Responsible Steel standards & certification

From Data to Decisions: Comparable GHG Emissions Data for Steel Procurement

September 2026

Acknowledgements

This report was prepared by Melav Salih, Dr Alli Devlin and Matthew Wenban-Smith, with support from Annie Heaton, Shivakumar Kuppuswamy, Nicholas Natrella and Joe Woodruff.

This research was made possible by contributing steelmakers across ResponsibleSteel membership, including Tata UK and Emsteel. This paper has benefited from comments by several experts, whom we would like to thank, including SteelZero (Sarah Campbell, Sameen Khan and Will Mullan), CARES (Ladin Camci), World Steel Association (Clare Broadbent and Terrence Busuttil) and the Industrial Deep Decarbonization Initiative (Jack Fraser and Sol Reeves).

The views expressed in this publication are those of the author(s) and do not necessarily represent those mentioned in the document or those who partook in the review process.

Suggested citation

ResponsibleSteel (2026), 'From Data to Decisions: Comparable GHG Emissions Data for Steel'

Copyright

Executive summary

The global steel industry is responsible for approximately 8% of greenhouse gas (GHG) emissions worldwide, and the construction sector consumes more than half of all steel produced. As specifiers, engineers and procurers increasingly seek to reduce the embodied carbon of the buildings and infrastructure they design, Environmental Product Declarations (EPDs) have become the default tool for identifying 'low emissions' steel. More than 130,000 EPDs for construction products have now been published globally, and they are increasingly referenced in green building certification, procurement specifications and emerging regulations across Europe, North America and beyond.

This paper presents the findings of original research conducted by ResponsibleSteel, with the support of four steelmaker member companies, into how the Global Warming Potential (GWP) values reported in EPDs are determined for steel products, and how they relate to ResponsibleSteel's site-level Decarbonisation Progress Levels (DPLs). This analysis is framed against the Steel Standards Principles' (SSP) Criteria for Transparency in GHG Reporting which is a benchmark already recognised across the sector. Our original objective was not to test the comparability of EPD-declared GWP values, but to establish whether those values, combined with disclosure of the use of recycled or Secondary Materials (SM), could be used to determine the DPL of the steelmaking site supplying the steel product. In pursuing that question, we found that GWP values widely differ for the same product calculated using the same Product Category Rule (PCR), and that EPDs do not consistently disclose Secondary Materials - exemplifying the challenge of conversion. More than 30 additional quantitative and qualitative data points were collected directly from participating steelmakers, beyond what a standard EPD discloses. Even so, the average conversion accuracy achieved was 94% with a wide range, considered insufficient for interoperability between EPD and DPL values.

The gap between a product's EPD-declared GWP and its site's crude steel GHG emissions intensity was driven by three key factors – system boundary, co-product allocation and secondary datasets. Logically, the most influential factor was the system boundary; correcting for the crude steel cut-off alone accounted for up to 35% of the difference. Following, co-product allocation methods and the choice of background dataset for upstream emissions proved the most material factors, each contributing up to 27% and 18% of the difference, respectively. Even after the three most material corrections were applied, the gap between the EPD-declared GWP value and a site's crude steel GHG emissions intensity ranged from 7% to 16%. This demonstrates that the choice of EPD standard and its application may have a greater impact on reported emissions than any real variations of the emissions themselves, undermining the reliability of any GWP threshold used in green public procurement that treats EPD-declared GWP values as directly comparable across producers.

EPDs were not originally designed to benchmark or compare steelmaking decarbonisation performance — their original purpose was broader environmental disclosure across multiple impact categories, and for that purpose they remain a valuable, well-established tool. This paper identifies three ways to improve EPDs currently used in practice:

1. **Require fuller disclosure of what a declared GWP value represents.** EPDs should include exactly which production site or sites are covered; whether the value represents a specific product or an average across multiple products, sites or production routes; which background datasets and emission factors were applied; and how environmental impacts were allocated between steel and co-products such as slag. This would let buyers judge how representative a declared GWP value actually is, without requiring any change to the underlying accounting rules.
2. **Tighten the application of existing standards to avoid variation.** Standardising the methodological choices allowed within a given standard (e.g. EN 15804) can remove a source of variation that currently exceed 10% between EPD programme operators applying the same core standard, independent of any real difference in the emissions of the product or the steel it is made from. Narrowing this permitted range is a comparatively low-cost step, since it works within standards that already exist rather than requiring new ones.
3. **Adopt a consistent, clearly defined basis for accounting for scrap**. 'Recycled content', 'Secondary Material' and 'scrap' are three distinct, non-interchangeable concepts, each governed and measured differently. For example, two steelmakers using an equivalent 70% scrap share can report materially different 'recycled content' percentages for the same physical material. This matters because global scrap recovery and recycling rates are already as high as 85%: a low declared GWP driven by high scrap share does not reflect a genuine contribution to the sector's decarbonisation, since that scrap would have been recycled elsewhere regardless.

These are not new observations in isolation, but this analysis is, to our knowledge, the first to test them directly against real, verified site-level data provided by steelmakers, and to examine in practice what would be required to bridge the gap between product-level and site-level GHG metrics.

These findings are not reasons to abandon EPDs. They remain valuable and, in many cases, the only available disclosure tools for product-level environmental data. But relatively simple, low-cost changes to how they are specified, combined with complementary site-level metrics such as ResponsibleSteel's DPLs, could make product-level GHG emissions data genuinely fit for the purpose of specifying 'low emissions' steel. Meaningful progress towards these changes is already under way: the Industrial Deep Decarbonisation Initiative, Catena-X, CEN's draft steel-specific standard (prEN 17662), the first North American steel-specific PCR for steel construction products, ongoing ISO harmonisation work between ISO 14064-1, ISO 14067 and the GHG Protocol (including the conditions for valid carbon footprint comparisons) and the Steel Standards Principles (SSP) have each, independently, converged on the conclusion that greater transparency and harmonisation of EPD methodologies is both necessary and achievable. In the interim, effective procurement decisions that genuinely drive decarbonisation will require reading multiple GHG data points together, rather than relying on a declared GWP value alone.

We call on steelmakers, product manufacturers, specifiers, green-building councils, certification bodies, EPD programme operators, standard-setters, civil society and policymakers to support these changes as a matter of urgency:

1. EPD-declared GWP values must comply with the SSP's Criteria for Transparency in GHG Reporting, including disclosure of the product-level crude steel emissions intensity and scrap content in line with the scrap definitions specified in ISO 20915;
2. Specifications for 'low emissions' steel must be based on both the GHG emissions intensity and scrap input share (as opposed to recycled content), applied via a defined decarbonisation framework such as ResponsibleSteel's DPLs, rather than product GWP alone;
3. EPD programme operators must work alongside stakeholders in the steel sector to develop Product Category Rules that eliminate current methodological inconsistencies in the determination of steel product GWP values.

Table of Contents

1. Introduction

1. Introduction

The iron and steel industry accounts for approximately 8% of global greenhouse gas emissions (GHG) (worldsteel, 2026). The construction sector is by far the largest consumer of that steel, accounting for 52% of global consumption (worldsteel, 2025). In some regions, designers, specifiers and procurers of steel-containing products in the built environment are increasingly engaging with suppliers on GHG emissions performance, though this market maturity is globally uneven and initial cost still dominates purchasing decisions in many markets; even where engagement is more advanced, procurers still lack all the tools they need to make informed decisions to effectively drive sectoral decarbonisation (WRI, 2025).

Environmental Product Declarations (EPDs) are independently verified and registered documents that transparently communicate the life cycle environmental impacts of a product. Life cycle assessment (LCA) methodologies are capable of evaluating a product's environmental impacts across its entire life — from cradle-to-grave, covering raw material extraction, manufacturing, transportation, use and maintenance, through to end-of-life disposal or recycling. The EPD quantifies multiple environmental impact categories such as ozone depletion, acidification and eutrophication alongside Global Warming Potential (GWP). EPDs help guard against burden shifting which is a safeguard a single-issue carbon metric cannot provide on its own. EPDs are increasingly used in construction, appearing in procurement specifications, green building certification schemes, and emerging regulatory frameworks across the world. More than 130,000 EPDs for construction products have now been published globally (Edge Environment, 2026).

In current practice, however, steel product EPDs are overwhelmingly cradle-to-gate, excluding use-phase and end-of-life emissions. This paper is concerned solely with this system boundary and does not propose changing it. We note, however, that green-building schemes such as LEED v5 increasingly reward whole-life (cradle-to-grave) declarations that include an end-of-life recycling credit (Module D), a trend that may over time increase demand for cradle-to-grave steel EPDs. Within the steel sector, EPDs have become the predominant mechanism through which downstream customers obtain product-level emissions data (RMI, 2026). It increasingly forms the basis for procurement, financing and reporting decisions (RMI, 2026). However, benchmarking the decarbonisation performance of steel production is not what EPDs were originally designed for and on their own they provide an incomplete picture of a producer's progress towards near-zero emissions steelmaking. Whilst EPDs provide disclaimers regarding the lack of comparability, this is often overlooked in procuring decisions. Yet, outside construction, EPDs carry far less commercial currency: other steel end-use sectors (e.g. automotive, packaging, machinery) rarely require or reference EPDs in specification or procurement, and are correspondingly under-represented on the ISO and CEN technical committees that define EPD standards — meaning these sectors currently have limited voice to influence how EPD rules for steel are set.

ResponsibleSteel's Decarbonisation Progress Level (DPL) framework is aligned with the International Energy Agency's definitions for near-zero and 'low emissions' steel (IEA, 2024). DPLs are a site-level benchmarking tool for crude steel: they are used to assess and track a steelmaking site's own trajectory towards near-zero emissions by using the same methodology to obtain the GHG and scrap metric. This is called the "sliding-scale approach" and allows for comparability across global steelmaking sites to evaluate decarbonisation performance on a like-for-like basis. The sliding-scale approach has subsequently been referenced in an IEA report for the G7 Industrial Decarbonisation Agenda (IEA, 2023) and adopted or recognised by other initiatives, including the China 2 Future (C2F) Standard from the China Iron and Steel Association (CISA) (C2F, 2026), Low Emission Steel Standard (LESS) (LESS, 2026) and the Science Based Targets Initiative (SBTi) (SBTi, 2023); although the degree of alignment between the sliding-scale approach used by these initiatives varies.

