and performed spot checks on categorizations of evidence into tiers. The report authors also identified evidence that was entirely irrelevant to our research inquiry and excluded these from the body of evidence discussed in this research report. This included evidence that addressed specific mitigation activities that can be financed using carbon credits without addressing credits themselves. An example of this was Griscom et al. (2017) which focuses on the mitigation potential of natural climate solutions but does not specifically discuss carbon credits. Unless carbon credits are discussed, these pieces of evidence were not used for the writing of this report; this is because this report focuses on the effectiveness of carbon credits and not of the underlying intervention. Please see Annex D for a list of evidence that was considered not relevant.

### 4.2 Report writing

The report authors reviewed the information collated by the review panel and read the relevant and partially relevant papers to identify the key themes across the full body of relevant evidence. In writing this report, the research questions were grouped into three themes:

- Theme 1 (Mitigation Outcomes and Conditions for Effectiveness): Research questions one to four.
- Theme 2 (Corporate Use Cases for Carbon Credits and Implications for Net-Zero Aligned Transformation and Climate Finance): Research questions five, seven and eight.
- Theme 3 (Claims): Research question 6

Several pieces of evidence were relevant to more than one research question and more than one theme, and are therefore mentioned more than once in this paper.

Within each theme, the evidence is discussed according to its tier. The information collated by the review panel was used to aid the writing of the report, including for example the information on the risk of bias and the extent to which the evidence supports conclusions that can be generalized across industries that purchase carbon credits, industries that issue credits, types of credits, geographies, and crediting methodologies and standards.

### Assessment step 5: Quality review

As a final step in the review process, the quality team ensured the integrity and credibility of the report. The process involved aligning the strategic objectives with the actual outputs to ensure that efforts led to meaningful outcomes. Conflict of interest checks were conducted for authors, the review panel, and the review team to mitigate potential biases. Scientific references and citations within the report underwent thorough verification for accuracy and reliability.

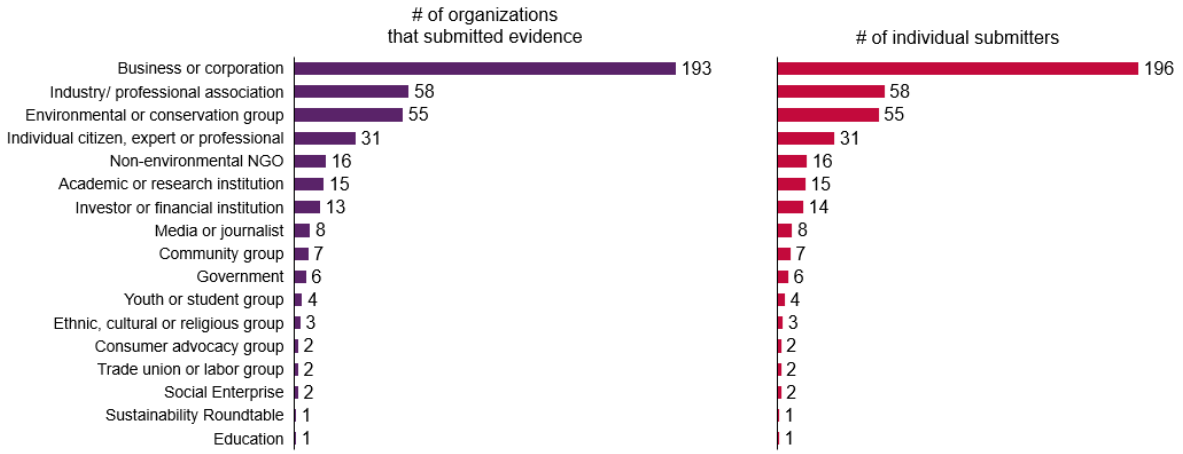
Methodologies used in the study were reviewed through evidence sampling to ensure transparency and deliver a balanced and fair presentation of information. Furthermore, appropriate documentation practices, data handling procedures, and data privacy measures were reinforced to adhere to ethical research and confidentiality principles.

