INDUSTRIAL DEEP DECARBONISATION
AN INITIATIVE OF THE CLEAN ENERGY MINISTERIAL

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION
Progress by innovation

Driving consistency in the GREENHOUSE GAS ACCOUNTING SYSTEM

A pathway to harmonized standards for steel, cement, and concrete

Acknowledgements and disclaimer

This white paper was developed based on a series of discussions held in 2023 involving representatives from the IDDI member governments, and a number of organizations, including: Agora Energiewende, American Iron and Steel Institute, British Standards Institute, Building Transparency, Carbon Leadership Forum, CEM Secretariat, ConcreteZero, ConstructionLCA, Deutsches Institut für Normung (German Institute for Standardization), Global Cement and Concrete Association, Global Steel Climate Council, International Energy Agency, Jernkontoret, The King Abdullah Petroleum Studies and Research Center, ResponsibleSteel, Swedish Institute for Standards, SmartEPD, Standards Council of Canada, VDZ Technology GmbH (Association of German Cement Works), World Steel Association, World Trade Organization, Wirtschaftsvereinigung Stahl (German Steel Association).

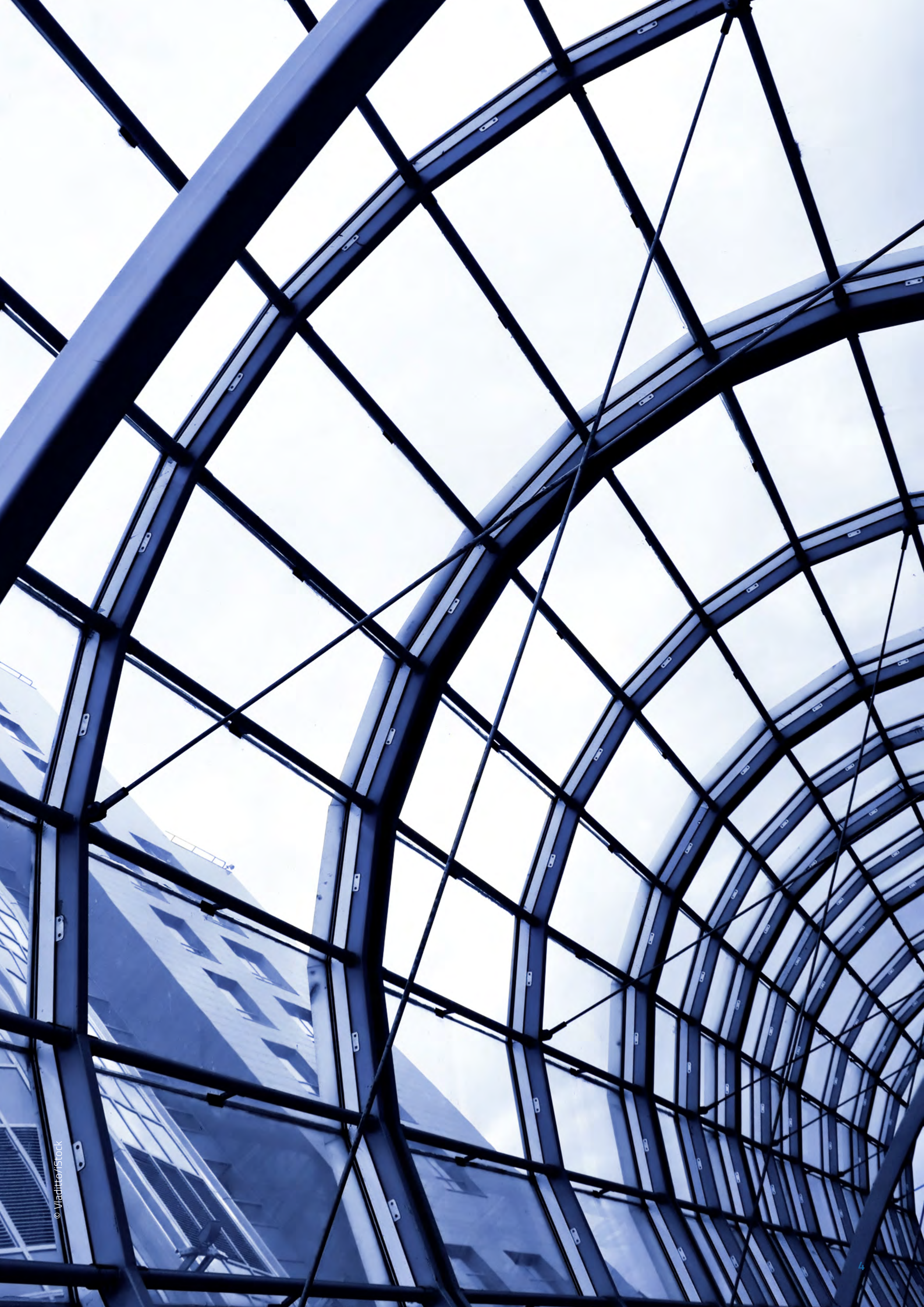
The contents of this document are not to be construed as endorsements or reflective of the official positions of member governments or the contributing organizations.

This white paper was developed with the support of Boston Consulting Group.

Cover photo: ©iStock and ©AdobeStock

Design: Small World Stories

Contents



Foreword

The need for a sustainable and just energy transition has never been more urgent. Global collaborative actions are needed to create an enabling environment for deep decarbonization of heavy industries. Policy frameworks that support a shared language for measuring and reporting the embodied emissions of products can help unlock the investments needed to deliver on the goals of the Paris Agreement and limit global temperature increase.

This white paper aims to initiate discussions and provide constructive input to national fora, facilitating a collaborative exchange of ideas and strategies for the practical implementation of harmonized greenhouse gas accounting on a global scale.

The urgency of driving towards harmonized greenhouse gas accounting approaches cannot be overstated. To achieve our climate goals, we must ensure that these frameworks can serve as a robust and trusted foundation for informed decision-making. A harmonized accounting system will not only enhance transparency, but will also facilitate fair comparisons of products and allow those investing in decarbonization to capture value from the market.

It is important to emphasize that this white paper represents a starting point – a call for collaborative action – rather than a conclusive stance of any government. We recognize the need for a nuanced approach that reflects the diverse circumstances and challenges faced by different regions and sectors. The journey towards harmonized emissions accounting is a shared endeavor, and its success relies on the engagement and commitment of governments, as well as industry, standardization bodies and civil society organizations around the world.

Rana Ghoneim,
Chief, Division of Energy and Climate Action,
United Nations Industrial Development Organization

Executive summary

- While often overlooked, greenhouse gas accounting standards play a critical role in the energy transition. These standards can enable companies to differentiate their products on the basis of greenhouse gas (GHG) emissions, allowing them to capture value from investing in decarbonization. They also serve as an important enabler for green procurement from both the private and public sectors, driving demand for low-emission products.
- Despite the critical role they play, current greenhouse gas accounting standards for steel, cement, and concrete fail to generate consistency in reporting due to gaps in existing standards or to inconsistencies across coexisting accounting frameworks.
- To accelerate the development of harmonized greenhouse gas accounting at a global level, the Secretariat of the Clean Energy Ministerial's Industrial Deep Decarbonization Initiative (IDDI), hosted by UNIDO, has identified the primary drivers of variance in emissions reporting for steel, cement, and concrete and proposed guidance to drive greater consistency.
- To provide a common basis for adjudicating disagreements in standards, this report proposes a set of common principles derived from the Greenhouse Gas Protocol and the International Energy Agency's work. These principles can serve as north star objectives for a harmonized greenhouse gas accounting system.
- While driving towards consensus on these issues represents progress, it will be essential to move from guidance to implementation in the major ISO and EN standards to drive meaningful change.
- Driving revisions to ISO and EN standards is an inherently complex process that requires engagement from and alignment with multiple stakeholders including national governments, national standards bodies, industry groups, and reporting organizations to build consensus on key issues.
- Given the complexity of this task, the IDDI Secretariat proposes interim implementation efforts that focus on revising the product category rules that govern reporting for steel and concrete construction products. Nevertheless, the guidance provided in this document is broadly relevant for non-construction steel as well.
- While the scope of this publication is limited to steel, cement, and concrete given the IDDI's focus on public procurement and the outsize impact of government purchasing in these sectors, the principles-based approach introduced here may serve as a model for efforts to harmonize GHG accounting in other industrial sectors. Any efforts to extend this approach would require extensive engagement with relevant stakeholders.

1. The critical role of standards in industrial decarbonization

The global energy transition has never been more urgent, a point underscored by the results of the first global stocktake from the UNFCCC. While emissions need to fall by 7 per cent annually from now to 2030 to keep a 1.5-degree world within reach, they have continued to rise over the last decade at a rate of 1.5 per cent each year.[1] Turning the tide will require dramatic and imminent action on all possible fronts to accelerate the journey to net-zero.

While climate policies are beginning to accelerate decarbonization in some regions, far more is needed. This is particularly true in hard-to-abate sectors where technologies exist to dramatically reduce the carbon intensity of production but remain uneconomical relative to fossil-based alternatives. Steel and cement, industries that collectively account for more than 15 per cent of global greenhouse gas emissions, exemplify the magnitude of the challenge.[2] Currently planned production of near-zero emissions steel will reach just over 50 per cent of the 2030 target laid out in the IEA's Net Zero Scenario. For decarbonized cement, the equivalent figure is just over 5 per cent.[3]

Decarbonization of these sectors is particularly challenging given the magnitude of capital required to produce low-emission steel and cement. Decarbonizing a single cement plant will cost approximately USD 0.5 billion, while the equivalent figure for a steel plant could run well over USD 1 billion.[4] In some regions, policies such as Emissions Trading Schemes or equivalent subsidies are helping producers build the business case to decarbonize their operations. However, even in geographies with supportive policy environments, the business case still often relies on the existence of buyers willing to pay a premium for low-emission products.

Purchasers for low-emission steel and concrete are beginning to emerge as building developers and automotive and white good manufacturers make more aggressive commitments to decarbonize their supply chains. Organizations such as the First Movers Coalition, SteelZero, and ConcreteZero are seeking to accelerate these commitments and strengthen demand signals by aggregating purchasing volumes. Meanwhile, the Industrial Deep Decarbonization Initiative (IDDI) is

working with governments to add the purchasing power of public procurement to the equation, a notable addition given governments purchase projects that use up to 20 per cent of steel and approximately 50 per cent of concrete produced globally.[5]

However, even with growing demand for low-emission products, a key challenge remains. How can purchasers of steel or concrete know that the product they purchase is truly low-emission? Steel produced with iron from a hydrogen-fueled DRI furnace will have no visible marker that it is greener when fashioned into the body of a car. And it is implausible for automakers to independently monitor and verify the emissions associated with each ton of material they procure. It is even more unrealistic to expect car dealers to verify the embodied emissions in the cars on the lot, and yet, they will ultimately be responsible for articulating the value of a greener vehicle to the end-consumer as they seek a price premium to offset higher production costs.