Within ResponsibleSteel's International Production Standard, the DPL and the EPD (or Product Carbon Footprint (PCF)) are both required to demonstrate decarbonisation progress. As shown in Figure 1, a site's DPL is determined by combining its crude steel GHG emissions intensity with its scrap share of metallics input, both measured at site-level, and plotting the result on ResponsibleSteel's sliding scale. The ResponsibleSteel Steel Certificate discloses crude steel emissions intensity, scrap percentage and DPL, in addition to a link to the product-level EPD. The two GHG metrics serve different purposes: the DPL is a site-level benchmarking tool, assessing decarbonisation progress; the EPD is a product-level disclosure tool, communicating the life cycle environmental impacts of a specific product which could be semi-finished or finished steel. Steel Certification therefore requires evidence both that the underlying steelmaking meets a genuine performance threshold, and that details of a resulting product's environmental footprint have been transparently and publicly disclosed. This paper is concerned with how these two datapoints relate to one another, and with considering the current limitations of EPDs in fulfilling the related roles of comparability, transparency and disclosure.

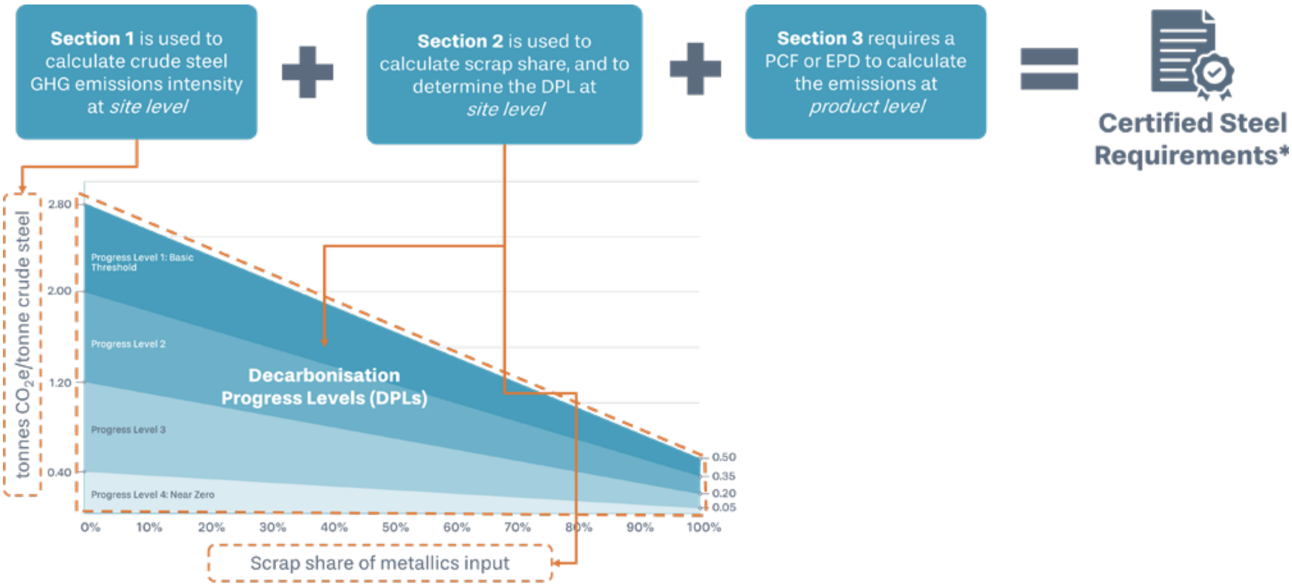

Figure 1. ResponsibleSteel's Steel Certification requires both a DPL and an EPD to capture the full picture of a product's GHG emissions performance.

1.1 What are EPDs and what are they used for?

EPDs originated in Sweden during the mid-1990s as a standardised way to communicate the environmental impacts of products based on a life cycle assessment (LCA). In the context of climate change, the key indicator is GWP, expressed in kilograms or tonnes of carbon dioxide equivalent (CO_2e) per mass unit of finished product; for example, per kilogram or tonne of hot rolled coil. EPDs cover 'cradle-to-gate', which includes emissions from raw material extraction through to the finished product leaving the factory gate — for steel, this typically means crude steel plus downstream processing such as hot rolling, coating or fabrication into the final product sold.

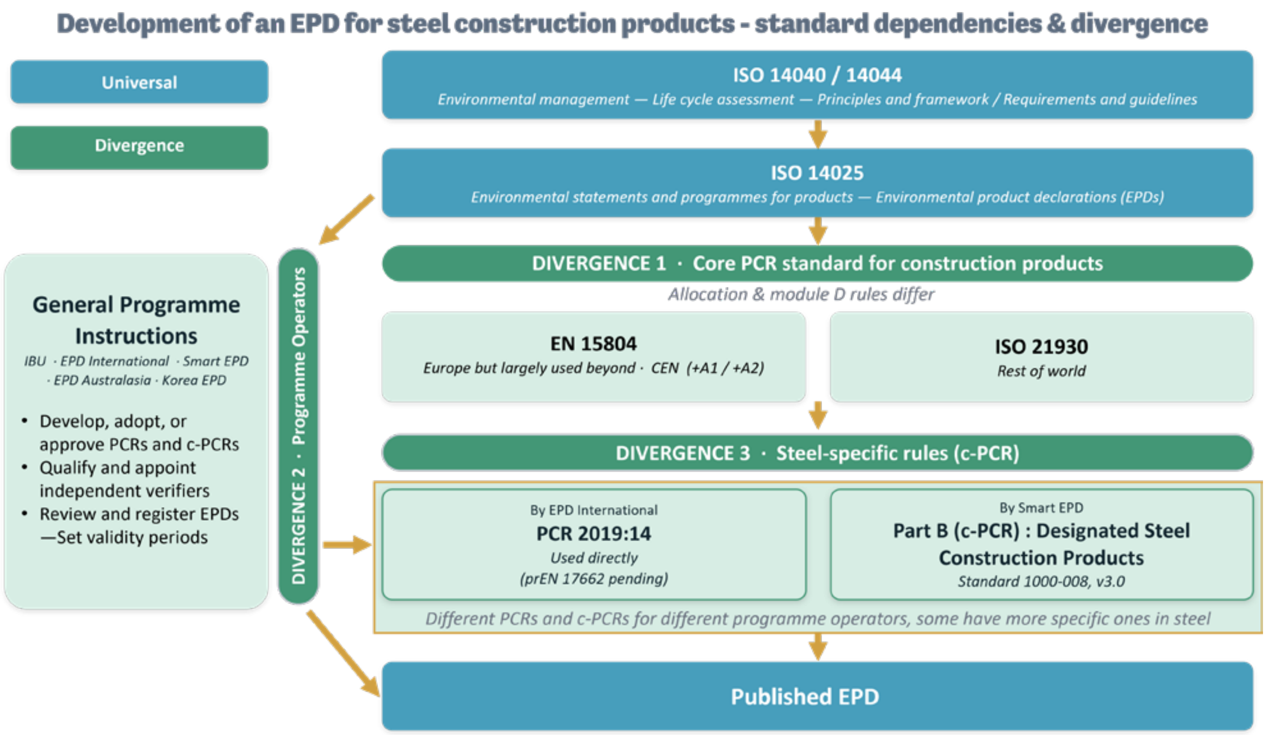

Figure 2. The hierarchy of standards and rules for determining an EPD (Inspired by Konradsen et al, 2024)

An EPD's publication rules are set by a four-level hierarchy (as shown in Figure 2), and each level allows further interpretation, the root cause of the variability discussed in Section 2. The standard dependencies can differ widely by region and sector, introducing dozens of variations for determination of the published environmental data.

1. **International LCA standards** — ISO 14040[6] and ISO 14044[7] set out general principles for conducting an LCA; ISO 14025[8] aligns EPD programme requirements globally.
2. **Core Product Category Rules (PCRs)** — for construction products, chiefly EN 15804+A2[9] (Europe and, increasingly, globally) and the broadly equivalent ISO 21930[10] (more common in the USA) — define how LCA is applied to construction products specifically.
3. **Complementary PCRs (c-PCRs)** — add product-specific rules for categories such as steel sections, concrete, timber or windows, developed by individual EPD Programme Operators or standards bodies.
4. **Programme Operator rules** — each EPD Programme Operator publishes its own General Programme Instructions (GPIs) and Part A PCRs, interpreting and enforcing the levels above.

EPDs themselves contain a disclaimer that warns users against direct comparison unless a

6 ISO 14040:2006 Environmental management — Life cycle assessment — Principles and framework

7 ISO 14044:2006 Environmental management — Life cycle assessment — Requirements and guidelines

8 ISO 14025:2006 Environmental labels and declarations — Type III environmental declarations — Principles and procedures

9 EN 15804:2012+A2:2020 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products

10 ISO 21930:2017 Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services

number of conditions have been met (see Box). In practice, it is rare for these conditions to be met, even when there is sufficient transparency.

Disclaimer

"EPDs within the same product category but registered in different EPD programmes, or not compliant with EN 15804, may not be comparable. For two EPDs to be comparable, they must be

- based on the same PCR (including the same version number) or be based on fully-aligned PCRs or versions of PCRs;
- cover products with identical functions, technical performances and use (e.g. identical
- declared/functional units);
- have equivalent system boundaries and descriptions of data;
- apply equivalent data quality requirements, methods of data collection, and allocation methods;
- apply identical cut-off rules and impact assessment methods (including the same version of characterisation factors);
- have equivalent content declarations;
- and be valid at the time of comparison."

Box: Example of an EPD disclaimer highlighting the conditions for comparability.

EPDs serve a range of purposes. In relation to GHG emissions, EPDs disclose a product's GWP, enabling users to understand and compare the emissions associated with products and to incorporate this information into decision-making processes.

EPDs are used throughout the value chain, typically by downstream steel product manufacturers, architects, engineers, contractors, developers, LCA consultants, public procurers and certification assessors.

Major uses of EPDs in the built environment include, but are not limited to, the following:

1. Comparisons of the environmental impacts of materials and designs, influencing the selection and specification of materials and architectural and engineering proposals.
2. Quantification of the embodied emissions of in-use steel products. For example, for a whole building LCA.
3. Green building certification, for example as specified in the UK's Building Research Establishment Environmental Assessment Method (BREEAM), the US Green Building Council's Leadership in Energy and Environmental Design (LEED) scheme, the German Deutsche Gesellschaft für Nachhaltiges Bauen (DGNB), and the Green Building Council of Australia (GBCA).

4. Public procurement regulations and related specifications, such as the Construction Products Regulation (CPR) in the EU and the US Buy Clean Initiative in the USA.

