SCIENCE BASED TARGETS

DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

Evidence Synthesis Report Part 2: Environmental Attribute Certificates – Commodities

A synthesis of the relevant evidence on environmental attribute certificates 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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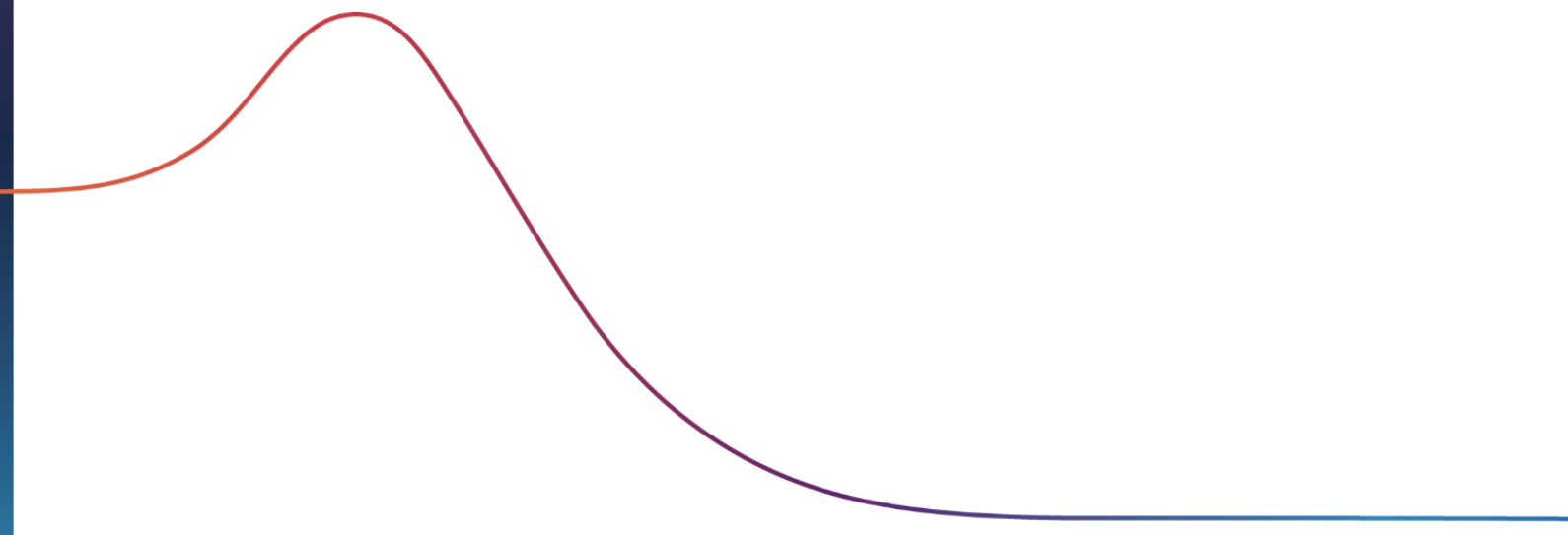
March 2025



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ABOUT 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.

We develop standards, tools and guidance which allow companies to set greenhouse gas (GHG) emissions reductions targets in line with what is needed to keep global heating below catastrophic levels and reach net-zero by 2050 at latest.

The SBTi is incorporated as a UK charity, with a subsidiary SBTi Services Limited, which hosts our target validation services. Partner organizations who facilitated SBTi's growth and development are CDP, the United Nations Global Compact, the We Mean Business Coalition, the World Resources Institute (WRI), and the World Wide Fund for Nature (WWF).

CONTENTS

ACRONYMS AND ABBREVIATIONS

Acronym	Description
ASI	Aluminium Stewardship Initiative
CCS	Carbon capture and storage
CCUS	Carbon capture, utilization and storage
CoC	Chain-of-custody
CSC	Concrete Sustainability Council
EAC	Environmental attribute certificate
EPD	Environmental product declaration
GHG	Greenhouse gas
GSCC	Global Steel Climate Council
ISCC	International Sustainability and Carbon Certification
ISO	International Organization for Standardization
LCA	Life cycle assessment
LUC	Land use change
PCR	Product category rules
RMI	Rocky Mountain Institute
RSPO	Roundtable for Sustainable Palm Oil
SBTi	Science Based Targets initiative

1. About this document

This document is a chapter of Evidence Synthesis Report Part 2: Energy Carriers and Commodities Certificates which has been published in a separate document for ease of use. A description of the call for evidence, review methodology, and main findings may be found in the main paper.

2. Evidence quantification

Quantification overall

In total, 418 pieces of evidence were considered in the evidence review of EACs for fuels, electricity, and commodities. This total includes unique evidence submitted as part of a list or pack of evidence, referred to as “nested” evidence; these pieces of nested evidence were reviewed individually. Note that many pieces of evidence were submitted by multiple respondents or submitted as both standalone evidence and a piece of nested evidence; these pieces of evidence have not been counted twice towards the total.

Of the evidence considered in this review, 220 pieces of evidence were labelled by the submitter as relevant to electricity, 190 relevant to fuels, and 44 relevant to commodities. Since some evidence was labelled as relevant to more than one type of EAC, the summed numbers in this paragraph do not equal the total number submitted. Following the evidence review, 181 pieces of evidence were determined to be relevant or partially relevant to the topic of electricity EACs, 150 relevant to fuels, and 28 relevant to commodities. Some evidence was reviewed and determined to be relevant to topics other or additional to what it was originally labelled, and some was determined to not be relevant to EACs or the research questions considered in this review.

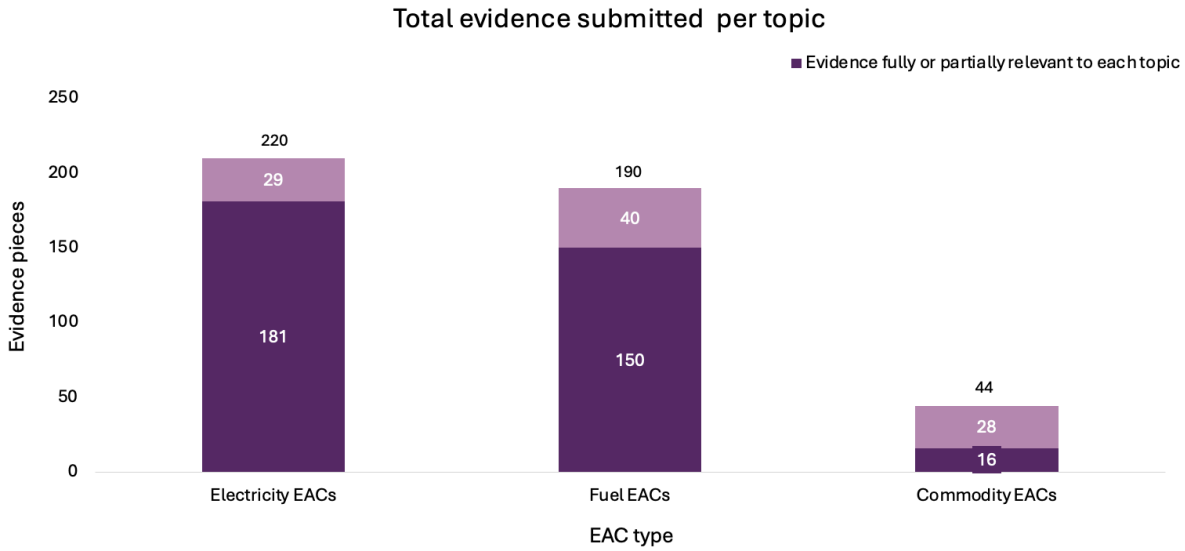

Figure 1: Overall data on evidence submitted to the call for evidence

Quantification per topic

Of the 28 pieces of evidence assessed for commodities and deemed relevant to the research questions, the most common type of evidence was a report or white paper (11 out of 28) followed by commentaries (5/28). No news coverage or legal/regulatory analysis was submitted for commodities.

The majority of the evidence assessed for commodities was categorized under Tier C; no evidence was categorized as Tier A. Several pieces of evidence were initially categorized as Tier A or B but were downgraded based on their limited relevance to the research questions.

Of the 28 pieces of evidence, the majority presented information relevant to Q4 (16/26). Only one piece of evidence was relevant to Q2, and no evidence was relevant to Q7.

A full table of the 28 pieces of evidence and their relevance to each research question is included in Annex A. A separate table of the five pieces of evidence assessed under commodities and deemed not relevant to the research questions is also included in Table 2, along with rationale for their exclusion in this report.

