WWF
AUSTRALIA

BUILDING TRUST:

A GUIDE TO NAVIGATING THE GLOBAL VERIFICATION REGIME FOR GREEN IRON & STEEL

OPPORTUNITIES FOR INTERNATIONAL COLLABORATION AND COORDINATION

PREPARED FOR WWF-AUSTRALIA
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FOREWORD

At WWF, we believe the transformation of the iron and steel industry is not only possible—it is essential. As one of the largest contributors to global greenhouse gas emissions, the sector must urgently shift toward near-zero emissions production to meet the climate goals of the Paris Agreement and secure a livable future for all.

We commissioned this report to support the global conversation on the need for trustworthy, high-integrity measurement and verification of embedded emissions in near-zero and low-emissions iron and steel production. WWF's vision is a world where iron and steel are produced in alignment with science-based targets that limit warming to below 1.5°C. In this future, "green iron & steel" are not marketing slogans—they are rigorously defined, transparently verified, and credibly certified.

For WWF, green iron & steel means materials produced with embedded emissions at least 90% lower than the current global industry average, powered by fossil-free renewable energy, excluding offsets or carbon capture from conventional high-emitting pathways, and minimising further negative impacts on nature and communities. It is a standard rooted in integrity—not compromise.

But ambition alone is not enough. To drive real change, we need trust. That is why verification is at the heart of this report. Without robust, transparent and internationally consistent verification of embedded emissions:

- Markets cannot reward low-emissions producers,
- Governments cannot design effective procurement or border adjustment policies,
- Investors cannot make informed decisions.

Verification is the bridge between ambition and action.

The emerging international regime for Green Iron & Steel Verification (GISV) is complex, contested and rapidly evolving. This report offers a clear guide to its key components—standards, certification schemes, environmental product declarations, and more—and proposes a structured approach to coordination that prioritises accuracy, interoperability and legitimacy.

WWF is proud to support this work. We see green iron & steel as a cornerstone of the global transition to clean industrial development—and a strategic opportunity for countries like Australia to lead.

Monica Richter
Senior Manager Low Carbon Futures

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EXECUTIVE SUMMARY

Dramatic reductions in emissions from the production of iron and steel are essential to meet global science-based emissions targets. Customers, governments and investors have an essential role to play in incentivising the industry to switch to near-zero emissions production, but can only play this role if they have trustworthy information about the emissions intensity of iron and steel products they are respectively purchasing, supporting, or investing in. An international regime is emerging to provide this information. But this regime is complex and contested, reflecting the combination of historical approaches and interests that the many stakeholders, including industry in different countries, bring to it. It is also rapidly evolving, reflecting the effort being exerted by various stakeholders due to the extremely high environmental and economic stakes at hand. How then can organisations and individuals engage to help drive the development of an efficient and effective regime?

This report aims to support stakeholders in helping coordinate and influence the emerging international regime for verifying the embedded emissions of iron and steel products. To do this, it first provides an introductory guide to key concepts and components of the regime, demystifying the conflicting jargon and acronyms that can be a barrier to meaningful engagement for busy stakeholders.

The broader regime of international climate governance encompasses many forms of emissions accounting and verification – including project-level, corporate/enterprise-level and territorial. Green Iron & Steel Verification (GISV), the topic of this report, refers to product-level emissions – specifically – verification of product "embedded emissions". Alternatively referred to as "embodied emissions", embedded emissions are defined broadly as upstream supply chain emissions per functional unit of product. Embedded emissions verification is playing an increasingly important role in supporting decisions of governments, customers, investors and producers in the net-zero transition. We highlight that without credible embedded emissions verification, markets will fail to incentivise low-emissions production, and policy tools such as green procurement, carbon border adjustments, and sustainable finance cannot function effectively.

The contribution of this report is not to catalogue, discuss or promote any particular schemes for GISV. Rather, our focus is on the international regime as a whole. According to the academic literature, international regimes are the set of rules, norms and principles that govern an issue area. International regimes are forms of polycentric governance – they are not controlled or created by any one organisation or initiative. The GISV regime thus comprises the set of rules, norms and principles governing the verification of the embedded emissions credentials of iron and steel products. The many components of the international GISV regime include certification schemes, environmental product declarations, standards, reports and collaborative initiatives. The current report defines these component types and explains their roles and relationships within the GISV regime. We do not attempt to catalogue or map the many individual elements of the current regime: instead we provide references to previous works that take on this ever-growing task.

Although necessary, an international GISV regime is far from sufficient. To support climate objectives, we need a high-performance international regime that is effective, efficient, fair and legitimate. The report identifies direct and indirect risks associated with that alternative—a poorly designed regime —such as greenwashing, trade barriers, and a lack of investment in near-zero-emissions supply chains.

The performance of the GISV regime will hinge on the quality of coordination and steering efforts. Recognising the critical role of coordination, numerous organisations and initiatives have taken up this mantle. So much so that the array of such efforts has become confusing in itself. One contribution of this report is to provide a non-exhaustive summary of leading international coordination efforts. International (inter-governmental) organisations involved in regime coordination efforts include the International Energy Agency (IEA), Organisation for Economic Cooperation and Development (OECD), The Climate Club, and Industrial Deep Decarbonisation Initiative (IDDI). Key transnational organisations and initiatives aiming to help coordinate the regime include the Science-Based Targets Initiative (SBTi) – Steel Guidance, The Climate Club (Pillar II), First Movers Coalition, ResponsibleSteel, Breakthrough Agenda, Mission Possible Partnership (MPP) - Net-Zero Steel Initiative, the Industry Transition Accelerator, Coalition on Materials Emissions Transparency, and the Steel Standards Principles. Key industry organisations and initiatives include the World Steel Association, American Iron and Steel Institute, China's Five-tiered Steel Emissions Standard, and the Global Steel Climate Council (GSCC).

Coordination efforts identified in this report are significant, but alone will not guarantee an effective, efficient and legitimate regime for GISV. The complexity of the current regime – including the number of coordination initiatives – leaves ample room for well-resourced vested interests to use and shape it to their own advantage. The report proposes a structured, top-down approach to regime design which can help clarify and align objectives, principles, and ultimately, approaches. It then illustrates the application of this approach to evaluate chain-of-custody models for supply chain emissions.


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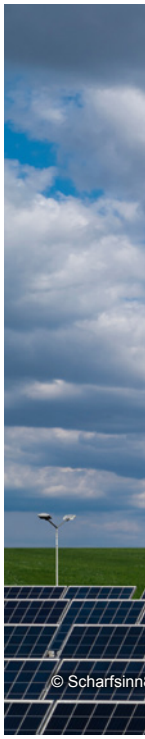
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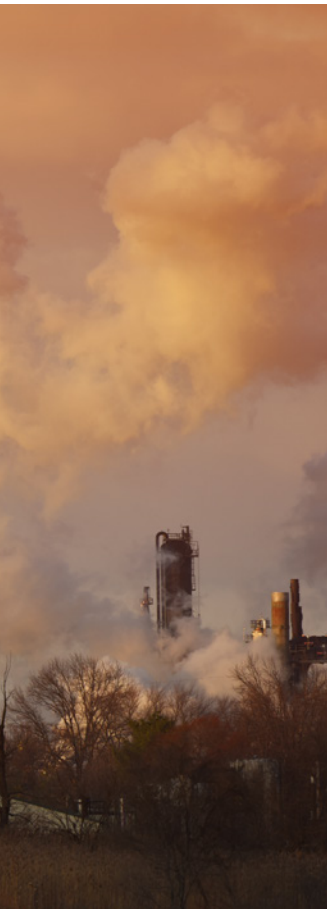

This report is intended for policymakers involved in embedded emissions verification processes, as well as industry stakeholders and civil society actors interested in establishing best practice standards and verification frameworks for near-zero steel. The report concludes with seven key recommendations:

1. **Prioritise regime coordination efforts on accuracy, interoperability, and comparability of emissions accounting methods and claim**s to promote regime integrity and legitimacy.