1.2 What are DPLs and what are they used for?

Decarbonisation Progress Level (DPL) classification within the ResponsibleSteel International Production Standard is a steel classification system that benchmarks the GHG emissions intensity of crude steel production against the proportion of scrap used as an input. It includes four progress levels (as shown in figure 3): from Progress Level 1, representing better than the global average, to Progress Level 4, representing near-zero emissions production. The scrap-variable approach (also called the sliding scale or decarbonisation scale) provides a practical framework for decarbonising steel while acknowledging the physical limits of scrap availability (ResponsibleSteel, 2026). Scrap-based steelmaking is inherently less emissions-intensive than iron ore-based steelmaking, since the emissions embedded in scrap were already accounted for when that steel was originally produced. As a result, even a primary steelmaker employing the most effective decarbonisation technologies may still have a higher emissions intensity than a scrap-based producer, simply because the two production routes start from fundamentally different emissions baselines (ResponsibleSteel, 2026).

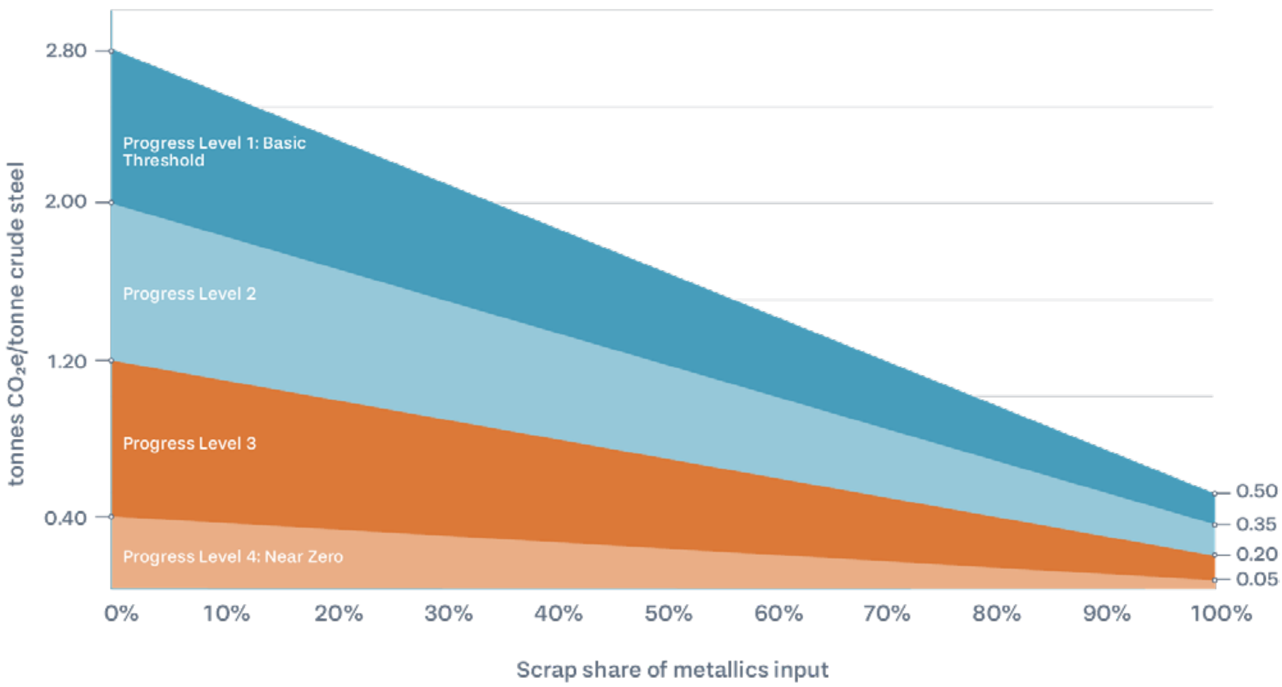

Figure 3. ResponsibleSteel Decarbonisation Progress Levels based on a scrap-variable scale. The progress levels are defined by the ratio of GHG emissions intensity to scrap input for crude steel production at a given steelmaking site.

The DPL emissions boundary runs 'cradle-to-crude steel', from raw material extraction to the point immediately after casting, so that sites can be compared on a like-for-like basis regardless of downstream hot rolling and finishing processes which depend on the product mix. By accounting for the proportion of scrap used in steelmaking, it provides a clear, comparable, technology-neutral method to evaluate emissions performance across production routes. The DPL classification system offers an internationally consistent way to measure progress while recognising that different regions will advance to near-zero at different rates, as is also recognised by the SSP Transparency Criteria[6].

In Principle 10 of ResponsibleSteel's International Production Standard, GHG Emissions and Climate Change, three key emissions metrics are utilised to assess a steelmaker's emissions profile and decarbonisation ambition (all required for Steel Certification as shown in Figure 1)[7] :

(i) Corporate-level climate transition plan;

(ii) Site-level Decarbonisation Progress Level;

(iii) Product-level EPD or PCF.

However, there is no direct relationship between the data that is commonly used in industry today to communicate the environmental impact of a product (as declared within an EPD or PCF), and the data that is needed to compare the decarbonisation progress of steel production (facilitated by ResponsibleSteel's DPL classification). The distinct yet reciprocal roles of these GHG metrics are summarised in Figure 4.

	Decarbonisation Progress Level (DPL)	Environmental Product Declaration (EPD)
Purpose	To measure, recognise, and reward the decarbonisation progress of steelmaking sites on the pathway to near-zero emissions	To communicate the environmental impact of a product in a verifiable format to support informed decision-making
System boundary	Site level	Product level
Lifecycle scope	'Cradle-to-crude steel'	'Cradle-to-gate' (minimum)
Units	tonne CO_2e/tonne crude steel (y-axis) scrap % (x-axis)	tonne CO_2e/tonne steel product (GWP) tonne/tonne steel product (secondary materials) (among many other impact categories)
Methodology	Consistent ResponsibleSteel methodology, providing a comparable unit of measurement across the entire global steel industry	Differs across programme operators and PCRs - not comparable across steel products due to different functional units and accounting methodologies
Scrap declaration	Mandatory declaration of scrap % (as portion of metallic inputs)	Not mandatory; No explicit definition for scrap; Differing definitions for recycled content/secondary materials

Figure 4. Comparison between key characteristics of the Decarbonisation Progress Levels and Environmental Product Declarations.

1.3 Study overview

ResponsibleSteel conducted a study with four steelmakers to analyse the feasibility of converting the GHG and scrap-related values found in an EPD to those required for DPL determination. Within the EPD, for the emissions intensity metric, the GWP value from A1-A3 was taken. Since the Secondary Material (SM) value from A1-A3 of the life cycle is currently the only scrap-related field reported under EN 15804 and ISO 21930 this was considered a proxy value for the scrap share. The data provided by four steelmakers covered a range of steel products across different geographies.

6 For more information see 'Charting Progress to 1.5°C through Certification' and 'The Steel Decarbonisation Scale: A briefing for policy makers in the EU designing a label for low-emission steel'.

7 For more information see the 'Decarbonisation Progress Levels guide' and 'Fundamentals for GHG Emissions Accounting and Classification'.

From the outset, the main known technical obstacles to conversion were the differences in system boundaries and accounting approaches: EPDs are calculated based on a 'cradle-to-gate' boundary and product-level LCA methodology, while DPLs are calculated based on a 'cradle-to-crude steel' boundary and facility-level emissions reporting for classification purposes. The study set out to test whether the gap in system boundaries and accounting approaches could be bridged.

To do this, each participating steelmaker was asked to provide additional data reflecting site-level production and emissions over the same period of the input data for EPD determination. Steelmakers were also asked to provide details on the individually permissible, methodological choices made under the applied PCR rules. Around 30 different quantitative and qualitative data points had to be collected. This covered emissions beyond crude steel, scrap inputs, upstream emissions data, the treatment of process gases, the electricity mix used, the treatment of slag and any credits, among others. Data collection with each steelmaker took an average of four months, including multiple rounds of feedback to ensure the data was accurate and representative.

Limitations to the study

The largest limitation to this study was obtaining the original site-level data from which the product-level declarations were made. The resource-intensive data collection process was augmented by the fact that many steelmakers outsource their LCA and EPD preparation to third-party consultants. In addition, the SM value used as a scrap proxy is not equivalent to ResponsibleSteel's scrap definition (further explained in section 2.2) making the need for granular data necessary to calculate the scrap share.

Chain of custody is acknowledged as materially relevant to EPD comparability but is outside the scope of this paper, which focuses on system boundary, allocation and background-data variability.

Beyond this, some simplifications had to be made in the conversion process:

- ResponsibleSteel's methodology applies a multiplier of 1.2 (or 1.6 for methane-intensive materials) to global averages to form the default embodied GHG values used in upstream emission calculation was accounted for as best as possible, but inaccuracies appeared depending on the case.
- Both the ResponsibleSteel methodology and EN 15804 account for downstream waste-related emissions, but define and allocate them differently (treatment of residual waste disposal versus co-product credit); reconciling these differing treatments was beyond the scope of this study, so waste-related emissions were excluded from the site-level comparison entirely, for both datasets, to keep the comparison like-for-like.
- Since EPDs are not always specific to individual sites or production routes, it was often difficult to isolate the 'cradle-to-crude steel' stage for direct comparison.

2. Challenges for the use of EPDs

2. Challenges for the use of EPDs

EPDs were not originally designed to benchmark or compare steelmaking decarbonisation performance. Their original purpose was broader environmental disclosure across multiple impact categories, and for that purpose they remain a valuable, well-established tool. Yet, EPDs have well-documented limitations (Konradsen et al, 2024). Three specific gaps in current EPD practice mean that, on their own, they are not yet a sufficiently reliable basis for identifying 'low emissions' steel, which is an emerging use case. These three gaps, which were dominant in this study, are:

1. Lack of transparency regarding what the EPD values represent;
2. Variability in GHG emissions accounting;
3. Inconsistent definitions and treatment of scrap and recycled content.

These three challenges are not confined to voluntary specification by private buyers, they equally undermine public procurement and regulatory frameworks that rely on EPDs. The EU's Construction Products Regulation (CPR) itself requires steel products to be accompanied by an EPD, but the specifications governing those declarations are not sufficiently defined or aligned to ensure comparability between similar products. Because methodologies differ across these instruments and the specifications are not sufficiently defined for consistency, datasets generated for CPR (or ESPR) compliance are unlikely to be interoperable with other carbon-accounting instruments, such as the EU Emissions Trading System (ETS) or the Carbon Border Adjustment Mechanism (CBAM), without the reforms proposed in this paper (ResponsibleSteel, 2026).