Producers of steel, cement and concrete have realized, therefore, that claims about the carbon footprint of a product must be backed up by a universal system of accounting. Emissions calculations must rest on a consistent 'recipe' so purchasers can reliably evaluate the environmental impact of a ton of concrete or steel and easily compare it to competing products. Furthermore, it is critical that downstream purchasers of these products trust this system of accounting to enable them to make green claims in turn.

GOVERNMENTS PURCHASE
PROJECTS THAT USE UP TO

20 % OF STEEL

and approximately
50 % OF CONCRETE

PRODUCED GLOBALLY

While there is broad consensus that this system is critically needed, agreeing on the details is far more challenging. Determining the lifecycle emissions of a product is an inherently complex task involving several assumptions, a fact that is particularly true for industrial products. Steel, cement, and concrete are made through various production routes, use different energy inputs, create several co-outputs along the way, and reuse materials that have been produced by other industries. Additionally, these industries face rapid technological evolution, resulting in the introduction of novel greenhouse gas accounting questions. Creating consistent and comparable reporting in this context will require a high degree of precision in accounting standards.

Unfortunately, the 'recipes' laid out in existing standards for steel, cement, and concrete do not currently achieve this level of precision, leaving room for interpretation on several substantive issues. The result is inconsistency in reporting that reduces comparability of products within a given industry, as well as across competing materials. This opens the door to a range of green claims with varying degrees of merit that risk undermining trust in the broader system. Creating more clarity and transparency in this system will be critical to enable green leaders doing the hard work of decarbonization to differentiate from the laggards making more dubious green claims. In turn, this will enable investments in decarbonization by establishing clear mechanisms to differentiate low-emission products.

This paper seeks to assess the current state of greenhouse gas accounting standards for steel, cement, and concrete to identify the key issues driving variability in reporting. In addition, it provides recommendations on how standards can be updated to address these gaps and, ultimately, to build a more consistent and trusted accounting system.

2. Baselining greenhouse gas accounting in steel, cement, and concrete

2. 1. Overview of relevant standards

While accounting standards are becoming increasingly prominent in climate discourse, the practice of accounting for a product's lifecycle impact is not new. As such, various reporting frameworks have already been developed, resting on an overlapping web of standards and methodologies. Examining this landscape, three dominant reporting archetypes emerge for companies to report product-level emissions:

1. **Environmental product declarations (EPDs)** are comprehensive and standardized documents that provide verified information about the environmental impact of a product throughout its lifecycle. They examine several 'impact categories,' of which greenhouse gas emissions are one, expressed as global warming potential (GWP). They are developed based on product category rules (PCRs) that set out specific methodologies to calculate impact for a family of products. Such PCRs are the most comprehensive guidance available to assess the environmental impact of steel, cement, and concrete products and are themselves based on supporting lifecycle assessment studies.[6] Furthermore, EPDs developed under best-practice standards must be independently verified prior to publication, adding a safeguard against dubious green claims. Therefore, EPDs, and their underlying PCRs, are the primary focus of this report, though the findings can be applied more broadly for steel, cement, and concrete products.

2. **Independently verified lifecycle assessments** are conducted by companies to report the emissions from their products based on common standards. They can be based on virtually any standard as long as independent third-party verifiers certify that the emissions measurements conform to methodologies defined by a specific standard. For example, some assessments use ISO 14067:2018, which provides general guidance on the calculation of the carbon footprint of a product, as the sole basis on which to calculate emissions. Other companies calculate emissions according to more specific standards such as ISO 20915:2018, which provides specific rules for calculating emissions for steel production.

3. **Certifications issued by global not-for-profits** are an additional privately managed method for companies to report emissions. Organizations such as ResponsibleSteel and the Global Steel Climate Council (GSCC) have developed proprietary methodologies to calculate emissions, building on EN and/or ISO frameworks for stationary source emissions monitoring and product lifecycle assessments. Sites or products are assessed directly by organizations to verify their adherence to specified rules and receive certification labels, partially analogous to labels such as Fairtrade and Energy Star in other industries.

EXHIBIT 1.1 | Overview of environmental reporting landscape including key international standards and methodologies

1 Environmental Product Declarations (EPDs)

Sub-PCRs and c-PCRs

Additional specifications (e.g., data requirements) for specific product categories/regions (not an exhaustive list)

Steel	Cement & Concrete
UL Environment V2.0 B Designated Steel Construction Product EPD Requirement **prEN 17662*** c-PCR to EN 15804 for aluminum & steel in construction works	**NSF International PCR** for Concrete v2.1 **EN 16757:2022** Concrete and Concrete Elements **EN 16908:2017+A1:2022** Cement and Building Lime

Product category rules (PCRs)

Sector-specific accounting methodologies for EPDs

- **ISO 21930:2017** Sustainability in buildings and civil engineering works
- **EN 15804:2012+A2:2019** Sustainability of construction works

EPD regulation

Rules governing EPD format and creation

- **ISO 14025:2006** Environmental labels / declarations
- **prEN 15941*** Data quality for construction EPDs

Building block methodologies

Core guidelines and principles for reporting the environmental impact of products, particularly greenhouse gas emissions

- **ISO 14040:2006 and 14044:2006** Lifecycle assessment and lifecycle inventory framework and guidelines
- **ISO 14064-1:2018** GHG reporting guidelines for organizations
- **ISO 14067:2018** Requirements for quantification of carbon footprint of products
- **Greenhouse Gas Protocol Product**, Corporate Standard, and Scope 3 Standard

2 Independently verified declarations

ISO/EN and industry/non-profit standards

Site-level standards	Product-level standards
Steel	
ISO 14404:2006 Route-specific CO_2 calculation methodology **Worldsteel CO_2** measurement methodology **ISO/AWI TS 19694-2*** Stationary source emissions	**ISO 20915:2018** LCI calculation methodology for steel products **Worldsteel LCI methodology** for steel products & supporting reports
Cement & Concrete	
ISO 19694-3:2023 Stationary source emissions **CSI Cement CO_2 and Energy Protocol**	**ISO 13315-2:2014** Environmental management of concrete and concrete structures

3 Certifications

Manufacturing sites certified under organization methodologies (below) may produce certified products when accompanied by product-level declarations (left)

Accounting Methodologies

- **ResponsibleSteel™ International Standard V2.0**
- **GSCC: The Steel Climate Standard**

*Standards under development at time of publication

2. 2. Key issues driving reporting variance

Where different standards are used to calculate a product's carbon footprint or global warming potential, significant variation in reported emissions can result. *Even in cases where the same standard is used*, accounting rules often leave sufficient ambiguity on key issues that subjective interpretation is required, limiting comparability across products. In this report, we have reviewed the major standards relevant to steel, cement, and concrete greenhouse gas accounting and identified the discrete issues that are responsible for driving a substantial portion of this variance. Based on detailed review of the standards listed in **exhibit 1.1** and interviews with a broad range of industry and government stakeholders, the IDDI Secretariat has identified seven issues that drive material variation in reporting:

1. **Data use in emissions reporting:** Many reporting standards do not mandate the use of primary data to report upstream emissions for purchased material inputs, risking misrepresentation of product emissions when highly emissive processes occur upstream. In the absence of primary data, secondary or reference data is used, which can vary significantly across sources and may not reflect the actual emissions of a product.
2. **Reporting at common lifecycle stage:** Products undergo several 'finishing' steps after the production of steel or cement, and it is important for reporting to include emissions associated with these steps. At the same time, most emissions occur in the core steel-making processes prior to 'finishing' and in the cement-making process prior to the mixing of concrete. Because product-level reporting blends these numbers, some stakeholders have called for reporting at a common step to enable greater comparability between products.
3. **Allocation of emissions to co-outputs:** Industrial processes can result in several outputs, or 'co-outputs', that may be allocated a portion of emissions from a particular process, thereby reducing the emissions allocated to the primary product. This is particularly relevant for steelmaking where blast furnace slag is a key co-output and frequently sold to cement producers.
4. **Accounting for utilization of scrap in steel:** Steel is a highly recyclable material and most steel contains some proportion of scrap. A key question arises on whether and how to assign emissions to scrap as an input into steelmaking, accounting for its future recyclability and any emissions incurred in original production.

Note on terminology

There is debate over the appropriate terminology to describe multiple outputs resulting from a single production process. As this paper investigates the merits of different emission accounting approaches within the regulatory frameworks found across different jurisdictions, **this paper uses the term 'co-output' and 'co-outputs' to acknowledge the production of intentional and incidental outputs from a process.**

The choice of terms to describe co-outputs can reflect the method of allocation of emissions to different co-outputs, affecting the result of the life cycle assessment. Depending upon local regulation and the specific reporting standard used, alternative terms may be more appropriate, and the use of terminology in this paper should not be construed as an argument for a particular allocation approach.

5. **Accounting for the use of alternative fuels:** Alternative fuels refer to biogenic matter or other waste products such as plastics, tires, or medical waste that can be used as energy sources in cement and steel production. Producers are increasingly replacing fossil fuels that have varying emissions intensities, especially when considering the whole lifecycle. It is critical to align on how producers should account for the emissions that result from the use of these fuels.

6. **Accounting for CCUS:** Carbon capture is a crucial emissions abatement lever in the cement and steel industries. However, major EN and ISO standards do not yet provide a pathway for producers to claim a reduction in direct emissions through carbon capture and sequestration. Additionally, standards must also determine the extent to which producers can claim emissions abatement for carbon that is utilized in different products and processes rather than stored geologically.

7. **Permissibility of alternative chain of custody (CoC) models:** Industrial producers are increasingly entertaining new approaches to lifecycle assessment and reporting, such as mass balance or book & claim, to capture value more effectively from investments in decarbonization. Several questions remain unanswered about the degree to which these approaches should be accepted and the guidelines needed to govern them.

Some of these issues have been debated for many years and may still require further analysis to reach consensus. Other issues are emerging as green markets become more mature, and in the absence of clear accounting guidance from standards, companies are likely to independently determine their own positions on these issues. While many positions taken by individual companies are rigorous and defensible, a fragmented approach reduces comparability or reporting, limits the ability of a consumer to understand what lies beneath an emissions declaration, and risks reducing trust in the system.