2. **Adopt a structured, top-down approach to regime coordination** to promote broader and more effective engagement and achieve an effective, efficient and legitimate regime.

3. **Engage internationally to help improve the international GISV regime,** including through supporting existing ambitious initiatives and providing leadership among countries with potential comparative advantage in green iron &/or steel.

4. **Ensure consistency with embedded emissions verification for other products** to support interoperability and comparability as decarbonisation and circularity efforts expand to other sectors.

5. **Promote consistency of the regime across policy domains** such as certification, industrial policy, procurement, investment taxonomies, and border adjustments to minimise regulatory burden, avoid technical trade barriers, and accelerate the net-zero transition.

6. **Lead efforts to establish a regionally aligned embedded emissions verification framework** to support the development of a credible and trade-compatible CBAM across the Asia-Pacific.

7. **Chain of custody models used in the verification of Green Iron & Steel should ensure consistency** with the actual emissions associated with the product's physical supply chain and prevent opportunistic allocation of emissions across products. Specifically, inventory and credit-based accounting should not be mixed, and Controlled blending is preferred to Mass balance or Book-and-claim chain of custody models.

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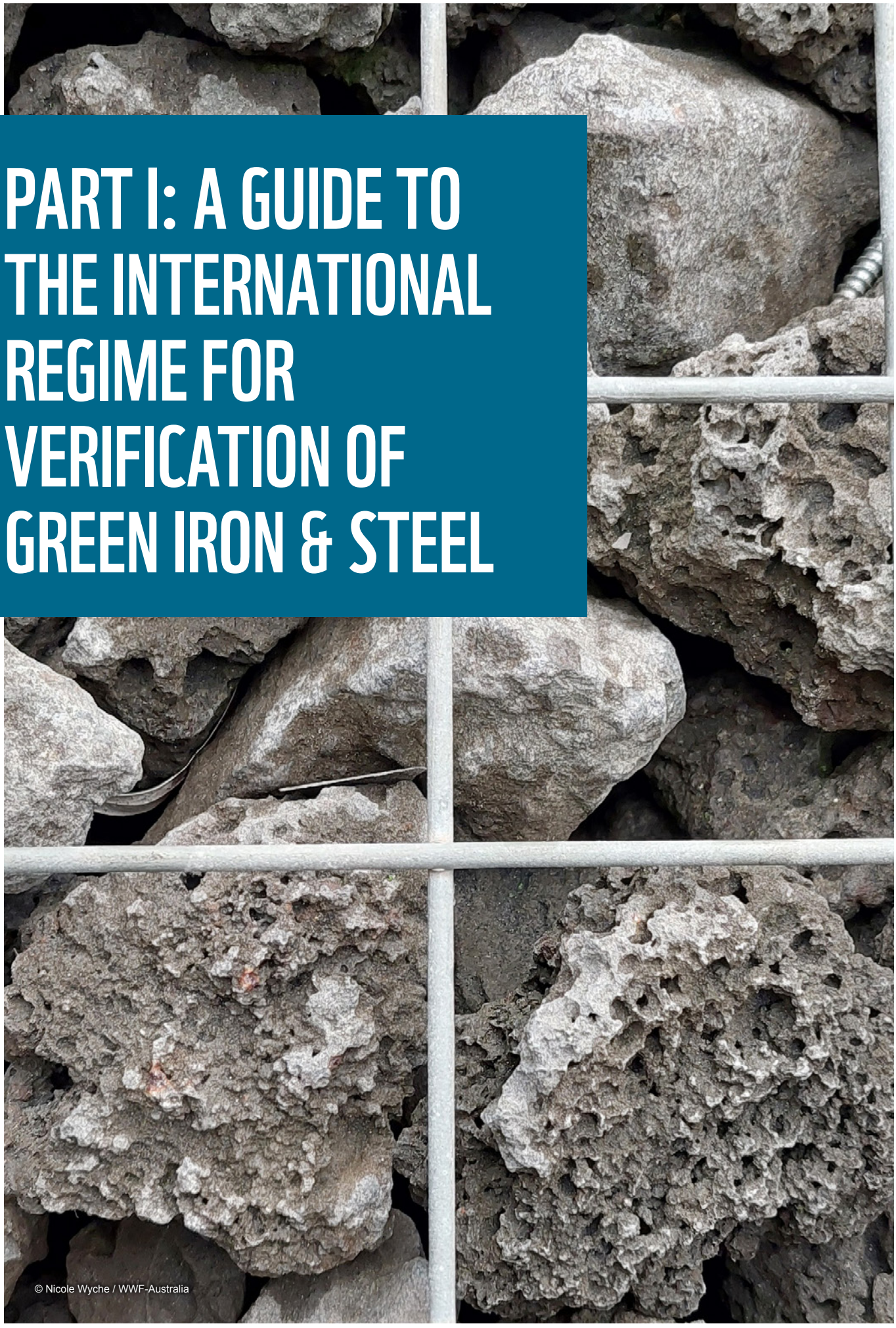

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1. INTERNATIONAL GREEN IRON & STEEL SUPPLY CHAINS

1.1 WHAT ARE IRON & STEEL SUPPLY CHAINS?

Steel is an alloy of iron and carbon containing less than 2% carbon and 1% manganese and small amounts of silicon, phosphorus, sulphur and oxygen. Commercially, iron is made by removing oxygen and other impurities from iron ores such as hematite and magnetite. Steel is made by combining iron with carbon and small amounts of other elements or recycled steel (WorldSteel, n.d.).

Iron and steel supply chains include three major stages: ore extraction and processing, ironmaking, and steelmaking. Typical steps in a traditional iron and steel supply chain are illustrated in Figure 1.