2.1 Lack of transparency regarding what the EPD values represent

EPDs are widely perceived as a highly transparent form of environmental disclosure. However, the absence of consistent transparency and consistent methodology means this is not true of most EPDs, and the range between a high-quality EPD and a low-quality EPD is wide enough that it undermines the credibility of the system as a whole.

In practice, transparency is often missing with respect to:

1. System boundary and value-chain traceability;
2. Background GHG emission factor datasets;
3. Co-product allocation methodologies.

Firstly, a declared GWP or Secondary Material (SM) value may relate to a single site and product, or to an average across multiple sites, production routes or product categories, but EPDs often do not clarify the specific system boundary. Within LCA modules A1–A3, which together represent the product stage, results may be reported as one aggregated value rather than disaggregated into raw material supply (A1), transport (A2) and manufacturing (A3). Aggregation hides which emissions sources are dominating a product's carbon footprint, for example, whether a low GWP reflects genuinely efficient manufacturing, or simply a favourable input mix (e.g. high scrap share). This is a transparency and disclosure problem: without disaggregation, a reader cannot tell whether a low GWP reflects 'low emissions' technology or simply scrap allocation. It is distinct from the more fundamental methodological problem addressed in Section 2.3: that even a fully transparent, correctly disaggregated GWP based on a high scrap input does not represent a genuine reduction in the steel sector's overall GHG emissions.

Secondly, GWP values depend heavily on the background datasets used to model upstream inputs including which database was used (e.g. GaBi, Ecoinvent, etc), its geographical scope (site-specific, national, regional or global average), and its vintage (how recently the underlying data was collected, and how current the modelled grid, fuel and process emission factors are relative to today's actual performance). These choices can materially change a reported GWP, as demonstrated in Section 2.2, yet EPDs rarely disclose the background data used in a way a purchaser or EPD user could meaningfully interpret. This form of disclosure, naming the dataset, its geography and its vintage, is consistent with standard database licensing terms, which restrict disclosure of the underlying data rather than its identification.

Finally, steelmaking often generates co-products (e.g. slag, process gases, heat, sludges, dust), to which environmental impacts may be allocated using one of several permitted approaches: physical (e.g. mass-based) allocation, economic allocation, or system expansion. EPDs typically state which approach was used but rarely disclose the assumed prices or the resulting impact on the declared GWP, nor demonstrate how the calculation was performed. In particular, economic allocation depends on assumed market prices for slag and steel that are neither standardised nor disclosed, so two EPDs stating "economic allocation was used" may have applied materially different assumptions which have not been communicated. The same problem applies, to a lesser extent, to physical allocation, where the basis for the split (e.g. by mass, energy content) is stated but the underlying values are not shown. The impact is that the EPD user cannot verify nor understand the quantitative impacts of the allocation choices from the statements typically provided in an EPD.

None of the above is disclosed consistently, and where such information is provided, it is rarely presented in a way that enables EPD users to interpret it effectively. As a result, EPDs often fall short on providing sufficient clarity on what the reported values represent.

2.2 Variability in GHG emissions accounting

EPD standards necessarily allow flexibility to accommodate diverse products and sectors, but this flexibility undermines comparability. Choices of system boundary, co-product allocation, background datasets, functional units and reference service life can all materially change a reported GWP.

> *Two EPDs, even for functionally equivalent products, are unlikely to be directly comparable.*

Research by Konradsen et al. (2024) demonstrated this problem clearly: by modelling the same triple-glazed window product under the PCRs of four different EPD programme operators, they showed that GWP results can vary by more than 10% from a base scenario. The variation arises not from a single methodological choice, but from the cumulative effect of multiple permissible differences.

Regional EPD programme operators often apply different standards, with significant differences. For example, the requirements of EN 15804+A2 (widely used in Europe, but also elsewhere) and ISO 21930 (more commonly used in the USA) differ in relation to the rules used for co-product allocation. EN 15804+A2 applies a defined allocation hierarchy (system expansion where feasible, otherwise physical/mass-based allocation as default) while ISO 21930 also prioritises system expansion but more readily permits economic allocation as an alternative — a materially different basis that is rarely disclosed. Contrast this with ResponsibleSteel's methodology, which does not allocate GHG emissions to slags, assigning all related emissions to crude steel, while applying a system expansion approach to process gases and their associated products, such as heat and electricity.

Even where the same standards are applied, and they are based on the same EN or ISO framework, PCRs and their application may differ. The key differences emerge in the approach to co-product allocation (particularly significant for slag), scrap allocation, background datasets used for upstream materials emissions, and the acceptance of renewable electricity market instruments.

This study identified major inconsistencies and gaps in the measurement and reporting of GHG emissions in EPDs, rendering impossible the reliable comparison between reported GWP values, and streamlined conversion to ResponsibleSteel DPLs.

As demonstrated in Figure 5, the most material accounting variables in the conversion from EPD-declared GWP to ResponsibleSteel DPL spanned allocation rules, system boundary and upstream emissions data source.

The variable with the largest potential impact, but also the easiest to resolve, was the system boundary, which was adjusted to cut-off at crude steel (post-casting) instead of the steel product (which also includes hot rolling and finishing processes). By measuring the GWP at crude steel, the emissions intensity increased by a maximum of 35% and decreased by a maximum of 26%. We found that the effect of the other two most material accounting variables, co-product allocation and the use of secondary data for upstream emissions, was 27% and 18%, respectively.

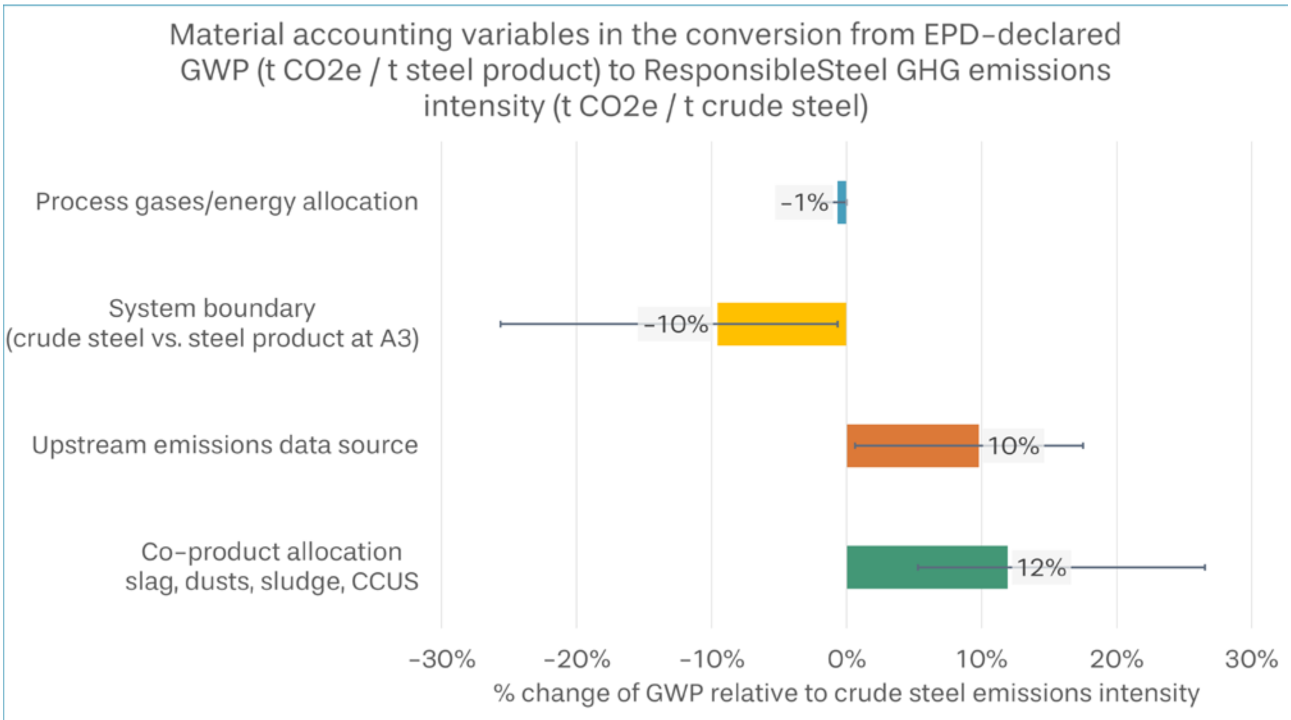

Figure 5. Impact of the most material accounting variables, considered in isolation, when reconciling EPD-declared GWP values with calculated ResponsibleSteel crude steel GHG emissions intensity.

The analysis converts the EPD-declared values to a comparable cradle-to-crude steel basis. Results are averaged across the four participating steelmaking sites and presented as an average and range, expressed relative to the calculated ResponsibleSteel crude steel GHG emissions intensity. The range illustrates the variation attributable to each accounting variable across the sites.

Additionally, the material accounting variables ranged widely from site to site as depicted in Figure 6, making it impossible to set a conclusive conversion factor.