# ANNEX C: RESPONDENT STAKEHOLDER ANALYSIS

The survey respondents provided information about their organizational affiliation and the type of organization with which they are affiliated. Using this information, the SBTi research team performed quantitative stakeholder analysis to determine who responded to the Call for Evidence, to help understand how representative the body of evidence may be.

421 individuals submitted evidence to the SBTi via the SurveyMonkey as shown in the figure below. According to the survey results, 196 individuals from businesses submitted evidence, 58 individuals from industry or professional associations, 55 from environmental or conservation groups, 31 individual citizens, experts or professionals, 16 individuals from non-environmental NGOs, 15 individuals from academic or research institutions, 14 individuals from financial institutions, eight individuals from media organizations, seven individuals from community groups, six individuals from governments, four individuals from youth or student groups, three individuals from ethnic, cultural or religious groups, two individuals from consumer advocacy groups, two individuals from trade union or labor groups, two individuals from social enterprises, one individual from a sustainability roundtable and one individual from an educational organization.

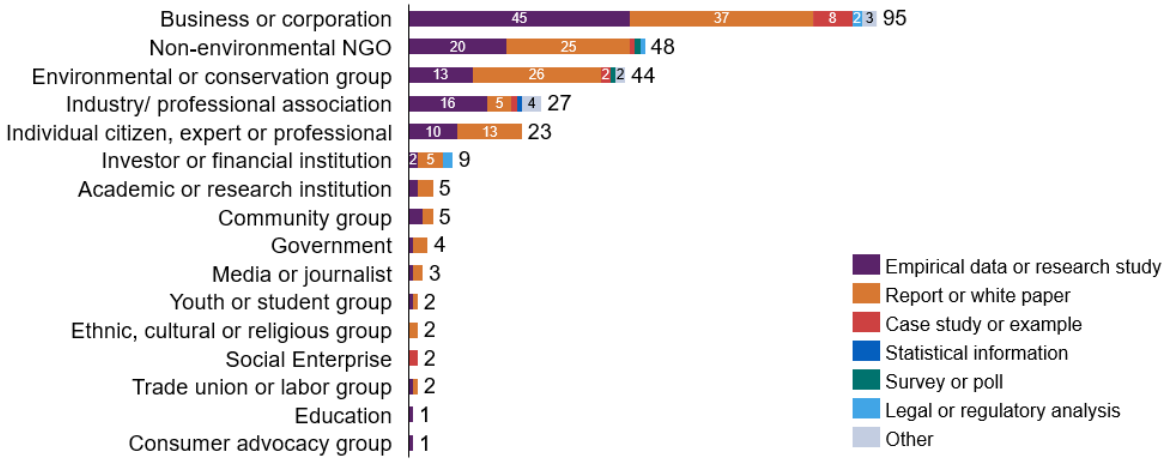
*Figure 2: Survey respondent stakeholder categorization (self-reported)*




However, it was noted that one organization developed an Application Programming Interface (API) to collect responses from their stakeholders; it seems that the "organization type" information relating to the API submission could be inaccurate as certain data inputs were characteristically uniform data and appeared to be bot-generated responses. It is therefore unclear whether the categorization above is correct.

The figure below shows the different types of evidence submitted that was tagged as potentially relevant to emissions reduction credits by submitters, according to the different stakeholder categories of survey respondents. Since some pieces of evidence were submitted multiple times by different respondents, the total count does not match the number of unique pieces of evidence.