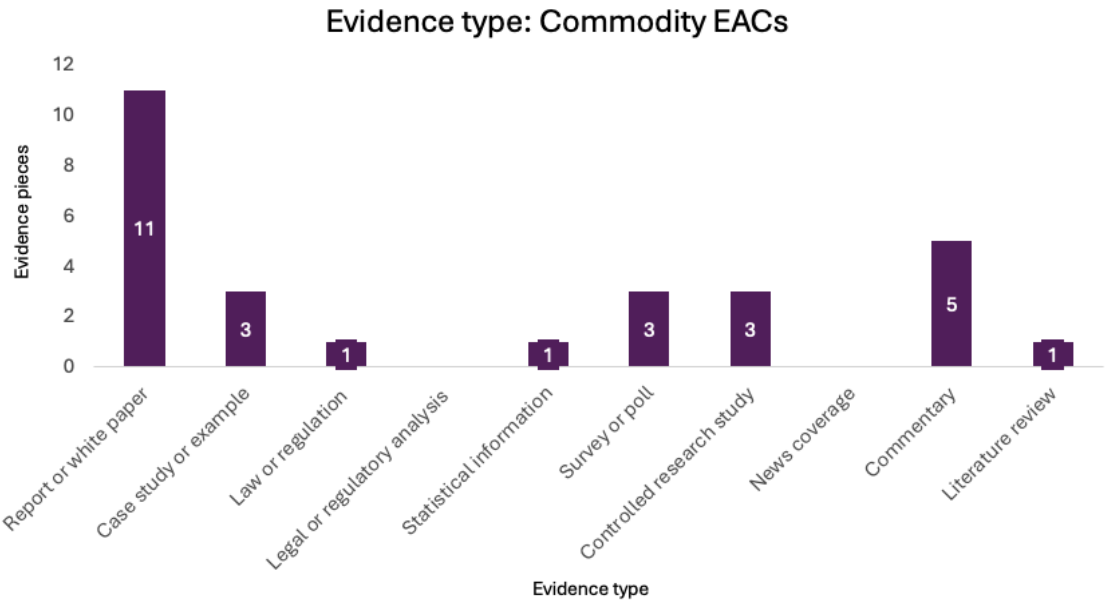

Figure 2: number of pieces of evidence per evidence type (commodities)

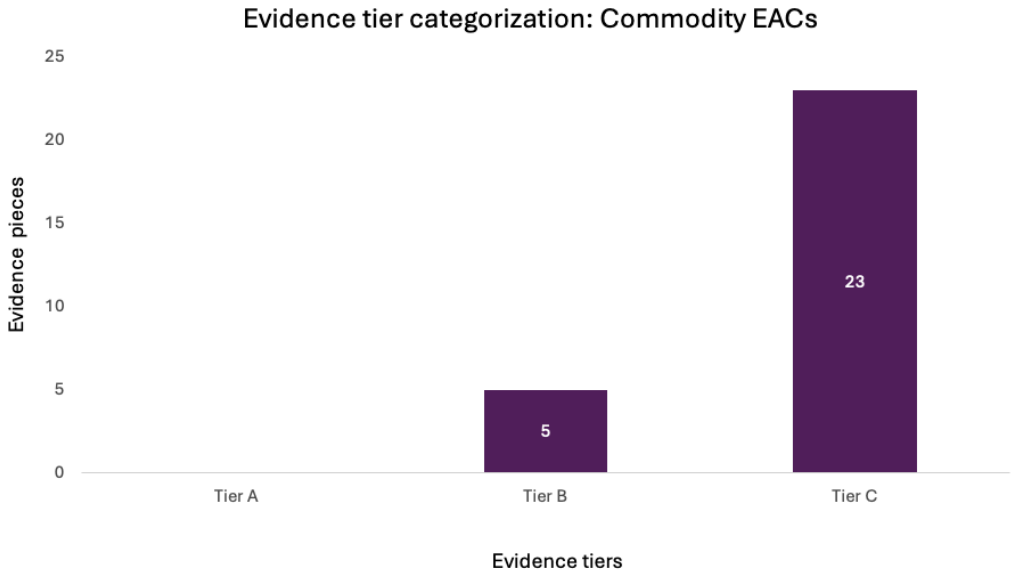

Figure 3: Number of pieces of evidence per tier (commodities)

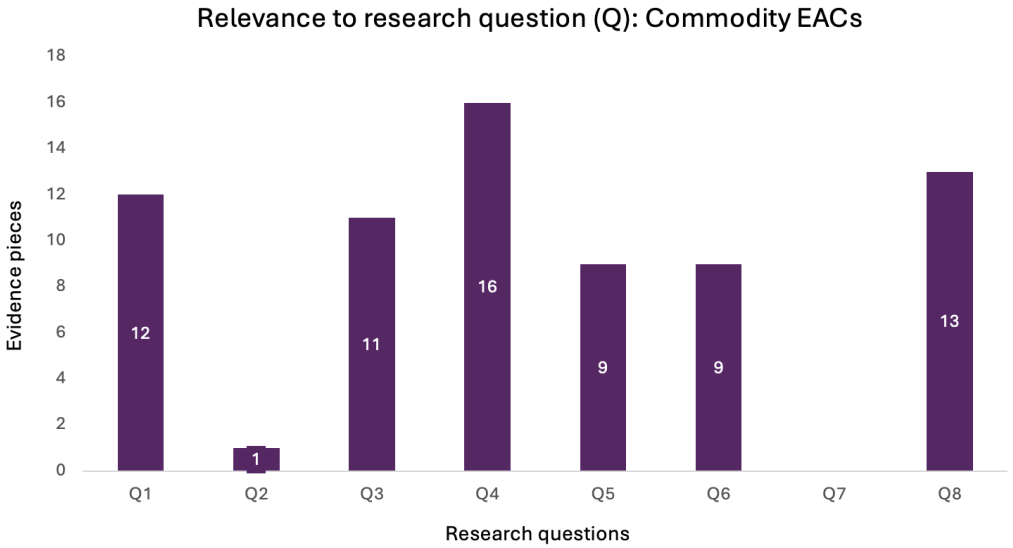

Figure 4: Number of evidence relevant to each research question (commodities)

3. Key themes for EACs for commodities

This section summarizes the key themes that emerged from the evidence. Note that this report does not exhaustively cover every point made by every piece of evidence; instead, selected relevant pieces of evidence have been quoted to highlight key points or to summarize topics addressed across multiple submissions. Moreover, italicized text in this report does not represent direct extracts from the evidence submissions but serves to aid understanding and interpretation of the findings.

The key topics from the evidence review are discussed here under five themes:

- **Theme 1** discusses how there are a wide variety of commodities and how this creates complexity when evaluating the role of EACs.
- **Theme 2** outlines the various chain-of-custody models used for various commodity EACs and the associated benefits and risks.
- **Theme 3** highlights the different approaches to GHG accounting to quantify the delivery of low-carbon commodities and the issues this causes for comparability.
- **Theme 4** outlines how there is a proliferation of different types of certificates, environmental labels, and claims for commodities.
- **Theme 5** discusses the potential for EACs for commodities to help drive system-wide change to a net-zero energy system.

4. Evidence Review

4.1 Introduction

It is important to clarify the market for EACs conveying a low GHG emission intensity for a commodity at an emerging stage. This is particularly true for non-agricultural commodities such as steel and cement. For agricultural commodities, while there is a longer history of sustainability certifications, the associated EACs do not typically convey the GHG intensity of the product.

The number of submitted pieces of evidence relevant to commodities is significantly lower than that for electricity or fuels. This may be partly explained by the lower maturity of the sector. The emerging nature of commodity EACs means that there is limited available data on their climate impact. Moreover, the evidence is generally graded as less reliable than for other sectors. 84% of the evidence was categorized as Tier C, 16% as Tier B, and none as Tier A. There has been a low level of engagement for multiple commodities; only one piece of evidence was submitted on the topics of aluminum and cement commodities each, and no pieces of evidence were submitted for other commodities such as fertilizers or plastics.

The market for commodity EACs is rapidly evolving. Evidence submitted under the SBTi's Call for Evidence (September 2023) may not be fully representative of the current body of evidence and recent developments in the area at the time of writing (December 2024). These developments include new certification schemes, standards or new GHG accounting practices to generate EACs – often being developed by one company alone rather than as part of a broader scheme. In this sector, there is a high risk of proliferation of approaches, as explained in the following sections.

Extended detail on emerging nature of commodity EACs

As highlighted by Mol and Oosterveer, sustainability certifications have been used for agricultural commodities as far back as 1972 (262, Mol and Oosterveer, 2015) *[Tier B]*. Currently, there are certifications covering a significant range of products, such as palm oil, cotton, sugar, timber, and fish. However, the certifications tend to focus on multiple aspects of sustainability, and to not focus solely (if at all) on the GHG emission intensity of the commodity—see theme 3 for more details.

