Carbon Direct Microsoft

2025 EDITION

# Criteria for High-Quality Environmental Attribute Certificates in the Concrete and Steel Sectors

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# Acronyms and abbreviations

**BF:** blast furnace
**BOF:** basic oxygen furnace
**CCr:** clinker-to-cement ratio
**$CO_2$:** carbon dioxide
**CoC:** Chain of Custody
**DIS:** Draft International Standard
**DRI:** direct reduced iron
**EAC:** environmental attribute certificate
**EAF:** electric arc furnace
**EPD:** environmental product declaration
**ERM:** Environmental Resources Management
**GCCA:** Global Cement and Concrete Association
**GHG:** greenhouse gas
**ISEAL:** International Social and Environmental Accreditation and Labelling
**ISO:** International Organization for Standardization
**LCA:** life cycle assessment
**MMRV:** measurement, monitoring, reporting, and verification
**OPC:** ordinary Portland cement
**PCRs:** product category rules
**PL:** Progress Level (ResponsibleSteel)
**REC:** renewable energy certificate
**SCM:** supplementary cementitious material
**$tCO_2e$:** tonnes of $CO_2$ equivalent emissions

# Introduction

In 2020, Microsoft announced its ambitious plans to be carbon negative by 2030, requiring a reduction in **scope 3** emissions, including building materials, by more than half compared to its 2020 baseline. In 2023, scope 3 emissions made up over 96% of Microsoft's total greenhouse gas (GHG) footprint, a 30.9% increase relative to the company's 2020 baseline. This is in part due to the **embodied carbon** of commodity materials used to build datacenters.[1] To meet its 2030 target, Microsoft must address these supply-chain emissions.

The initial commodity targets, and the focus of this document, are **concrete** and **steel**. Concrete and steel account for approximately 13% of global $CO_2$ emissions.[2] There are two primary pathways to address concrete and steel emissions: a reduction in the use of these materials and decarbonization of the material supply chain. Microsoft is taking ambitious steps to reduce the need for concrete and steel, through innovative building design or by using lower-carbon alternatives, such as sustainably sourced mass timber. For the remainder, decarbonizing these supply chains is essential and Microsoft's efforts have the potential for broader impact outside of the company's supply chain.

To drive both company-level and broader sectoral decarbonization, Microsoft is directly engaging with suppliers to procure low-carbon alternatives to conventional concrete and steel. Further, Microsoft is investing in and helping pilot new low-carbon production pathways. However, the current market poses some challenges to direct procurement.

1. Independent analysis shows that more than half of a datacenter's embodied emissions are from equipment, with the remainder from construction materials. Although the overall emissions profile of datacenters is changing rapidly as design evolves to support AI-related workloads, substantial use of concrete and steel remains an important contributor to their emissions footprint.

2. Thirteen percent represents the rough sum of emissions shown in Exhibit 1 of the 2024 report, Structuring Demand for Lower-Carbon Materials.

# Meeting market challenges with environmental attribute certificates

Microsoft's primary goal is to integrate low-carbon materials directly into its builds. However, the market for low-carbon concrete and steel is immature, and Microsoft's datacenter construction activities occur around the globe. Together, these factors often result in a geographic mismatch between Microsoft's locations and the ideal locations for first-of-a-kind and transformational low-carbon concrete and steel projects. In addition, Microsoft's proximate demand for low-carbon materials would be insufficient to fully utilize the output of a project and additional demand for project output may not be localized.[3]

While physical procurement of low-carbon materials remains a critical priority for Microsoft, indirect connections to producers, difficulties in scheduling material availability to meet project timelines, and associated contracting complexities present further challenges. Microsoft is seeking solutions to catalyze market expansion for low-carbon materials so that direct procurement is more attainable in the future.

**Environmental attribute certificate** (EACs) offer an innovative market-based solution to these challenges with direct procurement by allowing companies to procure lower-carbon materials independently of their physical supply chain. EACs represent the **environmental attribute** of a sectoral commodity, such as concrete or steel, that may be **unbundled** and transacted separately from the physical material (**box 1**). While some low-carbon materials have achieved price parity with conventional materials, deeply decarbonized materials[4] typically have a higher production cost. This means they require a "green premium" price when first introduced to the market, and buyers willing or able to pay this higher price are limited. Especially when paired with multi-year purchase agreements, EACs enable buyers to provide a demand signal for low-carbon commodities. Buyers can also use EACs to support the finance of emission-reducing retrofits or new clean-production units, often while alleviating some of the complexities involved in direct procurement, such as contracting, delivery timing, and transport.

3. Transporting physical commodities over long distances, particularly using modes of land transport, can add significant costs, climate impacts, and broader environmental impacts. These challenges highlight the need for indirect procurement methods to be used as a complement to physical procurement. Indirect procurement provides a way to efficiently scale low-carbon materials to meet demand now and in the future.

4. Deeply decarbonized materials are commodities whose GHG footprints are reduced substantially beyond what is attainable with common practice methods. For example, low-carbon cement or concrete that achieves a D grade on the Global Cement and Concrete Association's low-carbon rating scale may achieve cost parity in some markets, but deeply decarbonized concrete that achieves a B rating or higher likely could not. Similarly, "near-zero" steel, the production of which relies on full electrification and a supply of low-carbon electricity, can demand a higher green premium relative to partially decarbonized options.

**Box 1.** Defining EACs

For the purposes of this document, EACs refer specifically to a **book and claim** Chain of Custody (CoC) model—as described by the International Organization for Standardization (ISO) Draft International Standard (DIS), ISO/DIS 22095 and the International Social and Environmental Accreditation and Labelling (ISEAL) Alliance Guidance (further detail provided in the *Appendix*). In a book and claim model, product characteristics such as environmental attributes can be unbundled and transacted separately from the physical commodity. Other CoC models, such as segregated, controlled blending, and **mass balance** models, may be useful to adopt in a particular market context, but those CoC approaches are variations of direct procurement and are not part of the definition for EACs used in this report, which is concerned with indirect procurement.

EACs are also defined here as distinct and separate from **carbon credits** or carbon offsets. EACs quantify and assign specific environmental characteristics to a unit of material, such as tonnes of $CO_2$ equivalent emissions ($tCO_2e$) per unit product, typically through an **attributional life cycle assessment**. For example, if 1.5 $tCO_2e$ is generated in the production of 1 tonne of steel, the EAC would carry the attribute of 1.5 $tCO_2e$/t steel. **This environmental attribute is intrinsic to the product and not contingent on a counterfactual**, or comparison scenario.

While the EAC could be used to calculate emissions displaced or avoided for reporting purposes, the attribute itself is independent of this additional step.

# The need for criteria

We believe it is essential that early EAC procurements serve well-defined goals to overcome specific market challenges. Microsoft has a significant opportunity to shape the future of how the nascent EAC market operates and how it can best support climate mitigation. To that end, Microsoft and Carbon Direct have collaborated to establish criteria for Microsoft's purchases of high-quality EACs in low-carbon commodities, with a near-term emphasis on concrete and steel, as outlined in this document. These criteria were developed with several core objectives in mind:

- **Communicate intent:** This document communicates Microsoft's intent to support the decarbonization of physical commodity supply chains where modest margins and robust competition have previously limited investments in deep emissions reductions at scale.
- **Guide decision-making:** This document provides insights into some of the factors in Microsoft's decision-making process for purchasing EACs, explaining the rationale behind accepting or declining certain pathways.
- **Set high integrity standards:** This document strives to maintain high integrity for EACs at an early stage, ensuring they are not used to avoid physical procurement but to enable it.
- **Stimulate partnership opportunities:** This document aims to encourage potential partnerships and purchasing pipelines by clearly describing criteria for high-quality EACs.

Further, EACs are understood to have specific objectives, which the criteria in this document are oriented toward:

- Accelerate sectoral decarbonization by overcoming barriers to direct procurement such as complexity in contracting, supply chain logistics, and geographic or temporal mismatch between supply and demand.
- Through multi-year agreements, mobilize financial resources toward projects with significant potential for sectoral decarbonization that are **additional**, **catalytic**, and **verifiable**.
- Serve as a temporary[5] solution on the pathway to scale, with the goal of reducing reliance on EACs over time as this market mechanism succeeds in lowering barriers to direct procurement.
- Support projects that align with Microsoft's core values by providing meaningful benefits and without contributing to broader social or environmental harms.

5. "Temporary" is used here to indicate that the desired end-state is a market for low-carbon commodities that has scaled to a point where direct procurement is broadly feasible and EACs are no longer required to overcome market challenges. EACs can serve alongside other market and regulatory mechanisms in the near term as a solution on the pathway to scale. Long-term, multi-year procurement agreements are still valuable as deeply decarbonized materials currently do not represent a significant share of the market; it will take time for the market to evolve.

This document builds upon prior research and stakeholder consultations, including collaborations with RMI (formerly known as the Rocky Mountain Institute), Environmental Resources Management (ERM), and Microsoft's internal sustainability teams. Insights from previous reports, as well as ongoing dialogue with suppliers, industry experts, and regulatory bodies, informed these criteria.