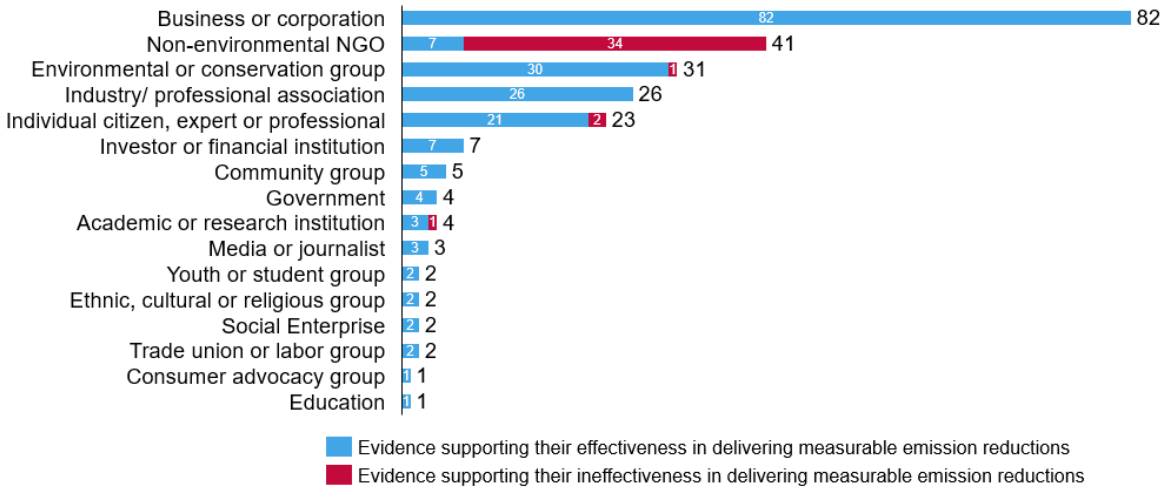
*Figure 3: Different types of evidence submitted that was tagged by SurveyMonkey respondents as potentially relevant to emissions reduction credits, according to the different stakeholder categories of survey respondents*




Looking just at the responses to research question one ("what evidence exists about the effectiveness or ineffectiveness of environmental attribute certificates in delivering measurable emission reductions?"), the figure below shows the breakdown of responses across the stakeholder types. As mentioned above, since the same evidence was submitted by multiple individuals, the total count is greater than the unique pieces of evidence. This figure is noteworthy as it shows that respondents from businesses or corporations all stated that the evidence supports the effectiveness of emission reduction credits in delivering measurable mitigation outcomes, whereas non-environmental NGOs tended towards arguing that the evidence supports their ineffectiveness in this regard.

However, the SBTi research team suspects that as many as 140 evidence submissions relating to emission reduction credits and relevant to this research question may have been submitted through the API link mentioned above and, of these, according to the submitters, 100% support their effectiveness in delivering measurable mitigation outcomes. According to submitters, 100% of these suspected API submissions also support that emission reduction credits lead to the scale-up of climate finance and that they lead to the transformation needed to reach climate stabilization. Given the homogeneity of the responses, it may therefore be that the API submissions automatically provided this response and that this represents a significant inaccuracy in the survey responses.

*Figure 4: Count of evidence submissions relevant to research question one and to emission reduction credits that, according to submitters, supports either their effectiveness or ineffectiveness in delivering measurable mitigation outcomes*



# ANNEX D: CARBON CREDIT EVIDENCE LIST

There were 111 unique pieces of evidence that were submitted to the SBTi under the Call for Evidence that submitters tagged as being relevant to emissions reduction credits.

Following the methodology described in detail in Annex B, the SBTi identified 71 pieces of evidence submitted to the SBTi were either relevant or partially relevant to both the research questions posed and to carbon credits that represent emissions reductions or emissions avoidance. This includes one evidence submission was not tagged by submitters as being relevant to emissions reduction credits but which references inset credits and is therefore included in the discussion (Adjin, 2023). These 71 pieces of evidence are listed in Table 7 below.

The remaining 41 pieces of evidence were considered "not relevant" to carbon credits (emissions reductions and emissions avoidance) and/or "not relevant" to any of the eight research questions. The rationale for considering these evidence submissions as "not relevant" is summarized in the right hand column of the table. Please note that these evidence submissions may be relevant to the other types of EACs and therefore may be discussed in future SBTi research reports. These 741 pieces of evidence are listed in Table 8 below.

These evidence submissions can be accessed on the SBTi website here.