The broad sustainability focus of existing sustainability certifications has likely contributed to there being limited submitted quantitative evidence of the GHG emissions impact of agricultural commodity EACs; only two submissions presented evidence comparing the emissions intensity of commodities with sustainability certifications versus those without.

- Schmidt and De Rosa presented data that Roundtable for Sustainable Palm Oil (RSPO)-certified palm oil produced in Malaysia and Indonesia has 35% lower emissions than non-certified palm oil (332, Schmidt and De Rosa, 2022) *[Tier B]*. This study is also cited in a submission by RSPO (329, RSPO, 2022) *[Tier C]*.

- A coffee industry-led initiative surveyed farmers in two regions of Southeast Asia (140, Enveritas, 2023) *[Tier C]* and demonstrated that farmers who are members of certification schemes such as 4C or Rainforest Alliance have 9% lower emission intensities for their coffee products.

However, none of these certification schemes convey a specific GHG intensity for the certified products. Also, the lower GHG emissions associated with certified agricultural commodities are partly explained by lower land use change (LUC) emissions. The evidence does not clearly state whether avoided emissions from LUC are already being claimed via carbon credits.

For non-agricultural commodities, there are emerging EACs that are focused on reflecting the GHG emission intensity of a commodity. The UPSTARK Project report by Wei et al. provides a breakdown of the certification landscape of low-carbon steel (428, Wei et al., 2023) *[Tier C]*. The report outlined 13 standards applicable at the company level, four standards at the site level, and ten standards at the product level. Several submissions highlight proposals for new standards or recently introduced EACs in the context of steel: (229, Jernkontoret, 2023) *[Tier C]*, (274, Oda, 2023) *[Tier C]*, (388, German Steel Association, 2023) *[Tier C]*, and (389, thyssenkrupp Steel, 2023) *[Tier C]*. There were no submissions that presented evidence assessing the impact of steel EACs in delivering sector-wide measurable emission reductions.

Beyond steel, there were two other submissions on non-agricultural commodities considered relevant to EACs.

- The Rocky Mountain Institute (RMI) conducted a workshop with stakeholders in the aluminum production industry to discuss electricity impacts and data quality (318, Rocky Mountain Institute, 2022) *[Tier C]*.
- In a piece of nested evidence, BASF presented their mass balance approach for feedstock substitution in chemicals production (389a, BASF, 2023) *[Tier C]*.
- There were no pieces of relevant evidence submitted on commodities such as fertilizers, metal ores, or glass.

In general, the submitted evidence (or lack thereof) shows that the use of EACs where the primary focus is to establish GHG emission intensities for commodities is at an early stage, both in terms of the establishment of certification schemes, and the production and procurement of green commodities. This presents a challenge when assessing the impact of commodities EACs in corporate sustainability, as there is little data available on the emission intensities of commodities with EACs, and little data available on the impact of their use on the system-wide transition to net-zero.

It is important to highlight that the emerging nature of green commodities is partly a reflection of the relatively early stage of industrial decarbonization world-wide. We also note that the emerging nature means that there have been developments in commodity EAC use between the SBTi's Call for Evidence (September 2023) and the time of writing (December 2024). These developments include new certification schemes and new GHG accounting practices to generate EACs, not all of which are necessarily public.

4.2 Theme 1: Wide variety of commodities

Note: all research questions are related to this theme

Summary

There is a large variety of commodities that could be relevant for EACs, including both agricultural and non-agricultural commodities. Moreover, for some commodity types there are significant differences in the GHG intensity of different products, or even in the GHG intensity of the same product produced through different production routes. The variation in the supply chain structure of different commodities also suggests careful thought is needed on whether a 'one size fits all' approach to chain-of-custody models and GHG accounting is appropriate.

For each commodity type, differences in terms of products, production routes, the commercial maturity and market penetration of low-carbon production methods, and supply chain structures need to be accounted for when generating EACs. When considering market-based mechanisms to create EACs, the risks of indirect impacts, lack of system-wide change, and awarding current practices need to be assessed separately for different commodities. Individual rules for each commodity type may be required to mitigate specific risks.

Detailed evidence

An important consideration when considering the use of EACs for commodities is their diversity. Here, "diversity" refers to a diverse number of types of commodities (e.g., steel, cement, sugar), the diversity of products within a commodity type (e.g., various steel grades, such as long steel products, flat steel products, high-alloyed steel, etc), and the diversity of production routes (e.g., electric arc furnace steel production, direct reduced iron steel production).

The idea that there is a wide range of commodities relevant for EACs is highlighted by Mol and Oosterveer, who categorize current EAC use (although the focus is not necessarily on GHG intensities) for agricultural commodities such as palm oil, soy, sugar, cotton, marine fish, aquaculture fish, timber, biofuels EU market, non-GMO crops, general agricultural products, tea, cocoa, coffee, and meat (262, Mol and Oosterveer, 2015) *[Tier B]*. They note that the supply chain of these commodities can be structured very differently. For instance, palm oil has a highly extended supply chain while aquaculture fish does not have an extended supply chain. There may also be differences in terms of the existence or not of an activity pool—i.e., a common "set of emissions sources which may physically serve the reporting entity, within which further traceability to the specific physical sources used by the reporting entity is not possible" (054, Brander & Bjørn, 2023) *[Tier B]*.

Steel provides an illustrative example of the diversity of production routes and product types for one commodity type. Oda and Wei et al. emphasize the variety of available steel production routes and processes, and that decarbonization can occur via multiple routes such as CCS, biomass and hydrogen utilization (274, Oda, 2023) *[Tier C]* and (428, Wei et

al., 2023) *[Tier C]*. Steel produced in electric arc furnaces from mostly scrap-based inputs or in basic oxygen furnaces from a majority of ore-based inputs have very different GHG intensities. Steel products include the broad categories of flat and long products. *Steel products also include stainless steel and high-alloy steel, which generally have a significantly larger GHG intensity than carbon steel*. Wei et al. highlight how it is technically challenging to produce flat and long steel products with identical carbon footprints, and that flat products tend to have larger carbon footprints since these products are more often produced using equipment such as blast furnaces rather than electric arc furnaces (428, Wei et al., 2023) *[Tier C]*.

The wide-ranging variety presents a practical challenge to assess the impact of commodities EACs in corporate sustainability, in part because there can be differences in the GHG intensity of products within the same commodity type or those produced through different production routes. The variety of supply chain structures for different commodities also has implications for the appropriate GHG accounting approach. Following a unified GHG accounting approach to generate EACs for all commodities may not be appropriate. For each commodity type, differences in terms of products, production routes, the commercial maturity and market penetration of low-carbon production methods, and supply chain structures need to be accounted for when generating EACs.

When considering market-based mechanisms to create EACs, the risks of indirect impacts, lack of system-wide change, and current practices need to be assessed separately for different commodities. Individual rules for each commodity type may be required to mitigate specific risks.

4.3 Theme 2: Variation in Chain-of-custody models

Research questions related to this theme:
Question 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?
Question 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?

Summary
The different chain-of-custody (CoC) models already in use for various commodities are identity preservation, segregation, mass balance, and book and claim. The evidence emphasized that requiring more restrictive CoC models such as identity preservation is not feasible for many commodities due to the complexity and interconnectedness of supply chains and production processes. The flexibility afforded by mass balance and book-and-claim can be attractive for many producers and buyers of certified commodities. Several surveys of producers and buyers of commodities reflect a strong interest in mass balance and book-and-claim models to generate EACs. However, with this increase in flexibility, the risk of fraud and double-counting is also increased.
Instead of using CoC models to track the movement of materials through the supply chain, there are companies which use an internal 'carbon bank' approach to aggregate GHG savings from project interventions and then allocate these savings (the carbon bank) to a proportion of their output in the form of certificates. While some companies call this approach mass balancing, it is fundamentally different in concept to a mass balance CoC model.
Guidance on which CoC models are acceptable and under which conditions is needed given the rapid development in commodities EACs. A balance needs to be struck between avoiding too restrictive CoC models and too flexible CoC models. Highly restrictive approaches could lead to indirect impacts such as increased GHG emissions and costs related to transport of physical products or lack of mixing leading to separate infrastructure. For highly flexible models, the risks of double-counting and non-additionality, if not addressed, may reduce the ability of EACs to drive the net-zero transition – see further discussion in Theme 5.