## The dynamic nature of criteria and quantitative thresholds

The market for commodity EACs such as concrete and steel is nascent, and early transactions will require flexibility. Strict adherence to verifiability, additionality, and catalytic impact criteria is essential to maintain the credibility of EACs. However, perfect adherence to all criteria addressed in this document may be infeasible. These criteria can serve as strong guardrails for early EAC procurements.

Cases may arise where there is a compelling reason to waive or revise some criteria. We anticipate and expect this and believe the iterative process of learning requires both attention and flexibility to achieve key outcomes. As pilot transactions progress and data availability increases, expectations for EAC project developers should become increasingly stringent, ensuring standards for high-quality EACs are maintained.

Sectoral decarbonization will also advance over time, shifting the thresholds for what is significant, additional, and catalytic in EAC transactions. Technologies and practices that currently require financial support through EACs may become more widespread and cost-competitive, reducing the need for market-based solutions. Consequently, significance thresholds for decarbonization must be reviewed and updated to maintain confidence that EACs continue to drive meaningful progress. If EAC standards do not keep pace, there is a risk that companies could report emissions reductions based on EACs that no longer represent meaningful departures from business-as-usual operations. Evidence of common practice, regulatory, and financial additionality should evolve with advances in policy, market conditions, and industry best practices.

# Criteria for high-quality EACs

The following criteria are intended to characterize thresholds for Microsoft's own high-quality commodity EAC procurements. We distinguish between "must" or "should" criteria to clarify our minimum viable EAC characteristics (must) versus ideal features for EAC development and implementation (should).

## Criterion 1. Qualifying conditions

Qualifying conditions are aimed at defining when EACs are the appropriate tool to support a low-carbon commodity project.

**PROCUREMENTS OF EACS MUST**

- Complement rather than replace or inhibit more direct means of acquiring sustainable building materials and be used only in cases where traditional procurement pathways are infeasible, ineffective, or inefficient.
- Represent significantly lower life-cycle GHG emissions than their traditional market equivalents. Thresholds will vary by material and production method due to differences in chemistry, engineering, and solution readiness.
  - The minimum significance threshold requires achieving at least a D rating on the Global Cement and Concrete Association's (GCCA's) low-carbon material rating scales for both concrete and **cement**.[6]
  - The minimum significance threshold for steel requires achieving ResponsibleSteel's Progress Level (PL) 2.[7]
  - All new steel production capacity must be compatible with **near-zero** emissions. Microsoft will prioritize steel suppliers with credible pathways and infrastructure to achieve PL4 over time and cement and concrete suppliers with credible pathways to achieve an AA rating (compatible with near-zero).

6. Details on the rationale behind this threshold can be found in the *Criteria for high-quality EACs in the concrete sector* section of this document.

7. Details on the rationale behind these thresholds can be found in the *Criteria for high-quality EACs in the steel sector* section of this document.

- Contractually require that the physical commodity is also sold to limit the creation of stranded products and to provide greater confidence in emissions benefits by proving actual product displacement.
- Represent a clearly defined, consistent unit of material such that the unit is verifiable and comparable to conventional materials. The unit for EACs and the **functional unit** used for a life cycle assessment (LCA), or determining commodity fungibility, may differ.[8] Examples of consistent units of material for EACs include:
  - Ordinary Portland cement (OPC) or blended cement on the basis of mass,
  - Concrete on the basis of volume and performance fungibility, and
  - Steel on the basis of mass.
- Support projects that have a clear and realistic path toward scale-up and cost reductions over time.

**PROCUREMENTS OF EACS SHOULD**

- Drive *ambitious* emissions reductions.
  - The *ideal* significance thresholds for concrete and cement are at least a B rating on each of the respective low-carbon material rating scales published by GCCA.
  - The *ideal* significance threshold for steel achieves at least PL 3 from ResponsibleSteel and demonstrates a credible, time-bound plan to achieve PL 4.
- Preferentially purchase EACs with the lowest carbon intensity, provided the other criteria are comparable.
- Consider purchase of novel technologies with significant decarbonization potential to: (a) learn if these products perform as required and (b) help catalyze the market.
- Seek to generate EACs at the most generalizable stage of the supply chain that is practical (e.g., cement, mass of ready-mix, semi-finished or finished steel), and at a point where the majority of associated emissions have already occurred. Early EAC procurements should anticipate a mature EAC market while remaining flexible and open to opportunities. For example, it would be preferable to generate an EAC in terms of cement rather than **clinker**, at concrete rather than aggregate, and at slabs, blooms, or billets of steel rather than at finished products like pipe or structural steel sections.

8. See the "should" criteria in this section, as well as *Criterion 6. Verifiability*, for additional comments on fungibility. Further discussion can be found in the *Criteria for high-quality EACs in the concrete sector* and the *Criteria for high-quality EACs in the steel sector* sections of this document.

- Seek as much performance fungibility as is practical between the EAC commodity and the physically procured commodity. This will balance market flexibility with the need for technical specificity, while addressing concerns related to product displacement. For example, the hierarchy to support fungible EACs from concrete will include the following guidelines, in order of importance:
  - Prioritize EACs from the same product category (e.g., ready-mix versus masonry block).
  - Verify that they meet the same technical standards (e.g., ASTM C150 for OPC versus ASTM C1157 for hydraulic cement, including supplementary cementitious materials).
  - Verify that they represent the same technical characteristics (e.g., compressive strengths of 2000 psi versus 3000 psi).

## Criterion 2. Social harms and benefits

Well-designed, EAC-supported projects can provide social benefits, including sustainable infrastructure, workforce development opportunities, job training, local economic benefits, and investments in community climate resilience. This benefits-forward approach can help set a precedent and shape market demand for low-carbon concrete and steel procurement. EACs also have the potential to address pollution mitigation, environmental health, and climate hazard impacts for under-represented, marginalized, and vulnerable communities. Localized social harms, benefits, and potential disproportionate environmental health impacts of each major new activity supported by the EAC must be carefully reviewed and assessed. If new mines, quarrying sites, and/or industrial facilities are opened to supply **raw materials** for concrete, steel, or other commodity production, those facilities must be included in the assessment. This verifies that new mining and industrial operations support EACs that do not create disproportionate impacts on local communities.

**PROCUREMENTS OF EACS MUST**

- Adhere to Microsoft's Supplier Code of Conduct.
- Include an identification and evaluation of potential social harms as well as social benefits from project activities and operations.

- Mitigate existing social harms while preventing the creation of new ones, particularly in communities that have historically faced economic hardship and disproportionate environmental and climate hazards.
- Provide transparency on worker compensation and clearly detail plans for paying a living wage[9] for the region.
- Develop a clear community engagement plan to gather local stakeholder input and encourage participation.
  - For existing industrial facilities, the engagement plan must fall into the "Inform" category according to the Movement Strategy Center's Spectrum of Community Engagement.
  - For new industrial facilities, the engagement plan must fall into the "Involve" category according to the Movement Strategy Center's Spectrum of Community Engagement.
- Consider adverse land impacts from new industrial facilities, including loss of land access or reduction in residential property values, and include deliberate measures to avoid displacement or loss of livelihoods.

**PROCUREMENTS OF EACS SHOULD**

- Prioritize projects and developers who are committed to sharing the economic benefits of EAC transactions with affected and nearby communities by developing a holistic community benefits plan in partnership with community members.
- Develop a community engagement plan for existing industrial facilities that falls into the "Involve" category according to the Movement Strategy Center's Spectrum of Community Engagement.
- Take proactive steps to minimize the risk that projects will disproportionately encumber local communities with high utility rates, stranded infrastructure, or other municipal costs.
- Consider opportunities to support small, emerging, and/or cooperatively owned businesses.
- Take proactive steps to expand outreach to and recruitment of underrepresented groups to help create a diverse pool of potential suppliers.

9. A living wage is defined as a wage that is adequate to maintain a satisfactory standard of living and that allows individuals and families to afford shelter, food, and other necessities. Living wages may be higher than prevailing wages in some markets.

# Criterion 3. Environmental harms and benefits

Given its emphasis on sectoral transformation and financing new technologies, EAC procurement has the potential to incentivize new industrial activity that could result in environmental harms. However, when projects are designed thoughtfully, they also have the potential to mitigate harms or provide additional environmental benefits. Benefits can include reducing the water demand of certain technologies, limiting the production of industrial byproducts, and reducing impacts related to transportation by keeping physical materials in local markets and transacting only the EAC to the point of physical demand.

**PROCUREMENTS OF EACS MUST**

- Adhere to Microsoft's Supplier Code of Conduct.
- Secure all necessary legal permits and operating permissions from local, state, and national regulatory authorities.
- Comprehensively quantify and document facility emissions profiles. This applies to both brownfield developments (existing facilities) and greenfield sites (new projects).
- Require that projects provide comprehensive documentation of waste management and disposal practices, including the handling of cement kiln dust, waste concrete, and slags.
- Include strategies to monitor and mitigate both acute environmental harms (such as fires or contamination events) and chronic harms (such as long-term pollutant discharge), including baseline monitoring.
- Avoid the use of industrial chemicals and pesticides banned in the United States or the European Union unless accompanied by a robust and publicly available risk management plan.
- Transparently report any toxic or persistent environmental pollutants and detail their potential risks.
- Regularly update the local community on any identified environmental risks and develop strategies for monitoring and mitigating these risks that are informed by community input according to the Movement Strategy Center's Spectrum of Community Engagement.
- Evaluate and document the impact of burning waste fuels, recognizing that it may alter pollution profiles rather than eliminate emissions entirely.