2. 3. Baselining cement and concrete reporting

Emissions reporting structures within cement and concrete are largely consistent, with EPDs serving as the dominant reporting format across most geographies. This practice is further bolstered by requirements to use EPDs from governments in several regions, as well as from private building certification schemes such as LEED and BREEAM.[7]

The standards used to develop reporting are also generally consistent. Virtually all cement and concrete is used in the construction sector, which means that the dominant construction PCRs (ISO 21930:2017[I] and EN 15804:2012+A2:2019[II]) are consistently used. The two standards have minimal differences due to the fact that ISO 21930 largely mirrored the previous version of the EN standard. The primary difference in the A2 version of the EN standard is the addition of new impact categories and the mandatory reporting of end-of-life product emissions.[8]

Although the dominant PCRs defining lifecycle assessment for cement and concrete products are broadly consistent with each other,[9] ambiguity *within the standards* can nevertheless drive variance in reporting. Further, some issues, such as allocation of emissions to co-outputs that cross system boundaries, require aligned accounting treatment across the steel and cement and concrete industries to avoid effective deletion of emissions at a system-level, resulting from each industry applying distinct accounting approaches. **Exhibit 1.3** summarizes the key sources of variance in reported product emissions and their potential impacts.[10]

© Wirestock/iStock

I Further references to ISO 21930 shall refer to ISO 21930:2017 for purposes of readability, unless otherwise specified

II Further references to EN 15804 shall refer to EN 15804:2012+A2:2019, unless otherwise specified

EXHIBIT 1.3

Maximum possible variation in reported emissions of a cubic meter of concrete resulting from differing accounting approaches

Key issue		Potential variation in reported emissions	Reason for variation
1 Data	Primary Data	7%	Impact of reporting average data for upstream processes if actual data is more emissive
	Secondary Data	10%	Discrepancy in reported emissions between major background databases for concrete product
2 Reporting Step	Re-carbonation	10%	Inclusion of carbon absorption in concrete after pouring and before demolition
3 Co-products	Slag allocation	55%	Difference between no allocation and system expansion approach to allocate emissions to blast furnace slag
4 Alternative fuels	Alt. fuels	7%	Exclusion of alternative fuels, including non-biogenic, from product carbon footprint

2. 4. Baselining steel reporting

Unlike in cement and concrete, the choice of reporting archetype is highly variable across the end-markets for steel. In regions where producers commonly report the environmental footprint of projects and products, EPDs are the dominant reporting format for steel construction products, which account for just over 50 per cent of steel production.[11] However, emissions reporting in other sectors including automotive and white goods is conducted through a mix of the three reporting archetypes described above. The result is variability in both reporting formats and the underlying standards used to calculate a product's global warming potential or carbon footprint.

Despite this starting point, steel buyers in many sectors are voicing a desire for consistent product carbon footprints. This is particularly apparent in the automotive sector, where reporting formats are highly variable but substantial commitments to decarbonize steel supply chains have been made. The ideal harmonized standards ecosystem would see broad uptake of more consistent reporting methodologies, and further work will be required to determine how to best implement appropriate reporting archetypes for steel purchasers that do not currently use EPDs.

The underlying accounting standards driving reporting for steel, noted in **exhibit 1.1**, also contain significant disagreements and gaps. PCRs offer insufficient guidance on the issues identified above and producers utilize a wide range of practices when producing EPDs. Newer certifications from global not-for-profit initiatives, such as ResponsibleSteel and the Global Steel Climate Council, have made strides towards filling these gaps but are not broadly used for product-level reporting at this juncture.

A survey of the various lifecycle assessment challenges for steel have been included in **exhibit 1.4**, along with the estimated impact from each issue on reported emissions for a ton of steel to demonstrate materiality. It should be noted that while an individual issue may not be significant, the combination of these issues can substantially reduce comparability of steel products.

Unlike in cement and concrete, THE USE OF THE REPORTING STRUCTURES IS HIGHLY VARIABLE ACROSS THE END-MARKETS FOR STEEL

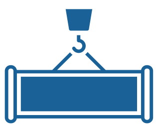


EXHIBIT 1.4 Maximum possible variation in reported emissions of a ton of steel resulting from differing accounting approaches[12]

Key issue		Potential variation in reported emissions	Reason for variation
1 Data	Primary Data	15%	Impact of reporting average data rather than more emissive actuals
	Secondary Data	11%	Discrepancy between major background databases for proxy steel product
2 Co-products	Slag allocation	10%	Difference between no allocation of steel emissions to slag and a credit equivalent to displaced clinker emissions
	Process gases	11%	Difference between no allocation of process gas emissions and system expansion
3 Scrap utilization	Scrap recycling	14%	Inclusion of credits for end-of-life recycling in product emissions footprint

3. A principles-based approach to greenhouse gas accounting

As shown in exhibit 1.3 and 1.4, the rules governing lifecycle assessment can substantially impact the reported emissions intensity of a product. It is no surprise, therefore, that disagreements in greenhouse gas emissions accounting have long existed and often prove challenging to resolve.

This gridlock underscores the need for a common set of principles that are widely accepted by stakeholders across industries to adjudicate these issues and drive towards consensus. As part of this work, the IDDI Secretariat has identified seven core principles, leveraging existing positions from the Greenhouse Gas Protocol (GHGP) and the International Energy Agency (IEA).[13] GHGP is a widely recognized international initiative that provides a framework for businesses to quantify emissions and is accepted by major producers of both steel and concrete.[14] GHGP has also issued specific guidance on product-level accounting principles, developed by experts from across sectors, which provides important guidance on how to apply the broader GHGP principles to lifecycle assessments. Meanwhile, the IEA has led key efforts to standardize emissions measurement in steel, resulting in a report on the topic at the 2023 G7 meeting hosted by Japan. The IDDI Secretariat believes that the positions asserted by these organizations represent a compelling basis to adjudicate the identified accounting issues in a fair and neutral manner. These principles have been summarized in exhibit 1.5 below.

By referencing these principles, stakeholders can identify where preferred accounting methods either support or detract from the broader emissions accounting system. The remainder of this whitepaper interprets the seven accounting issues identified through the lens of these principles to propose a view on which solutions meet the accounting rigor and system-level priorities identified by GHGP and IEA.

EXHIBIT 1.5 **Core principles to guide evaluation of identified emissions accounting issues**

Five core Greenhouse Gas Protocol accounting principles are universally recognized and can serve as basis to align guidance…

…along with **two additional considerations** highlighted by IEA

1 Relevance	2 Completeness	3 Consistency	4 Transparency	5 Accuracy	6 Facilitates decarbonization	7 Minimize complexity
Ensure the GHG inventory appropriately reflects key activities and decision-making	Account for *all* GHG emission sources without double counting	Use consistent rules across industries, organizations & products to create comparability	Maximize disclosure of assumptions & data use and create visibility into methodology	Ensure that quantification of GHG emissions reflects actual emissions and processes	Support systems decarbonization solutions by enabling emissions-reducing practices for all parties	Build from existing foundations and avoid 'starting from scratch'

Description of GHGP principles partially modified to reflect system-level (vs corporate-level) focus of IDDI effort

4. Evaluation of identified accounting issues

The following section includes a brief summary of each of the major accounting issues, as well as proposals from the IDDI Secretariat on how to best harmonize accounting approaches based on application of the principles (**exhibit 1.5**).

4. 1. Data use in emissions reporting

CHALLENGE

Many reporting standards do not mandate the use of primary data to report upstream emissions for purchased goods, risking misrepresentation if highly emissive processes occur upstream of the producer preparing the reporting. In the absence of primary data, secondary or reference data is used, which can vary significantly across sources.

BACKGROUND

To calculate a product's emissions footprint, producers use a range of data sources, which fall under two categories. Primary data, also known as specific data, is derived from the entity that is responsible for the specific production step under study. Secondary data, also known as generic data, is obtained from average or estimated data calculated by third parties, rather than producers or suppliers themselves.[III]

Major ISO and EN reporting methodologies for steel and cement require the use of specific data for processes that are under a producer's control. However, they allow the use of generic data for 'upstream' emissions associated with a product. Given that production is not always integrated across the value chain, it is possible for production steps that drive substantial emissions to exist upstream of a producer and therefore to fall outside of primary data requirements. For example, iron production can account for 50 per cent of steel emissions or more depending on the production technology and may be purchased rather than produced.[15] Similarly, concrete producers may purchase cement, which accounts for up to 85 per cent of embodied emissions in concrete.[16] In these cases, the use of generic data would reflect *average* values of emissions intensity, opening the door to undercounting if supplier production is more emissive than the regional or global average.

While primary data is preferable for key inputs, there are many cases where collection of primary data is not feasible and may not be justified given costs of collection relative to materiality of emissions. In these cases, secondary data must be used. The major sources of secondary data are proprietary databases such as GaBi by Sphera or ecoinvent, as well as industry average EPDs and national utility databases. However, the use of these databases presents three key challenges. First, emissions values can vary across databases for the same process. Second, databases may lack sufficient granularity to accurately reflect emissions in some cases. Third, databases are privately held and accessing them generally requires licensing, which limits common use and understanding.

III Secondary data is used both to estimate 'emission factors,' which estimate the pollutants released with a particular activity, as well as to estimate the pollutants from activities carried out in production of a material. The use of secondary data for emission factors is commonly accepted. For example, ISO 21930 outlines default databases to be used for emission factors for different regions. While consistency of these data sources is important, the remainder of this guidance focuses primarily on the use of secondary data to estimate the actual activities carried out in production, as it is a more material driver of variation between reported emissions.

PROPOSAL

The IDDI aims to incentivize greater use of primary data where possible and drive greater consistency in the use of secondary data where primary data cannot be reasonably sourced.

To drive greater use of primary data, three potential approaches have been identified:

1. **Requiring the use of primary data:** PCRs should specify that specific processes with a high impact on overall product emissions should be based on site-specific data or environmental reports, rather than secondary data. To address the fact that many upstream suppliers do not provide this data today, this requirement could be phased in with a substantial lead time. Additional discussion with industry stakeholders would be required to determine the appropriate threshold for primary reporting requirements and a realistic timeline to implement such a measure.

2. **Addition of a metric to measure primary data use:** A new metric could be added to reporting to reflect how much primary data was used in calculating a product's carbon footprint. Specifically, this score could represent the percentage of product emissions reported from primary vs. secondary data. While further discussion would be required to align on a specific calculation methodology, it is notable that several LCA analysts are already developing such approaches. Over time, minimum thresholds for this score could be required by procurers to incentivize increased use of primary data.

3. **Application of uncertainty factor for secondary data:** EPDs could apply an 'uncertainty factor' that would adjust the reported global warming potential of a product based on the percentage of secondary data used, reflecting uncertainty from using generic data. Several methodologies already employ this approach, such as EC3's uncertainty score and ResponsibleSteel's burden of doubt.

While these are promising approaches to increase the accuracy of environmental reports, they may require significant revisions to how EPDs are produced and subsequently evaluated by end-customers. Therefore, key questions must be addressed, in consultation with relevant stakeholders, before they are implemented.

To drive more consistent use of secondary data, the IDDI Secretariat offers the following illustrative principles that may be incorporated into PCRs and communicated to LCA practitioners to encourage best possible use:

- LCA practitioners should build a baseline understanding of the upstream processes and inputs that drive emissions for the product under study. For example, if coal is used in hot metal production, practitioners should aim to understand geographical source of coal.
- Where possible, practitioners should choose the most relevant and specific values from databases, reflecting this baseline in the lifecycle inventory. For example, if 100 per cent of coal used by a supplier is from a particular region in a country, practitioners should input the emissions value associated with coalmining in that region rather than the national average.
- Practitioners should disclose independent statements to accompany reporting highlighting the extent to which background datasets have been adjusted to reflect reality.

Recognizing the need for further discussion on specific implementation pathways for this guidance, the IDDI Secretariat proposes embedding these topics in its workplan with the goal of drafting specific recommendations for inclusion in PCRs in 2024.