Detailed evidence
A key topic highlighted across the submitted evidence is that there are different CoC models available for commodity supply chains, and that these CoC models differ in their practicality, flexibility, potential for fraud, and potential to drive decarbonization. It is generally recognized that CoC models can be placed on a 'spectrum' of flexibility and traceability, with identity preserved the least flexible (but highest in traceability), followed by segregation, then mass balance, with book-and-claim the most flexible (but lowest in traceability).
For agricultural commodities, Mol and Oosterveer highlight that the CoC models of identity preservation, segregation, mass balance, and book-and-claim are currently in use for tracing sustainability certificates (which are not necessarily focused on GHG intensity) (262, Mol and

Oosterveer, 2015) *[Tier B]*. The analysis shows that certain types of commodities such as palm oil, sugar, and soy tend to have large market shares of certificates employing more flexible CoC models such as book-and-claim, whereas other types of commodities such as tea, cocoa, and coffee tend to employ CoC models with higher traceability such as segregation. The paper identified five factors that tend to result in more flexible CoC models being preferred and achieving larger market shares. These five factors are extended supply chains, a low ability of consumers to distinguish between buying or consuming certified products versus non-certified products, low (real or perceived) inherent differences in quality between certified and non-certified products, low levels of public debate, and institutional actors (e.g., processing companies, traders, states) being dominant across the supply chain.

For non-agricultural commodities, BASF present their own mass balance approach for feedstock substitution to produce chemicals (389a, BASF, 2023) *[Tier C]* in a piece of evidence nested in evidence from thyssenkrupp (389, thyssenkrupp Steel, 2023) *[Tier C]*. thyssenkrupp is planning to use a mass balance approach for their bluemint® Steel product once they start operation of a direct reduction plant in the pipeline (389, thyssenkrupp Steel, 2023) *[Tier C]*.

No evidence was submitted that discusses the use of book-and-claim models for non-agricultural commodities.

It is important to clarify there can be multiple CoC models used across a given commodity supply chain. For example, given a supply chain involving material sourcing, processing, production, transportation, local distribution, and retail, several different types of CoC models can be used at different stages. For instance, for activity pools a CoC model with higher traceability such as identity preservation or segregation can be used before the point of blending.

It was emphasized in multiple pieces of evidence that CoC models that allow for greater flexibility (e.g., mass balance and book-and-claim) may be desirable due to the complexity and interconnectedness of commodity supply chains. These pieces of evidence argue that the implementation of strict CoC models to separate products with low GHG intensity from those with higher GHG intensity would result in cost-prohibitive changes to either the production process or management of the supply chain. The implication of this is that the cost-prohibitive changes could discourage the development of lower carbon production activities.

- The Value Chain Initiative highlights that physical segregation is not always possible at the batch level, and that suppliers may be diversified in their products and services (419, Value Chain Initiative, 2023) *[Tier C]*.
- Mol and Oosterveer mention that identity preservation and segregation have higher costs of administration and greater management complexities (262, Mol and Oosterveer, 2015) *[Tier B]*.
- BASF also argue that due to complex and networked processing and infrastructure with multiple feed-in points for feedstocks, establishing a separate value chain for lower carbon feedstocks would prove too onerous and would lead to efficiency losses (389a, BASF, 2023) *[Tier C]*.

- thyssenkrupp mention that, while they transition away from blast furnaces, liquid hot metal produced from direct reduced iron will still be mixed with hot metal from blast furnaces, impeding physical separation (389, thyssenkrupp Steel, 2023) *[Tier C]*.

Two pieces of evidence also highlighted that a mass balance approach to CoC models allows for differentiated products that can attract larger premiums.

- thyssenkrupp argue that to obtain green premiums it is necessary that, while lower-carbon processes scale up, the lower GHG intensity of the resulting products is not diluted when mixed with the higher carbon footprint of conventional production that has not yet been transformed (389, thyssenkrupp Steel, 2023) *[Tier C]*. This differentiation and separate marketing is possible with mass balancing.
- Similarly, BASF argue that the mass balance approach offers the opportunity to differentiate their product in the market and obtain a return of the additional costs which are a result of transitioning to lower-carbon production approaches (389a, BASF, 2023) *[Tier C]*. BASF emphasized that in the absence of quotas or regulations for feedstocks, the main driver for transformation is the market.

Several surveys of producers and buyers of commodities reflect significant interest in mass balance and book-and-claim models to generate EACs.

- The Book and Claim Community and partner organizations conducted a survey on EAC use (not including renewable electricity) (317, Rocky Mountain Institute, 2023) *[Tier C]*. The survey was sent to the Book and Claim Community, SABA Community, ZEMBA Community, and AIM Platform Community. The 49 survey participants were asked which sectors they would be interested in participating in "if robust book and claim systems existed" for those sectors. *It is not clear how the term "robust" was interpreted by participants in this context*. The most popular sectors (by number of positive responses) were steel (11), cement (7), agriculture (6), chemicals (6) and other metals (7). This evidence suggests that there is some interest in book-and-claim CoC models for commodities. However, the evidence did not assess whether there would be higher interest for commodities with different CoC models.
- A paper by Dauda et al. surveyed consumers of palm oil and found there is a higher willingness to pay for palm oil products with a mass balance CoC than for products with a segregated CoC (107, Dauda et al., 2022) *[Tier C]*. However, it appears that this preference from consumers is likely due to the design of the survey, where palm oil with a mass balance CoC was associated with higher levels of biodiversity conservation and lower CO_2 emissions.
- Bonsucro made a submission (051, Bonsucro, 2023) *[Tier C]* where eight end-users of sugarcane—who are Bonsucro members—were surveyed on their preferences for commodities and CoC models. All interviewed companies were interested in the mass balance CoC model, but there was skepticism around book-and-claim due to the perception that it would be "unlikely to be accepted by the GHG Protocol and SBTi". Three companies that currently source using mass balance volumes said that they would prefer segregated products in the long-term.

This survey evidence suggests that there is interest in the market for more flexible CoC models, but there is also interest in the long-term for CoC models with higher traceability.

Despite the perceived benefit of flexible CoC models, the submitted evidence also highlighted potential downsides. Mol and Oosterveer highlight that it is "widely conceived that book-and-claim systems are more vulnerable to fraud than identity preserved and segregation systems, with mass balance systems in-between" (262, Mol and Oosterveer, 2015) *[Tier B]*. This is attributed to book-and-claim systems having a greater level of decoupling between the administration of sustainable primary production and final certified products being sold. As a result, there are greater vulnerabilities in terms of illegal introduction of non-sustainable products, creation of certificates, and fraud in monitoring and registration.

Mol and Oosterveer also argue that "book-and-claim systems have a lower level of environmental effectiveness through the equivalent of a 'hot air' mechanism", where all production that fulfils sustainability criteria will be used in a book-and-claim traceability system, while in segregation/identity preservation systems, not all volumes will be certified due to costs and management complexities. This means that segregation/identity preservation "results in higher volumes of sustainably produced primary commodities than certified [commodities] in a market". In contrast, if book-and-claim is the dominant CoC model, the volumes of sustainably produced commodities will be closer in number to the amount of certified commodities. This implies that there would be greater production of sustainable commodities if segregation/identity preservation were the only accepted CoC models, thus resulting in a larger climate benefit.

In the context of corporate GHG accounting, Brander and Bjørn explore requirements for GHG inventories and solutions to market-based accounting such as book-and-claim. They suggest that establishing additionality or causal relationships is required for market-based mechanisms. They state that using an emission factor for a specific source within an activity pool can only be accurate if there is a link to that specific emission factor. The authors claim that using an emission factor associated with a specific source to which there is no traceability (i.e., using flexible approaches such as free attribution under a mass balance approach or book-and-claim) should only be permitted if it is not possible to trace the specific source physically used (i.e., the commodity comes from an activity pool) and if a specific source is part of the activity poll that physically serves the reporting entity (054, Brander & Bjørn, 2023) [Tier B].

Note that, instead of using CoC models as defined by ISO 22095, some companies use an internal 'carbon bank' approach. Under an internal carbon bank approach, intervention-based accounting is used to calculate GHG emissions reductions from a given baseline. Reductions from one or multiple interventions are aggregated in a carbon bank and are then allocated to virtually decarbonized product lines or are sold as certificates to offset scope 3 emissions. This internal carbon bank approach is common practice among integrated steel producers. Oda and Wei et al. identify seven different steel producers using an internal carbon bank approach (274, Oda, 2023) *[Tier C]*, (428, Wei et al., 2023) *[Tier C]*.

While some steel producers, Oda, and Wei et al. refer to this method as “mass balance”, it is fundamentally different in concept to a mass balance CoC model.

4.4 Theme 3: Different approaches to GHG accounting of commodities

Research questions related to this theme:

Question 1: What evidence exists about the effectiveness or ineffectiveness of environmental attribute certificates in delivering measurable emission reductions?

Question 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?