- Source biomass feedstocks in accordance with sustainable sourcing principles, particularly for biofuels and biocoke (see Carbon Direct's *Buyer's Guide to Sustainable Biomass Sourcing for Carbon Dioxide Removal*).

**PROCUREMENTS OF EACS SHOULD**

- Consider pollution burdens, excessive water consumption, and other resource-intensive impacts (e.g., disruption of nutrient cycles, thermal pollution, or overconsumption of local resources) that might arise from increased demand for low-carbon materials, relative to the resource intensity of conventional products.
- Identify natural and industrial systems that could be enhanced through project activities, such as waste remediation, habitat restoration, or air and water cleanup.
- Develop plans for monitoring and reporting progress against clearly defined and quantified environmental goals.
- Prioritize the use of industrial waste products wherever feasible to advance broader industrial sustainability objectives, in accordance with technologies that adequately align with *Criterion 4. Additionality and baselines* and *Criterion 5. Catalytic impact*.
    - Require that projects maintain transparent records on the use of industrial waste products, including any additional environmental benefits resulting from the valorization of legacy waste materials.
- Encourage projects to implement further measures to enhance industrial sustainability, such as design circularity, recycling concrete wash water where possible, and reducing the energy intensity of concrete production to address non-carbon environmental impacts.

## Criterion 4. Additionality and baselines

To meet core commodity material EAC objectives, and to verify that project activities would not have occurred without EAC finance, projects must be evaluated across three key aspects of **additionality**: **financial**, **regulatory**, and **common practice** (**figure 1**). While localized and comparable emissions baselines are not essential for quantifying EAC characteristics, they can provide important context to support EAC procurements in meeting key objectives. GCCA's low-carbon rating system accounts for national context and recognizes variations in regional practices, such as the use of waste materials, that influence carbon intensity.

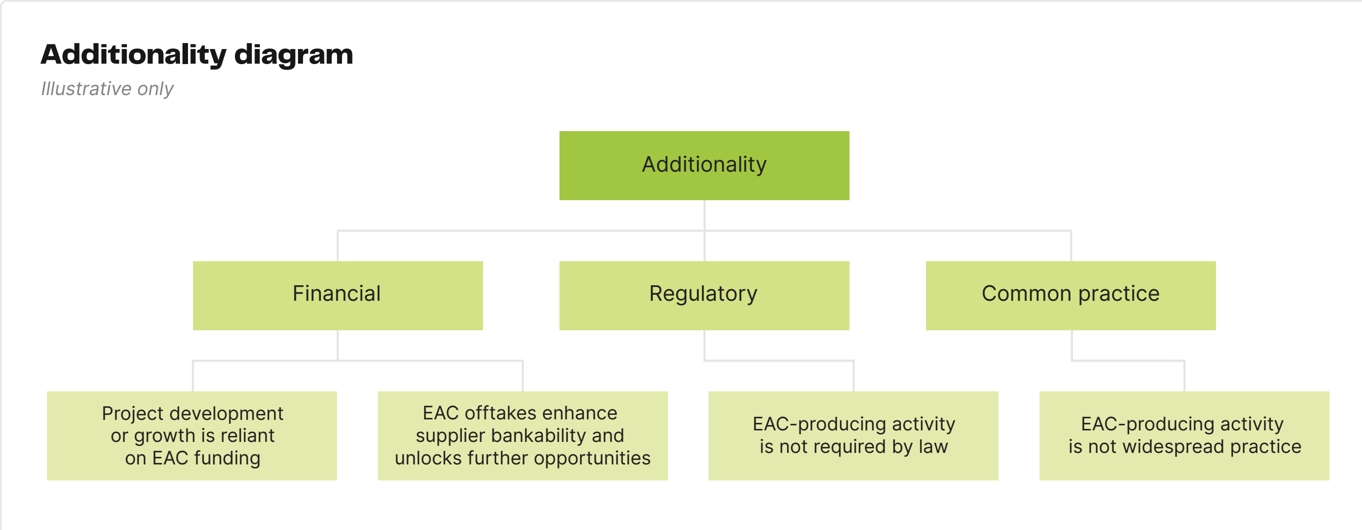



**Figure 1.** Additionality includes three aspects: financial, regulatory, and common practice. Source: Carbon Direct.

### PROCUREMENTS OF EACS MUST

- Support projects that are demonstrably additional. Additionality requires that financial support provided through EAC purchases drives real and meaningful reductions in GHG emissions that would not have otherwise occurred.
- Demonstrate that EACs are a necessary component for project initiation via detailed financial disclosures provided to buyers and their agents, especially if multiple sources of funding are involved.
- Require full transparency regarding any tax credits, subsidies, or incentives that are part of the project's financial structure, as these may reduce the magnitude of the need for EAC purchases.
- Demonstrate that EAC projects are not mandated by existing or enforced laws, regulations, or other binding obligations.
- Demonstrate that a project's proposed activities are not already common practice within its respective industry. If a low-carbon technology or process is already widely adopted, it does not qualify as additional under the EAC framework.

### PROCUREMENTS OF EACS SHOULD

- Consider whether EAC procurement supports broader market scalability and repeatability, helping to lower costs and drive investment in future low-carbon projects across the sector.
- Report the impacts of EACs relative to appropriate baselines.

- For cement, report EAC impacts against local average cement baselines in the region or market where the EAC was generated. For concrete, report EAC impacts against local average concrete baselines in the region or market where the EAC was generated, comparing to a baseline of the same product category, compressive strength, and which meets the same technical standards.[10]
- For steel, report EAC impacts relative to a conservative global average.[11]

## Criterion 5. Catalytic impact

The catalytic objective of EAC procurement is to target decarbonization pathways that have the potential for large-scale impact and adoption. Solutions that achieve marginal reductions or that create lock-in of technologies that cannot be significantly decarbonized do not meet this criterion. First-of-a-kind projects may face challenges accessing financing due to their risk profiles compared to projects using traditional technologies. Project finance models that provide investment certainty and financial derisking through multi-year purchase commitments can be catalytic. As technological viability evolves, the criteria for catalytic projects must be regularly reassessed to maintain impact.

**PROCUREMENTS OF EACS MUST**

- Support projects and technologies that have the potential to scale and significantly contribute to sectoral decarbonization. Sectoral significance should be consistent[12] with the commodity significance thresholds identified in *Criterion 1. Qualifying conditions*.
- Require project developers to articulate a clear and reasonable pathway for scaling the solution and achieving cost competitiveness over time. Developers must outline the dependencies (e.g., renewable energy, green hydrogen, or other enabling technologies) that may influence their ability to reach affordability and scale.
- Prioritize innovative, scalable solutions that require temporary financial support to achieve cost reductions and become commercially viable.

10. Please see the *Criteria for high-quality EACs in the concrete sector* section of this document for more information.

11. Please see the *Criteria for high-quality EACs in the steel sector* section of this document for more information.

12. Recognizing there is some ambiguity in the principle of sectoral significance, we leave some flexibility for interpretation. A fixed sectoral threshold cannot account for all possible pathways to sectoral decarbonization, which may depend on the cumulative benefits of multiple intervention pathways.

- Apply only to cases where reductions are substantial[13] and not be applied to minor, ultimately non-catalytic, reductions in emissions for a commodity.

**PROCUREMENTS OF EACS SHOULD**

- Verify that materials meet performance requirements such that the products are applicable at scale across a significant portion of the market.
- Occur through multi-year purchase agreements, rather than relying solely on spot-market transactions, to provide the price stability and investment certainty needed to scale new production capacity. Furthermore, the bankability of multi-year EAC purchase agreements can unlock a lower cost of capital for early-stage projects.

# Criterion 6. Verifiability

A high-integrity verification approach must be established in the absence of a formal EAC standard to set a high bar for documentation, rigor, and conservative carbon accounting. Established **product category rules** (PCRs) used for the development of **environmental product declarations** (EPDs) are an appropriate starting point to guide the calculation of environmental attributes. Moreover, **certification** of commodities under an existing green standard, even if that standard is not designed for book and claim, can support the integrity of early market transactions.

**PROCUREMENTS OF EACS MUST**

- Demonstrate that the claimed environmental attributes are real, measurable, and not double counted.
- Require a robust cradle-to-gate measurement, monitoring, reporting, and verification (MMRV) plan that serves as the foundation for an auditable environmental attribute.
- Require that EACs and associated physical commodities be traceable from production to point-of-displacement. Minimum requirements include:
  - Batch information (year of production and date of entry into the CoC tracking system),
  - Supplier details (name, address, and production site),
  - Customer information (name, address, point of delivery), and
  - Product specifications.