*Table 7. List of evidence that was considered "relevant or partially relevant"*

| Author | Date | Title | Relevant/partially relevant to theme: | | |
|---|---|---|---|---|---|
| | | | 1 | 2 | 3 |
| Abatable and the International Platform for Insetting | 2023 | Addressing Scope 3 – how insetting can be scaled to tackle supply chain emissions | | Yes | Yes |
| Acampora et al. | 2023 | Towards carbon neutrality in the agri-food sector: Drivers and barriers | | | Yes |
| Ajdin | 2023 | Norden looks to drive down emissions using carbon insetting | | Yes | |
| Anew Climate LLC | 2023 | Case Study: The Impact of Voluntary Carbon Credits on Landfill Methane Destruction | Yes | | |
| Anew Climate LLC | 2023 | Case Study of Private Forest Lands Managed for Climate Mitigation: Bluesource Sustainable Forests Company | Yes | | |
| Badgley et al. | 2022 | California's forest carbon offsets buffer pool is severely undercapitalized | Yes | Yes | Yes |

| | | | | | |
|---|---|---|---|---|---|
| Badgley et al. | 2022 | Systematic over-crediting in California's forest carbon offsets program | Yes | | |
| Ballentine | 2023 | The unusual suspects: Are well-meaning environmental stakeholders and institutions undercutting the contributions that companies can make to fighting climate change? | | Yes | |
| Barreto et al. | 2018 | A study of carbon offsets and RECs to meet Boston's mandate for carbon neutrality by 2050 | | Yes | |
| Berk and Lungungu | 2020 | REDD-MINUS: The Rhetoric and Reality of the Mai Ndombe REDD+ Programme | Yes | | |
| Berkeley Carbon Trading Project | n.d. | Repository of Articles on Offset Quality | Yes | | |
| Elgin | 2020 | The Real Trees Delivering Fake Corporate Climate Progress | Yes | | |
| Broekhoff | 2022 | Expert Report on KLM's Climate Claims | | Yes | Yes |
| Calyx Global | 2023 | Science vs. Everland: Who is correct on REDD? | Yes | | |
| Cames et al. | 2016 | How additional is the Clean Development Mechanism – Analysis of the application of current tools and proposed alternatives | Yes | | |
| Carbon Market Watch | n.d. | Carbon Credit Tracker | Yes | | |
| Carbon Market Watch | 2021 | Net-zero pipe dreams: Why fossil fuels cannot be carbon neutral | | Yes | Yes |
| Carbon Market Watch | 2023 | Secretive Intermediaries: Are carbon markets really financing climate action | | Yes | |
| Carbon Market Watch | 2022 | Flights of Fancy: Preventing European airlines from making far-fetched climate claims | | Yes | Yes |
| Carbon Market Watch | 2023 | Assessing the carbon neutrality claims of products in Belgian supermarkets | | Yes | Yes |
| Carbon Market Watch | 2022 | Poor tackling: Yellow card for 2022 FIFA World Cup's carbon neutrality claim | | | Yes |
| Climate Impact Partners | n.d. | Project Spotlight – Orb Rooftop Solar, India | Yes | | |
| Coffield et al. | 2022 | Using remote sensing to quantify the additional climate benefits of California forest offset projects | Yes | | |