Summary

Different GHG accounting frameworks are being used to quantify the delivery of low-carbon commodities. The coexistence of multiple CoC models and GHG accounting frameworks make it difficult to compare GHG intensities between commodities of the same type. Several approaches to GHG accounting have been developed that use a product life cycle approach, which are mainly attributional. These differ in terms of the system boundaries, data types such as use of average and supplier-specific emission factors, approaches to treatment of co-products, flexibility in apportioning varying emissions to different outputs in a mass balance, and the allowance of market-based accounting for inputs such as electricity. However, there are also approaches to generation of certificates, treated as EACs by respondents, that take a purely consequential or intervention-based approach perspective. For instance, multiple steel producers use an internal 'carbon bank' to aggregate GHG savings from project interventions and then allocate these savings to a proportion of their output in the form of certificates. The criteria used to allocate the savings from these interventions varies widely between steel producers. *The GHG intensity of products that are used for internal carbon banks may be only slightly lower than the GHG intensity of unabated products. However, free attribution of GHG savings to products suggest a very low GHG intensity, and so the carbon bank approach may be considered misleading by some.*

Detailed evidence

Several approaches to GHG accounting have been developed that use an attributional product life cycle approach.

- An environmental product declaration (EPD) is a document that measures the environmental impact of a product over its entire life cycle. EPDs include multiple environmental attributes, including fossil and biogenic global warming potential. *EPDs are often used in the construction industry and are common for commodities such as steel or cement*. EPDs are developed according to ISO 14025 and are based on product category rules (PCRs), that set out how the life cycle assessment (LCA) should be carried out for a specific product. *However, rules from a PCR still allow certain flexibility in the use of data and in methodological choices, which limits comparability*. Moreover, there is often a duplication of PCRs for similar product categories. For instance, PCRs developed under the ISO framework differ from those developed under the European

Committee for Standardisation framework. Wei et al. identify ten different LCA, EPD or PCR standards applicable for steel (428, Wei et al., 2023) *[Tier C]*.

- Bonsucro developed a Bonsucro Production Standard and Calculator to calculate the GHG footprint of sugarcane, which is an optional attribute to include for Bonsucro-certified sugarcane (050, Bonsucro, 2022) *[Tier C]*.
- The ResponsibleSteel International Standard and the labelling system from the German Steel Association take a product life cycle approach. However, these standards do not define a comprehensive set of rules to calculate the product carbon footprints for all steel products. The system boundaries and the treatment of co-products differ between both standards (314, ResponsibleSteel, 2023) *[Tier C]*, (388, Theuringer and Endemann, 2023) *[Tier C]*.

Other approaches to GHG accounting still take a product lifecycle approach but introduce flexibility in apportioning emissions between co-products and/or between batches of the same product in a mass balance, and allow market-based accounting for inputs such as electricity.

- BASF uses a mass balance approach for feedstock substitution to calculate the GHG footprint of their eco-branded products (389a, BASF, 2023) *[Tier C]*. They use this approach with renewable feedstock, such as biomass, biogas or bio-naphtha, as well as with recycled feedstock such as pyrolysis oil from those who commercialize biomass balanced products and Ccyled® products.
- Once a planned direct reduction plant is commissioned to begin their transition away from blast furnaces, thyssenkrupp Steel expects to market the products from the direct reduction plant on the basis of mass balancing. As part of the transition process, hot metal produced from direct reduced iron will be combined with hot metal from existing blast furnaces. The GHG accounting approach will calculate the GHG footprint of products that would result from complete separation between direct reduction and blast furnace routes (389, thyssenkrupp Steel, 2023) *[Tier C]*.
- The aluminum industry has been discussing the impacts of mass balancing EACs for electricity to calculate the GHG intensity of aluminum products. Electricity-related emissions represent a large share of the total GHG intensity of aluminum products. In a workshop conducted by the Rocky Mountain Institute with stakeholders in the aluminum production industry, most participants opposed mass balance of renewable energy certificates through market-based accounting, although one dissenting producer argued that the mass balance approach allows low-carbon product lines to be distinguished (318, Rocky Mountain Institute, 2022) *[Tier C]*.

There are approaches to the generation of certificates that take a purely consequential or intervention-based approach perspective.

- In its 2022 Impact Report, the Roundtable for Sustainable Palm Oil states that implementation of their various procedures has led to significant avoidance of CO_2 emissions (329, RSPO, 2022) *[Tier C]*. This effect is also quantified by Schmidt and De Rosa (332, Schmidt and De Rosa, 2020) *[Tier B]*. While the Impact Report highlights avoided emissions, there is no reference to the carbon footprint of delivered palm oil with

RSPO certification. It is also unclear whether the avoided emissions are being claimed as carbon credits separately.

- While thyssenkrupp plan to calculate the GHG intensity of future products using a product carbon footprint approach with mass balance of inputs, for their current products thyssenkrupp takes an intervention-based approach perspective. They calculate GHG savings due to different interventions compared to a baseline and allocate those savings to the products, which is an example of an internal carbon bank approach (389, thyssenkrupp Steel, 2023) *[Tier C]*.
- The Japan Iron and Steel Federation released guidelines for GHG accounting for green steel products that lay out rules for an internal carbon bank approach. Under the guidelines, producers can allocate GHG emissions reductions from project interventions to steel products (274, Oda, 2023) *[Tier C]*.
- *It should be noted that the resulting GHG intensity of products that are used for internal carbon banks are just slightly lower than the GHG intensity of unabated products. However, the free attribution of GHG savings to products suggests a very low or even neutral GHG intensity which many would consider misleading. Stakeholders participating in the Jernkontoret study mentioned that the carbon bank approach has a risk of greenwashing (229, Jernkontoret, 2023) [Tier C].*

The coexistence of multiple GHG accounting frameworks makes it difficult to compare GHG intensities between commodities of the same type. Gillenwater highlights that the GHG Protocol Corporate Accounting and Reporting Standard does not include comparability as a data quality principle, unlike the IPCC Guidelines for National GHG Inventories for instance. As such, the author argues that corporate emissions inventories are not comparable by nature (186, Gillenwater, 2022) *[Tier C]*. Greater comparability of lifecycle GHG methodologies is needed to underpin credibility of commodity EACs. This point is stressed by the German Steel Association, who mention that credibility can be built “on the basis of uniform rules and established ISO standards”, and balancing should be used “only if technically necessary and under clearly defined conditions” (388, Theuringer and Endemann, 2023) *[Tier C]*.

4.5 Theme 4: Proliferation of types of certificates and claims

Research questions related to this theme:
Question 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?
Question 6: What specific evidence-based claims can and cannot be made when employing environmental attribute certificates to corporate decarbonization?

Summary
The evidence includes mentions of a broad variety of existing and emerging certificates, environmental labels and claims. This proliferation reflects the lack of standardization that characterizes commodities' EACs. The different types of environmental labels include ecolabels, self-declared environmental claims and EPDs (also called Type III environmental labels). Within each type of environmental label and for each commodity there may be multiple standards and accounting frameworks being used. Moreover, multiple definitions of near-zero products are in place.
The evidence shows that certification and claims are often backed by third-party verification. While this provides assurance on GHG performance, internal tracking and registries, it is not sufficient to ensure consistency and comparability, as different standards or guidance are followed to generate certificates. There are also self-declared environmental claims that are not backed by external certifications, which leads to additional challenges in ensuring consistency and comparability. *Moreover, the lack of global or regional registries introduces the risk of double counting*.

Detailed evidence
There is a proliferation of types of certificates, environmental labels and claims for commodities. While this proliferation may be partly explained by the wide-ranging variety of commodities (Theme 1) and by the variation in CoC models (Theme 2), in many cases multiple environmental labels also coexist for the same commodity type. The different types of environmental labels include ecolabels, self-declared environmental claims and Type III environmental labels.
Ecolabels certify products that meet third-party criteria. The third-party ecolabelling organization may be either a governmental organization or a private non-commercial entity. While some ecolabels focus on just one environmental, social or governance aspect, many ecolabels belong to multi-criteria ecolabel programs. This variability in terms of attributes being certified means that, in many cases, the ecolabel does not convey the GHG footprint of the product.
The use of ecolabels that do not convey the GHG footprint of the product is common for agricultural commodities.

- While studies by Schmidt and De Rosa (332, Schmidt and De Rosa, 2020) *[Tier B]* and Enveritas (140, Enveritas, 2023) *[Tier C]* show a correlation between certified products

and lower GHG footprints of the corresponding products, the associated ecolabels (RSPO for palm oil; 4C or Rainforest Alliance for coffee beans) do not include information about the GHG footprint of the product. A submission from the Roundtable for Sustainable Palm Oil (RSPO) highlighted that the RSPO certification for palm oil considers aspects such as deforestation, social safeguarding, biodiversity, and child labor (328, RSPO, 2021) *[Tier C]*.