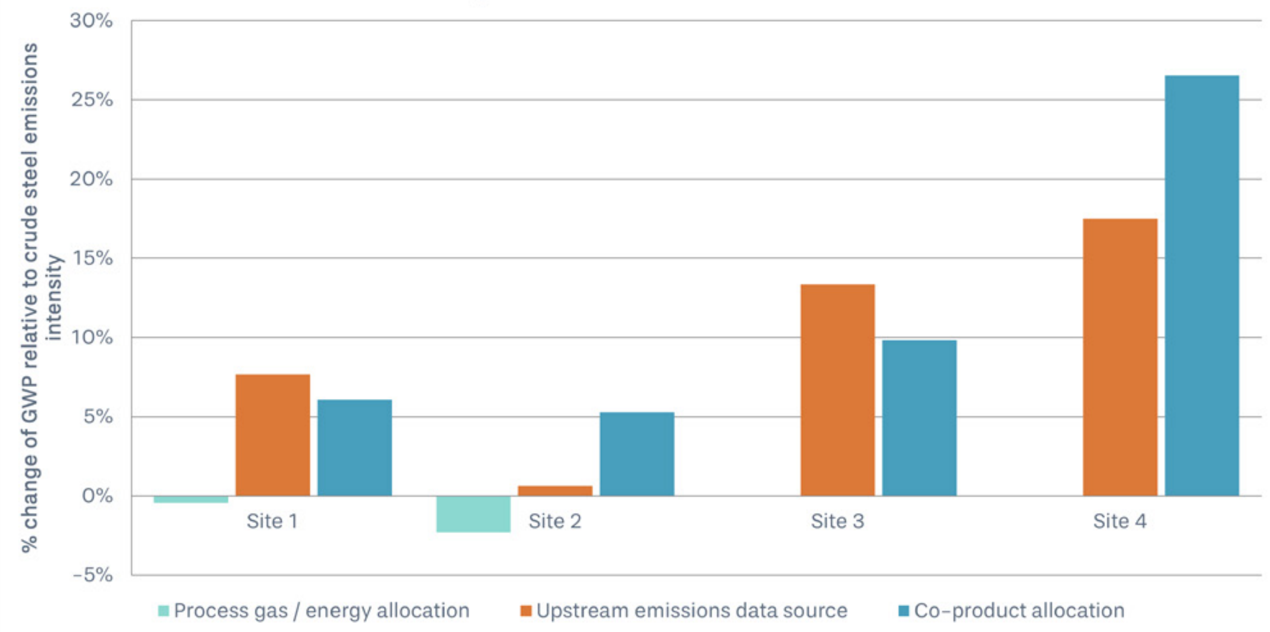

Figure 6. Site-by-site variation in the material accounting affecting the conversion from EPD-declared GWP to ResponsibleSteel crude steel GHG emissions intensity, across the four participating steelmaking sites.

2.3 Inconsistent treatment of scrap

In addition to the emissions intensity, scrap use is central to assess the decarbonisation performance of steel production and products. Yet, EPDs treat scrap inconsistently in three ways: many do not require scrap share disclosure at all; where disclosed, definitions vary; and, more fundamentally, EPDs apply an attributional approach that assigns scrap's low embodied emissions to whichever product it is allocated to.

This section addresses two related issues: first, the differing definitions used to describe 'scrap', or recycled steel, across relevant standards; and second, how those definitions are applied in GHG accounting.

Scrap Definitions

Three related but distinct concepts govern how "recycled steel" is defined across the standards referenced in this paper.

- **Recycled content** is a finished-product claim governed by ISO 14021[8], the standard referenced by EPDs based on EN 15804 and ISO 21930, which defines pre-consumer and post-consumer recycled material as a percentage of the finished product's output mass,

8 ISO 14021:2016 Environmental labels and declarations — Self-declared environmental claims (Type II environmental labelling)

and explicitly excludes internal scrap.

- **Secondary material** is a distinct LCA accounting term defined in EN 15804 as "any material recovered from previous use or from waste which substitutes primary materials", used to track net input/output flows across life cycle modules rather than to declare a content percentage.
- **Scrap** is defined specifically for the steel sector in ISO 20915:2018[9] as home scrap[10] , manufacturing scrap, internal scrap[11] and end-of life scrap.
- **Scrap share** is a steelmaking input metric based on the proportion of scrap to the total metallic inputs used in steel production. In ResponsibleSteel this is explicitly measured as the percentage of total metallics input into crude steel production, excluding internal scrap.

These definitions matter beyond steel-to-steel comparison because EN 15804 and ISO 21930 are cross-material standards, applied identically to concrete, timber and other construction products. In harmonising how 'recycled content' and 'secondary material' are defined and measured for steel, this also supports fair comparisons between steel and competing materials

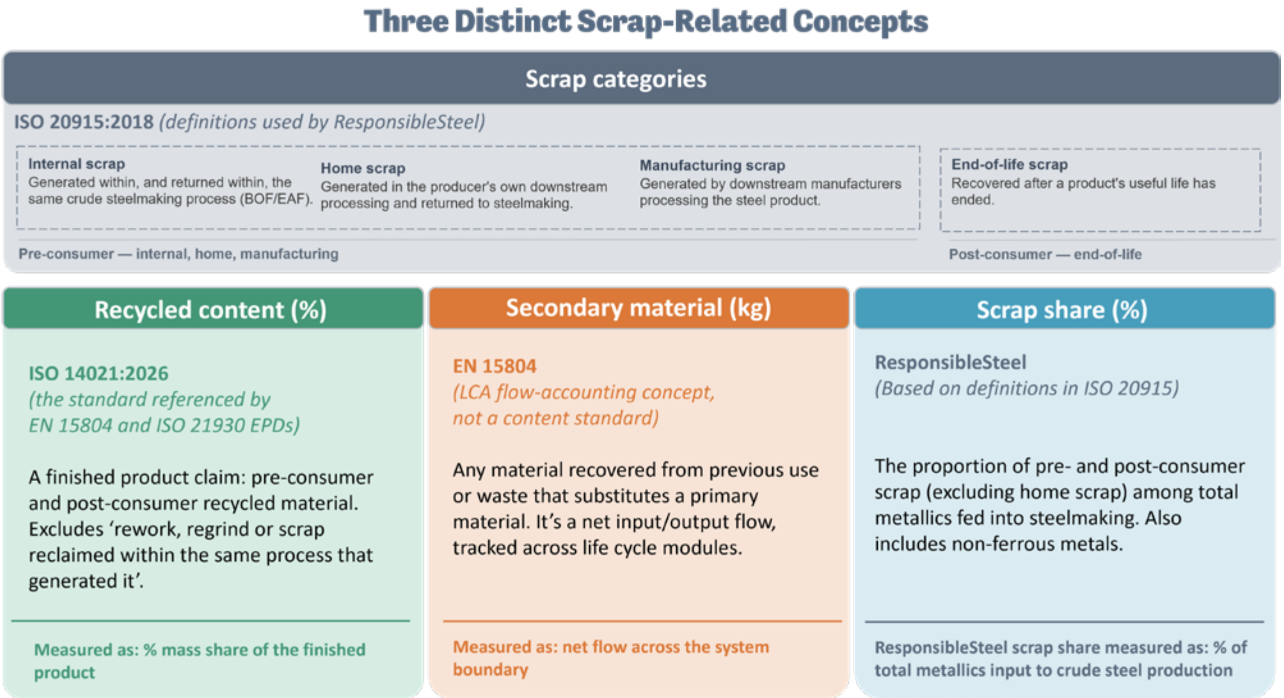

Figure 7. Scrap, recycled content and secondary material are three distinct but overlapping concepts, each governed by a different standard and measured in a different way.

in whole-building LCA and green-building certification — a further reason to resolve these inconsistencies as a priority.

The practical consequence is that these three terms are not interchangeable, even though they substantially overlap for steel: all end-of-life and manufacturing scrap qualifies as both

9 ISO 20915: 2018 Life cycle inventory calculation methodology for steel products

10 Home scrap: material generated after that point (e.g. during hot rolling or coating) that is returned to steelmaking, and is included within RS's scrap definition.

11 Internal scrap: material rejected before the point of crude-steel saleable-tonnage measurement (e.g. within the BOF/EAF process itself), excluded entirely from RS's metallics-input and scrap figures.

scrap and recycled content, but internal scrap is not considered under recycled content nor in ResponsibleSteel, and Secondary Material is a life-cycle flow-accounting concept that sits outside both frameworks.

EN 15804 and ISO 21930 do not define scrap specifically. Instead, they rely on concepts such as ISO 14021's "recycled content" and EN 15804's "secondary material", which are defined and applied differently. As a result, two steel products made using the same physical scrap inputs can report different figures, depending on how the scrap is classified and how the calculation is applied. The difference reflects the fact that these concepts measure different things, rather than a difference in the underlying physical scrap input.

Scrap Accounting Approaches

A further distinction is required between the different approaches used to calculate scrap share. Differences arise particularly from

1. The categories of scrap included;
2. Whether non-ferrous metals and ferroalloys are included in the metallic input; and
3. Whether the calculation is based on the total mass of inputs or their metallic content.

Consequently, scrap-share percentages reported under different methodologies are not necessarily directly comparable, even where they appear to describe the same underlying concept.

The ResponsibleSteel approach is based on the metallic input mix of crude steel production and excludes internal scrap from the scrap-share numerator. This is conceptually aligned with the approach used in the SBTi Steel Sectoral Decarbonization Approach (SDA), which distinguishes the emissions trajectories of primary and secondary steelmaking and uses the proportion of scrap relative to ore-based metallic inputs to determine a steel producer's position between these pathways.

Both attributional (on a product/company-level) and consequential (on a system/sector-level) accounting approaches are legitimate, widely used LCA conventions, each suited to answer different questions. Essentially, the attributional approach used in EPD methodologies considers the low embodied emissions of scrap as an input material for steelmaking, and attributes this to the GWP of the resulting product. The problem with the attributional approach is that it ignores the consequential aspects of allocating scrap to one product rather than to another.

EPDs account for scrap in one of two ways, both permitted under EN 15804 and ISO 21930: a 'cut-off' approach, under which scrap enters with zero embodied emissions (as applied by ResponsibleSteel at crude-steel level); or an allocation approach, under which scrap is assigned a share of upstream emissions in Module A1, but the product also receives a downstream 'recycling credit' in Module D. In practice, both tend to assign low net-embodied emissions to scrap-containing products. ResponsibleSteel's own cut-off approach is not, in itself, a flaw: crucially, unlike EPDs, ResponsibleSteel pairs the cut-off with a scrap-variable Decarbonisation Progress Level framework that assesses a site's performance in the context of its scrap availability. In the absence of an equivalent framework, EPDs risk crediting scrap use as a decarbonisation achievement when that scrap would have been recycled regardless of which product it was allocated to.

For these reasons, within the study, the Secondary Material values found in the EPDs were deemed unusable. The scrap share, based on the total metallics input into crude steel production, was calculated based on separately collected data for ferrous and non-ferrous material inputs, and home, manufacturing and end-of-life scrap.

The steel sector globally is already highly efficient at recovering and recycling available scrap, not least because doing so makes sound financial sense even in the absence of additional 'green' incentives. Because recovery and recycling rates are already as high as 85% (worldsteel, 2025), this fundamentally limits the potential for additional greenhouse gas emission reductions to be achieved by increasing recycling rates further. Even at this recovery rate, current scrap supply is estimated to meet only around one-third of global steel demand (ResponsibleSteel, 2026), leaving the majority of production reliant on primary, emissions-intensive steelmaking regardless of how efficiently existing scrap is captured. Therefore, differences in scrap share can cause substantial variation in the reported GHG emissions intensity that are not attributable to differences in the efficiency or decarbonisation performance of the steelmaking process itself. The result is that steel products with a high scrap share have a low GWP value under the attributional approach of EPDs, but this value does not reflect the product's overall impact on global GHG emissions, as the scrap it contains would have been recycled anyway, but elsewhere. In practice, this means a specifier or policymaker who rewards steel purely on the basis of a low declared GWP risks simply directing existing scrap toward whichever buyer values it most, without driving any additional investment in decarbonising primary steelmaking, and without increasing the total amount of 'low emissions' steel available to the market overall[12].