13. Microsoft's requirements may differ from those of other organizations. The criteria outlined above should guide significance thresholds but should not be viewed as prescriptive for the broader market. Microsoft is working to reduce absolute GHG emissions for delivered goods and services by at least 55% by 2030. The pertinent emissions reductions threshold may differ depending on organizational goals and sector-specific realities.

- Require that environmental attributes be quantified and audited using transparent project-level data and consistent methodologies that are tailored to the specific sector, ideally PCRs for that sector.
- Require verification by independent auditors at the project level.
- Implement safeguards against **double counting**:
  - Verify that environmental attributes are attributable only to the EAC and are not monetized for attribute claims in other carbon markets.
  - Verify that the attribute is not reportable as an emissions reduction by the physical product via an EPD as well as in an EAC.
- Adhere to Microsoft's *Supplier Carbon-Free Electricity Guidance* and utilize **proportional attribution** when renewable energy certificates (RECs) are part of environmental attribute claims.
- Require that projects report the carbon intensity of materials both before and after the application of RECs to provide a clear and accurate emissions profile.
- Utilize verifiable and accurate emissions accounting at the project level, ideally with primary data from individual production sites whenever possible. In multi-product systems, follow ISO 14044 guidelines for allocation to verify that carbon and renewable energy attributes are appropriately distributed. If physical allocation (e.g., allocation to products and co-products by mass or heating value) is determined to be appropriate,[14] make sure this is well justified by a shared physical link between the products. If a physical basis is not suitable or does not reflect the system's main function, economic value can be used instead. Careful procedures for environmental attribute allocation are necessary to demonstrate that each certificate represents a unique and additional environmental attribute with minimal risk of double counting.

**PROCUREMENTS OF EACS SHOULD**

- Strive for interoperability with existing PCRs and EPDs for concrete, steel, or other commodities. The goal is to augment existing best practices for industry data sharing on sustainability rather than to interfere with or complicate them. EACs should endeavor to use comparable system boundaries, functional units, and allocation rules in their verification processes.

14. The LCA practitioner will decide on the appropriateness of an allocation procedure. ISO 14044 indicates a preference for avoiding allocation where possible and, where it is unavoidable, recommends that allocation should reflect the physical relationships between the products. Context is important. Products may not share physical characteristics (e.g. a process that produces both a material good and electricity). Moreover, two products with equal mass may have vastly different economic value. Physical allocation may not accurately reflect the activity driving process emissions. As such, justification for the allocation procedure is always required.

# Criterion 7. Leakage

There are two primary types of economic leakage: **activity-shifting leakage** and **market leakage**. Activity-shifting leakage occurs when production activities that were previously operating within a project's boundary do not stop, but are simply relocated to outside of the project boundary due to the introduction of EAC-supported processes. Market leakage happens when a reduction in the production of a specific commodity in one location leads to an increase in production of that commodity elsewhere to meet market demand. In the context of low-carbon commodities, market leakage can occur when decarbonization of the commodity is dependent on a low-carbon input with inelastic supply that is currently used for another purpose. Market leakage is particularly difficult to predict and measure, but a high-level assessment of leakage risk should be part of the screening process for EAC purchases.

#### PROCUREMENTS OF EACS MUST

- Assess leakage risk as part of the diligence process when deciding whether to move forward with procurement.
- Conduct a **consequential life cycle assessment** to quantify the magnitude of leakage risk before moving forward with procurement if a significant potential for leakage risk is identified in the initial diligence.
- Determine that the project is not a suitable candidate for an EAC if it is more likely than not that leakage would nullify more than 20% of anticipated emissions reductions and the risk cannot be mitigated.

#### PROCUREMENTS OF EACS SHOULD

- Aim to minimize market leakage risks and prioritize using waste materials that do not have other high-value applications.

# Sector-specific criteria

## Criteria for high-quality EACs in the concrete sector

Cement production is globally distributed. The newest infrastructure (under 10 years old) is concentrated in China and India, where construction demand is expected to rise (**figure 2**). Clinker producers and buyers provide material to cement producers, who sell in bulk to subcontractors for specific projects. Numerous stakeholders influence purchasing decisions. The complexity of the construction supply chain creates inherent challenges for connecting the supply of low-carbon materials with the demand for them. In addition, the industry's tight profit margins make it challenging to finance new low-carbon equipment or to take on additional cost risk.

### EAC units and functional unit recommendation

For cement, which is sold by mass, producers often buy raw materials and supplementary cementitious materials (SCMs) in bulk. EACs can be generated at the cement level, either by a cement producer or a precursor producer, so long as the EAC abides by the criteria described in this document. This approach not only more accurately reflects the materials used at scale but also benefits novel OPC producers. These producers are addressing emissions challenges in the cement kiln and exploring alternative methods for producing OPC—often at technology readiness levels that are lower than those of many SCM technologies. While SCMs play an important role in reducing emissions, their impact is inherently capped by technical substitution limits and building code constraints—barriers that novel OPC production pathways may be able to bypass, offering greater potential for long-term decarbonization at scale.

### Geographic distribution of cement supply chain

*Illustrative only*


**Global centers of cement production as of 2023 (based on the number of individual cement plants per country)**

- **1. China** (1,159)
- **2. India** (256)
- **3. United States** (105)
- **4. Brazil** (90)
- **5. Vietnam** (73)
- **6. Iran** (71)
- **7. Turkey** (69)
- **8. Italy** (63)
- **9. Russia** (56)
- **10. Germany** (52)
- **11. Spain** (48)
- **12. France** (47)
- **13. South Korea** (40)
- **14. Bangladesh** (38)
- **15. Indonesia** (36)
- **16. Mexico** (34)
- **17. Japan** (32)
- **18. Pakistan** (29)
- **19. Egypt** (24)
- **20. Australia** (22)

**Figure 2:** Map of global centers of cement production as of 2023. Source: Carbon Direct, using data from Tkachenko et al. (2023).

For concrete, which is procured in wet volumes (cubic yards or meters) and shrinks slightly as it dries, offering EACs based on wet volume establishes better compatibility for buyers to assess impacts on a comparable basis. In addition, concrete EPDs also use volume as a functional unit. This allows buyers to purchase adequate EACs to cover the actual amount of material they use.

## Significance threshold recommendation

**To qualify for EACs in concrete and cement, projects *must* achieve at least a D rating on GCCA's low-carbon rating scale (figure 3a and figure 3b) and *should* achieve a B rating if possible** (see **figure 4** for some examples of decarbonization interventions in the cement and concrete supply chains). Project developers must demonstrate a credible plan to reach AA rating. Smaller reductions are common and don't need EAC funding (i.e., aren't additional), while more significant emissions reductions typically require additional financial support.

GCCA's low-carbon rating system for cement and concrete provides a valuable framework for contextualizing deep decarbonization within these sectors. Specifically, GCCA's framework accounts for regional differences: allowing producers to compare their products against a national context. It recognizes that cement and concrete are not single, uniform products but rather distinct product families, each with their own individual commodities, that vary based on application. The rating system relies on EPD results. However, pilot technologies may not yet be at the scale required to obtain EPDs and may need to estimate their placement on the rating scale. Moreover, since the GCCA framework allows manufacturers to assess their own performance, technical diligence will be critical in evaluating EAC offtake agreements for decarbonized cement and concrete products.

As the EAC market matures, the minimum reduction threshold that is appropriate for EAC offtakes will need to be revisited and refined to maintain confidence that EAC financing supports the most impactful decarbonization pathways. In the concrete sector, EAC significance thresholds may evolve over time based on three key factors: (1) technological developments and learnings, especially as material incompatibilities or synergies become evident when combining multiple decarbonization techniques; (2) a shift away from current building codes that prescribe specific material formulas for cement and concrete toward performance-based standards that could create new opportunities for alternative materials; and (3) quantitative thresholds for green building materials established by national, state, and local governments, which will influence EAC standards.