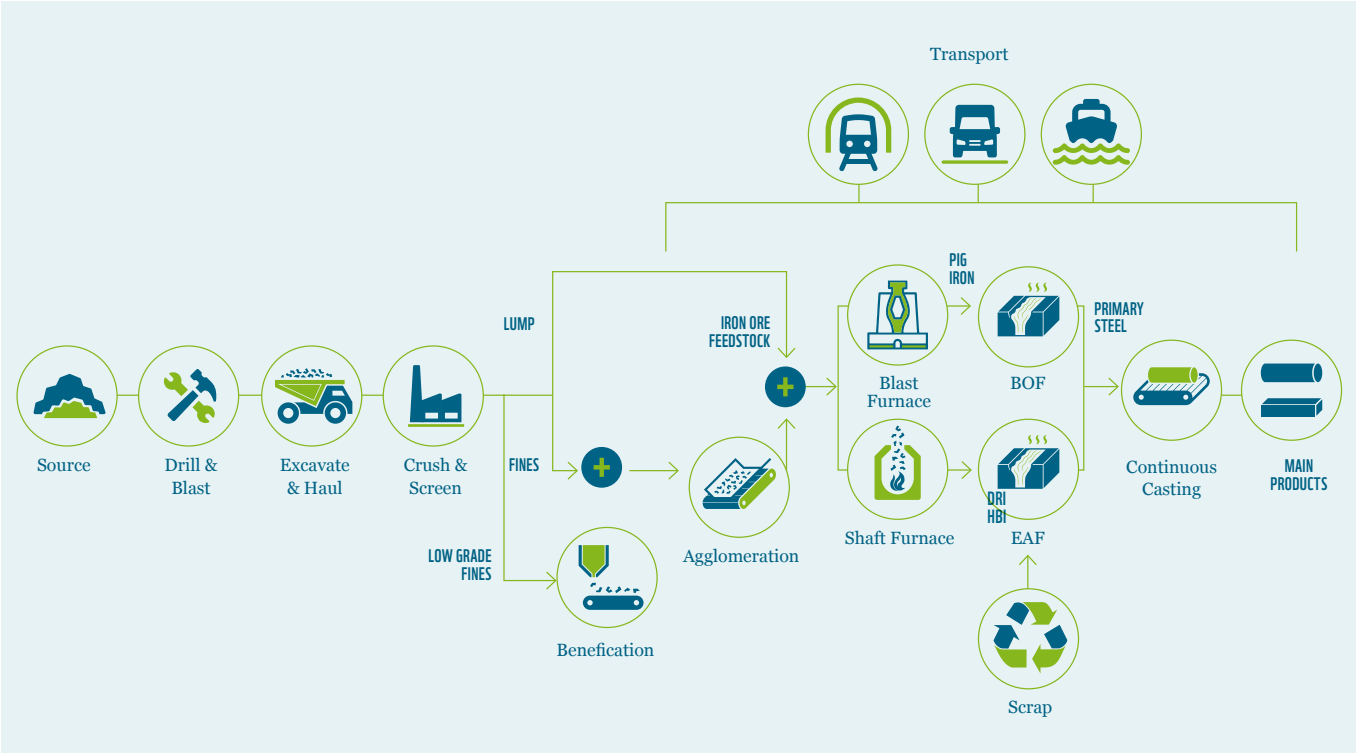


Figure 1: Schematic of conventional steel supply chains. Figure source adapted from Minerals Research Institute of Western Australia (2023).

1.2 WHAT DO WE MEAN BY GREEN IRON & STEEL SUPPLY CHAINS?

The exact definition of "green" iron & steel is contested and, as we discuss below, certification and verification schemes currently vary widely in their definitions. For the purposes of this report we use 'green steel' as a short hand for 'near-zero steel'. In more detail, we take the approach of the Science-based Targets Initiative (SBTi), Bowen and Wyche (2024), Venkataraman et al. (2022), and IEA (2024 [1]) and require green iron & steel to have been produced in a way that their supply chain emissions are consistent with science-based targets to limit global warming below 1.5 C. In accordance with the Steel Standards Principles, we consider green iron & steel to have embedded emissions [2] at least 90% lower than current global industry average (WTO 2023). In accordance with WWF-Australia's Green Iron Key Report

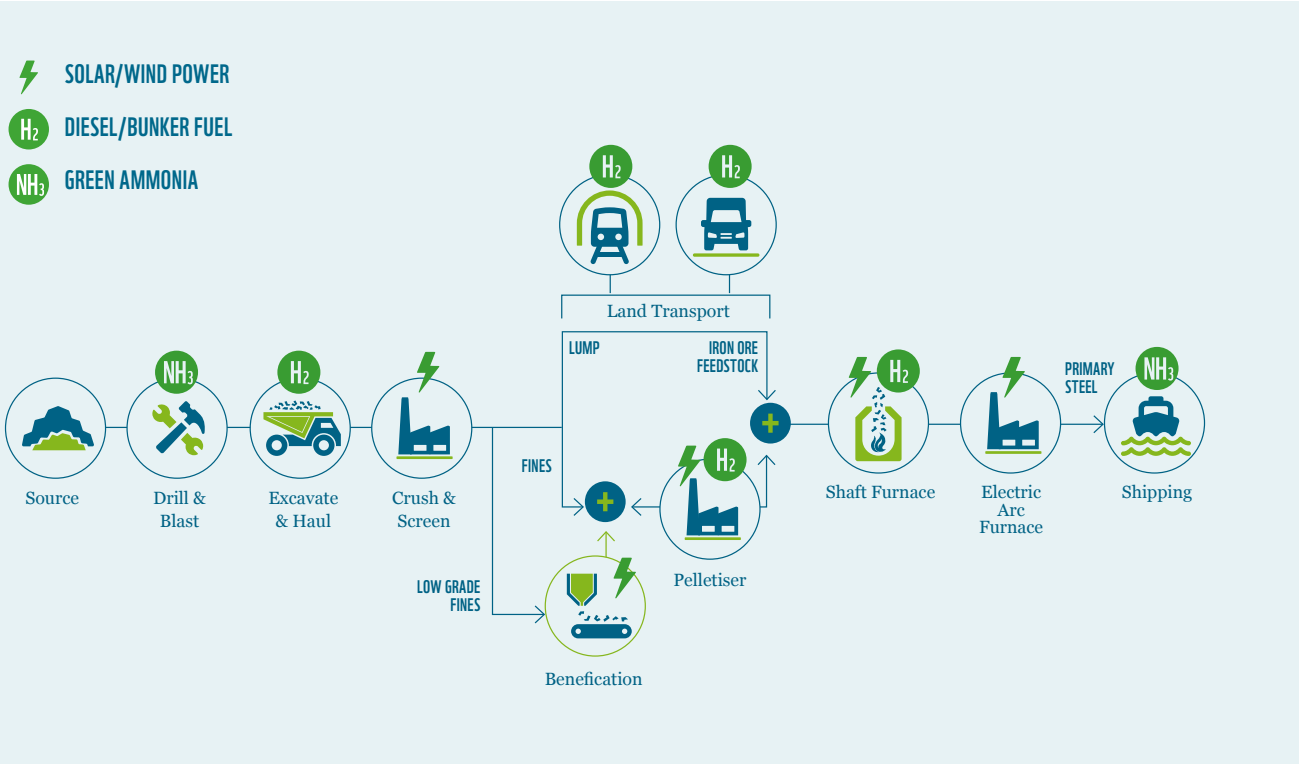
1 https://www.iea.org/reports/definitions-for-near-zero-and-low-emissions-steel-and-cement-and-underlying-emissions-measurement-methodologies

2 See page 9 for definition of embedded emissions.

(Bowen and Wyche 2024), energy inputs must be from non-biomass renewable sources and fossil fuel free. We do not include in the definition of green iron & steel conventional blast furnace or other high-emitting process pathways combined with the use of carbon capture and storage or utilization (CCUS), nor using offsets or insets to counterbalance unmitigated emissions. [3]

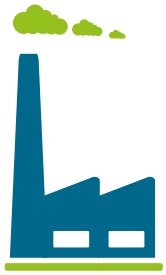
For the purposes of this report, we consider iron and steel supply chains to include raw material extraction, processing, iron-making, steel-making, and all transport steps from raw material extraction to final product production gate. As such, for the purposes of this report, "supply chain emissions intensity", "product emissions intensity", "product upstream scope 3" and "embedded emissions" are synonymous. A hypothetical green steel supply chain illustrating the steps to be included in embedded emissions accounting is illustrated in Figure 2 (figure source: Minerals Research Institute of Western Australia (2023).

Figure 2: Illustration of a hypothetical green steel supply chain showing elements to be included in embedded emissions accounting. Figure source adapted from Minerals Research Institute of Western Australia (2023).