4. 2. Reporting of emissions at a common production step

CHALLENGE

Products undergo several 'finishing' steps after the production of crude steel, and it is important for reporting to include emissions associated with these steps. At the same time, most emissions occur in the core steel-making processes prior to 'finishing'. Similarly, the vast majority of concrete emissions occur in cement production, not in the subsequent mixing of concrete. Because product-level reporting blends these numbers, some stakeholders have called for reporting at the crude steel step, or at the equivalent cement step, to enable greater comparability between products.

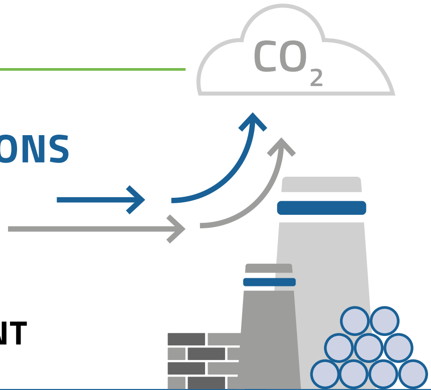
BACKGROUND

EPDs are almost always made for an intermediate or finished product that is acquired by an end customer, such as hot-rolled sections (steel) or concrete beams (concrete). While finishing steps can represent a non-trivial portion of emissions, the bulk of emissions occur during production of crude steel and cement. To that end, enabling purchasers to compare the emissions intensity at these production steps can be a critical enabler to driving decarbonization of the most emissive activities in the production process.

PROPOSAL

Most steel products can be compared as crude steel, which is the first solid state of steel after melting and is suitable for further processing.[IV] Meanwhile, concrete undergoes limited processing after the step of cement production, which is common between all products. **The IDDI Secretariat proposes that all EPDs transparently declare emissions associated with 1 metric ton of crude steel and 1 metric ton of cement for all steel and concrete products.**[V] This approach allows for consistent comparison of product emissions and evaluation against established thresholds for low-emission steel and cement.

The IDDI Secretariat recommends that all
EPDs TRANSPARENTLY DECLARE EMISSIONS
associated with



1T OF CRUDE STEEL & 1T OF CEMENT

FOR ALL STEEL AND CONCRETE PRODUCTS

IV High-alloy steels are a notable exception, where the emission intensity of crude steel can be significantly higher.
V Alternatively, if reporting is conducted in other units, unit conversion factors can be used and declared.

4. 3. Allocation of emissions to co-outputs

CHALLENGE

The production of industrial materials often creates several co-outputs that are either disposed of or sold for utilization in other industries. In cases where these co-outputs are sold, they are sometimes allocated a portion of the emissions from the production process. The challenge arises in the fact that multiple approaches exist to allocate these emissions, each of which can result in dramatically different emissions burdening on the co-outputs. In turn, the remaining emissions allocated to the primary material being produced can be substantially impacted.

It is crucial for stakeholders within and across industries that use a particular co-output to align on a single approach that satisfies the principles laid out above. Doing so will drive more consistent reporting within industries, as well as avoid the risk of emissions being effectively deleted from the system because producers and users of that co-output are using distinct allocation approaches. This section explores how allocation methods apply to notable examples and highlights two approaches consistent with the principles, either of which could be applied to all co-outputs.

BACKGROUND

There are several co-outputs that arise in steelmaking. These can largely be classified into material products, such as slags, sludges, and dust, and off-gases or 'process gases', which are re-combusted to produce energy. Slag in steelmaking arises from reactions in blast furnaces, basic oxygen furnaces, and electric arc furnaces. Of these three sources, blast furnace slag captures the highest economic value and will be used in the following section as the primary illustration for various approaches to co-output allocation.[VI]

Blast furnace slag has properties that allow it to be used as a substitute material for clinker in cement production. Because clinker production drives up to 85 per cent of emissions in cement, substituting treated blast furnace slag can dramatically reduce emissions from cement production.[VII, VIII]

The question then becomes the level of emissions steel producers can allocate to blast furnace slag when it is sold as a material input to cement producers. This allocation question affects both the embodied emissions of steel and cement, since the input burden for cement producers should be equivalent to the emissions allocated to slag by the steel producer.

There are five commonly used methods to allocate emissions to co-outputs with varying impacts on the emissions burden of steel and concrete. **Exhibit 1.5** describes the methods and their use across each sector and **exhibit 1.6** illustrates the impact of each method on reported emissions for the primary product being studied using the example of blast furnace slag.

VI It should be noted that different slags may be chemically different and should not be considered as like or substitutable co-outputs.

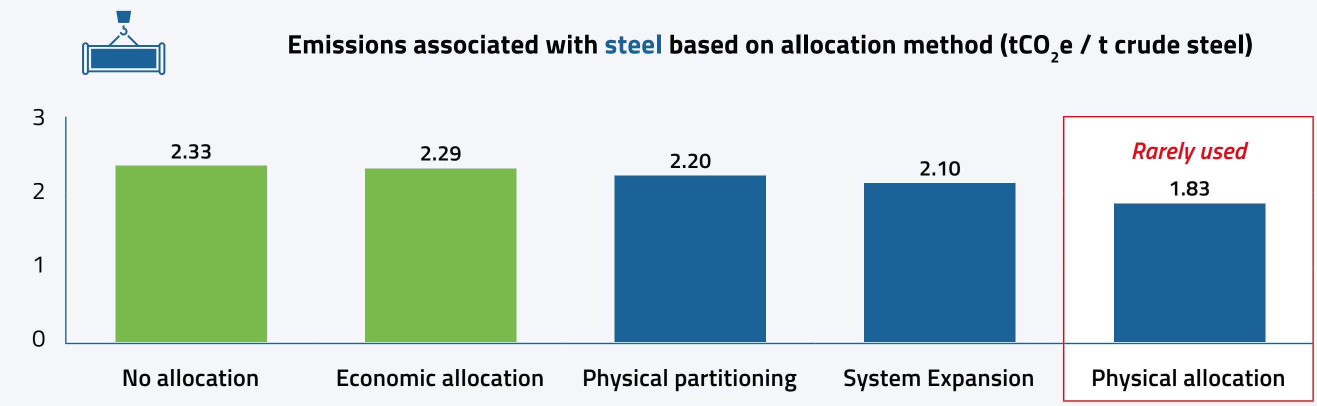
VII Depending upon method to allocate emissions to blast furnace slag.

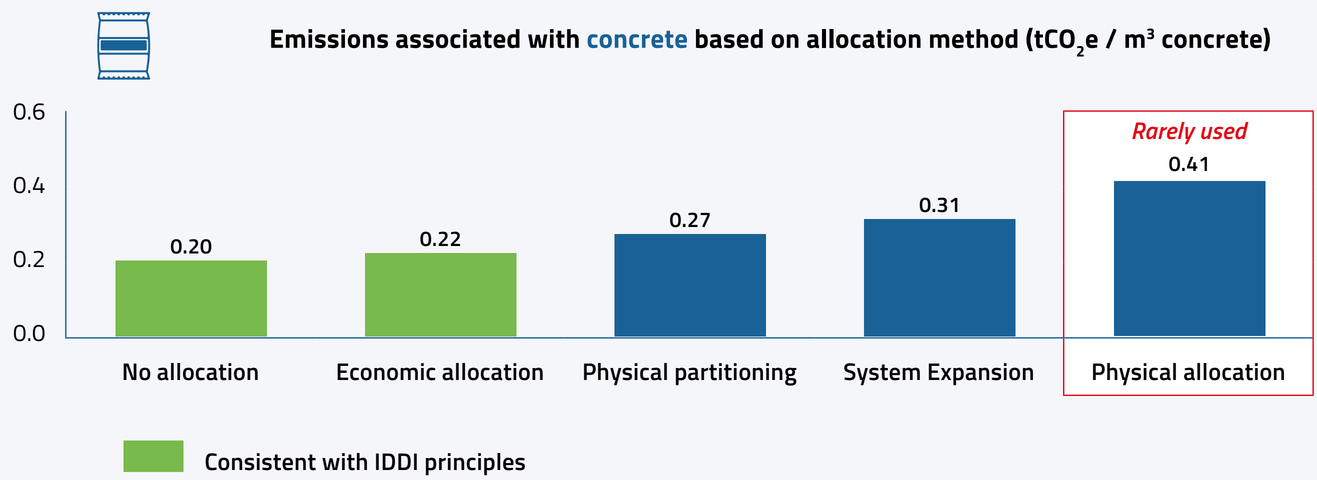
VIII The IDDI Secretariat also recognizes that Ground Granulated Blast furnace Slag could confer desirable technical properties to concrete in certain use cases, which could also drive demand from the cement and concrete sector.

EXHIBIT 1.5 Observed allocation methods across steel and cement producers[17]

Allocation method	1 No allocation	2 Economic allocation	3 Physical partitioning	4 System expansion	5 Mass-based allocation
Description	All emissions allocated to intended product of the process (i.e., all to steel, none to slag)	Emissions allocated based on earned revenue from co-outputs made from same process and then sold	Emissions allocated based on inputs/outputs of distinct processes which produce steel and slag	Products assigned emissions credits equivalent to emissions displaced in adjacent system by use of co-outputs	Emissions allocated based on physical relationships between co-outputs (e.g., mass, energy) made from same process
Use by cement:	Common outside EU	Common in EU, used elsewhere	Never	Never	Never
Use by steel:	Sometimes; always in Japan	Common in EU, rare elsewhere	Common in EU	Official worldsteel LCI methodology	Rare, no recent examples

EXHIBIT 1.6 Impact of blast furnace slag allocation on reported emissions of crude steel and concrete products[18]





PROPOSAL

It is important to acknowledge at the outset the longstanding disagreement on allocation methodologies. Nevertheless, there is broad consensus that a single approach is critical to drive consistent reporting. While any recommendation is likely to face criticism given the wide range of views on appropriate allocation and the potential impacts to emissions profiles of primary products, the IDDI Secretariat aims to illustrate which approaches are compatible with the principles-based approach and have a pathway to global adoption.

The analysis presented in this paper has found that "No Allocation" and "Economic Allocation" are both consistent with the identified principles, as well as with GHGP's stated preference for more conservative allocation approaches.[11] However, broad acceptance of allocation in the major standards studied in this report[19] and the extensive use of allocation in steel EPDs may make the shift to a "No Allocation" model challenging. While adherence to the principles remains the primary concern in selecting a preferred approach, likelihood of adoption is an important secondary consideration given the voluntary nature of standards and the need for producers, as well as purchasers, to adopt them. Given this broader context, "Economic Allocation" represents another model worthy of consideration due to its ability to conform with the principles and its potential to drive the adoption necessary to result in harmonized reporting. While the subsequent paragraphs present initial analysis of this issue, the IDDI Secretariat recognizes that multiple perspectives remain and recommends further engagement with relevant stakeholders in 2024 to select a definitive approach.