## Global low-carbon ratings for concrete

*Illustrative only*

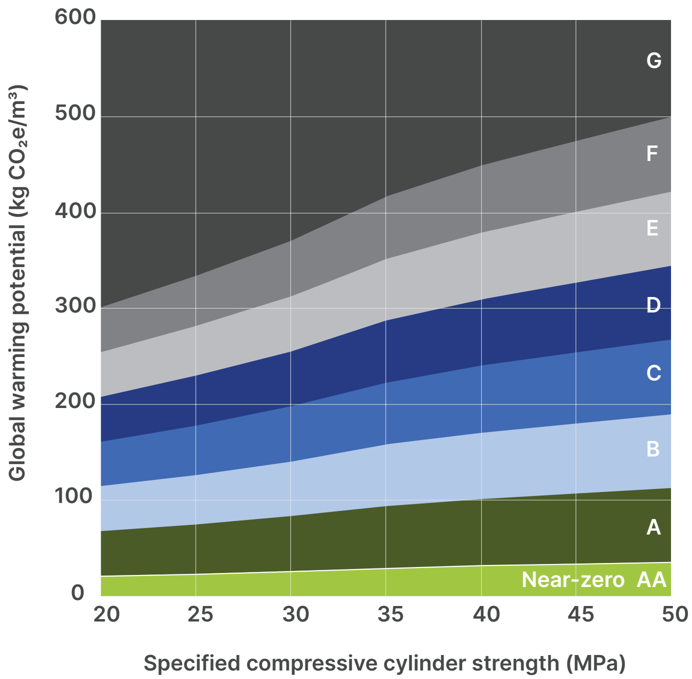
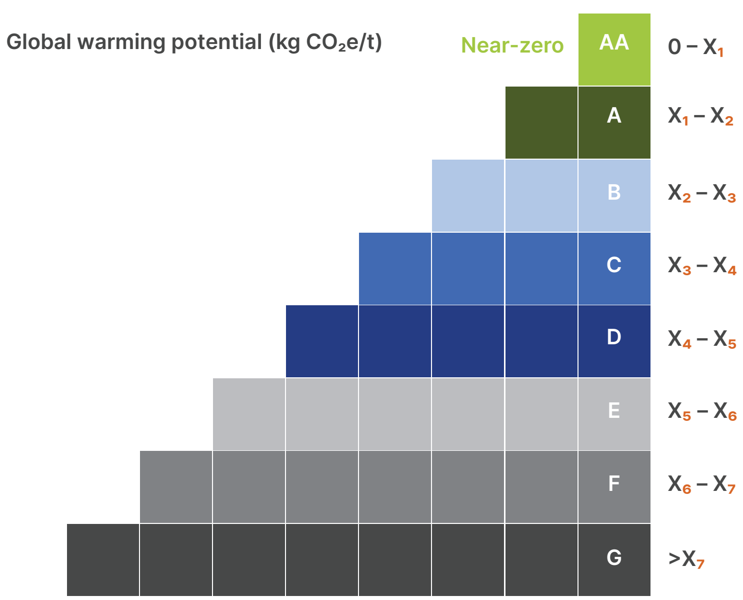



**Figure 3a:** Global Cement and Concrete Association's low-carbon rating system for concrete. Note: MPa = Megapascals (a unit of pressure used to measure the amount of force per unit area needed to cause a material to fail). Source: Carbon Direct, adapted from GCCA (2025) and republished with permission.

## Global low-carbon ratings for cement

*Illustrative only*




$X_i = (40 + 85 * CCr) * i$, where CCr is the clinker-to-cement ratio

**Figure 3b:** Global Cement and Concrete Association's low-carbon rating system for cement. Note: Countries choose a clinker-to-cement ratio (CCr) to establish country ratings. For example, Germany chose a national average CCr of 0.706. To determine a product's rating, a producer reports the greenhouse gas emissions in $tCO_2e$/tonne of cement, in line with the method used for environmental product declarations in their country or region, and then compares that to the category markers determined by the $X_i$ formula and selected CCr value to assign a rating. Source: Carbon Direct, adapted from GCCA (2025) and republished with permission.

## Decarbonization opportunities in the cement and concrete supply chains

*Illustrative only*

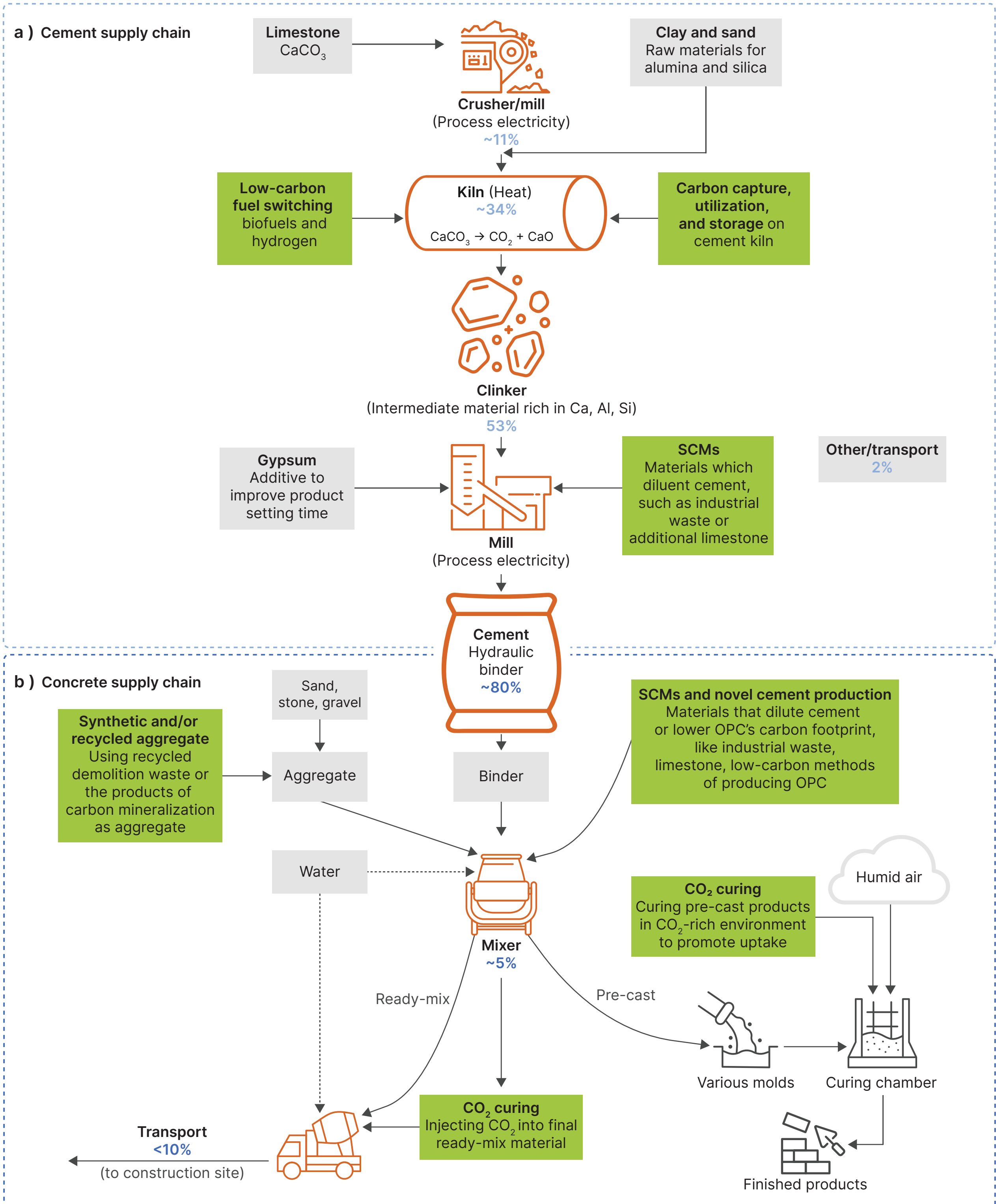



**Figure 4.** Concrete supply chain (a) and cement supply chain (b) including potential points of intervention to decarbonize. Emissions percentages are shown in light blue for cement and darker blue for concrete: where the process emissions of cement accumulate to be ~80% of concrete's total emissions. Note: Al = aluminum, Ca = calcium, $CaCO_3$ = calcium carbonate, CaO = calcium oxide, $CO_2$ = carbon dioxide, SCM = supplementary cementitious material, Si = silicon, OPC = ordinary Portland cement. Source: Carbon Direct.

### Common practice additionality and catalytic impact

Certain project types are unlikely to be suitable for EAC procurement due to their limited decarbonization potential or because of incentives that already exist and are readily available. To drive meaningful impact, the criteria outlined here incorporate both additionality (*Criterion 4*) and catalytic impact (*Criterion 5*), preventing companies from claiming EACs for business-as-usual practices. EACs procurement should be prioritized for projects that contribute to clinker decarbonization or significantly reduce clinker demand. Individual project diligence will be essential for early EAC offtakes in the cement and concrete industry to critically assess carbon accounting as strategies like burden-free waste streams; fuel switching; and carbon capture, utilization, and storage become more widely adopted.

In the mid-20th century, the cement industry was more concerned with cost than with emissions. While OPC was expensive, fly ash (a coal combustion waste that is rich in calcium oxide and silica) was an inexpensive alternative that could partially replace OPC without compromising concrete performance. By the late 20th century, blending fly ash into cement became widespread and common practice. This practice, now prevalent, contributed to a gradual reduction in the sector's carbon footprint. In isolation, the emissions reductions associated with fly ash as an SCM would not satisfy common practice additionality. The same can be said for other common waste products incorporated into cement such as ground granulated blast furnace slag, silica fume, and foundry sand, which vary by geography and availability. However, technologies that innovate on or scale the use of fly ash, or other waste materials, may offer a viable path to EAC procurement.