We acknowledge that product "green", "responsible", "clean" or "eco" certification could reasonably be expected to depend on criteria other than greenhouse gas emissions intensity. These may include water consumption and pollution impacts, or even social criteria such as respect for First Nations rights and community consultation. Our focus in this report, however, is on embedded greenhouse gas emissions accounting and verification as this is the current focus of efforts in the international verification regime, including the Steel Standards Principles.

3 That is, emissions reductions either elsewhere (offsets) or within the supply chain (insets) cannot be used to lower the apparent emissions intensity of the product.



IRON & STEELMAKING
ANNUALLY EMITS NEARLY
3 BILLION METRIC TONNES OF CARBON DIOXIDE
ACCOUNTING FOR AROUND
7% OF TOTAL GLOBAL GREENHOUSE GAS

1.3 WHY ARE INTERNATIONAL GREEN IRON & STEEL SUPPLY CHAINS IMPORTANT?

Steel is a cornerstone of the global economy, forming the backbone of infrastructure, transportation, energy systems, and manufacturing. From skyscrapers and bridges to railways, wind turbines, and household appliances, steel is indispensable to modern life. Its strength, durability, and recyclability make it a material of choice across virtually every sector. As global development and urbanization continue—particularly in emerging economies such as India, Southeast Asia, and Africa—demand for steel is projected to rise significantly. Estimates from the International Energy Agency and World Economic Forum suggest global steel demand is expected to grow by around one-third or more by 2050 (IEA 2020b; WEF 2022). This growth will be driven by rising social and economic welfare needs, infrastructure expansion, and the global energy transition, which itself depends heavily on steel-intensive technologies like wind turbines and power grid.

Despite its widespread use, the production of iron and steel is highly concentrated. Just 15 countries account for approximately 87% of global steel output, with China alone producing more than half of the world's crude steel (Hasanbeigi 2022).This geographic concentration means that international trade and supply chains are essential to meeting global demand. Countries that do not produce steel at scale rely heavily on imports, while major producers depend on global markets for raw materials, energy inputs, and export opportunities. As a result, the iron and steel sector is deeply embedded in international supply chains that span continents.

Economic importance notwithstanding, the global significance of steel supply chains is arguably greatest with regard to the environment. Iron and steelmaking is one of the most energy-intensive sectors and a major contributor to climate change. It emits nearly 3 billion metric tonnes of carbon dioxide annually, accounting for around 7% of total global greenhouse gas (GHG) emissions (Tseo 2025). When considering only carbon dioxide emissions, the share rises to approximately 11% (Hasanbeigi 2022). [4] If the steel industry were a country, it would rank the world's third largest emitter after the USA and China. Most of these emissions come from traditional blast furnaces where coal is used to reduce iron ore to metallic iron.

Given the scale of its emissions and its central role in global trade, greening the iron and steel sector is both a climate imperative and a logistical challenge. Greening international supply chains for iron and steel—through cleaner production technologies, low-carbon inputs, and coordinated policy frameworks—is essential to achieving global climate goals. **This transformation will require international cooperation, investment in innovation, and a rethinking of how steel is produced, traded, and used across borders. A high-performance international embedded emissions verification scheme for iron and steel is an essential pre-condition for this transformation.**

4 These figures include emissions associated with the production of energy used in iron- and steelmaking (i.e. Scope 2 emissions).

2. THE INTERNATIONAL REGIME FOR GREEN IRON & STEEL VERIFICATION

2.1 WHAT IS THE INTERNATIONAL REGIME FOR GREEN IRON & STEEL VERIFICATION?

International regulatory regimes comprise the set of principles, norms and rules which work together to regulate a particular issue area (Krasner 1982). In our case we are interested in the international regime for green iron & steel verification (GISV). We can think of this regime being comprised of components. To qualify as part of the GISV regime as we define it, a component must play some role regarding verification of information about the embedded emissions of iron and/or steel products.

Product "embedded emissions" are the emissions resulting from part or all of the product's supply chain, expressed per functional unit (e.g. per tonne of steel). Embedded emissions are effectively synonymous with product "embodied emissions"(US EPA 2024) or "emissions intensity" or "Scope 1-2 and upstream Scope 3 emissions". The emissions accounting boundary for embedded emissions is typically "Cradle-to-gate", where the gate may be specified as the production or delivery gate. [5] "Cradle-to-delivery-gate" includes extraction and upstream production (raw material supply), transport to factory, and manufacturing.

Although not necessary to qualify as part of the GISV regime, many components play a role in the verification of additional information about green iron & steel products. For example, they extend the emissions accounting boundary to "life-cycle emissions", "carbon footprint" or "Scope 3 emissions". That is, they include consideration of use and disposal stages of life cycle - applying a "Cradle-to-grave" accounting boundary. For example, EDP International's Carbon Footprint labels aim to provide full life cycle accounting.

Some components of the GISV regime also support the verification of information other than GHG emissions intensity, such as other environmental or social indicators. For example, the Green Hydrogen Organisation's Green Iron & Steel Initiative is currently considering developing a product certification scheme that includes criteria beyond GHG emissions such as: Water resource management, Land use planning, Human rights, Community benefits, and Transparency and consultation. [6]

We categorise components of the GISV regime as "simple" or "complex". "Complex" components entail one or more "simple" component. Simple components include *written statements, rules, procedures, and guidelines* for:

- **Methods**: for calculating the emissions intensity of iron and steel products,
- **Thresholds**: of emissions intensity to qualify for standards, and definitions for iron and steel products,
- **Verification**: of information about emissions and related product attributes,
- **Claims**: of verified information about emissions and related product attributes,
- **Analysis**: and discussion of the regime,
- **Principles**: for the regime or certain components thereof,
- **Objectives**: of the regime or certain components thereof.

Compound regime components include:

- **product** certification schemes,
- environmental product declaration (**EPD**) programs,
- product **standards** [7],
- **reports** by organisations or individuals with relevant expertise, and
- **initiatives** by groups of stakeholders.

Note the Science Based Targets initiative uses the umbrella term "Environmental Attributes Certificates (sub-type Commodity Certificates)" to describe both certificates issued by product certification schemes and EPDs (Science Based Targets and ERM 2024). We do not use the Environmental Attributes Certificate (EAC) language here both because we want to provide clarity on the difference between product certification and EPD, and because EACs are mostly referred to in the context of corporate or enterprise GHG accounting and targets. This type of accounting is adjacent but distinct from product accounting and verification.

Table 1 summarises the relationship between simple and compound regime components.

5 Note that while there is broad agreement on terminology in this regard, one of the issues with the current international regime is that exact boundary definitions currently vary across verification frameworks.

6 https://gh2.org/what-we-do/green-iron-and-steel

7 A standard is a document, established by a consensus of subject matter experts and approved by a recognised body that provides guidance on the design, use or performance of materials, products, processes, services, systems or persons. https://www.iso.org/sites/ConsumersStandards/1_standards.html

Table 1: Relationship between simple and complex components of the green iron & steel verification regime.

	Product certification schemes	EPD programs	Standards	Expert Reports	Initiatives*
Methods	Yes	Yes	Yes	Sometimes	Sometimes
Thresholds	Yes	No	Yes	Sometimes	Sometimes
Verification	Yes	Yes	No	No	Sometimes
Claims	Yes	Yes	No	No	Sometimes
Analysis	No	No	No	Yes	Sometimes
Principles	Usually	Usually	Sometimes	Sometimes	Usually
Objectives	Usually	Usually	Sometimes	Usually	Usually

*Initiatives will often produce other compound regime components such as standards and reports.