- Other ecolabel programs, such as Bonsucro, applicable to sugarcane production, include GHG emissions as one of the criteria to achieve certification (050, Bonsucro, 2022) *[Tier C]*.

A variety of ecolabels are also used for non-agricultural commodities.

- The UPSTARK Project report identifies and compares various reporting and certification standards for steel, including company-, site- and product-level certification (428, Wei et al., 2023) *[Tier C]*. The report highlights that the boundaries for the production processes, GHG accounting methodologies, and the definition of near-zero steel vary significantly between standards. A report by Jernkontoret (which is partly based on the UPSTARK Project report by Wei et al.) also highlighted the large number of standards available for green steel, and the variation in the methodologies of each standard (229, Jernkontoret, 2023) *[Tier C]*.
- The ResponsibleSteel International Standard includes 13 different principles covering environmental, social, and governance aspects. In addition to showing compliance with its 13 principles, to become certified a steel product needs to meet specified thresholds for the GHG emissions footprint of crude steel production. The standard defines different Progress Levels, which range from slightly below the global average GHG intensity to near-zero emissions steel. For each Progress Level, the threshold varies according to the scrap share of metallics input (314, ResponsibleSteel, 2023) *[Tier C]*.
- The German Steel Association took a similar approach to create a label system for green steel, although their labelling system is single attribute and focuses on GHG emissions only: it includes several performance levels and thresholds varying with the scrap share of inputs (388, Theuringer and Endemann, 2023) *[Tier C]*. However, the boundaries for the calculation and the numeric value of the thresholds differ from ResponsibleSteel.
- ResponsibleSteel and the German Steel Association are not alone in defining performance levels and near-zero steel as a function of the proportion of scrap use in total metallic inputs. *SBTi's Sectoral Decarbonisation Approach for steel*, the IEA, and First Movers Coalition (428, Wei et al., 2023) *[Tier C]* also use this approach. The use of a sliding scale for steel scrap is used to represent that there is limited scrap availability, that the increased use of scrap at one site does not reduce sectoral GHG emissions, that increasing the share of scrap is not connected with transformative steps, and that there is not always a clear-cut distinction between ore-based and scrap-based production (388, Theuringer and Endemann, 2023) *[Tier C]*.
- Other standards used to certify green steel products take an altogether different approach. For instance, the Global Steel Climate Council (GSCC) Product Standard

does not consider the scrap share of inputs, but instead uses a carbon intensity threshold that varies over time and defines different trajectories for flat and long steel products (428, Wei et al., 2023) *[Tier C]*.

Self-declared environmental claims are not backed by external certifications. *While producers may follow standards that lay down rules for calculating product carbon footprints, there is a great degree of flexibility. As long as specific claims can be substantiated, producers can frame the claims and brand their products as they desire*.

- thyssenkrupp Steel offers three different types of products under their bluemint® Steel umbrella, with two products already available and a third one to be made available after a planned direct reduction plant is commissioned. The GHG accounting methodology and the GHG footprint of these products differs markedly. The two products that are already available, bluemint® pure and bluemint® recycled, are marketed by calculating GHG savings due to different interventions and allocating those to the products, which is an example of an internal carbon bank approach. The third product will instead use mass balancing of inputs from the direct reduction plant into the steelmaking process (389, thyssenkrupp Steel, 2023) *[Tier C]*.
- In Japan, the three integrated steel companies (Nippon Steel Corporation, JFE Steel Corporation, and Kobe Steel) offer different "green steel" products. To homogenize self-declared environmental claims from steel producers, the Japan Iron and Steel Federation released guidelines for GHG accounting for green steel products. The guidelines lay out rules for an internal carbon bank approach, allocating GHG emissions reductions from project interventions to steel products. The rules set conditions that must be met and require financial additionality to be demonstrated (274, Oda, 2023) *[Tier C]*. *However, use of an internal carbon bank approach is not comparable with attributional lifecycle GHG accounting methodologies, even if additionality is demonstrated.*

EPD or Type III environmental labels are well-established in the construction industry. There is limited reference to EPDs in the evidence submitted to SBTi.

- EPDs are only mentioned by Wei et al. in the context of comparing standards for green steel (428, Wei et al., 2023) *[Tier C]*.
- While Brander and Bjørn do not specifically mention EPDs, their paper makes it clear that these can already be used for corporate scope 3 accounting using supplier-specific emission factors (054, Brander & Bjørn, 2023) *[Tier B]*.
- *Depending on the traceability to specific physical sources, buyers of commodities can use either industry-wide or product-specific EPDs. EPDs are the most comprehensive reporting framework for environmental declarations, but it should be noted that they do not certify whether a product is "green" or not. Current PCRs used to generate EPDs are not compatible with mass balance or book-and-claim approaches. Hence, there is a double claiming risk if a company issuing EPDs also uses mass balance or book-and-claim approaches to generate EACs.*
- The possibility of using either industry-wide or product-specific EPDs also introduces a double counting risk. To mitigate this risk, buyers that do not use industry-wide EPDs

should use a residual average emission factor instead of the emission factor informed by the industry-wide EPD (054, Brander & Bjørn, 2023) *[Tier B]*.

Third-party verification and external auditing provide assurance on GHG emissions data and that there is traceability of certificates being issued (389, thyssenkrupp Steel, 2023) *[Tier C]*, (389a, BASF, 2023) *[Tier C]*. *However, it should be noted that auditing does not provide assurance on the consistency or comparability between products using different methodologies; the GHG footprint varies considerably depending on the CoC model and GHG accounting methodology being used.*

- BASF, who commercialize biomass balanced products and Ccyled® products fulfilling the requirement of certification schemes REDcert^2 and ISCC PLUS, acknowledge that standards are evolving and that there are multiple standards for auditing and certification (389a, BASF, 2023) *[Tier C]*.
- Oda highlights that "too loose certification criteria risk undermining the credibility of third-party certification, while too strict criteria can discourage and discourage [sic] emission reduction projects" (274, Oda, 2023) *[Tier C]*.

Finally, one piece of evidence mentioned the use of Sector Transition Acceleration Contacts (STACs) in the context of cement (336, Scope 3 Climate Capital CIC, n.d.) [Tier C]. Here, a buyer of cement, Swire Properties—who is unable to directly source low-carbon cement—purchases "Sector Decarbonisation Units" to allow a cement producer, Siam Cement, to make investments to reduce the GHG intensity of future production. There is also co-investment from other parties. This results in Swire Properties claiming lower Scope 3 emissions.

Overall, there are a variety of existing and emerging certificates, environmental labels and claims for commodities. Issues caused by this proliferation in the context of green steel are highlighted by a report by Jernkontoret, which includes stakeholder engagement with various companies involved across the value chain for green steel, as well as investors and authorities (229, Jernkontoret, 2023) [Tier C]. The stakeholders mentioned that the large number of green steel standards is confusing for purchasers of green steel, which can impede procurement. The report emphasizes the need for transparent reporting on the GHG intensity of green steel products.

Finally, without global or regional registries that allow calculation of residual emission factors there is an obvious risk of double counting. The impact of this risk is likely to be minor for emerging low-carbon production technologies that have low market penetration. For lower-carbon production routes that are already commercially mature, this is a significant risk. As highlighted by Brander and Bjørn, this risk is material even for stricter GHG accounting methodologies and environmental labels (054, Brander & Bjørn, 2023) *[Tier B]*.

4.6 Theme 5: Potential of EACs to lead to system-wide change

Research questions related to this theme:
Question 5: What evidence exists that uptake of attribute certificates leads to or hinders the transformation needed to reach climate stabilization?
Question 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?

Summary
The submitted evidence emphasizes that the use of the EACs for commodities is expected to help drive system-wide change to a net-zero economy, provided there is international agreement on definitions and rules for the use of labels and EACs. The positive effect is achieved since certificates for green commodities help to create green lead markets and attract green premiums, which are key in many instances to compensate the potentially higher costs of production for commodities with lower GHG intensities.[1] Positive returns on projects for green commodities allow for further investment in lower-carbon production processes.

The submitted evidence from producers claimed that more flexible approaches such as free attribution under a mass balance approach allow them to create differentiated steel and chemicals products which can attract larger premiums. Several pieces of evidence suggest that there is likely consumer demand for commodities through flexible CoC models such as mass balance and book-and-claim. *A book-and-claim model to generate EACs may also help to connect producers with a larger demand pool, as they can access buyers beyond their physical supply chain, as well as buyers within their physical supply chain who are several steps away and do not buy directly from producers*.