# Criteria for high-quality EACs in the steel sector

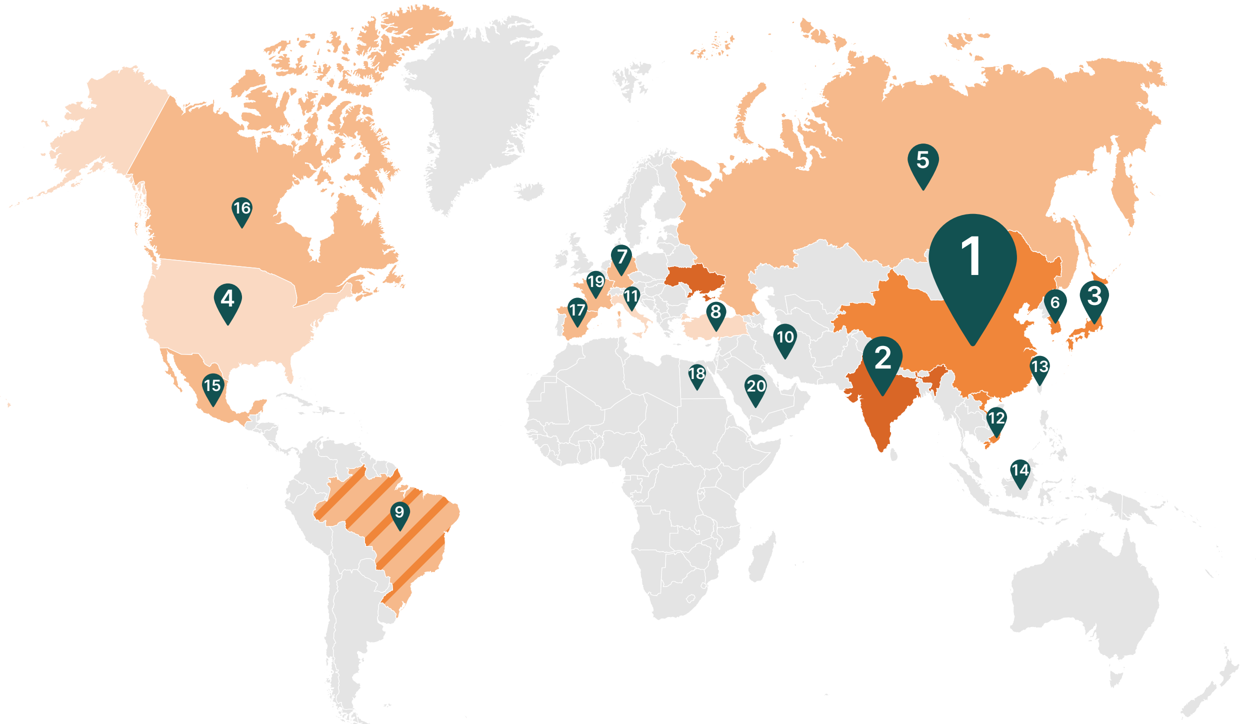
Steel is a globally traded commodity with a complex supply chain involving multiple stakeholders (**figure 5**). Steel manufacturing encompasses various stages, starting from raw materials to semi-finished and finished products. Raw materials such as iron ore, coking coal, and scrap steel are traded extensively and internationally. Steel producers manufacture various **semi-finished steel products** (e.g., slabs, billets, and blooms) and **finished steel products** (e.g., hot-rolled, cold-rolled steel, and beams) which are traded worldwide to meet the demands of the construction, automotive, and manufacturing sectors.

### EAC units and functional unit recommendation

EACs for low-carbon steel should be generated based on mass, measured in tonnes, to align with steel procurement. Steel EACs can be generated at various production stages, provided they meet the criteria described in this document, with the semi-finished steel stage (e.g., slabs, billets, blooms) being a reasonable point of generation. While iron and steel production are typically integrated within a single facility, EACs could alternatively be generated at the iron production stage if the decarbonization intervention is implemented during ironmaking. The EAC should be generated at a stage where the most emissions have occurred, key decarbonization strategies are implemented, and the materials remain generalizable across the supply chain. Additionally, the mass-based approach is consistent with LCA methodologies, and is interoperable with PCRs and EPDs, which typically define steel-related emissions intensity in terms of kilograms or $tCO_2e$ per tonne of steel produced.

## Geographic distribution of steel supply chain

*Illustrative only*




**Global centers of steel production as of 2023 (based on crude steel production in million tonnes)**

1. **China** (1,019.1)
2. **India** (140.8)
3. **Japan** (87.0)
4. **United States** (81.4)
5. **Russia** (76.0)
6. **South Korea** (66.7)
7. **Germany** (35.4)
8. **Turkey** (33.7)
9. **Brazil** (31.8)
10. **Iran** (31.0)
11. **Italy** (21.1)
12. **Vietnam** (19.2)
13. **Taiwan** (19.1)
14. **Indonesia** (16.8)
15. **Mexico** (16.2)
16. **Canada** (12.2)
17. **Spain** (11.4)
18. **Egypt** (10.4)
19. **France** (10.0)
20. **Saudi Arabia** (9.9)

**Carbon intensity of steel production based on data from 2019**

0.0 0.5 1.0 1.5 2.0 2.5

Data not available

**Figure 5:** Map of global centers of steel production as of 2023 and carbon intensity of steel production as of 2019. Source: Carbon Direct, using data from World Steel Association (2024) and Hasanbeigi (2022).

### Significance threshold recommendation

**EAC projects must meet at least PL2 of the ResponsibleSteel framework**. The ResponsibleSteel International Production Standard's Decarbonization Progress Levels offer valuable steel-specific benchmarks (**figure 6**), using a scrap-variable approach that recognizes both the benefits of scrap-based production and its limited, geographically-distributed availability. This framework incentivizes all steelmakers, regardless of technology or scrap access, to adopt low-emission production pathways.

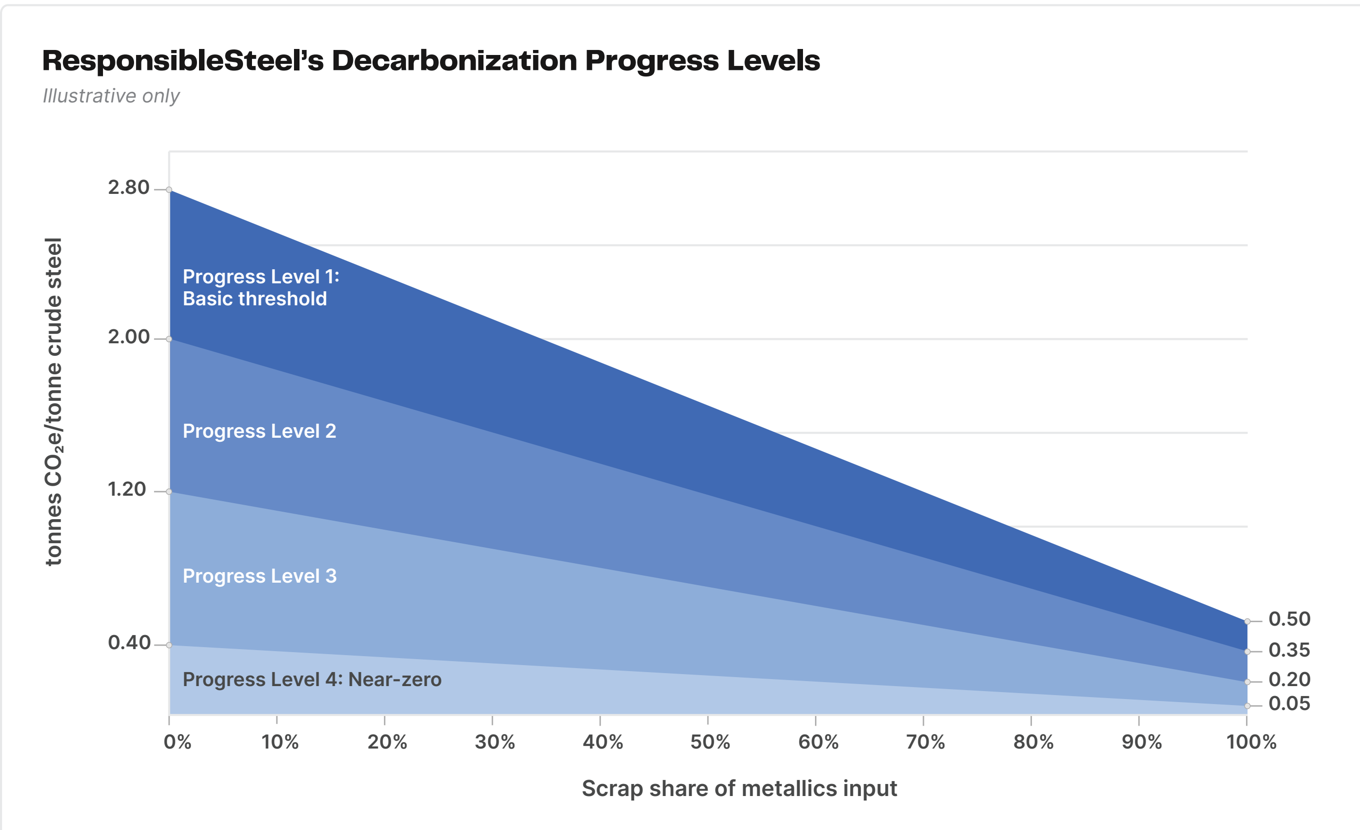



**Figure 6:** ResponsibleSteel's Decarbonization Progress Levels. Source: Carbon Direct, adapted from ResponsibleSteel (2024) and republished with permission.