Tables 2 and 3 respectively provide some key examples of simple and complex components of the GISV regime.

Table 2: Examples of simple regime components.

Component	Examples
Methods	Stand-alone: ISO14044 life-cycle analysis series, ISO14067 – carbon footprint of products, ISO13662 – Chain of custody - Mass balance (final draft stage), ISO/FDIS 13662, ISO14027 - Environmental labels, ISO20915 - Life cycle inventory calculation methodology for steel products, World Steel CO2 methodology, World Steel's LCI methodology; EU CBAM accounting rules. Embedded in complex components: Product category rules for disclosures and standards.
Thresholds	Embedded in complex components: IEA Threshold recommendations (of 50–400 kg CO_2e/t of crude steel, sliding scale by scrap share[8] (IEA 2024) – been adopted by multiple certification schemes and initiatives: Responsible steel international productions standard Principle 10 V2.1[9] (Responsible Steel, n.d.), RMI Low emission steel standard (LESS)[10] (RMI 2022), Industrial Deep Decarbonisation initiative (IDDI)'s green procurement pledge.
Verification	Embedded in complex components: Found in certification schemes and environmental product disclosure programs.
Claims	Embedded in complex components: Found in certification schemes and environmental product disclosure programs. E.g. labels for certification schemes; disclosure documents and libraries for EPD programs.
Analysis	Embedded in complex components: Found exclusively in reports, see Table 3.
Principles	Stand-alone: Steel Standards Principles (WTO 2023) Embedded in complex components: Responsible steel principles, IEA definitions and methodological principles.
Objectives	Embedded in complex components: Sometimes present in a variety of components, see Table 3.

8 International Energy Agency. (2024). Definitions for near-zero and low-emissions steel and cement, and underlying emissions measurement methodologies. IEA. https://iea.blob.core.windows.net/assets/0910c4ff-4008-48f5-a3ecc52996ed694d/Definitionsfornearzeroandlow emissionssteelandcementandunderlyingemissionsmeasurementmethodologies.p

9 Responsible Steel. (2022). Responsible Steel International Production Standard V2.1. Responsible Steel. https://www.responsiblesteel.org

10 Low Emission Steel Standard (LESS). (2022). Low Emission Steel Standard. Rocky Mountain Institute. https://lowemissionsteelstandard.org/

Table 3: Examples of complex regime components.

Component	Examples
Product certification schemes	Responsible Steel Product Standard [11] (Responsible Steel, n.d.), Global Steel Climate Council Certification (GSCCC) [12] (GSCC 2024)–Independent third party verification of The steel climate standard(GSCC 2024).
Environmental Product Declaration programs	ISO2025 certified *Type III Environmental Declaration (ISO 2006) programs* such as EPD International Environmental Product Declarations [13] (EPD International, n.d.); *Non ISO2025 compliant programs* and declarations such as Australian Gov. Guarantee of Origin Scheme; EPD International Carbon Footprints
Standards	ISO 14040/44, EN15804, 1SO 14067, ISO 21930, RMI Low emission steel standard (LESS) [14] (RMI 2022)
Reports	World Steel Association Methodology Mapping (2024); IEA's Emissions Measurement and Data Collection for a Net-zero Steel Industry (International Energy Agency 2023)
Initiatives	Carbon Border Adjustment Mechanism (CBAM)-providing specific methodology to measure embodied emissions of products; Industrial Deep Decarbonisation Initiative (IDDI); First Movers Coalition; Climate Club; OECD Steel Decarbonisation Workstream

11 https://www.responsiblesteel.org/certification-process

12 GSCCC includes more than 35 international producing members and supporters across the steel value chain, including steel producers, upstream material and services suppliers, downstream manufacturers and end-users, and trade associations.

13 (EPD International, n.d.).

14 Low Emission Steel Standard (LESS). (2022). Low Emission Steel Standard. Rocky Mountain Institute. https://lowemissionsteelstandard.org/

2.2 WHY IS GREEN IRON & STEEL VERIFICATION IMPORTANT?

Verification means the "confirmation, through the provision of objective evidence, that specified requirements have been fulfilled" (ISO 2006). Verification of the "greenness" of iron and steel is important because - despite what the name suggests - it is extremely difficult to judge the environmental attributes of a product based on its physical characteristics. Hence, economic theory tells us that in the absence of verification, markets do not operate efficiently because of an "information failure". Specifically, although the producer and other supply chain participants may know the emissions associated with processes they control, other market participants, governments and regulators do not. Hence, customers cannot base purchasing decisions and investors cannot make investment decisions on the basis of product supply chain emissions intensity (see Table 1). In turn, this means that supply chain participants receive incorrect or insufficient signals to decarbonise. Market, regulatory and policy signals are particularly important drivers of decarbonisation in industries like iron and steel, where low-emissions production remains substantially more expensive than conventional high-emissions pathways.[15] In short, product-level green iron & steel verification is essential to effectively reduce emissions caused by iron and steel supply chains.

Table 4: Decisions that can be supported by the green iron & steel emissions verification regime (adapted from Aisbett & Burkitbayeva, 2025).

Actors	Decisions
Customers (business and final consumer)	• Choice of product (e.g. metal versus wood) • Choice of supplier of otherwise like product (e.g. conventional or green steel)
Producers	• Product choices • Decarbonisation pathways • Investments • Market opportunities
Governments	• Targeting industry support • Border adjustments • Regulation • Procurement
Investors	• Support investment decisions • Risk assessment

2.3 WHY IS THE INTERNATIONAL REGIME FOR GISV IMPORTANT?

Regimes are important because actors (producers, customers, investors and governments) make choices based on the regime in which they operate – not purely on the basis of any one certification scheme or other element of the regime.

The internationality of the GISV regime is important because the iron & steel industry is international – characterised by a high intensity of trade in both intermediate and final products ("World Steel in Figures 2025," n.d.) and increasing amounts of foreign investment (Bazhenov et al. 2020; Voncujovi 2025). International trade and foreign investment are particularly essential to help the nascent green iron & steel supply chains achieve cost reductions through scale economies and meet substantial capital requirements for growth.

Not only is the existence of an international GISV regime important, but also its nature and performance. A poor-quality regime will lead to:

1. Lack of confidence and trust in the information, leading investors, consumers, and governments to be reluctant to provide incentives based on it;
2. Confusion for consumers, investors, and governments who are unsure which information they should trust; this in turn provides opportunities for greenwashing and incentives being incorrectly provided to production of high-emissions products; and
3. Excess regulatory burden and non-tariff barriers to trade eroding incentives and inhibiting the competitive advantage of low-emissions products.

15 Except for steel produced from scrap in electric arc furnaces (EAF) that are powered by a steady and low-cost renewable energy source such as established hydroelectricity.

3. REGIME COORDINATION EFFORTS

Acknowledgement of the dangers of a poorly functioning international regime has spurred a range of organisations to invest in influencing its evolution. The current section provides a brief overview of who's who and what they do.

Note that this section focusses on regime coordination efforts. For analysis of the regime components (e.g. mapping certification schemes and related policy and comparing rules across certification schemes), we encourage interested readers to consult previous efforts such as: IDDI (2023); IEA (2023); Aslam and Aisbett (2024a; 2024b), Carvalho and Muslemani (2025), Toledano et al. (2023a), and Barton (2024) in our bibliography.