| | | | | | |
|---|---|---|---|---|---|
| Cullenward | 2023 | A framework for assessing the climate value of temporary carbon storage | | | Yes |
| Cullenward et al, | 2023 | Carbon offsets are incompatible with the Paris Agreement | | Yes | Yes |
| de Haldevang | 2021 | How Mexico's Vast Tree-Planting Program Ended Up Encouraging Deforestation | Yes | | |
| Edmonds et al. | 2021 | How Much Could Article 6 Enhance Nationally Determined Contribution Ambition towards Paris Agreement goals through economic efficiency | Yes | Yes | |
| Elgin | 2022 | This Timber Company Sold Millions of Dollars of Useless Carbon Offsets | Yes | | |
| European Commission | 2023 | Annex 1 to the Commission Delegated Regulation – supplementing Directive 2013/34/EU of the European Parliament and of the Council as regards sustainability reporting standards | | | Yes |
| Everland | 2023 | New analysis reveals just how effective REDD+ is | Yes | | |
| Fearnehough et al. (NewClimate Institute) | 2020 | Future role for voluntary carbon markets in the Paris era | | Yes | Yes |
| Forest Trends' Ecosystem Marketplace | 2023 | All in on Climate: The Role of Carbon Credits in Corporate Climate Strategies | | Yes | |
| Forest Trends' Ecosystem Marketplace | 2022 | The Art of Integrity: State of the Voluntary Carbon Markets 2022 Q3 | | Yes | |
| FSC Indigenous Foundation, IPACC, Peoples Forest Partnership, Alianza Mesoamericana de Pueblas e Bosques | 2023 | Open Letter: Global South Voices in Support of REDD+ | Yes | | |
| GHG Protocol | 2022 | Land Sector and Removals Guidance, Draft for Pilot Testing and Review, Part 2 | | | Yes |
| Gill-Wiehl et al | 2023 | Cooking the books: Pervasive over-crediting from cookstoves offset methodologies | Yes | | |
| GoodShipping and Routescanner | n.d. | Route $CO_2$ Zero: A step-by-step guide to decarbonise your scope 3 emissions | | Yes | |
| Haya et al. | 2023 | Quality Assessment of REDD+ Carbon Credit Projects | Yes | Yes | Yes |

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|---|---|---|---|---|---|
| Healy et al. | 2023 | Assessing the transparency and integrity of benefit sharing arrangements related to voluntary carbon market projects | | Yes | |
| Hurteau et al. | 2008 | Carbon protection and fire risk reduction: Toward a full accounting of forest carbon offsets | Yes | | |
| International Civil Aviation Organization | 2019 | CORSIA Emissions Unit Eligibility Criteria | Yes | | |
| International Dairy Foods Association | 2023 | Idaho Milk Case Study | Yes | | |
| Lakhani | 2023 | Revealed: Top carbon offset projects may not cut planet-heating emissions | Yes | | |
| Landholm et al. | 2022 | Unlocking Nature Based Solutions through Carbon Markets: Global Analysis of Supply Potential | Yes | | |
| Miltenberger et al. | 2021 | The Good Is Never Perfect: Why the Current Flaws of Voluntary Carbon Markets Are Services, Not Barriers to Successful Climate Change Action | Yes | | |
| Nabuurs et al. | 2022 | Agriculture, Forestry and Other Land Uses (AFOLU). Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change | Yes | Yes | Yes |
| NewClimate Institute and Carbon Market Watch | 2023 | Corporate Climate Responsibility Monitor 2023 | | Yes | Yes |
| Oeko-Institut, The World Wildlife Fund-US, Environmental Defense Fund | 2022 | Methodology for assessing the quality of carbon credits Version 3.0 | Yes | | |
| Oneshot.earth | 2023 | A Case for Pragmatism: Our Theory of Change | Yes | | |
| Pauly et al. | 2023 | REDD+ project baselines accurately correspond with observed forest loss globally | Yes | | |
| Perspectives Climate Group | 2023 | Assessing the robustness of carbon market grievance mechanisms | Yes | | |
| Probst et al. | 2023 | Systematic review of the actual emissions reductions of carbon offset projects across all major sectors | Yes | | |