The differences between existing steel-sector methodologies illustrate why reported scrap-share values cannot be assumed to be directly comparable. ResponsibleSteel, SBTi, LESS and CISA all use scrap input to contextualise the emissions performance of steelmaking, but they differ in the categories included, the denominator used and the basis on which metallic inputs are quantified. ResponsibleSteel calculates scrap share as qualifying pre- and post-consumer scrap relative to total metallic inputs to crude steel production, excluding internal scrap. SBTi follows a similar conceptual approach but calculates the ratio using the iron content of scrap-based and ore-based metallic inputs and excludes ferroalloys from the ratio. LESS instead defines scrap share as the mass of scrap relative to the combined mass of scrap, pig iron, DRI and HBI, explicitly excluding alloying agents from the calculation. CISA's methodology excludes internal scrap but calculates the denominator using the iron-equivalent content of other iron-containing inputs, including pig iron, DRI, HBI, iron ore, sinter and ferroalloys.

12 See 'The role of scrap in steel decarbonisation' and 'The Steel Decarbonisation Scale: A briefing for policy makers in the EU designing a label for low-emission steel' for a more detailed explanation.

3. Proposed solutions for improving EPDs

3. Proposed solutions for improving EPDs

An EPD underpinned by an LCA approach is an extremely useful tool for valorising the overall environmental impact of a steel product by understanding potential trade-offs between different environmental impact categories (e.g. global warming, ozone depletion, acidification, and eutrophication potential) across different stages of a product's life cycle (e.g. raw material supply, transport, manufacturing, waste processing and disposal). Nevertheless, the utility of EPDs will be limited without:

1. Enhanced transparency;
2. A harmonised, globally consistent, approach to the applied LCA methodology within the steel sector; and
3. Disclosure of material data such as scrap share.

The proposed solutions to address these concerns, and drive more accurate and comparable GHG data, are outlined below.

3.1 Transparency about what a declared value represents

The solution to the transparency problem identified in Section 2.1 is consistent disclosure of the specific variables that determine whether a purchaser can understand what an EPD, and the values disclosed, represents. We recommend that EPDs be required to state, in plain terms, disclosures addressing each of the three aspects identified in Section 2.1: (**1) System boundary and value-chain traceability, (2) background datasets used, and (3) co-product allocation methodology and values.** Each is addressed in turn below.

On production site configuration, EPDs should state clearly whether a declared GWP or Secondary Material value relates to a single, named production site and product, or is averaged across multiple sites, production routes or product categories, and if averaged, how many, and the range of individual values covered. Within A1-A3, results should be disaggregated into raw material supply (A1), transport (A2) and manufacturing (A3) rather than reported as a single aggregated figure, so that a purchaser can distinguish whether a product's GWP is driven by input material choices or by the efficiency of the manufacturing process itself. These are different things, pointing to different purchasing and investment decisions, and an aggregated A1-A3 figure alone cannot tell a reader which is which. A full hotspot analysis, identifying which specific processes or inputs drive the largest share of a product's impact, would provide additional insight, but is more resource-intensive and is not itself standardised across EPD programmes. We therefore recommend A1/A2/A3 disaggregation as the minimum, low-cost baseline that any EPD can disclose consistently, without precluding fuller hotspot analysis where feasible. This reinforces the first point of the SSP's Criteria for Transparency in GHG Reporting, which likewise calls for disaggregated, mine-to-crude-steel GHG data rather than a single aggregated product-level figure.

On background data, EPDs should disclose which background dataset was used to model upstream inputs (e.g. GaBi, Ecoinvent), its geographical scope (site-specific, national, regional or global average), and its temporal scope (the year the underlying data was collected), given the extent to which these choices can materially change a reported GWP, as demonstrated in Section 2.2. Although this is covered in the LCA report which is disclosed to the EPD user, it is not shared publicly. Naming the database is necessary but not sufficient, since the underlying emission factors typically remain proprietary. As a next step, the sector should move toward a shared, publicly accessible database of default emission factors.

On allocation methodology, where a steelmaking process generates co-products, EPDs should disclose not only which allocation approach was used (physical, economic, or system expansion) but the resulting values and the basis for the calculation. For economic allocation, this means disclosing the market prices assumed for slag and steel; for physical allocation, it means disclosing the basis for the split (e.g. by mass or energy content) and the resulting figures. A single sentence naming the approach used, without these figures, does not allow a reader to verify or even understand the scale of its effect on the declared result.

Even further, removing the allocation of GHG emissions to co-products such as slag should be prioritised. Full GHG emissions should remain assigned to the crude steel and its downstream product; the commercial value of co-products should be captured through their sale, not through a lower declared carbon footprint for the steel itself. Because this paper's recommended no-allocation approach assigns full emissions to crude steel, steel products can be compared with one another consistently. However, comparing steel with materials that consume steelmaking co-products as their own primary input; for example, cement or concrete products using blast furnace slag; requires that some emissions be allocated to the co-product. Otherwise, the co-product's footprint would be understated and that of steel would be overstated. For comparisons across different products, the allocation approach makes more sense.

In 2025 the SSP published its Criteria for Transparency in GHG reporting (SSP, 2025), specifying basic requirements to improve comparability in GHG reporting for steel sites and products, and disclosure points. SSP endorsing organisations further commit to coupling this harmonisation with increased data reporting to improve transparency and global tracking of emissions, directly supporting the disclosure recommendations set out in this section. ResponsibleSteel is committed to ensuring that its own standards meet all of these requirements. As transparency is a key defining feature of ResponsibleSteel's Standard, the majority of the criteria have already been met (see Annex A).

We recommend that EPDs adopt the SSP's transparency criteria in full, and in particular prioritise the three commonly missing disclosure points: the crude steel emissions intensity of the steel used; the share of primary data underlying the reported GWP; and the share of scrap used in the production process. Beyond these three disclosure points, we recommend extending the same transparency principle to production site configuration, background data, and allocation methodology — presented in an easily interpretable format for an EPD user. This includes a clear statement of whether the EPD-declared data represents an average across multiple products or sites, and the range covered, so that users can assess how representative the reported value is of the products they are purchasing. Some EPD Programme Operators and individual producers already implement high-transparency practices; the objective is to establish these practices as the norm across EPDs in the steel sector.

3.2 Harmonisation of steel-specific EPD methodologies

Greater disclosure alone will not fully resolve comparability while differences in system boundaries, background datasets, and allocation methods remain permitted; full comparability requires standardising the methodology itself. This requires agreement on the key data variables that should be reported, and on the ways those variables should be measured.

In this regard, a lot of work has already been done by several independent bodies. The Industrial Deep Decarbonisation Initiative (IDDI)'s Guidance for PCR Harmonization (IDDI/UNIDO, 2024) sets out a common technical foundation for steel, cement and concrete PCRs precisely because, as IDDI's own analysis found, current EPDs for embodied carbon "have several unresolved issues" that undermine the comparability PCRs are meant to deliver. In the automotive supply chain, Catena-X's Product Carbon Footprint Rulebook narrows the room for interpretation left open by ISO 14067[13] by mandating a single, binding calculation ruleset and a standardised digital exchange format, on the basis that "differences in PCFs should only be caused by factually deviating emissions" (Catena-X, 2025) rather than by undisclosed accounting choices.

A steel-specific harmonisation effort is already underway in the European Union: prEN 17662 (provisional), developed by CEN/TC 135 as a c-PCR complementary to EN 15804 for steel, iron and aluminium structural products. It prescribes allocation procedures for multi-output processes and for reuse and recycling, and provides default data for transport, reuse/recycling and end-of-life scenarios. These default values are currently generic EU-average assumptions rather than site- or product-specific figures. Because end-of-life LCA phases (Modules C1-C3) depend on speculative downstream scenarios outside a manufacturer's direct control, we recommend that, where included in an EPD, their results always be disclosed separately from the A1—A3 cradle-to-gate GWP value that is the focus of this paper. This substantiates our view that the changes recommended in this section are neither technically difficult nor without precedent — the rules themselves are already largely worked out. What it also illustrates, however, is that voluntary, consensus-based standards development can be slow for institutional and governance reasons unrelated to technical difficulty: as of 2026 the standard remains under approval, five years after work began. This is itself an argument for the transparency mandate proposed here, which specifiers and policymakers can adopt immediately, without waiting for the underlying standard to be finalised. It should also be noted that prEN 17662 only complements EN 15804; so, it would not by itself close the global comparability gap described in Section 2.1.

The first North American steel-specific PCR was published in 2025 for steel construction products. This provides region-specific allocation and background-dataset rules analogous to CEN's prEN 17662 in Europe (Smart EPD, 2026). Smart EPD®'s Part B Product Category Rules for Designated Steel Construction Products illustrates the same objective pursued through a different mechanism. Rather than embedding its own default-value tables as prEN 17662 does, it mandates region-specific inputs by reference: electricity accounting is prohibited from using national or continental grid-mix averages, steel datasets must be the most recent regionally representative figures published by AISI or worldsteel unless supplier-specific primary data exists, and furnace slag is treated as a co-product whose burden is allocated downstream to its purchaser rather than retained by the steel producer — a materially different allocation choice from the "all emissions to crude steel" convention used in ResponsibleSteel's emissions intensity value.

Programme-operator-led harmonisation initiatives are also emerging: in September 2024, EPD International (the International EPD® System, Stockholm) signed a Memorandum of Understanding with the China Iron and Steel Association and China Baowu Group to explore mutual recognition of steel PCRs — a concrete example of the cross-programme convergence this paper recommends being extended sector-wide (EPD International, 2024). Moreover,

13 ISO 14067:2018 Greenhouse gases — Carbon footprint of products — Requirements and guidelines for quantification

some EPD Programme Operators have already gone beyond the minimum requirements of EN 15804 and ISO. The CARES EPD Programme, for example, applies a shortened 3-year validity period, mandatory company and site and product specificity, explicit scrap-content breakdown, and dual-layer (i.e. independent verification of both the underlying LCA calculation and the primary data inputs supplied by the producer) independent verification (CARES, 2026). We treat this as confirmation that the changes recommended in this paper are practical and already precedented, not merely theoretical, and set out above where CARES's own practice can usefully inform sector-wide requirements.