PL2 supports the gradual shift toward lower-carbon production by allowing the inclusion of new natural gas-based DRI-EAF[15] and emerging hydrogen-based DRI-EAF projects (**figure 7**). Steel producers can achieve this transition by incorporating cleaner electricity sources and low-carbon-intensity hydrogen as they become more widely available. Project developers should aim to achieve at least PL3 by 2030 and verify that projects have a credible and time-bound transition plan to PL4. This requirement is essential to minimize the risk of stranded assets and improve alignment with long-term climate commitments.

## Common practice additionality and catalytic impact

The most suitable EAC projects for steel involve low-carbon ore reduction technologies. These technologies are capital-intensive, would benefit most from EAC financial support, and have the potential to transform the sector. In contrast, process improvements within blast furnace-basic oxygen furnace (BF-BOF) steelmaking route are expected to become cost-competitive without EAC support and are not likely to require additional financial incentives. Incremental upgrades, such as using best-available technologies, fuel switching, and waste-gas recycling, should be carefully evaluated to avoid inadvertently prolonging the industry's reliance on coal-based processes.

Projects in the steel sector that rely primarily on renewable electricity procurement as their main emissions reduction strategy are not appropriate candidates for EAC support. Shifting to renewable electricity in existing EAF facilities is a valuable step toward decarbonization, but it is not transformative enough on its own to warrant EAC support. It does not directly transform the underlying processes responsible for the sector's high emissions (see *Criterion 5. Catalytic impact*). EACs should be targeted toward transformative capital changes, such as the replacement of BF-BOF with DRI-EAF to enable electrification, adoption of DRI with low-carbon hydrogen, or carbon capture in primary steel routes, rather than toward incremental shifts in electricity sourcing.

15. In direct reduced iron (DRI) steel production, iron ore is reduced to produce DRI. This is then melted in an electric arc furnace (EAF) to create steel. The DRI-EAF process offers a potentially lower-carbon method of steel production compared to conventional blast furnace methods, especially when using low-carbon hydrogen in the DRI stage.

**Scrap recycling:** EAFs can operate with up to 100% scrap, while BOFs use 15–25% scrap to regulate temperature and efficiency. Increasing scrap use significantly reduces emissions by avoiding carbon-intensive primary iron production. However, scrap availability is limited by historical steel consumption, product lifespans, and end-of-life recovery rates, making it insufficient to meet total steel demand. Projects relying solely on high scrap usage are unlikely to be additional due to an established recycled steel market, but combining scrap recycling with low-carbon ore reduction could create viable EAC opportunities.

## Steel supply chain and emissions hotspots

*Illustrative only*

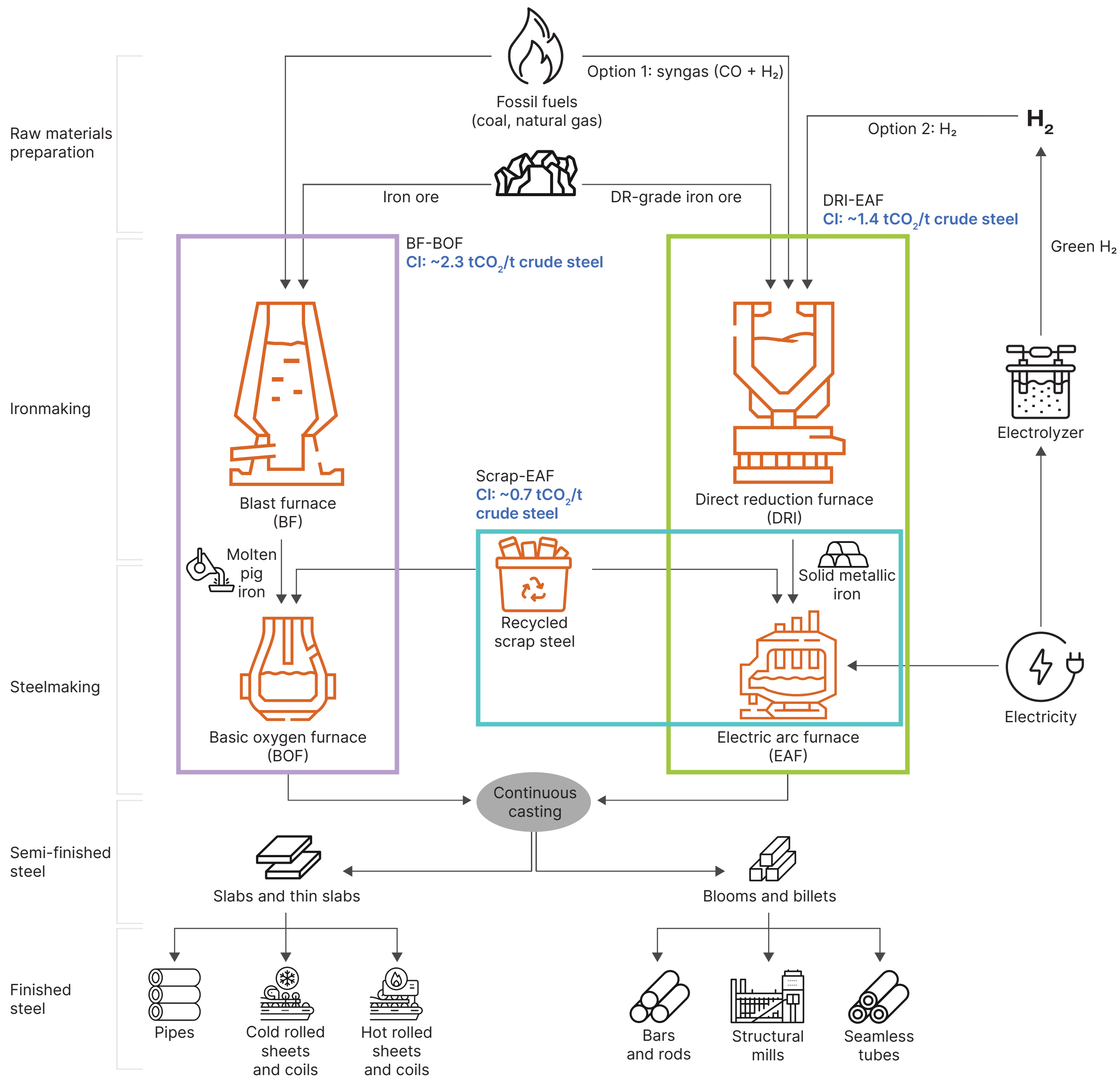
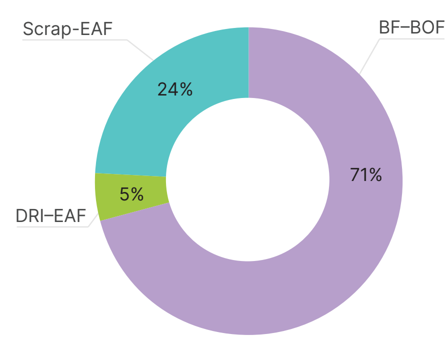



**Figure 7:** Steel supply chain and potential points of intervention to decarbonize. Average carbon intensities, in $tCO_2$ per tonne of crude steel cast, are denoted in blue. Division of global steel production by method is shown via a pie chart—colors correspond to the production routes enclosed in purple (BF-BOF), blue (scrap-EAF), and green (DRI-EAF) lines in the diagram. A DRI furnace requires premium iron ore with an iron content of more than 65%. Only 13% of globally shipped iron ore is of sufficient grade for DRI-EAF production. Note: CI = carbon intensity, CO = carbon monoxide, $CO_2$= carbon dioxide, DRI = direct reduced iron, $H_2$ = hydrogen. Source: Carbon Direct.

**Global steel production methods (% of global production)**



# Conclusion

As the EAC landscape continues to evolve, stakeholder engagement in a number of initiatives is already underway. The criteria we have outlined here represent a starting point for setting high-integrity standards in the EAC market. These criteria may adapt over time as markets, technologies, and best practices mature. We hope this first edition serves as a valuable foundation for advancing transparency, impact, and integrity in EAC markets.

Open dialogue is essential to advancing our shared understanding of what constitutes high-quality EACs and to fostering innovation in this rapidly evolving space. We welcome feedback, questions, and suggestions on the guidance presented in this document. Please feel free to reach out to Carbon Direct at info@carbon-direct.com.

Investment, collaboration, and shared learning are essential to building a robust and credible EAC market. We invite interested parties to explore Microsoft's procurement efforts and consider how they might contribute to the pipeline of high-quality EAC projects. For more information or partnership inquiries, please visit Microsoft's Carbon Reduction Program.

Ultimately, our goal is to contribute to a rapid and just climate transition. By collaborating, sharing insights, and promoting transparency, we aim to support the development of high-quality EACs. Our initial focus on concrete and steel reflects the urgent need to address emissions from some of the most carbon-intensive sectors in industry. Thank you for your engagement—we look forward to working with you as we continue on this vital journey.

# Glossary

**Additional:** Projects are additional if they result in emissions reductions that would not have occurred without the certificate purchase. Additionality is evaluated across three aspects—regulatory additionality, financial additionality, and common practice additionality. See the definition of each of these terms below for more detail.