However, EACs that demonstrate the delivery of low-carbon products do not necessarily provide evidence that this leads to a reduction in GHG emissions at a system level. For instance, scrap-based steel production has a significantly lower GHG intensity than ore-based steel production, but increasing the use of scrap is constrained by its availability. EACs demonstrating a low GHG intensity linked to the use of scrap-based steel may not contribute to the overall decarbonization of the production system. For EACs to lead to system-wide change, the delivery of the low-carbon product itself must demonstrate that the system-wide GHG outcomes would not have happened without its purchase—i.e., EACs should be able to demonstrate additionality.

The use of EACs for commodities presents a risk of double-counting for all types of certificates – from more 'robust' EPDs to flexible book-and-claim models. However, more flexible systems are also associated with an increased risk of fraud and double-counting.

[1] Note that in some cases the costs of production for commodities with lower GHG intensities may be lower. For example, this could be the case for the use of energy from waste in cement production.

The evidence is conflicting when trying to identify which GHG accounting methods to generate EACs can drive the greatest level of system-wide change to climate stabilization.

Detailed evidence

There is general consensus in the submitted evidence that the use of EACs for commodities is expected to contribute positively to climate finance and to the transition to a net-zero economy. The argument for this is that the decarbonization of commodity production is expected to lead to significant additional costs in most cases. The use of certificates to generate a green premium allows companies to recuperate the costs of lower-carbon processes, and to invest in additional lower-carbon production, thus leading to system-wide change. For example:

- A piece of evidence by the German Steel Association argues that transparent label systems and an internationally accepted definition of “green steel” are required to create green lead markets that incentivize the transformation of the steel industry (388, Theuringer and Endemann, 2023) *[Tier C]*.
- Oda highlights that green steel—and by extension, the use of EACs to certify green steel—is a valuable and promising tool for the steel industry’s transition to a low-carbon economy. (274, Oda, 2023) *[Tier C]*. Note, however, that Oda argues for an internal carbon bank approach and thus uses a very different concept of “green steel”.
- The submitted evidence also emphasized that decarbonization of primary steel production can occur via carbon capture, utilization and storage (CCUS), biomass and hydrogen utilization, with these transformations requiring significant additional costs (388, Theuringer and Endemann, 2023) *[Tier C]*, (274, Oda, 2023) *[Tier C]*, (389, thyssenkrupp Steel, 2023) *[Tier C]*. *It should be noted that currently not all practices in steelmaking and production of other commodities that result in lower emissions are necessarily cost-additive – for example, the use of recycled steel may cost less in some instances.* Selling the resultant “green” steel at a premium through long-term contracts is necessary to reduce investment risk in low-carbon steel production projects.
- ResponsibleSteel also highlighted that they expect their ResponsibleSteel International Standard to help drive investment in decarbonization technologies (314, ResponsibleSteel, 2023) *[Tier C]*.

No submitted evidence presented data that has clearly demonstrated that the use of EACs has already led to additional finance for system-wide change, which may be as a result of the emerging nature of green commodities. While there is evidence that certain certificates for agricultural commodities have resulted in lower GHG intensities than for non-certified products (332, Schmidt and De Rosa, 2022) *[Tier B]*, (329, RSPO, 2022) *[Tier C]*, (140, Enveritas, 2023) *[Tier C]*, these studies do not demonstrate a causal relationship, and the certified products mostly do not convey GHG intensity as an attribute.

The submitted evidence from producers claimed that more flexible approaches such as free attribution under a mass balance approach allow them to create differentiated products which can attract larger premiums.

- Several pieces of evidence highlighted that multiple commodities have a high level of interconnectedness in the supply chains or production processes (419, Value Chain Initiative, 2023) *[Tier C]*, (389a, BASF, 2023) *[Tier C]*, (389, thyssenkrupp Steel, 2023) *[Tier C]*. Separating the low-carbon products from the activity pool can introduce large burdens due to additional logistic costs and efficiency losses (262, Mol and Oosterveer, 2015) *[Tier B]*. This would prevent low-carbon products from being competitive in the market and achieving a significant market share, and thus challenging additional investment in green production.
- thyssenkrupp and BASF argue that creating EACs for differentiated steel and chemical products under a mass balance approach allows them to access green lead markets and attract larger premiums, as otherwise the lower GHG intensity would be diluted when the feedstocks or products are blended with the conventional ones (389, thyssenkrupp, 2023) *[Tier C]*, (389a, BASF, 2023) *[Tier C]*.
- A number of surveys suggest that there is a market interest in procuring commodities with flexible GHG accounting approaches, which could allow for increased procurement of green commodities (107, Dauda et al., 2022) *[Tier C]*, (051, Bonsucro, 2023) *[Tier C]*, (317, Rocky Mountain Institute, 2023) *[Tier C]*.
- *A book-and-claim model to generate EACs may also help to connect producers with a larger demand pool, as they can access buyers beyond their physical supply chain as well as buyers within their physical supply chain who are several steps away and do not buy directly from producers*.

However, it was also highlighted that the more flexible CoC models have a higher risk of fraud due to administrative decoupling (262, Mol and Oosterveer, 2015) *[Tier B]*. Other evidence mentioned that there is also potentially an increased risk of double-counting (051, Bonsucro, 2023) *[Tier C]*, (054, Brander & Bjørn, 2023) *[Tier B]*. Mol and Oosterveer also argued that more flexible CoC models have a lower level of environmental effectiveness since they result in lesser amounts of green production to fulfill a given amount of demand for certified commodities (i.e. the ‘hot air’ mechanism) – see Theme 2 for more info.

EACs that demonstrate the delivery of low-carbon products do not necessarily provide evidence that this leads to a reduction in GHG emissions at a system level. For EACs to lead to system-wide change, the delivery of the low-carbon product itself must demonstrate that the system-wide GHG outcomes would not have happened without its purchase.

- Brander states that attributional GHG accounting methods are not adequate to evaluate whether actions lead to system-wide GHG emissions reduction, and that this type of claims should be supported with “estimations using an appropriately chosen consequential method” (053, Brander, 2022) *[Tier B]*.
- Oda highlights that one of the guidelines from the Japan Iron and Steel Federation for GHG accounting for green steel products is that financial additionality needs to be demonstrated (274, Oda, 2023) *[Tier C] – although this guideline sets rules for the use of an internal carbon bank approach which, even if it leads to additionality, is fundamentally not comparable with attributional GHG accounting approaches*.

- There is no mention of regulatory additionality in evidence submitted to the SBTi. *This is likely to be because mandates for the procurement of low-carbon products are not widespread. However, this topic could become more important if mandates or public procurement requirements are put in place.*
- For commodities where low-carbon production routes are already well-established there is a higher risk of non-additionality when using EACs.
    - In the steel sector, this has motivated the introduction of a sliding scale to reflect the fact that the increased use of scrap at one site does not reduce sectoral GHG emissions (388, Theuringer and Endemann, 2023) *[Tier C]*.
    - In the aluminum sector, many aluminum smelters have a historical supply of captive low-carbon power and produce aluminum with a significantly lower GHG intensity than global average. Mass balancing of renewable energy certificates *or the use of book-and-claim models* may lead to oversupply of low-carbon aluminum, and does not incentivize additional decarbonization (318, Rocky Mountain Institute, 2022) *[Tier C]*.
- Issues of non-additionality are not exclusive to flexible approaches such as free attribution under a mass balance approach or book-and-claim. *Buyers of commodities who use emission factors for their corporate GHG inventory based on product-specific EPDs could choose to switch to suppliers with commercially mature and well-established low-carbon production processes*. *While, as Brander and Bjørn argue, this complies with principles for accurate accounting of supply chain emissions (054, Brander & Bjørn, 2023) [Tier B]*, *it could still lead to non-additional outcomes*.