In addition, considerable progress towards such agreement has been achieved on these aspects in the steel sector under the auspices of the Steel Standards Principles (SSP), established by ResponsibleSteel, the World Steel Association and others in 2023, and now endorsed by more than 65 leading standards organisations, steel businesses and associations, civil society organisations and international bodies. SSP organisations endorse the principle that GHG emissions measurement standards and methodologies, data collection and disclosure frameworks, at the project, production, and product level, should be interoperable, enable recognition, build on existing international standards, and avoid duplication.

3.3 Mandatory measurement and disclosure of scrap share

Thirdly, and of equal importance, is the need to address the inconsistent treatment and definitions of scrap in product-level GHG accounting.

EN 15804+A2 and ISO 21930 generally rely on broader concepts such as recycled content, pre-consumer recycled material and post-consumer recycled material. By contrast, ResponsibleSteel uses ISO 20915 to explicitly define scrap. It requires scrap share to be measured as the share of total metallic inputs used in crude steel production, while excluding internal scrap. ResponsibleSteel's metallics-input denominator is unique in including ferro-alloys and non-ferrous metallic additions alongside ferrous scrap and primary iron units. Most other steel decarbonisation frameworks (e.g. worldsteel, the SBTi Steel Sector Guidance) confine the denominator to ferrous inputs only. This is one further reason a direct, formulaic conversion between an EPD's Secondary Material value and a ResponsibleSteel scrap share is not straightforward. This provides a transparent and consistent basis for comparing steelmaking routes and for applying the ResponsibleSteel DPLs.

Our recommendation is clear: the measurement and disclosure of the scrap share of any steel product, using the scrap definitions in ISO 20915 and the specifications for pre- and post-consumer material in ISO 14021, should be made a mandatory specification within the PCRs for any steel product EPD. This is a first, achievable step towards closing the scrap-disclosure gap identified in Section 2.3. Although it may be simple to implement the definitions of pre/post-consumer material, it is difficult to trace scrap which is an issue that has been addressed in (RRRM, 2024). Once comparable GHG emissions and scrap data are available, in accordance with the SSP transparency criteria (Annex A) and the specifications described in Section 3.1, above.

We call on EPDs to disclose the emissions intensity and scrap share of steel production from 'cradle-to-crude steel'.

Disclosing the scrap share, systematically across all EPDs, as previously defined removes the incentive for steelmakers to allocate scrap to specific products or projects where low GWP values are needed, at the expense of products and projects where scrap allocation is reduced, increasing other GWP values by an equivalent amount. Instead, it incentivises steelmakers to reduce overall GHG emissions through the sourcing of primary input materials with lower embodied emissions, reduced emissions for mining and transportation, lower Scope 2 emissions, the efficient recovery and reuse of energy and process gases, and the introduction of new, low emissions technologies for primary iron production — irrespective of how much scrap is used.

4. Towards interoperability between EPDs and ResponsibleSteel DPLs

4. Towards interoperability between EPDs and ResponsibleSteel DPLs

Interoperability is defined as the state of measurement methodologies (or thresholds) that are seen as sufficiently aligned to enable conversion between two or more schemes (SSP Glossary, 2026). The initial intent of this study was interoperability: to test whether the EPD-declared GWP and scrap values could be used to calculate a ResponsibleSteel DPL for the underlying product. We already understood that EPDs use a 'cradle-to-gate' boundary at the product-level through an LCA whereas the ResponsibleSteel DPL uses a 'cradle-to-crude steel' boundary at the site-level for classification purposes. Yet, we were interested in whether GHG and scrap data could be converted from one scheme to the other, and in how the underlying accounting methodologies behind EPDs compared with those behind the DPL.

A site's DPL and a product's declared GWP are two important GHG metrics which answer different questions and therefore should be used together, not as substitutes. The DPL confirms that the steel production meets a genuine, independently verified decarbonisation threshold, with performance assessed in the context of scrap availability. The GWP confirms the cradle-to-gate footprint of the specific steel product, including hot rolling and downstream processing.

> ***A specifier seeking genuinely 'low emissions' steel should request both: the DPL as evidence the underlying steelmaking meets a consistent, comparable, credible decarbonisation threshold, and the GWP to compare the steel product against alternatives in the market, so long as the functional unit and accounting rules base is sufficiently aligned.***

In practice, this means confirming that both products report GWP for the same functional unit (e.g. per tonne of crude steel), the same A1—A3 system boundary, and PCRs applying comparable co-product allocation and background-data rules. These are conditions that, as this paper demonstrates, cannot currently be assumed and should be actively verified by the specifier using the disclosure fields recommended in Section 3.1.

As outlined in the ResponsibleSteel Framework for Credible Interoperability, GHG accounting is a fundamental component of interoperability. As a first step towards interoperability, we must understand if two emissions accounting methodologies are sufficiently defined for effective conversion of GHG data. ResponsibleSteel recommends the building blocks for standard alignment (Figure 8a) as a framework for assessing the level of alignment between standards, spanning the sub-categories of systems boundary, allocation, data and declaration. Significant variations exist between the building blocks of EN 15804-compliant EPDs and ResponsibleSteel DPLs (Figure 8b), the most substantial differences being the system boundary (product v site, crude steel v hot rolled steel cut-off point; though both EPDs and DPLs can be set at the crude-steel boundary), co-product and scrap allocation methods, as well as the secondary datasets utilised.

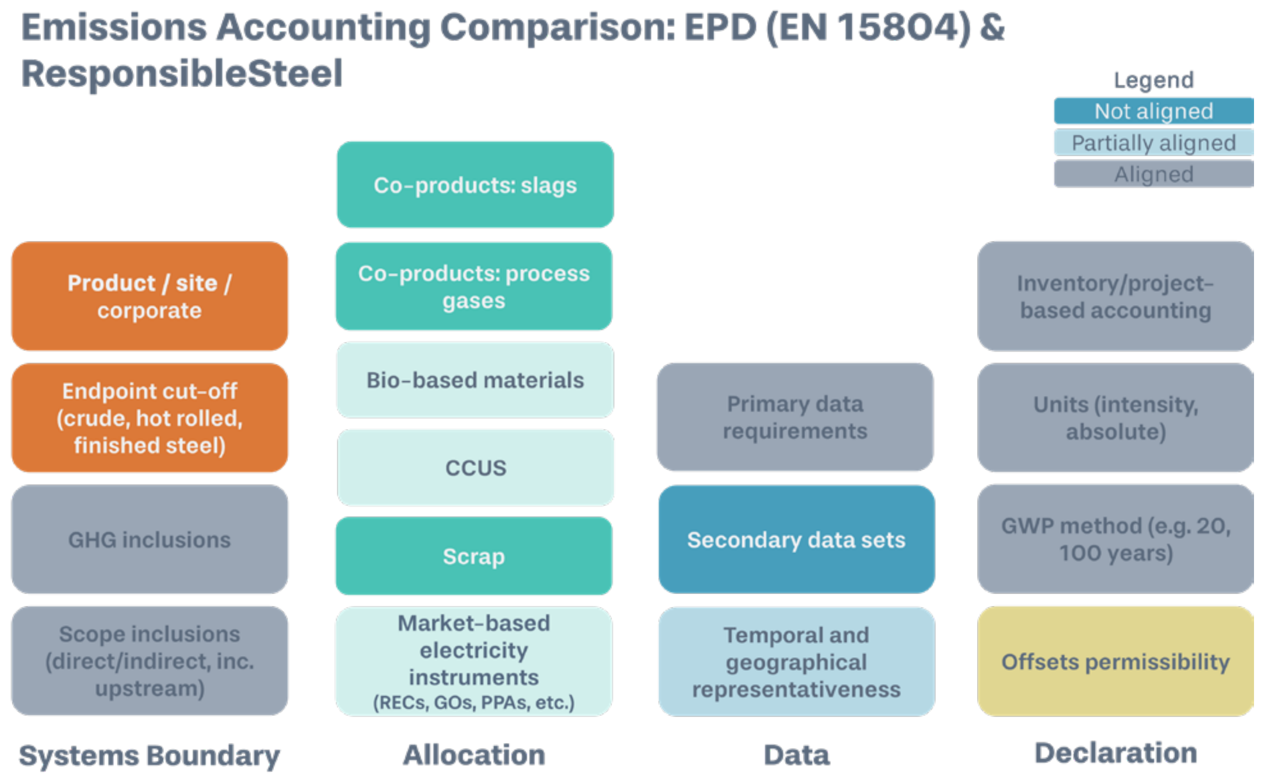

Figure 8a – Building blocks for standard alignment to assess degree of alignment between GHG emissions accounting methodologies

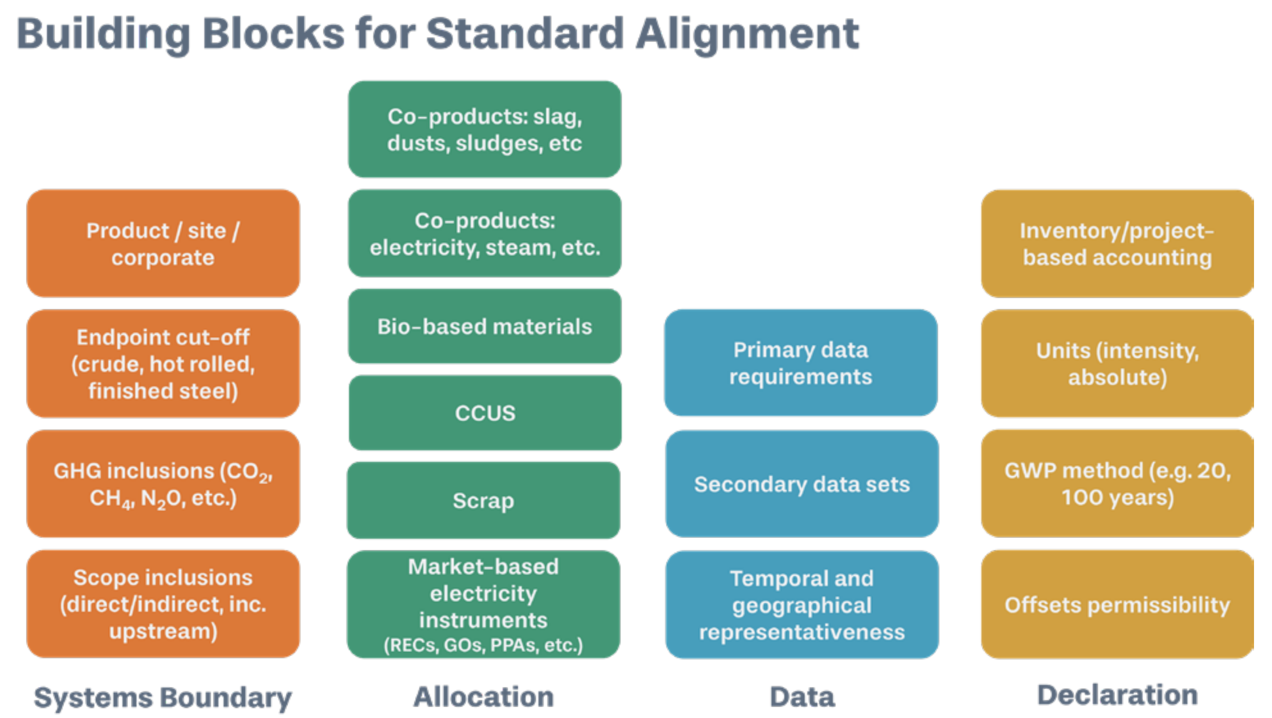

Figure 8b – Building blocks for standard alignment with differences identified between EN 15804-compliant EPDs and ResponsibleSteel DPLs, demonstrating the value of the SSP Transparency Criteria.