EXHIBIT 1.7

Principles appear most closely aligned no allocation and economic allocation approaches

Principle	1 No allocation	2 Economic allocation	3 Physical partitioning	4 System expansion	5 Mass-based allocation
Consistency	Irrespective of method, steel and cement producers should use same approach				
Completeness	✓	✓	✓	✗	✓
Relevance	✓	✓	✗	✗	✗
Transparency	✓	✓	✓	✓	✓
Accuracy	✓	✓	✓	✓	✓
Incentivizes decarbonization	✓	✓	✓	✗	✗
Minimize creation of additional complexity	✓	–	–	✓	✓
Feasibility of implementation	Allocation already accepted In both industries	Accepted by cement industry, major steel players, and global orgs	Ongoing debate on inclusion in upcoming c-PCR prEN-17662	Disallowed by construction product category rules	Rejected by cement industry given high emissions burden

It is notable that the 'No allocation' approach satisfies all principles and has been identified by the IEA's 'Emissions Measurement and Data Collection for a Net Zero Steel Industry' report as the appropriate approach in a 'net-zero' world, when all sectors, including cement, make substantial progress towards decarbonization. 'No allocation' is also the least complex to implement and explain to customers as it assigns the complete environmental impact burden of steelmaking to the primary product: steel. However, concerns remain about the ability to implement this approach in the near-term given broad use of allocation today. Nevertheless, this approach warrants further discussion, including as a potential end-state for the system.

Economic allocation offers another approach that conforms with the identified principles and has a wider degree of acceptance among at least some steel and cement producers. The approach's adherence to the principles will be explored in greater detail with a particular focus on the Relevance principle due to its role as the primary differentiator between economic allocation and other allocation approaches. It should be noted at the outset that economic allocation does pose implementation challenges, but ones that could be managed with consistent guidance on how the method should be applied and the use of supporting reference data.

The Greenhouse Gas Protocol's Relevance principle is defined as ensuring the GHG inventory appropriately reflects key activities and decision-making. Because the fundamental purpose of allocation is to attribute the environmental impact of an emissive process, it is worthwhile to consider what is driving the decision to undertake that process in the first place. In examining the operations of iron and steel producers, it is apparent that blast furnace production occurs to produce a return on invested capital. This is achieved by generating sufficient revenue from the various co-outputs from the blast furnace to justify the capital and operating costs required to run it. Therefore, the relative revenue of the primary product and co-outputs produced in the process is inherently the most relevant determinant of whether the emissive activity occurs.

It is important to note that the concept that economic value should play a role in determining the allocation of emissions is already implicitly accepted in other approaches. Emissions are not allocated to co-outputs that are treated as waste and disposed of rather than being sold. In other words, emissions are allocated to materials or gases only *when they carry value in the marketplace.* However, although alternative approaches acknowledge the role of economic value in allocation, they do not account for the magnitude of economic impact of a co-output in decision-making. If co-outputs have some economic value, they are assigned a share of emissions based on other factors, such as embodied energy. Meanwhile, economic allocation is unique in capturing the extent to which a co-output affects the decision to operate an emissive process.

The IDDI Secretariat notes that implementing an economic allocation model will present three key challenges. First, data on slag pricing is opaque and may vary depending on regional contexts. Second, steel prices fluctuate on a cyclical basis, resulting in relative changes in allocation. Third, long-term price fluctuations of co-outputs, such as increasing value of blast furnace slag due to its decarbonization benefit and expected scarcity, have the potential to shift emissions baselines for the primary product. While these concerns are valid, potential solutions exist. Reference data can be used to provide consistent values, long-term averages can mitigate the impact of price cyclicality, and the relatively low revenue of blast furnace slag compared to steel at only 1-2 per cent renders long-term increases in the value of slag trivial.[20] Nevertheless, the IDDI Secretariat feels specific guidance would be needed to evaluate these options in detail and recommends including these issues in the scope of the data working group that will be convened in 2024.

While economic allocation has been evaluated against the principles, it is worth also considering alternate allocation methods to understand their applicability and potential acceptance.

Physical partitioning, which links the energetic inputs of a process to its outputs by tracing the chemical reactions that occur within the process, is an alternate method proposed to allocate emissions from blast furnace slag. Setting aside concerns about the Relevance of this approach discussed above, this method could allocate emissions to blast furnace slag in a consistent and chemically traceable manner. However, physical partitioning has not been studied for other co-outputs including blast furnace process gases, which contain substantial energetic value and may result in non-trivial allocations. This underscores the complexity of this method and raises questions about applicability to other co-outputs. Meanwhile, economic allocation could be applied to process gases that are exported or combusted for the purpose of energy exports, resulting in expected allocations of <1 per cent of blast furnace emissions away from steel products.[21]

An additional allocation approach that has been used for slag and is currently accepted for process gases is system expansion. This approach aims to understand a product's consequences on emissions in other industries or 'systems', and producers can then allocate emissions to co-outputs equivalent to the emissions displaced elsewhere. While understanding the system-level consequences of production is valuable, focusing on the emissions directly within the operational control of a producer appears to be more consistent with the GHGP's Relevance principle. Further, understanding whether a co-output actually results in displaced emissions in other systems is an art more than a science, resulting in the possibility that more emissions are allocated than displaced and presenting substantial risk to the Completeness principle.[22]

Looking forward, the IDDI Secretariat recognizes that significant further engagement on this issue will be required across government and industry stakeholders to align on an allocation approach. It is important to acknowledge that shifts in allocation methods may impact key stakeholder groups but, equally, that driving towards a consensus approach will be a critical and necessary step to enable comparability in reporting.

4. 4. Accounting for utilization of scrap materials

CHALLENGE

Steel is a highly recyclable material and most steel contains some proportion of scrap. A key question arises on whether and how to assign emissions to scrap as an input into steelmaking, accounting for its future recyclability and any emissions incurred in original production.

BACKGROUND

There are two dominant approaches to scrap accounting, depending upon the scope of the lifecycle assessment.[23] The cut-off method is used to understand cradle-to-gate emissions for a product. Scrap used in steelmaking is assumed to carry no emissions burden from its past life, and producers do not credit the finished steel-product based on expected recycling potential. The closed-loop method is used to understand cradle-to-grave emissions. The steel product receives an emissions credit with the assumption that at the end of its life, it will be re-used as scrap and displace primary iron production. This credit must consider the specific type of steel product, its lifespan, and its properties at the end of its life. Any scrap used as an input also receives an emissions burden based on its theoretical emissions footprint from a past life.

PROPOSAL

The IDDI Secretariat recommends scrap used as an input is accounted with zero emissions burden at the point of entry to the system boundary, as per the cut-off method. This is in line with the IDDI focus on measuring emissions from LCA modules A1-A3, or 'cradle-to-gate', for purposes of determining emissions thresholds for the Green Public Procurement (GPP) Pledge campaign. The IDDI Secretariat acknowledges that full lifecycle assessments can help decision-makers gain a holistic picture about the environmental impact of products, including their degree of circularity. To that end, Level Two of the IDDI's GPP Pledge outlines a requirement for the monitoring and disclosure of whole life cycle emissions for all public construction projects by 2030.

Whilst it is important to enable the choice of low emissions materials for construction, the world still needs to lower the emissions intensity of production of heavy materials.[24] Therefore, another key objective of emissions-sensitive procurement pledges such as the IDDI GPP Pledge is to create the demand pull for near-zero emission production technologies that are critical in the transition to net-zero. To that end, and in line with other global organizations such as the Science Based Targets Initiative (SBTi) and First Movers Coalition, the IDDI aims to isolate and understand the emissions associated with the production of a material from cradle-to-gate.

In addition, the GHGP principles also support the appropriateness of using the cut-off method. This method minimizes complexity as steel producers do not need to estimate the emissions from a product in its past life nor attempt to model displaced emissions in the future life of a product. It also avoids the challenge of consistently estimating the future use of scrap across geographies, given the variability of recycling infrastructure and scrap use in different countries. Furthermore, the cut-off method incentivizes decarbonization as it encourages the optimal consumption of process scrap produced and the maximal use of input scrap. In contrast, the closed-loop method focuses on creating credits for displaced future emissions.

While scrap should be considered to have zero emissions burden, the GHGP principle of Completeness requires accounting for any emissions incurred once it enters the system boundary of the new steel product. To that end, all emissions relating to the transport, sorting, and processing of scrap should be considered.

4. 5. Accounting for the use of alternative fuels

CHALLENGE

Alternative fuels refer to biogenic matter or other waste products (e.g., plastics, medical waste, tires, etc.) that can be used as energy sources in cement and steel production. Producers are increasingly replacing fossil fuels with alternative or waste fuels that can have varying emissions intensities when combusted, and especially earlier in their lifecycle. It is key to align on how producers can account for the emissions savings, particularly from avoided emissions, resulting from the use of these fuels.

BACKGROUND

Alternative fuels that replace traditional fossil fuels in cement and steelmaking can broadly be grouped into two categories, depending upon whether they are produced from organic matter.[IX]

First, biogenic fuels can be waste fuels (biomass) or purpose-grown from organic matter and are considered by various international reporting standards to produce zero emissions in combustion.[25] Burning these fuels is assumed to release carbon captured previously in their lifetime, allowing them to be considered as net-zero fuels if they are sustainably sourced.

Second, non-biogenic waste fuels are composed of other waste such as municipal solid waste (MSW), industrial waste or commercial waste. The combustion of these fuels results in direct emissions that can sometimes be higher than the replaced fossil fuels, however, their use can mitigate emissions beyond the processes under study by avoiding emissions in other parts of the economy. It is important to note that in some jurisdictions, cement kilns are encouraged or mandated to use these fuels as a form of waste management, contributing to circularity and ensuring efficient use of energy generated from combustion.

The cement industry commonly documents the global warming potential of their products without emissions from non-biogenic alternative fuels in a value referred to as 'net emissions.' Reporting net emissions conveys progress towards increasing the use of alternative fuels and displacing emissions in other sectors.

PROPOSAL

The IDDI Secretariat proposes that biogenic fuels continue to be regarded as producing zero emissions upon combustion, in line with major product category rules. Any emissions owing to the production of biogenic fuels, including impacts from transportation or land-use change, should be accounted for in line with the GHGP principle of Completeness. For waste biomass, this value will be zero, if the biomass has been certified as sustainably sourced.

Emissions from combustion of non-biogenic waste fuels should be considered in a product's gross emissions value, in line with the Completeness principle. Consistent with proposals on co-outputs and scrap, system expansion should not be used to account for avoided emissions in other sectors.

Reporting gross emissions ensures consistency with methods outlined by GHGP, as well as the SBTi, which identifies gross emissions as the basis for target-setting in the cement sector.[26] Meanwhile, robust and transparent reporting of net emissions could recognize the potential of waste combustion to mitigate emissions in other sectors of the economy.

The IDDI Secretariat proposes that both gross and net emissions should be documented in EPDs, satisfying the principle of Completeness and providing additional value by encouraging the use of alternative energy sources.

IX This guidance also applies to emerging fuels such as hydrogen, which can be produced using a variety of pathways from sources including biomass and natural gas. Therefore, producers should transparently declare the fuel source and pathway used, and follow the guidance proscribed here for the treatment of biogenic and non-biogenic fuels as appropriate.

4. 6. Accounting for carbon capture utilization and sequestration (CCUS)

CHALLENGE

Carbon capture is a crucial emissions abatement lever in the cement and steel industries. Like other green technologies, carbon capture requires significant capital expenditure to install, and green procurement presents a key value opportunity to justify that investment. However, major ISO and EN standards do not yet provide a pathway for producers to claim a reduction in direct emissions through carbon capture. Further, standards must determine if producers can claim emissions abatement for carbon that is utilized, and therefore temporarily stored, in products rather than stored geologically.