Double-counting risks could also undermine the ability for commodity EACs to drive system-wide change. *The risk of double-counting is high as there are no global or regional registries in place for the tracking of EACs for commodities.*

- Double-counting risks are not exclusive to flexible approaches such as free attribution under a mass balance approach. As identified by Brander and Bjørn, there is a double-counting risk when buyers that do not use supplier-specific emission factors (e.g., obtained from a product-specific EPDs) use average emission factors (054, Brander & Bjørn, 2023) *[Tier B]*. *While the use of residual emission factors could mitigate this risk, this is not possible without global or regional registries that allow calculation of residual emission factors.*
- However, more flexible approaches to GHG accounting present an increased risk of double-counting, as mentioned by Bonsucro in their SBTi submission (051, Bonsucro, 2023) *[Tier C]* as well as by Brander and Bjørn (054, Brander & Bjørn, 2023) *[Tier B]*. Double-counting was also mentioned briefly as a risk for market-based instruments by the GHG Management Institute (182a, GHG Management Institute, 2024) *[Tier C]*. *As mentioned in Theme 4, current PCRs used to generate EPDs are not compatible with mass balance or book-and-claim approaches. Hence, there is a double claiming risk if a company issuing EPDs also uses mass balance or book-and-claim approaches to generate EACs.*

- An article by Gillenwater (182, GHG Management Institute, 2023) *[Tier C]* argues that market-based approaches are not reconcilable with the fundamental goals of GHG accounting and should thus not be used, as they confound attributional and consequential accounting. Because of this, they argue that it is not possible, by design, to "nonexclusively assign responsibility for emissions to a company". This is irrespective of the effectiveness or not of EACs to incentivize and lead system-wide decarbonization.
- Brander and Bjørn suggest two possible solutions for the accounting of EACs to achieve "accurate" GHG inventories (054, Brander & Bjørn, 2023) *[Tier B]*. They argue that allocation of emissions without double counting is necessary but not sufficient for accurate GHG inventories. One of the potential solutions they suggest is to allow the use of supplier-specific emissions sources only when there is physical traceability to that supplier; otherwise, an average emission factor should be used. This is not sufficient to avoid double counting, as different reporting entities could choose to use either an average or supplier-specific emission factor.

ANNEX A

Table 2 below gives the evidence #, name, date, and title of evidence reviewed as relevant or partially relevant to commodity EACs. The table indicates “Y” where the evidence was relevant or partially relevant to each of the eight research questions.
Table 3 lists the pieces of evidence reviewed under commodity EACs that were not deemed relevant to any of the research questions, and so are not discussed above in the Evidence Review.

Table 2: Evidence reviewed as relevant to commodity EACs

Evidence relevant to commodity EACs				Relevant/partially relevant to research question							
#	Author	Date	Title	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
050	Bonsucro	2023	SBTi Call for Evidence Submission	Y							
051	Bonsucro	2023	Survey: Bonsucro Carbon Impact Claims	Y		Y		Y			Y
053	Brander	2022	The most important GHG accounting concept you may not have heard of: The attributional-consequential						Y		

			distinctio n					
054	Brander and Bjørn	2023	Principles for accurate GHG inventorie s and options for market-b ased accountin g		Y		Y	
055	Brander and Bjørn	2022	Principles for accurate corporate GHG inventorie s and options for market-b ased accountin g – Working Paper		Y		Y	
107	Dauda et al.	2021	Consume r Preferenc e for Certified Sustaina			Y		Y

			ble Palm Oil with Environmental Sustainability Attributes: A Choice Experiment Approach				
140	Enveritas	2023	Establishing carbon footprint baselines for Robusta coffee production in two key origins: Central Highlands, Vietnam and Southern Sumatra, Indonesia	Y		Y	
182	GHG Manage	2023	What is Greenhouse Gas	Y		Y	

	ment Institute		Accounting - Fitting to Purposes						
186	Gillenwater	2022	Examining the impact of GHG accounting principles			Y		Y	
211	Intergovernmental Panel on Climate Change (IPCC)	2006	Guidelines for National Greenhouse Gas Inventories, Chapter 2: Approaches to data collection			Y			
229	Jernkontoret	2023	Utredning av standardiseringsbehov kopplat till stålindustrins klimatomställning	Y	Y	Y	Y		Y

262	Mol and Oosterveer	2015	Certification of Markets, Markets of Certificates: Tracing Sustainability in Global Agro-Food Value Chains		Y				Y
274	Oda	2023	The Green Steel Challenge: Prospects and Challenges			Y	Y		Y
314	ResponsibleSteel	2023	ResponsibleSteel International Standard - Decarbonisation Progress Levels	Y					Y
328	Roundtable on	2021	RSPO Jurisdicti			Y			

	Sustainable Palm Oil (RSPO)		onal Approach Piloting Framework						
329	Roundtable on Sustainable Palm Oil (RSPO)	2022	Moving Ahead: Impact Report	Y		Y	Y		
332	Schmidt and De Rosa	2020	Certified palm oil reduces greenhouse gas emissions compared to non-certified	Y		Y			
336	Scope 3 Climate Capital CIC	n.d.	Worked Example: Forward Looking Sector Transition Acceleration Contracts with Collaborative Finance					Y	Y

317	Rocky Mountain Institute	2023	Book and Claim Community Survey Responses		Y	Y	Y	Y		Y
385	The International REC Standard	2023	How the EU's Carbon Border Adjustment Mechanism (CBAM) supports actual emissions reporting through PPAs and Energy Attribute Certificates (EACs)		Y					
388	Theuringer and Endemann	2023	A Label System for Green Steel and Green Lead Markets: A	Y	Y	Y	Y			Y

389	thyssenkrupp Steel Europe	2023	Proposal of the Steel Industry in Germany Transformation of steel production to climate neutrality and certification of CO2-reduced steel products at thyssenkrupp Steel	Y		Y	Y			Y
419	Value Change Initiative	2023	Making value chain decarbonisation a scalable reality					Y		
428	Wei et al.	2023	Initiatives and Standards for the Transition to				Y			

			Near-zero Steel Production							
142d	EMA	2023	The Importance of Market-Based Accounting and Tradable Environmental Instruments for the Achievement of Scope 1, 2, and 3 Emission Reductions				Y		Y	Y
182a	GHG Management Institute	2024	What is GHG Accounting? Market-based mistake	Y			Y			
389a	BASF	2024	The Mass Balance Approach in	Y		Y	Y	Y		Y

318	Rocky Mountain Institute	2023	Feedstock Substitution RMI Horizon Zero Aluminum Working Group Session 4 notes and feedback	Y		Y	Y			Y

Table 3: Evidence reviewed as not relevant to commodity EACs

#	Author	Date	Title	Rationale for exclusion in commodities report
007	ABB	2023	SBTi Call for Evidence Submission on certified commodities conveying a specific emission factor e.g. green steel	Not relevant to research questions
008	Acampora et al.	2023	Towards carbon neutrality in the agri-food sector: Drivers and barriers	Does not discuss EACs for commodities
042	Berkeley Carbon Trading Project	n.d.	Repository of Articles on Offset Quality	Does not discuss EACs for commodities
073	Carbon Market Watch	2021	Two shades of green: How hot air forest credits are being used to avoid carbon taxes in Colombia	Does not discuss EACs for commodities
075	Carbon Market Watch	2022	Poor tackling: Yellow card for 2022 FIFA World Cup's carbon neutrality claim	Discusses carbon credits and is not relevant to the use of EACs for commodities
171	Forest Trends' Ecosystem Marketplace	2023	All in on Climate: The Role of Carbon Credits in Corporate Climate Strategies	Does not discuss EACs for commodities
172	Forest Trends' Ecosystem Marketplace	2022	The Art of Integrity: State of the Voluntary Carbon Markets 2022 Q3	Does not discuss EACs for commodities
208	Hurteau et al.	2008	Carbon protection and fire risk reduction: Toward a full accounting of forest carbon offsets	Does not discuss EACs for commodities
264	Nabuurs et al.	2022	Agriculture, Forestry and Other Land Uses (AFOLU).	Does not discuss EACs for commodities

			Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change	
268	NewClimate Institute and Carbon Market Watch	2023	Corporate Climate Responsibility Monitor 2023	Not relevant to research questions
275	Oeko-Institut, The World Wildlife Fund (WWF-US), Environmental Defense Fund (EDF)	2022	Methodology for assessing the quality of carbon credits Version 3.0	Does not discuss EACs for commodities
283	Paniagua Tufinio et al.	2023	Achieving net zero through value chain mitigation interventions: Exploring accounting, monitoring and assurance in food and agriculture	Not relevant to research questions
346	Soil Capital	2023	3 years on: What results are we seeing on the ground	Does not discuss EACs for commodities
376	SustainCERT	n.d.	Soil Capital/ Cargill - Workstream 1: Allocation to end-products goods	Does not discuss EACs for commodities
396	Trove Research	2023	Investment trends and outcomes in the global carbon credit market	Does not discuss EACs for commodities
406	UN High-Level Expert Group on the Net-Zero Emissions Commitments of Non-State Entities (HLEG)	2022	Integrity Matters: Net Zero Commitments by Businesses, Financial Institutions, Cities and Regions	Does not discuss EACs for commodities
418	United States Federal Trade Commission	2012	Guides for the Use of Environmental Marketing Claims	Does not discuss EACs for commodities

441	Climate Policy Initiative	2023	Global Landscape of Climate Finance 2023	Does not discuss EACs for commodities
442	Peace et al.	2020	Market Mechanisms: Options for Climate Policy	Does not discuss EACs for commodities

SCIENCE BASED TARGETS

DRIVING AMBITIOUS CORPORATE CLIMATE ACTION