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|---|---|---|---|---|---|
| Rainforest Foundation UK | 2023 | New analysis finds leading global carbon offset schemes are failing forests, people and the climate | Yes | | |
| Roopsind et al. | 2019 | Evidence that a national REDD+ program reduces tree cover loss and carbon emissions in a high forest cover low deforestation country | Yes | | |
| Seymour | 2021 | California's LCFS is successfully proliferating. Is it also successfully decarbonizing transport? | Yes | | |
| Sky Harvest Resources LLC | 2022 | Carbon 2.0: A Better Yardstick for Carbon Markets | Yes | | |
| Sylvera | 2023 | Carbon Credits: Permission to Pollute, or Pivotal for Progress | | Yes | |
| The Carbon Credit Quality Initiative | 2023 | Resources – Factsheets | Yes | | |
| The New Yorker | 2023 | The Great Cash-for-Carbon Hustle | Yes | | |
| Tropical Forest Alliance and Proforest | 2023 | Accelerating Progress for Nature, Climate and People at Scale: Companies' Roles and Action | Yes | Yes | |
| Tropical Forest Credit Integrity Guide | 2023 | Tropical Forest Credit Integrity Guide for Companies Version 2 | | Yes | |
| Trouwloon et al. | 2023 | Understanding the Use of Carbon Credits by Companies: A Review of the Defining Elements of Corporate Climate Claims | | Yes | Yes |
| Trove Research | 2023 | Corporate emission performance and the use of carbon credits | | Yes | |
| Turner et al. (Trove Research) | 2023 | 1Q23 voluntary carbon market in review the state of integrity | Yes | Yes | |
| UN High-Level Expert Group on the Net-Zero Emissions Commitments of Non-State Entities | 2022 | Integrity Matters: Net Zero Commitments by Businesses, Financial Institutions, Cities and Regions | | Yes | Yes |
| Verra | 2023 | Survey on the use of Environmental Attribute Certificates in Corporate Climate Targets – Results | | Yes | Yes |
| Voluntary Carbon Markets Integrity Initiative | 2023 | Scope 3 Flexibility Claim, Beta version | | Yes | |

| | | | | | |
|---|---|---|---|---|---|
| Voluntary Carbon Markets Integrity Initiative and MSCI Carbon Markets | 2023 | Using carbon credits to meet corporate climate targets | | Yes | |
| West et al. | 2020 | Overstated carbon emission reductions from voluntary REDD+ projects in the Brazilian Amazon | Yes | | |
| West et al. | 2023 | Action needed to make carbon offsets from forest conservation | Yes | | |
| World Business Council for Sustainable Development | 2023 | Report on WBCSD Member Survey and Focus Groups In Response to SBTi's Call for Evidence | | Yes | |

*Table 8. List of evidence that was considered "not relevant"*

| Author | Date | Title | Rationale for exclusion |
|---|---|---|---|
| AB Texel Group | 2023 | SBTi Call for Evidence Submission | Does not discuss carbon credits |
| Anew Climate LLC | 2023 | Case Study: The Impact of Voluntary Carbon Credits on Landfill Methane Destruction (Data File) | Data file |
| Backstrom et al. | 2023 | Corporate Power Purchase Agreements and Renewable Energy Growth | Does not discuss carbon credits |
| Ballentine et al. | 2022 | Modernizing How Electricity Buyers Account and are Recognized for Decarbonization Impact and Climate Leadership | Does not discuss carbon credits |
| Brander and Bjørn | 2023 | Principles for accurate GHG inventories and options for market-based accounting | Does not discuss carbon credits |
| Climate Impact Partners | 2023 | Commitment Issues. Markers of Real Climate Action in the Fortune Global 500 | Not relevant to research questions |
| Center for Resource Solutions | 2022 | 2022 Green-e Verification Report | Not relevant to research questions |
| Davydenko, et al. | 2022 | Mass-Balance Method for Provision of Net Zero Emission Transport Services | Does not discuss carbon credits |
| Ehrler et al. | 2023 | Global Logistics Emissions Council Framework for Logistics Emissions Accounting and Reporting V3.0 | Mentions carbon credits once in the context of CORSIA |