3.1 INITIATIVES OF INTERNATIONAL ORGANISATIONS

International Energy Agency (IEA)

The IEA has played a leading role in regime coordination efforts, partly through its secretariat role for G7 and Climate Club on these issues. Its key outputs on this topic are (in chronological order):

Iron and Steel Technology Roadmap (IEA 2020a) provides a comprehensive framework for decarbonising the steel sector. It emphasizes the need for standardised emissions metrics and transparent reporting to track progress toward net-zero goals. The roadmap outlines pathways for low-carbon technologies and includes guidance on emissions accounting that supports interoperability across national and corporate reporting systems.

Achieving Net-zero Heavy Industry Sectors in G7 Members (IEA 2022) requested by Germany's 2022 G7 Presidency recommends a series of common and practicable definitions of what constitutes near-zero emission steel, including distinct thresholds for near-zero emissions and low-emissions steel, based on a scrap-variable scale.

Emissions Measurement and Data Collection for a Net-zero Steel Industry (IEA 2023) produced for the G7 in the context of Japan's Presidency. ▪ Highlights the need for robust methodologies for measuring emissions at the site- and product-level, together with data collection frameworks to facilitate comparison and track progress. ▪ Identifies and evaluates the existing array of methodologies and frameworks for the steel industry. ▪ Provides "net-zero principles" to guide potential next steps for their development and implementation, together with specific policy recommendations for G7 members.

Definitions Near-Zero and Low-Emissions Steel and Cement, and Underlying Emissions Measurement Methodologies (IEA 2024b) prepared as part of discussions over the course of 2024 in the IEA's Working Party on Industrial *Decarbonisation (WPID) and the Climate Club*. This report summarises the state of the international conversation and emerging understandings on definitions for near-zero and low-emissions steel and cement, as well as underlying emissions measurement methodologies. It also provides suggestions for possible next steps.

Organisation for Economic Cooperation and Development (OECD)

The OECD promotes harmonisation and interoperability of emissions accounting in the steel sector through two key avenues:

Inclusive Forum on Carbon Mitigation Approaches (IFCMA) [16]

The Inclusive Forum on Carbon Mitigation Approaches (IFCMA) is the OECD's flagship initiative designed to help optimise the global impact of emissions reduction efforts around the world. Key objectives are to take stock of and consider the effectiveness of different mitigation approaches, and explore interoperable approaches to measuring the carbon intensity of products. The IFCMA aims to help to limit administrative costs and firms' reporting burdens, improve transparency and avoid fragmentation of international supply chains by developing and implementing interoperable approaches to measure carbon intensity metrics.

16 https://www.oecd.org/en/about/programmes/inclusive-forum-on-carbon-mitigation-approaches.html

Steel Decarbonisation Work Stream

The OECD Steel Committee has launched a dedicated work stream to support the transition to low-carbon steel while addressing structural challenges such as excess capacity and market distortions. Their work related to the green iron & steel verification regime includes development of emissions intensity benchmarks and convening workshops of key stakeholders.

Other OECD involvement

The OECD Secretariat also provide support initiatives such as the Climate Club and G7. Notably their report prepared for the Japanese G7 presidency on "The Heterogeneity of Steel Decarbonisation Pathways" (OECD 2023) examines how heterogeneity should be considered when developing definitions for near-zero and low-emissions steel production, as well as emissions measurement methodologies and data collection frameworks.

Climate Club

Launched in 2022 and supported by over 30 governments, the Climate Club is an international initiative aimed at accelerating industrial decarbonisation through stronger global cooperation. It focuses on hard-to-abate sectors like steel, cement, and chemicals. Climate Club Pillar II workstream: Transforming industries aims "to advance the enabling conditions for substantial industrial decarbonisation by discussing and aiming to align, as far as possible, methodologies, standards, sectoral strategies and expanding markets for green industrial products."(The Climate Club 2023).

The Climate Club promotes the alignment of emissions accounting methodologies and standards to avoid carbon leakage and ensure fair competition. It draws on the work of existing initiatives (like the IEA and COMET) and aims to create a shared framework for tracking and comparing emissions performance across countries (Climate Club Interim Secretariat 2023).

Industrial Deep Decarbonisation Initiative (IDDI)

The Industrial Deep Decarbonisation Initiative (IDDI), coordinated by UNIDO under the Clean Energy Ministerial, is a global coalition focused on accelerating the decarbonisation of heavy industries—particularly steel—by driving demand for low- and near-zero emission materials. According to the IDDI Website ("The Industrial Deep Decarbonisation Initiative," n.d.), its key objectives are:

1. Establishing an approach for collecting interoperable data to report on the procurement of low- and near-zero-emission materials.
2. Working with governments, private sector, civil society, and intergovernmental organisations to harmonise standards and definitions for low- and near-zero emission products.
3. Setting commitments and best practices for the public procurement of these materials.

According to a recent report (IDDI 2024), the IDDI aims to create an enabling environment for deep decarbonisation of heavy industry by:

1. Stimulating demand for low and near-zero emission materials through green public procurement commitments
2. Harmonising product-level emissions accounting methodologies
3. Endorsing definitions for low and near-zero emission materials

3.2 TRANSNATIONAL AND MULTISTAKEHOLDER INITIATIVES

International Standards Organisation (ISO) and Greenhouse Gas (GHG) Protocol

ISO- a globally recognised standard setting body and GHG protocol-a joint initiative of World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD), have announced a landmark strategic partnership to streamline emission measurement and reporting to enhance transparency and accountability. Although not directly steel specific, the collaborative effort is integral to the global supply chain of iron and steel to provide a coherent and consistent approach to emissions accounting. This includes standards from the ISO 1406X family of standards, alongside the GHG Protocol Corporate Accounting and Reporting, Scope 2 and Scope 3 standards. The significance of a partnership on this topic between these two organisations is highlighted by the findings of a recent social network analysis of embedded emissions accounting frameworks for iron and steel Aslam and Aisbett (2025).

Steel Standards Principles (SSP)

The initiative was designed to address the fragmentation of emissions measurement standards in the steel sector by promoting common methodologies, interoperability, and mutual recognition. The principles statement is currently short, including six agreed points of recognition about the importance of decarbonising the global iron & steel industry, followed by seven dot point "principles" related to standards. The principles emphasize interoperability, alignment, mutual recognition, transparency, multistakeholder participation, and alignment with decarbonisation goals (WTO 2023). Although there are currently 61 signatories to the SSP, the World Trade Organisation, World Steel Association, and Responsible Steel were key drivers of the initiative.

Breakthrough Agenda

Since its launch at COP 26, the Breakthrough Agenda has become established as an annual collaborative process centred around the Conference of the Parties (COP) meetings of the United Nations Framework Convention on Climate Change (UNFCCC). It is currently supported by 59 countries representing over 80% of global GDP, and by over 100 initiatives working to enhance collaboration within major emitting sectors. Steel is one of the 6 priority sectors. Within steel, Priority Action S1 is on definitions and standards with the first objective being development of principles for net-zero compatible standards and definitions to enable their equivalency and adoption within national policies by the end of 2025 (Breakthrough Agenda, n.d.).

The Breakthrough Agenda Report (IEA 2024a) recommends that "The Governments, industry, and other relevant stakeholders should work through existing collaborative forums and with international standards bodies to identify by end of 2024 and implement by end of 2025 priority revisions for interoperability and net-zero compatibility of steel GHG emissions accounting methodologies. Governments should collectively provide clarity on principles for near-zero and low-emission steel definitions, commit to adopting definitions within national policies by the end of 2025, select methods for determining equivalency of different certification schemes, and provide guidelines on chain of custody models." This process is being tied into Marrakech Partnership for Global Climate Action (the Action Agenda) also being reinforced by COP30 presidency, to ensure that the sectoral priorities under the Breakthrough Agenda are carried forward by non-party stakeholders (Global Climate Action UNFCCC 2020). In this context, Action group no.23 has been established to directly support S1, positioning carbon accounting and carbon markets as a systematic enabler of low carbon transition and industrial decarbonisation (COP 30 2025).