BACKGROUND

Carbon capture technology is a crucial technology for both the cement and steel industry. It currently presents the primary pathway to producing cement products with near-zero emissions and it may be crucial to abate new blast furnace capacity that is currently being built or planned in developing countries over the coming years.

Captured carbon dioxide can be stored in geological formations. Major international regulations, such as emissions trading schemes, and emissions reporting methodologies, such as the SBTi have recognized the role of carbon capture and storage (CCS) to allow producers to decarbonize their assets.[27] Efforts are also underway under the ISO and EN framework to develop methodologies for CCUS accounting.[28]

Captured carbon dioxide can also be used to displace fossil-sourced CO_2 that is currently used in products or that will be for emerging green products such as e-fuels. While these products have varying lifespans, it is crucial to acknowledge that CCU only stores carbon temporarily with the timespan varying depending on the product.[X]

Given the nascency of carbon capture technology, CCU has been identified as a key transition lever to generate economic value from carbon capture and incentivize the installation of carbon capture technology where CCS does not provide a sufficient case for investment. It is key to consider how, if at all, to reflect these policy priorities in emissions accounting for CCU, and how to account for the system-wide emissions reductions achievable when CCS is implemented. Two different philosophies to CCU accounting are emerging:

1. **CCU accounting to act as an estimate of emissions in the system.** This approach seeks to measure the system-level emissions as accurately as possible. However, even here, disagreements exist on how to best accomplish that goal. The conservative approach would limit CO_2 abatement in product-level reporting to cases where CO_2 is stored in products permanently, based on a to-be-defined duration. Meanwhile, others argue for a system expansion approach, which would allow crediting for emissions that would be avoided from alternative methods of producing or extracting CO_2 for the equivalent use.

X A significant proportion of carbon captured today is utilized for hydrocarbon recovery in a process known as enhanced oil recovery. This process may have varying emissions impacts and will need to be evaluated along with other CCU pathways.

2. **CCU to be accounted as full abatement.** This approach would reflect regulatory incentives in some markets to catalyze carbon capture by monetizing use of CO_2 as well as to catalyze critical green industries such as the production of e-fuels, which will require CO_2 as an input.

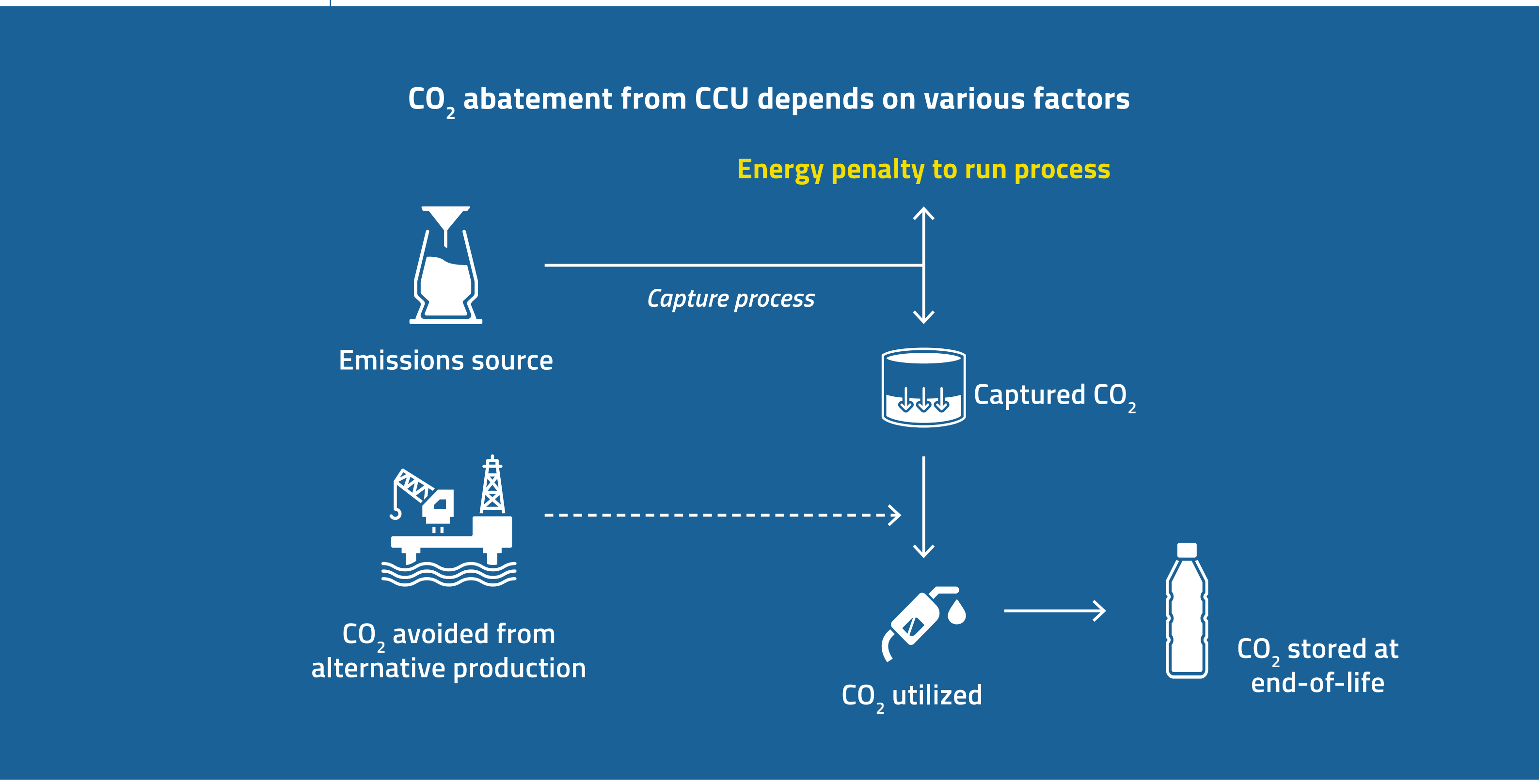
PROPOSAL

The IDDI Secretariat proposes that ISO and EN standards define methodologies for CCS to be included as abatement pathway, in line with recent revisions to major international standards, such as EU ETS and California Cap-and-Trade Program.[29]

Treatment of CCS in the standards mentioned above has unveiled specific accounting considerations on which clarity is required to guide the environmental reporting ecosystem. Considerations include mechanisms to account for energy penalties from operations of CCS and how those should be reported, as well as considerate of accounting for possible carbon leakage.

The IDDI Secretariat recognizes that the regulatory frameworks around CCU are evolving, and accounting decisions must be made in consultation with a range of stakeholders. To that end, IDDI's Working Group 2 could convene a dedicated workstream in 2024 to address several key questions. These include the certainty and duration of CO_2 storage required to claim abatement, whether and how to apply system expansion to consider avoided emissions, and whether green policy objectives should be reflected in product-level carbon accounting.

EXHIBIT 1.8 **System-wide emissions abatement and leakage through CCU**



4. 7. Alternative chain of custody accounting

CHALLENGE

Thus far, this paper has addressed challenges associated with measuring or allocating the emissions associated with the manufacture of physical products, but a new set of challenges is emerging as companies increasingly seek to redefine their products by virtually attributing the embodied emissions across them in novel ways to capture green value. Examples of these approaches are mass balance and book & claim frameworks that enable producers to concentrate decarbonization in a subset of their products to more effectively market and sell them as 'green'.

Several questions exist around whether these approaches should be accepted and the common guidelines that would be needed to govern them. This document does not offer guidance on the permissibility of these approaches but, rather, seeks to outline the rationale and risks associated with alternative chain of custody models given their increasing use in heavy industrial sectors. This is intended to serve as the frame for multi-stakeholder discussions in 2024 on the degree to which standards should embrace alternative chain of custody models and the guidance required in PCRs to ensure consistent and responsible use.

BACKGROUND

The net-zero transition in steel and cement requires investment in capital intensive technologies, such as carbon capture and hydrogen production. But building the business case for these investments remains challenging, even in supportive policy environments, and often requires the belief that green products can be differentiated and sold at a premium in the market.

However, producers face many practical challenges to capturing this green value. First, decarbonized steel and cement remain exceedingly rare, presenting challenges for companies to understand what premium, if any, customers will be willing to pay for low-emission products. Second, customers willing to pay premiums for these products may not be located near the production facility being decarbonized, leaving producers with challenging choices about whether to incur additional costs and emissions to transport products to reach customers with a willingness to pay. And third, the producers of steel or cement may not sell directly to parties that are willing to pay the premium. For example, cement producers may be multiple steps removed from developers willing to pay for greener buildings that they can, in turn, charge higher rents for. Alternative chain of custody mechanisms are seen as potential transition levers to overcome these difficulties in the near-term, but differ in the production stage at which they are applied and the extent to which they re-attribute emissions.

A widely accepted approach today is that inputs with different emissions footprints are 'mixed' at a batch or site, and the total emissions associated with their use are attributed proportionally to all products from the batch or site. In comparison, alternative emerging frameworks allow more flexible attribution of decarbonization across a process, site, or a company.

Alternative chain of custody frameworks consistent with lifecycle assessment methodologies considered by the IDDI Secretariat fall into two broad categories:

1. **Mass balancing with free attribution.** Emissions can be allocated unevenly, enabling producers to 'concentrate' emissions reductions in certain products. However, emissions are assigned within a company's overall emissions boundary, so the sum of emissions from all company products is equal to emissions from the process, site, or company depending on the level of balancing occurring. For example, if 20 per cent of emissions are eliminated from a process, 20 per cent of products from that process could be considered zero-emissions with the remaining 80 per cent maintaining the original carbon footprint.