| | | | |
|---|---|---|---|
| Environmental Markets Association | 2023 | SBTi Call for Evidence Submission | Primary focus on energy certificates and not carbon credits specifically |
| General Mills and SustainCERT | 2022 | Hitting the right target: A proposal for monitoring accurate supply shed impacts | Does not discuss carbon credits |
| German Federal Ministry of Justice and the Federal Office of Justice | 2023 | German Renewable Energy Act EEG 2023 | Not relevant to research questions |
| Getting to Zero Coalition | n.d. | Global Maritime Forum | Does not discuss carbon credits |
| GoodShipping | 2022 | Impact Summary report 2021 - 2022 | Does not discuss carbon credits |
| GoodShipping | n.d. | Client Certification | Not relevant to research questions |
| Griscom et al. | 2017 | Natural climate solutions | Does not discuss carbon credits |
| Hale et al. | 2013 | The sorption and desorption of phosphate-P, ammonium-N and nitrate-N in cacao shell and corn cob biochars | Does not discuss carbon credits |
| He et al. | 2023 | Paths to Carbon Neutrality: A Comparison of Strategies for Tackling Corporate Scope II Carbon Emissions | Does not discuss carbon credits |
| IPCC | 2006 | Guidelines for National Greenhouse Gas Inventories, Chapter 2: Approaches to data collection | Does not discuss carbon credits |
| Leavitt et al. | 2021 | Natural Climate Solutions Handbook: A Technical Guide for Assessing Nature-Based Mitigation Opportunities in Countries | Not relevant to research questions |
| Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping | 2023 | Maritime Book and Claim. Design decisions and justification | Does not discuss carbon credits |
| Majer et al. | 2021 | REGATRACE Assessment of integrated concepts and identification of key factors and drivers | Not relevant to research questions (focus on book and claim) |
| Mo et al. | 2023 | Integrated global assessment of the natural forest carbon potential | Does not discuss carbon credits |
| Mol and Oosterveer | 2015 | Certification of Markets, Markets of Certificates: Tracing Sustainability in Global Agro-Food Value Chains | Not relevant to research questions (focus on book and claim) |

| | | | |
|---|---|---|---|
| National Grid | 2023 | SBTi Call for Evidence Submission | Does not discuss carbon credits |
| Nordenstam et al. | 2018 | Corporate greenhouse gas inventories, guarantees of origin and combined heat and power production – Analysis of impacts on total carbon dioxide emissions | Does not discuss carbon credits |
| Rathnayake et al. | 2023 | Biochar from animal manure: A critical assessment on technical feasibility, economic viability, and ecological impact | Does not discuss carbon credits |
| REGATRACE | 2019 | Guidelines for establishing national biomethane registries | Not relevant to research questions (focus on book and claim) |
| Roundtable on Sustainable Biomaterials | 2023 | RSB Book and Claim Manual Version 3.0 | Not relevant to research questions (focus on book and claim) |
| Schmidt et al. | 2021 | Biochar in agriculture – A systematic review of 26 global meta-analyses | Does not discuss carbon credits |
| Scope 3 Climate Capital CIC | n.d. | Worked Example: Forward Looking Sector Transition Acceleration Contracts with Collaborative Finance | Does not discuss carbon credits |
| Scope 3 Climate Capital CIC | 2023 | Sector Transition Acceleration Contracts (STAC) Term Sheet V1.0 | Does not discuss carbon credits |
| Sol Systems | 2023 | Reimagining REC Markets: Integrating Additionality and Emissionality into a New Carbon-Free Paradigm | Primary focus on RECs and not carbon credits |
| Stockholm Environment Institute | 2018 | How limiting oil production could help California meet its climate goals | Does not discuss carbon credits |
| Trove Research | 2023 | Investment trends and outcomes in the global carbon credit market | Not relevant to the research questions (discusses uptake and size of the VCM) |
| U.K. Chamber of Shipping | 2023 | SBTi Call for Evidence Submission | Not relevant to research questions (focus on book and claim) |
| United States Environmental Protection Agency | 2021 | LFG Energy Project Development Handbook | Does not discuss carbon credits |
| WattCarbon | 2023 | Sample of EAC records in WattCarbon marketplace | Does not discuss carbon credits |
| WattCarbon | 2023 | The value of Environmental Attribute Certificates in accelerating decarbonization in market based procurement | Does not discuss carbon credits |

| | | | |
|---|---|---|---|
| WattCarbon | n.d. | Measurable Electrification Carbon Reductions | Does not discuss carbon credits |
| WattCarbon | n.d. | How EACs will promote scale up of low-carbon technologies | Does not discuss carbon credits |