**Activity-shifting leakage:** Activities that directly cause emitting activities to be shifted to another location outside of project boundaries, canceling out some or all of a project's emissions benefits.

**Attributional life cycle assessment:** A method that estimates and attributes life cycle environmental burdens (including greenhouse gas emissions) of a product system to all its products and/or functions.

**Book and claim:** Book and claim is a Chain of Custody model that allows environmental attributes to be decoupled from physical, lower-carbon products or services that would ordinarily directly carry those attributes. This creates a separate certificate that allows buyers without physical access to lower-carbon products or services to financially enable the decarbonization of a sector and claim its benefits.

**Carbon credits:** Programs or policy regimes in which companies or individuals pay for activities that result in emissions reductions or removals. Voluntary programs involve direct payment to project developers, while compliance programs, like cap-and-trade, permit companies to exceed emissions caps by supporting offset projects.[16]

**Catalytic:** An environmental attribute certificate purchase is catalytic when it funds the expansion of a technology that has the capacity to play a large role in sector-wide decarbonization. The technology must both allow for significant emissions reductions on the product level and, when scaled, reduce a large share of emissions in the sector as compared with other decarbonization levers.

16. Adapted from Wilcox et al. (2021).

**Certification:** Certification is the process of evaluating something (in this document, the sustainability of a supply chain) against a set of established criteria. An independent accredited auditor conducts the certification process.

**Cement:** A hydraulic binder composed primarily of calcium silicates, produced by grinding clinker with gypsum. When mixed with water, it undergoes hydration reactions and hardens to bind the aggregates used in concrete.

**Clinker:** A precursor to cement that is produced by calcining limestone and aluminosilicates at 1,300–1,500°C in a rotary kiln.

**Common practice additionality:** A metric which establishes that a project's activities are not already widespread within a given industry. A project lacks common practice additionality if its decarbonization measures are already standard practice.

**Concrete:** A composite material consisting of cement, water, fine and coarse aggregates, and optional additives. Through cement's hydration reaction, it gains compressive strength, making it foundational for structural engineering and building.

**Consequential life cycle assessment:** A method that estimates changes in environmental impacts within and outside of a product system due to change(s) in the product system.

**Counterfactual:** Hypothetical scenario representing what would have occurred in the absence of a specific action that generated an environmental attribute; often the business-as-usual case is used as a counterfactual to assess additionality.

**Double counting:** Double counting in book and claim systems refers to the erroneous, duplicate, or improper accounting of emissions reductions. This term encompasses three main scenarios: double issuance (duplicate creation of certificates for the same solution), double claiming (multiple parties claiming the same certificates),and double use (repeated utilization of a single certificate by the same party for multiple purposes).

**Embodied carbon:** The greenhouse gas emissions associated with the production stages (extraction, transport, and manufacturing) of a product's life. Many initiatives to track, disclose, and reduce embodied carbon emissions also consider emissions associated with the use of a product and its disposal.[17]

17. Adapted from United States Environmental Protection Agency (2025).

**Environmental attribute:** Environmental attributes are characteristics of products that represent specific sustainability aspects of those products. These attributes may include carbon intensity, emissions reductions, and other sustainability characteristics.

**Environmental attribute certificate (EAC):** An environmental attribute certificate represents the environmental attributes (including carbon intensity, emissions reductions, and other sustainability characteristics that substantiate a claim) associated with a given quantity of a lower-carbon product (e.g., a tonne of crude steel).

**Environmental product declaration (EPD):** A verified report detailing a product's environmental impacts, including greenhouse gas emissions, per ISO 14025 and 21930 standards. Used for procurement, environmental product declarations follow product category rules and provide data specific to a product and supply chain, typically covering cradle-to-grave impacts.[18]

**Financial additionality:** A metric which establishes that environmental attribute certificates are essential to a project's financial viability or scalability. Financial additionality can be demonstrated when revenues from environmental attribute certificates directly enable project implementation, unlock more favorable financing terms, or improve bankability.

**Finished steel products:** Steel products, including coils, sheets, strips, wire, bars, rods, tubes, pipes, and rail, which are made for customers and created by further processing semi-finished steel through rolling, forming, pressing, cutting, and bending.

**Functional unit:** A property of a product or product system that directly represents the core function and performance the product delivers in its use phase.

**Identity preservation:** Chain of Custody model in which the materials or products originate from a single source and their specific characteristics are maintained throughout the supply chain.[19]

18. Adapted from Natural Resources Defense Council (2022).

19. Adapted from International Organization for Standardization (2020).

**Inelastic supply:** Inelastic supply tends to not increase or decrease substantially with a change in price or demand. For example, sawdust supply is driven by demand for wood, not demand for sawdust.

**Market leakage:** Increase in GHG emissions when other market actors shift their activities due to a project affecting the supply and demand equilibrium.

**Mass balance:** A Chain of Custody method which accounts the movement of materials into, out of, and within a system to allow the blending of lower-carbon products with conventional products.

**Near-zero:** The threshold for ResponsibleSteel's near-zero, ResponsibleSteel's Progress Level 4, and the Global Cement and Concrete Association's AA rating, which are aligned with the International Energy Agency's proposed threshold for near-zero emission production of steel, cement, and concrete. ResponsibleSteel's intermediate levels, Progress Level 2 and Progress Level 3, are also aligned with proposed performance ranges from the International Energy Agency.

**Product category rules (PCRs):** Guidelines that define how to conduct a life cycle assessment and develop environmental product declarations for a specific product type. PCRs ensure consistency, transparency, and comparability by standardizing what data to include, how to calculate impacts, and how results must be reported.

**Proportional attribution:** Suppliers allocate a proportional percentage of resources (such as carbon-free electricity) to all products or customers within a specific market rather than preferentially allocating the resource to a single customer or subset of customers.[20]

**Raw materials:** Naturally occurring materials or minimally processed inputs used in the production of goods, components, or energy. They serve as the foundational building blocks for manufacturing processes and can be classified as renewable (e.g., timber) or nonrenewable (e.g., minerals).

20. Adapted from Microsoft (2025).

**Regulatory additionality:** A metric which establishes that the climate benefits associated with a project go beyond what is already required by law or regulation. Environmental attribute certificates fulfill regulatory additionality only if they support voluntary actions that exceed existing policy mandates.

**Scope 1:** Scope 1 emissions are defined by the Greenhouse Gas Protocol as direct emissions from an organization's owned or controlled sources, such as company-owned vehicles, on-site fuel combustion, or industrial processes.

**Scope 2:** Scope 2 emissions are defined by the Greenhouse Gas Protocol as indirect emissions from an organization's energy use from purchased electricity, heating, or cooling. These are generated off-site but result from an organization's energy consumption.

**Scope 3:** Scope 3 emissions are defined by the Greenhouse Gas Protocol as indirect emissions from across an organization's value chain, including supply chain activities, business travel, employee commuting, and product lifecycle emissions. Often the most significant portion of a company's footprint, scope 3 emissions are also the most challenging to measure due to their complexity.

**Semi-finished steel products:** Initial solid forms of steel after casting (e.g., slabs, billets, and blooms) which are often transported for further processing into finished steel goods.

**Steel:** Steel is a durable alloy of iron and carbon widely used in the built environment for structural frameworks, reinforcements, and infrastructure due to its high strength-to-weight ratio.

**Unbundled:** The separation of the environmental attribute from the physical commodity, allowing the certificate to be traded and claimed independently of the physical material.

**Verifiable:** The ability of an independent party to confirm that the reported impacts (e.g., carbon accounting, community benefits) accurately match the real physical and financial impacts of activities from a specific EAC-generating project.

# Appendix: Chain of Custody models

**Table 1.** Chain of Custody models in ISO/DIS 22095 and ISEAL Alliance Guidance compared to EAC definitions

| Chain of Custody model | Description | ISO/DIS 22095 | ISEAL | EAC |
|---|---|---|---|---|
| Book and claim certificate model | Administrative record flow is not necessarily connected to the physical flow of material or product throughout the supply chain | Yes | Yes | Yes |
| **Identity preservation** model | Materials or products originate from a single source and their specific characteristics are maintained throughout the supply chain | Yes | Yes | No |
| Segregated model | Specified characteristics of a material or product are maintained from the initial input to the final output | Yes | Yes | No |
| Controlled blending model | 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 | Yes | No | No |
| Mass balance model | Materials or products with a set of specified characteristics are mixed according to defined criteria with materials or products without that set of characteristics | Yes | Yes | No |

# Acknowledgement

This first edition of the *Criteria for High-Quality Environmental Attribute Certificates in the Concrete and Steel Sectors* is the result of thoughtful collaboration among several science contributors, including leading experts from Carbon Direct, Microsoft, and practitioners across industry and academia. Their combined expertise was essential in shaping the guiding principles and technical foundations of this work. We are also deeply grateful for the invaluable support of our management, marketing, legal, editorial, and design teams, whose efforts enhanced the clarity, usability, and accessibility of this document. Bringing this inaugural version to life has been a true collective effort. We extend our sincere thanks to all those who contributed their time, knowledge, and care to this endeavor.

Cover image: Steel truss in construction roof site. Source: Adobe Stock