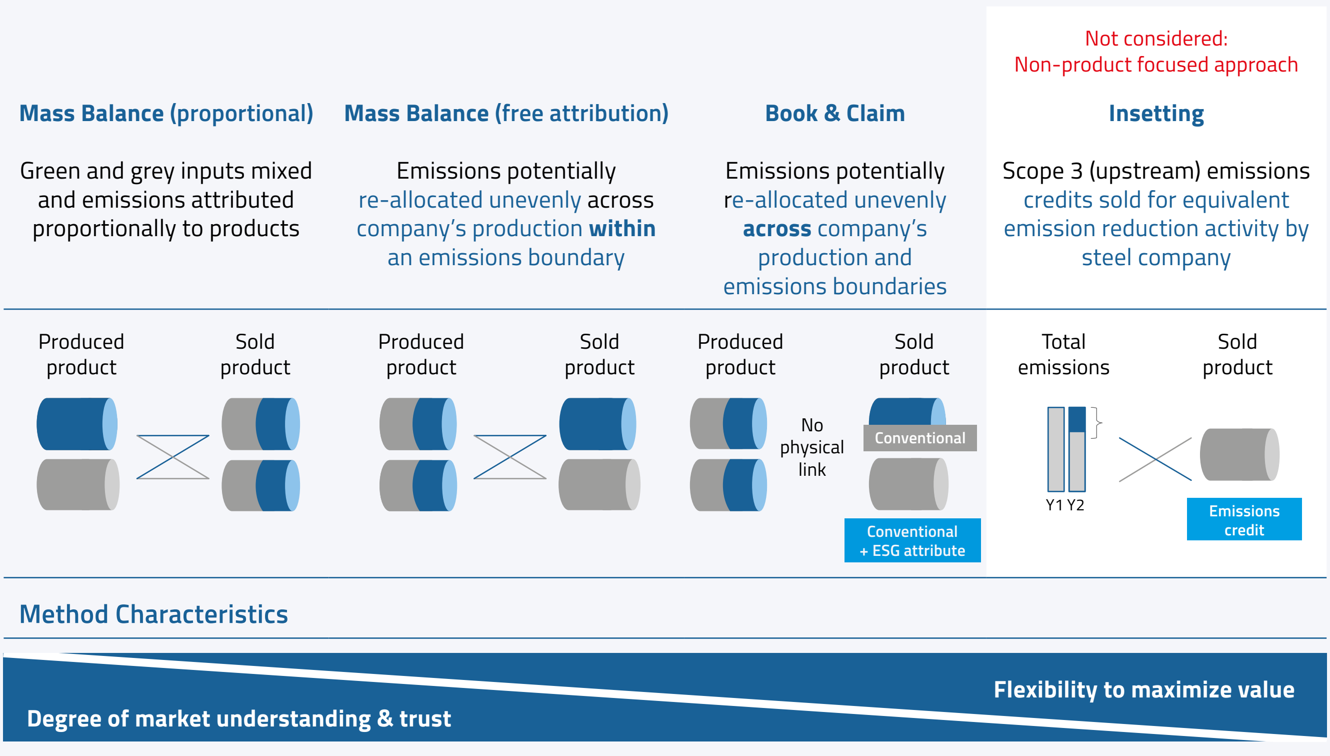
2. **Book & Claim.** Similar to mass balance, emissions can be allocated unevenly, enabling producers to 'concentrate' emissions reductions. However, these emissions reductions are sold as certificates, rather than allocated to the physical good produced. It is notable that the certificate could be sold to a party distinct from the one buying the good, enabling a cement producer to sell decarbonization value to developers that may use their product but not procure it directly.

A third framework, known as in-setting, is used by companies to sell credits equivalent to any emission reductions realized from investing in decarbonization projects. The sale of these credits does not need to tie back to the total emissions inventory of a company's products, and therefore, this framework is outside the scope of IDDI's focus. Together, the four models are summarized in **exhibit 1.9**.

Existing standards have not yet defined the permissibility of these approaches, but existing studies underway from the Greenhouse Gas Protocol, SBTi, and emerging work from an ISO technical committee[XI] may provide greater clarity on the permissibility of alternative chain of custody models such as those described here.

EXHIBIT 1.9

Commonly observed chain of custody models, including three alternative models deployed by producers to generate 'green value' for products[30]



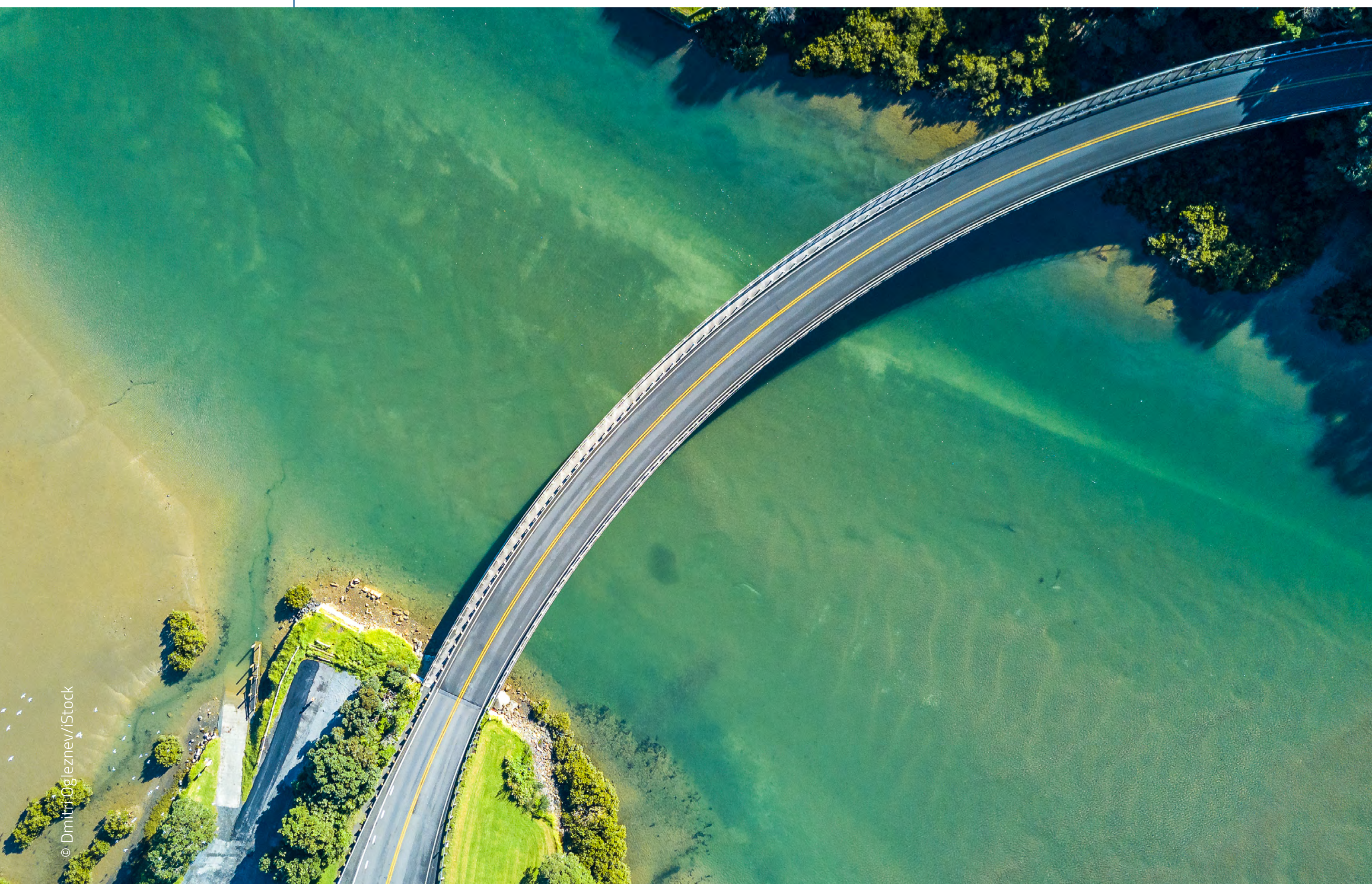
XI Through technical committees ISO TC 308 and ISO TC 207

PROPOSAL

These frameworks could prove to be valuable tools to enable early decarbonization investments in steel and cement. At the same time, they would need to address key risks before being broadly accepted to ensure the maintenance of trust in the broader carbon accounting system. These risks have been enumerated below:

1. **Methodological inconsistency** from producers launching distinct approaches.
2. **Double-counting emissions reductions** or overselling of certificates in absence of trusted ledgers for emissions reduction. The maintenance of a common ledger in the aviation sector has been seen as a critical enabler of a system of cross-border book & claim for sustainable aviation fuel.[31]
3. **Lack of interoperability with existing reporting structures** such as EPDs or product carbon footprints, which are often not digital and may face challenges interfacing with dynamic ledgers.
4. **Creation of green products without additionality** in the event producers balance emissions to create green products without associated decarbonization investments. This can be particularly problematic in instances where some customers may have low sensitivity to product emissions, enabling producers to load emissions onto a subset of their output.

To provide specific guidance on whether to permit alternative chain of custody models and, if so, how to best address these issues within major standards, the IDDI Secretariat intends to convene a working group in 2024 in coordination with other relevant stakeholders referenced in this section.


© Dmitri Oleznev/iStock

5. Driving change: a pathway to implement guidance in standards

Thus far, this paper has laid out a set of common principles to guide greenhouse gas accounting for steel, cement, and concrete, as well as to provide specific examples of how those principles can translate into discrete proposals on key issues. While offering a clear viewpoint and beginning the process of moving stakeholders towards consensus represents substantial progress, it will be essential to take the additional step of moving from proposals to implementation with the major global standards to drive meaningful change.

While several carbon accounting methodologies exist, the most prominent standards for product-level accounting remain those governed by the International Standards Organization (ISO) and The European Committee for Standardization (CEN). It should be noted that other standards that provide valuable guidance on site-level accounting also exist, such as the ResponsibleSteel Standard and the Global Steel Climate Council's Steel Climate Standard. However, even these certifications build on the methodologies laid out in ISO and EN standards, making those the critical building blocks to drive consistent reporting across the steel, cement, and concrete ecosystems.

Driving revisions to ISO and EN standards represents a complex process that will require coordinated engagement across multiple stakeholders. These frameworks produce voluntary standards, which require the national standards organizations that make up their membership and the associated stakeholder groups they engage to achieve meaningful consensus to implement revisions. Furthermore, reporting for a given industrial product may reference multiple standards. For example, one standard may govern general lifecycle assessment rules but reference a separate standard for CCUS accounting. Each of these are developed and managed by independent technical advisory groups that, in turn, require an independent process to update the respective standard. This process generally takes years rather than months and requires broad stakeholder engagement. Finally, parallel revisions will need to be made across both ISO and EN to drive truly harmonized reporting.

Despite these challenges, the ISO and CEN frameworks represent a clear starting point to drive more consistent GHG accounting for steel and cement products. Specifically, ISO 21930 and EN 15804 govern lifecycle assessment for construction products, including steel, cement, and concrete, and address most issues discussed in this white paper. As a result, the IDDI Secretariat suggests focusing implementation efforts on aligning stakeholders behind revisions to these standards, in line with the proposals in this paper and in consultation with relevant stakeholders.

Successful implementation of the proposals laid out here into these standards will result in meaningful improvement in the comparability of embodied GHG emissions in construction products, an important milestone since all concrete procurement and 95 per cent of public procurement for steel fall within the construction sector.[32] However, it is important to consider that non-construction steel products, such as automobiles and white goods, represent another key segment of steel production and will not be addressed by these PCRs. While a separate effort will be required to establish a comparable product category rule and common reporting format for non-construction steel products, the principles-based framework and guidance laid out in this paper could nevertheless serve as the basis for such work.

To advance the implementation of this guidance into ISO 21930, EN 15804, and other relevant emerging standards, the following activities will need to be undertaken over the coming years. Achieving these goals will require active engagement from stakeholders to successfully drive changes to these standards by 2025, when governments that have made commitments in line with the IDDI GPP pledge will require to disclosure of embodied carbon for concrete and steel procured for public construction projects.