The Breakthrough Agenda Action Plan for 2025[17] – lists all the all organisations taking action on embedded emissions and who is taking the lead and what needs to be done.

Industry Transition Accelerator (ITA)

ITA is a global multistakeholder initiative (Hayes 2025), which was launched at COP28, exploring potential programs in industrial decarbonisation. This includes specific standards work program, to drive harmonisation and interoperability of GHG accounting methodologies. Key initiatives include:

- Developing an ISO international workshop agreement (IWA)- In partnership with the International Institute for Environment and Development (IIED) and the United Nations Industrial Development Organisation (UNIDO).
- Thought leadership on accounting methodologies, including appropriate use of COC models, identifying "guardrails" for adoption across different industrial sectors to prevent misuse.
- Broad strategy on potential partnerships with the UNFCCC Technology Executive Committee on standards mapping for steel, cement, and chemicals; developing 'Steel Standards Principles' with world steel; supporting the Clean Energy Ministerial (CEM) Future Fuels Life Cycle Assessment (LCA) Working Group; and mapping GHG accounting methodologies for cement with the World Cement Association.

17 https://breakthroughagenda.org/wp-content/uploads/2025/01/Power-Breakthrough-Priority-InternationalActions-2025.pdf

Coalition on Materials Emissions Transparency (COMET)

COMET is a multi-stakeholder initiative including RMI, CCSI and the UNFCCC which aims to harmonise GHG accounting across materials supply chains, including steel. It promotes methodological transparency and comparability by aligning with existing standards and disclosure platforms. COMET supports consistent emissions data for producers, investors, and policymakers to accelerate decarbonisation. COMET aims to develop a unified framework of principles, standards, and reporting requirements so the emissions associated with commodities and intermediate goods can be transparent and verifiable (Calderon et al. 2023). Its work on steel includes a report on "Conflicts Between GHG Accounting Methodologies in the Steel Industry" (Toledano et al. 2023b).

ResponsibleSteel

ResponsibleSteel is the world's first global multi-stakeholder certification initiative for the steel industry, aiming to establish a credible and internationally recognised standard for responsible steel production. Its certification framework is built around 13 principles that encompass environmental, social, and governance (ESG) criteria, including climate change, water and resource management, and human rights. A key focus of Responsible Steel's work is the development of a consistent and comparable methodology for greenhouse gas (GHG) emissions accounting, which is embedded in its International Production Standard.

To support harmonisation, ResponsibleSteel has published a set of GHG Emissions Accounting and Classification Fundamentals, which outline how to calculate and disclose emissions intensity at the site level, classify decarbonisation progress, and report product-level emissions (Responsible Steel 2025). This framework enables steelmaking sites worldwide to be assessed on a like-for-like basis using transparent and fair accounting rules. While these fundamentals are part of the broader certification system, they also serve as a reference for policymakers and other standard-setting bodies seeking to align emissions methodologies.

ResponsibleSteel's Decarbonisation Progress Level 4 (Criteria 10.4 and 10.6: Climate Change and Greenhouse Gas Emissions) aligns with the IEA's threshold for near-zero emissions steel (IEA 2022) and is referenced by initiatives such as the First Movers' Coalition as the standard for their Near-Zero Steel 2030 Challenge (Responsible Steel 2023) and the SteelZero commitment framework (2024).

First Movers Coalition (FMC), World Economic Forum

Other regime coordination efforts include the First Movers Coalition (FMC), a public– private partnership launched by the World Economic Forum and the U.S. government. FMC brings together leading companies committed to purchasing near-zero-emissions industrial products (including steel, aluminium, shipping, aviation fuels, and trucking) to stimulate early markets and harmonise demand signals. By setting shared procurement targets, FMC helps align private actors and governments around credible definitions of low-emissions steel and other hard-to-abate sectors.

Mission Possible Partnership (MPP)

A flagship public-private partnership launched by the World Economic Forum, MPP coordinates a net-zero Steel Initiative that brings together major cross sectoral commodities and governments, industries, and financial parties including producers such as ArcelorMittal, Tata Steel, SSAB, Liberty Steel, Rio Tinto, and Boston Metal. It provides an industry-backed transition strategy toward net-zero steel by 2050, with clear investment and emissions milestones.

Science-Based Targets Initiative (SBTi)

The Science Based Targets initiative (SBTi) provides companies with tools to set and verify decarbonisation strategies on corporate level. The methodology is based on the allocation of the global 1.5°C-aligned carbon budget to specific sectors. In 2023 SBTi released their Guidance for the Sectoral Decarbonisation Approach of the iron and steel sector.

3.3 INDUSTRY INITIATIVES

World Steel Association (Worldsteel)

World Steel Association represents over 160 steel producers, industry associations, and research institutions, constituting around 85% of production. It builds on climate action data collection methodology based on ISO 14044:2013 and plays a leading role in several key standards and initiatives towards harmonizing GHG accounting methodologies, including: ISO 20915:2018 on lifecycle inventory methodology for steel products (International Organisation for Standardization (ISO) 2018). It is also founding member of Global Steel Climate Council (GSCC), deeply engaged with ResponsibleSteel certification scheme, and co-developed the Steel Standards Principles. The association has also developed chain of custody principles and guidelines to support the use of emission reduction certificates and are aligned with international procurement policies (World Steel Association 2024b). These are based on Mass balance and Book and claim models to provide producers with flexibility to demonstrate their emission reductions. These approaches are discussed further in Section 6.

Global Steel Climate Council (GSCC)

The GSCC is a non-profit association organised to advance climate strategy by establishing standards and advocating for carbon emissions reductions by members of the steel industry. The GSCC includes more than 35 international producing members and supporters across the steel value chain, including steel producers, upstream material and services suppliers, downstream manufacturers and end-users, and trade associations.

The GSCC Steel Climate Standard's three objectives are to:

- Provide a single, technology neutral framework for steel product certification and company science-based emissions target-setting that applies to all steel producers equally on a global basis.
- Allow all steel customers to know the carbon emissions associated with the steel products they are purchasing.
- Create an industry standard for achieving the emissions reduction goals in the Paris Climate Agreement by 2050.

The GSCC Standard encompasses a two-part strategy of setting, certifying and assessing progress toward meeting corporate-wide emissions reduction targets along with certifying product emissions intensities. More details are published in its Global Steel Climate Standard (GSCC 2024a) and accompanying technical guidance (GSCC 2024b).

American Iron and Steel Institute (AISI)

The AISI has published detailed Greenhouse Gas Emissions Calculation Methodology Guidelines for steel production (AISI 2022). These guidelines align with ISO standards and are designed to support both product-level disclosures and corporate-level reporting. They aim to reduce inconsistencies in emissions reporting by providing a robust, cradle-to-gate methodology that includes Scope 1 and 2 emissions.

China's Five-tiered Steel Emissions Standard

China's National Steel Association, led by BAOWU steel has concluded 3-year consultation and launched their 5-tiered Steel Emissions Standard. Developed in consultation with the IEA, it is part of China's broader strategy which involves shifting to greener technologies like electric furnaces and hydrogen based production, with allocation plans and methods to be specified in phase 4, supported by the national ETS to encourage decarbonisation efforts across the steel industry [18].