Interoperability could work in principle, but in practice, due to the current number of fundamental differences in accounting approaches between EPDs and DPLs, conversion was characterised by limited accuracy and high resource-intensity.

Even with 15 additional data points, the highest conversion accuracy obtained was 94% – insufficient for reliable use in determining a DPL based on EPD-declared GWP and scrap values.

The necessary data for conversion already exists within steelmakers' own records but is not disclosed within the EPD itself. Additional data points had to be requested and collected directly from participating steelmakers, outside the standard EPD reporting process, precisely because current EPD disclosure requirements do not capture them, as expanded on in Section 2.1. The overall conclusion was that 'conversion' between EPD-declared GWP values, and ResponsibleSteel DPL values, requires much greater levels of transparency from EPDs, together with a standardised disclosure of scrap share. For more reliable conversion, full alignment of GHG measurement rules would be required — as recommended in Chapter 3.

Interoperability is not only a technical challenge of methodological adjustments and data conversion, but also a structural challenge which requires concerted commitment from standard-owners. As Figure 2 illustrates, an EPD's methodology is determined by a whole hierarchy of standards which makes interoperability infeasible. Achieving interoperability requires tighter, internationally standardised specifications. Current standards leave key methodological choices to individual programme operators without requiring sufficient transparency about which choices were made — which is exactly what Sections 3.1 to 3.3 recommend addressing.

In contrast, ResponsibleSteel is driving interoperability forward with the Brussels-based Low Emission Steel Standard (LESS) and the China Iron and Steel Association (CISA) China 2 Future (C2F) Standard, to enable conversion and co-calculation between their respective GHG measurement and classification systems (ResponsibleSteel, 2025). This was possible because all three standards share a common structure: a single classification method (GHG emissions intensity plotted against scrap share) with defined thresholds, set out in a standard with specific, transparent criteria, authored and maintained by a single organisation; and because their respective standard-owners agreed to work together under a Memorandum of Understanding (MoU) (ResponsibleSteel, 2025).

We do not expect classification systems such as those provided by ResponsibleSteel, LESS or C2F to replace product-level EPDs. Buyers will likely need to reference both: a classification label to confirm the steel production meets a credible decarbonisation threshold, and a product EPD (reformed as recommended in Section 3) to assess the specific product's carbon footprint.

To be explicit: this paper does not propose that EPD A1—A3 GWP values be used to calculate or substitute for a ResponsibleSteel DPL. It is more efficient and accurate to independently calculate the ResponsibleSteel DPL.

5. Discussion and conclusions

5. Discussion and conclusions

Over 80 different emissions accounting methodologies currently exist in the steel sector, of which 50 are commonly referenced, as identified and compared by worldsteel (2025). Individual emissions accounting methodologies often serve slightly different purposes, for example, to compare emissions at the national, sectoral, company, site, project, or product-level, or classify the decarbonisation progress of steel production. A case can be made for the application of different methodologies for different purposes; however, it is hard to justify the level of inconsistency that currently exists within and between certain methodologies that are intended to serve the same general purpose. **Harmonisation rather than alignment should be viewed as the objective for improving the comparability of GHG measurement across the steel sector and to support the decarbonisation of the industry.** Specifically, we are not proposing that all methodologies converge on a single global standard; rather, if EPD programmes adopt the transparency and scrap disclosure reforms recommended in Section 3, then both a product-level and a site-level, scrap-variable declaration can be derived from the same underlying data. That would enable EPDs and DPLs to be recognised by policymakers and specifiers as consistent, complementary and potentially mutually reinforcing, disclosure routes for the specific purpose of identifying 'low emissions' steel, instead of simply a conventional EPD.

EPDs and DPLs originated to solve different problems, as set out in Section 1.2, and are likely to continue coexisting as distinct tools. EPDs are product-level disclosure tools: their primary purpose is to communicate the life cycle GHG emissions associated with a specific product. **They do not provide a sufficient carbon metric to effectively drive decarbonisation when used in isolation.** ResponsibleSteel's DPLs, by contrast, are designed as benchmarking tools: their purpose is to assess and compare the ***decarbonisation progress*** of steelmaking sites on a like-for-like basis and to provide a transparent pathway towards near-zero emissions steel production. It would facilitate more efficient transfer of GHG emissions information for decision making if they were more closely aligned. This paper takes a significant step towards the goal, though system interventions are required to fully reconcile differences and align the two approaches.

The challenge is not to replace one emissions accounting system with another, but to establish sufficient interoperability between them to enable them to work together, allowing information to flow efficiently through value chains. This will reduce reporting burdens, improve transparency and support the scaling of markets for low and near-zero emissions steel.

EPDs have other uses, but to be effective for specifying 'low emissions' steel two things must both be true: the declared GWP value must provide a genuine, like-for-like basis for comparing the GHG emissions of different products including disaggregated data based on the mine-to-crude-steel GHG boundary (requiring the transparency and harmonisation reforms of Sections 3.1–3.2); and the scrap share underlying that GWP must be disclosed and interpreted in the context of a defined performance scale (requiring the scrap disclosure reform of Section 3.3). We are not arguing for the EPD approach to be abandoned; but for the purposes of rational, comparable procurement, our research and that of others, we are arguing that when it comes to the specification and procurement of 'low emissions' steel products, the current approach is fundamentally flawed and must be urgently revised.

Recommendations

We make the following recommendations to producers and users of the EPD system:

1. Any programme, public policy, or label applicable to the steel sector and referencing the use of EPD GWP values, should specify that only EPD programmes that comply with the SSP Criteria for Transparency in GHG reporting (Annex A) (SSP, 2025), and that require the disclosure of mine to crude steel emissions intensity and the scrap share of the covered steel products in conformity with the definitions of scrap in ISO 14021, will be recognised.
2. Any programme, public policy, or label specifying the use of 'low emissions' steel as a driver for climate change mitigation should base such specifications on a 'scrap-variable' scale, such as ResponsibleSteel's DPLs, based on the GHG emissions intensity and scrap share. In practice this requires: (a) EPD Programme Operators and PCR developers to embed mandatory scrap share and crude steel emissions-intensity disclosure fields, per ISO 20915, into steel PCRs; and (b) EPD users — specifiers, procurers and green-building certification bodies — to require both the GWP value and the scrap-variable metric when setting or assessing 'low emissions' steel thresholds, rather than relying on GWP alone.
3. And finally, in addition, we urge EPD programmes to work with other steel stakeholders, including with ResponsibleSteel, to develop PCRs for the generation of steel product EPDs that eliminate the current levels of inconsistency in the determination of steel product GWP values.

Annex

Annex

ResponsibleSteel's conformity assessment against the SSP Transparency Criteria

Qualitative explanations of accounting rules	Alignment?
GWP impact assessment method	Complete alignment
Source(s) of primary and secondary data	Complete alignment
Allocation of emissions from co-products	Complete alignment
Use of alternative fuels (e.g. biobased fuels or hydrogen)	Partial alignment – guidance exists for biomass; hydrogen guidance under development
Use and allocation of market or location-based electricity and contractual instruments	Partial alignment – further harmonisation proposed[14], including alignment with GHG Protocol approaches
Cradle-to-gate emissions accounting for imported electricity, including transmission losses	No alignment
Inclusion/exclusion of raw material transport emissions	Complete alignment
Carbon Capture and Utilisation and/or Storage (CCUS)	Complete alignment
Treatment of offsets, credits and insets	Complete alignment

Point of disclosure	Alignment?
Cradle-to-gate GHG emissions (mining to crude steel), reported per tonne of crude steel	Complete alignment
All relevant GHGs included, including CO_2, methane and nitrous oxide	Complete alignment
Data quality disclosure, including the share of primary data used in GWP calculations	Complete alignment
Ferrous scrap input disclosed at crude steel level using harmonised ISO-based methodology	Partial alignment – optional disclosure under discussion

14 For more information see 'Revision of the ResponsibleSteel International Production Standard'

List of Acronyms

BREEAM	Building Research Establishment Environmental Assessment Method
C2F	China 2 Future (Standard)
CEN	European Committee for Standardisation
CISA	China Iron and Steel Association
CO_2e	Carbon Dioxide Equivalent
CPR	Construction Products Regulation
DPL	Decarbonisation Progress Level
EN	European Norm (European Standard)
EPD	Environmental Product Declaration
GHG	Greenhouse Gas
GPI	General Programme Instructions
GWP	Global Warming Potential
IDDI	Industrial Deep Decarbonisation Initiative
IEA	International Energy Agency
ISO	International Organization for Standardization
LCA	Life Cycle Assessment
LEED	Leadership in Energy and Environmental Design
LESS	Low Emission Steel Standard
PCF	Product Carbon Footprint
PCR	Product Category Rule(s)
SBTi	Science Based Targets initiative
SM	Secondary Material
SSP	Steel Standards Principles
TC	Technical Committee
UNIDO	United Nations Industrial Development Organization

info@responsiblesteel.org