EXHIBIT 1.10 **Key activities to drive towards harmonization of standards**

	2024	2025 onwards	
1 Convene working groups to develop guidance on key accounting issues ▪ CCUS ▪ Mass Balancing ▪ Common Data Use ▪ Co-outputs	Develop additional guidance through IDDI working groups	Assess key standards against IDDI guidance	**2025 Onwards** Governments implement project lifecycle assessment reporting using harmonized standards
2 Align on definitions for emissions thresholds to enable green procurement pledges	Define thresholds for steel and concrete emissions bands		
3 Implement revisions to ISO 21930 and EN 15804+A2	Propose and drive revisions through relevant ISO and EN technical committees		

The path to harmonizing emissions accounting in steel, cement and concrete will be a challenging one, but it can be navigated and must be pursued with haste to enable the transition to net-zero in these sectors. Doing so will require the active support of several stakeholder groups given the voluntary nature of standards, and it will be essential for both industry and national stakeholders to work towards consensus to successfully build a harmonized and trusted emissions accounting system. The IDDI Secretariat will continue to work with member countries and partner organizations to advance the mission of more harmonized reporting and unlock the power of green procurement.

References

1 United Nations, Technical Dialogue of the First Global Stocktake, 8 September 2023: https://unfccc.int/documents/631600

2 Decarbonizing Steel & Cement: Columbia Center on Global Energy Policy

3 International Energy Agency (IEA): Iron and Steel Technology Roadmap

4 Estimates based on BCG analysis. Estimates for both sectors could vary significantly depending upon geography, technology pathway, stage of investment, maturity of technology, incentives, and other factors.

5 Steel estimates based on data from Global Efficiency Intelligence; public consumption taken as weighted average across available representative datasets of Germany, India, Japan, Korea, USA. Cement estimates based on data from Clean Energy Ministerial and calibration across IDDI member countries.

6 Comprehensive product category rules should be based on supporting lifecycle assessments and carbon footprint studies, as specified by ISO 14027:2017 (Chapters 5 and 6). The transparent and representative use of reference LCAs in PCR development can ensure consistency in reporting and provide clear guidance to LCA practitioners.

7 LEED (Leadership in Energy and Environmental Design) and BREEAM (Building Research Establishment's Environmental Assessment Method).

8 ISO 21930 contains five mandatory impact categories, while EN 15804+A1 required seven impact categories. EN15804+A2 reorganizes these categories (for example, by requiring global warming potential to be reported through four distinct 'climate change impact' figures) and requires a total of 18 reporting categories. Source: OneclickLCA, ISO21930:2017, EN15804:2012+A2:2019.

9 Any comparison requires that the reference LCAs underlying sub/c-PCRs created beneath each standard are broadly consistent.

10 Variance driven by accounting issues for cement and concrete:

- **Primary data**: Based on difference between 75th percentile and 50th percentile emissions intensity of clinker in the United States (Source: 2021 US EPA data); clinker factor used to isolate intensity of production without accounting for substitution through supplementary cementitious materials.
- **Secondary data**: Reflects discrepancy in emissions for a finished concrete product between two background datasets: GaBi by Sphera and ecoinvent. Based on sample of cement industry LCA experts.
- **Re-carbonation**: Reflects reduction in lifecycle emissions for concrete product due to carbon uptake after concrete is poured and over a product's lifecycle. Excludes carbon uptake after service life given uncertainty over sequestration and recycling. Based on estimates in World Business Council for Sustainable Development (WBCSD) Cement Sustainability Initiative CO_2 Protocol, which states that CO_2 uptake during service life of concrete can reach up to 10% of initial emissions from production. While corresponding value for concrete would be slightly lower, this is rounded to 10% to reflect uncertainty in estimates.
- **Slag allocation**: Reflects impact on reported emissions of concrete from assigning an emissions burden to blast furnace slag equivalent to emissions associated with clinker, following the 'system expansion' methodology proposed by some steel standards. Assumes 50 per cent replacement of clinker with GGBS. Concrete emissions of 0.31 tCO_2 / m^3 used as baseline.
- **Alternative fuels**: Reflects difference between 'gross' and 'net' emissions (detailed in technical guidance section of this white paper) for a producer using worldwide average of fuel mix, as detailed in World Bank / IFC report 'Increasing the Use of Alternative Fuels at Cement Plants'.

11 World Steel Association: World Steel in Figures - 2023

12 Variance driven by accounting issues for steel:

- **Primary data**: Based on difference in emissions intensity reported for steel produced through the EAF route when average data is used to represent upstream iron rather than more emissive actuals. Average reflects global average emissions intensity of iron production, based on worldsteel data on emissions factors of upstream inputs and global mix of BF-BOF vs DRI production. High emissions case reflects weighted average of emissions associated with blast furnace steel-making in top three countries with highest emissive BF-BOF emissions footprints, based on global BF-BOF benchmarking from **Global Efficiency Intelligence**.
- **Secondary data**: Reflects discrepancy in emissions for same product between two background datasets: GaBi by Sphera and ecoinvent. Due to constraints in accessing and sharing data from privately held datasets, publicly available findings for emissions from tinplate steel used as proxy. While characteristics and use cases of tinplate steel differ significantly from construction products investigated in other parts of this report, it is assumed as a suitable proxy, as the purity requirements of tinplate steel necessitate a high proportion of virgin iron use in its production. **Result for tinplate steel** corroborated by benchmarks from other industries including cement and aluminum.
- **Slag allocation**: Based on estimate of emissions credit to crude steel under system expansion method, based on results of the EUROFER IPP Project 'A methodology to determine the LCI of steel industry co-products', hosted on worldsteel.org. For simplicity, the figure only estimates the impact of allocating blast furnace slag on the emissions footprint of average steel produced through the BF-BOF route.
- **Process gases**: Estimates impact of process gases on GWP of product by subtracting credits for slag allocation from net increase in GWP of product, reported in worldsteel 2021 LCA methodology report. Assumes 79 per cent of blast furnace slag is used in cement production, per worldsteel 2021 LCA study report. BOF slag and other co-outputs including sludges are assumed to have minimal impact on product emissions footprint as they replace substantially less emissive inputs in other industries.
- **Scrap utilization**: Reflects emissions credit to products for end-of-life recycling of steel, net of input burden for hypothetical emissions in past life of steel scrap that is used in production. Calculated through average of credit for three products (source: worldsteel): steel sections, hot rolled coils and hot-dip galvanized steel, weighted by the relative mix of each product in overall steel exports (source: worldsteel). Assumes 85 per cent recycling rate for all products. Emissions credit will vary significantly depending upon type of product, lifespan in use, recycling rate in geography, and assumptions over emissions footprint of primary steel production displaced in next life. The challenges of estimating end-of-life recycling credits are discussed in further detail in Chapter 4.5.

13 **IEA**, **GHGP**: GHGP standard outlines rules for the disclosure of cradle-to-gate emissions for Scope 3, Category 1 (purchased goods and services). Where applicable, these principles can also apply to reporting of alternative Scope 3 emissions categories, such as 3.2 (capital goods)

14 GHGP has been acknowledged as a standard for emissions reporting by steel producers including **Arcelor Mittal**, **Tata Steel**, **Nippon Steel**, among others. It has been acknowledged by cement and concrete producers including **Cemex**, **HeidelbergCement**, and **Holcim**. Producers from both industries have also contributed to the creation of the **GHGP Project Accounting Standard** as well as the Product Lifecyle Standard.

15 'Low-carbon production of iron and steel: Technology options, economic assessment, and policy': Friedmann, J and Fan, Z. Joule, Volume 5, Issue 4, p. 829-862 (2021)

16 Cement contribution to concrete emissions from the **Cement Association of Canada**. Cement producers may also purchase clinker, which is responsible for the majority of cement emissions, as reported by the **US EPA.**

17 Use of 'no allocation' in Japan is partly due to approach in ISO 20915 standards for lifecycle reporting used by steel producers to report product emissions in Japan.

18 Based on sensitivity analyses in EUROFER/worldsteel commissioned report referenced in (x), with additional data from secondary data sources such as SteelBenchmarker to refine economic allocation impacts.

Note: While system expansion is disallowed by EN 15804:2012+A2:2019 and ISO 21930:2017, along with other major PCRs, it is the officially stated method in the worldsteel LCI methodology referenced in this paper. Given the goal highlighted in this report of eventually driving harmonization between various methods of reporting, system expansion is included as a reference point to highlight its acceptance in the steel industry. Correspondingly, the impact assessment of system expansion on concrete emissions assumes that any credits in one industry would be balanced by consistent treatment in other industries to avoid undercounting of emissions at the system level.

19 Allocation is accepted by building block methodologies including ISO 14067:2018 and Greenhouse Gas Protocol Product Lifecycle Accounting Guidance, as well as construction sector PCRs including ISO 21930:2017 and EN 15804:2012+A2:2019. Additionally, a representative sample of EPDs published by steel producers found use of allocation methods in the majority of EPDs.

20 Slag prices based on various sources representing range of prices in recent years, including **US Geological Survey** & **worldsteel**.

21 Most steelmaking sites are known to reuse waste gases onsite or flare them for health and safety reasons. Estimate assumes typical export percentages for sites that do export are 10 per cent, **based on publicly available data**.

22 In line with the Greenhouse Gas Protocol, the IDDI Secretariat encourages companies to report any estimates of avoided emissions separately from the reported emissions in environmental reports. As stated in GHGP, system expansion also risks undercounting of emissions if purchasers of co-outputs in the downstream industry do not accept an emissions burden for co-outputs that is equivalent to the traditional alternatives they displace.

23 Highlighted in World Steel Associaton Lifecycle Inventory Methodology Report (2017); **https://worldsteel.org/wp-content/uploads/Life-cycle-inventory-methodology-report.pdf**.

24 IEA Iron and Steel Sector Roadmap.

25 **GHGP Stationary Combustion Guidance (1.3.1)** specifies standard practice for accounting of biomass in national inventories and standards. Separately, ISO 21930:2017 follows a -1/+1 approach, where carbon is assumed to have been drawn from the atmosphere as biomass is grown, and re-entered into the atmosphere when it is burned. Therefore, accounting for full cradle-to-gate emissions would lead to zero emissions burden for combustion, with an additional burden associated with land-use change, transportation, and any other emissions incurred in preparing biomass for use.

26 Science Based Targets Initiative Cement Guidance, page 22. While the system boundary of SBTi reporting is less comprehensive than emissions reported in EPDs, SBTi proposes near-term Scope 3 targets for fuel usage, which must be accounted using gross emissions.

27 **SBTi Steel Guidance**

28 Efforts under ISO are being spearheaded by **ISO Technical Committee 265**. Efforts under EN are being spearheaded by **PSE/265**.

29 'Emissions Trading Systems and Carbon Capture and Storage,' International Carbon Action Partnership (2023).

30 Scope 3U refers to Scope 3 upstream emissions, or emissions relating to purchased or acquired goods Source: **ISEAL**, BCG Analysis.

31 **International Civil Aviation Organization**

32 Publicly available UK steel procurement data used as proxy.

INDUSTRIAL DEEP DECARBONISATION
AN INITIATIVE OF THE CLEAN ENERGY MINISTERIAL

UNIDO
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Progress by innovation

CLEAN ENERGY MINISTERIAL
Advancing Clean Energy Together