3.4 CSO, THINK TANKS AND ACADEMIC INPUTS

WWF

WWF International is a leading contributor to the SBTi. The global focal point of WWF's global action and national offices is the Steel Decarbonisation Workstream. Their stand-alone efforts also include a "Toolkit for the procurement of lower emissions steel" reduce customer confusion and guard against greenwashing (WWF International 2025). WWF is a member of Steel Standard Principles.

WWF-Australia has been instrumental in advocating for the development of a green iron & steel industry in Australia, emphasising its potential to drive economic growth while contributing to global decarbonisation efforts. In July 2024, WWF-Australia released the report titled Australia's Green Iron Key: Unlocking Asian Steel Decarbonisation, Securing Australia's Economic Future [19]. The report outlines the strategic steps necessary for Australia to become a global leader in green iron manufacturing and decarbonise the iron and steel industry. In March 2025, WWF-Australia and Deloitte released a joint report on the trade competitiveness of Australia as a green iron producer. [20] Other WWF offices are also highly engaged with industry in their respective countries.

Rocky Mountain Institute (RMI)

RMI play an important role in research related to the green iron & steel verification regime. In addition to the role in COMET, they have published "Steel GHG Emissions Reporting Guidance" (Wright et al. 2023). The effectiveness of this guidance has been demonstrated through pilot case studies and collaboration with industry leaders such as ArcelorMittal , Toyota and SINAI technologies [21]. They have also played a leading role in the development of the Low Emissions Steel Standard (LESS) (RMI 2022).

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18 https://icapcarbonaction.com/en/news/china-officially-expands-national-ets-cement-steel-and-aluminum-sectors#:~:text=online%20monitoring%20results.-,Allocation%20plan,selected%20industrial%20sectors%20in%202024

19 WWF-Australia. (2024). Australia's Green Iron Key: Unlocking Asian Steel Decarbonisation, Securing Australia's Economic Future. https://assets.wwf.org.au/image/upload/v1721362051/file_WWF_Green_Iron_Report.pdf

20https://wwf.org.au/news/2025/new-report-says-green-iron-is-australias-economic-sweet-spot/

The Heavy Industry Low-Carbon Transition Cooperative Research Centre (HILT CRC)

HILT CRC's certification project RP3.006, led by Australian National University (ANU), is a critical component of HILT CRC's Program 3, which focuses on facilitating transformation in heavy industry. The initiative addresses the need for embedded emissions accounting to support the transition to low-carbon supply chains. To date it has produced two reports on GISV: Mapping embedded emissions accounting frameworks for heavy industry low-carbon transition: The case of iron and steel (Aslam and Aisbett 2024a) and Policies and regulatory drivers of embedded emissions accounting for Australian heavy industry low-carbon transition: The case of the iron and steel sector (Aslam and Aisbett 2024b).

3.5 CONNECTIONS BETWEEN ORGANISATIONS AND INITIATIVES

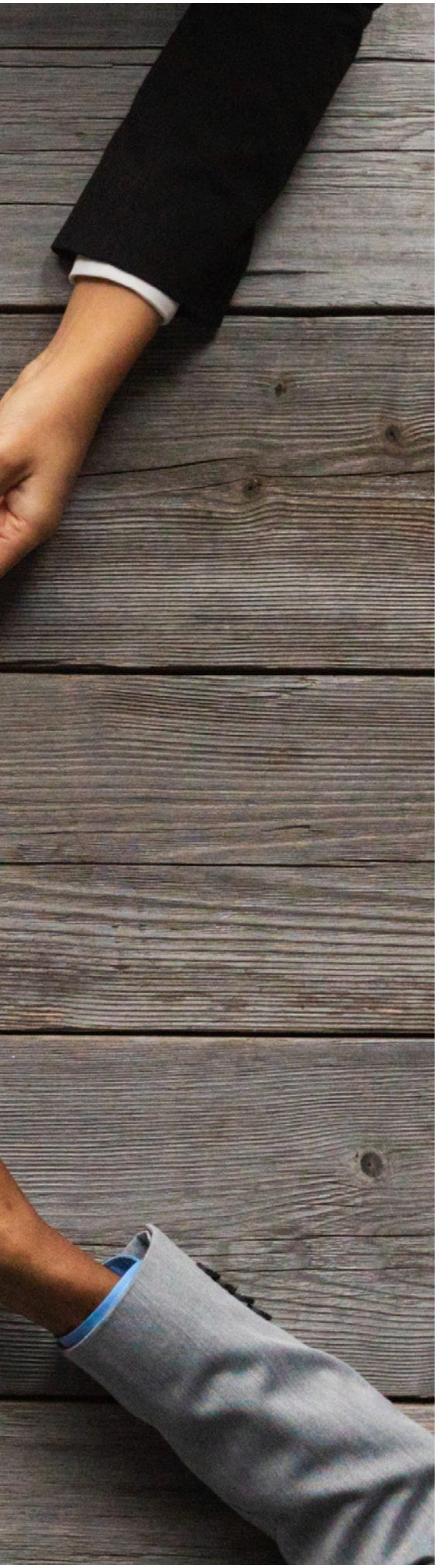
Although a full social network analysis is beyond the scope of this report, Table 5 summarises identified connections between initiatives and organisations involved in coordination of the international GISV regime.

Table 5: Connections between GISV regime coordination efforts.

Initiative / Organisation	Connected To / Collaborates With	Nature of Connection
IEA (Iron & Steel Technology Roadmap, Net-zero Reports, Definitions)	G7, OECD, Breakthrough Agenda	Provides technical guidance, common definitions, emissions accounting methodologies; informs Climate Club Pillar II; aligns with Breakthrough Agenda principles.
OECD IFCMA	IEA, Climate Club, Steel Decarbonisation Work Stream, G7	Promotes harmonised carbon intensity measurement, interoperability, least-restrictive means, transparency.
OECD Steel Decarbonisation Work Stream	Breakthrough Agenda Steel, coordinated by Climate Club, WTO, and OECD Steel Committee, ResponsibleSteel, Worldsteel	Supports low-carbon steel transition, emissions intensity benchmarks, workshops; informs verification regimes.
Climate Club (Pillar II: Transforming Industries)	OECD, COMET, IEA, Breakthrough Agenda, IDDI, member governments	Aligns methodologies and standards, avoids carbon leakage, promotes interoperability.
IDDI (Industrial Deep Decarbonisation Initiative)	UNIDO, COMET, Governments, Private Sector, Civil Society	Harmonising standards, stimulates demand for low/near- zero emissions materials; interoperable data collection.
Steel Standards Principles (SSP)	WTO, Worldsteel, ResponsibleSteel	Promotes interoperability, mutual recognition, transparency, multi-stakeholder engagement.
Breakthrough Agenda	IEA, Climate Club, International Standards Bodies, UNIDO, member governments	Develops principles for net-zero compatible standards, interoperability; priority for steel GHG accounting standards.
COMET (Coalition on Materials Emissions Transparency)	RMI, CCSI, UNFCCC, IEA, IDDI	Harmonises GHG accounting across materials; promotes methodological transparency and comparability.
ResponsibleSteel	First Movers Coalition, OECD, SSP, Worldsteel	Provides certification, GHG accounting fundamentals; supports standardization; Decarbonisation Progress Level 4 used by FMC.
First Movers Coalition (FMC)	ResponsibleSteel, World Economic Forum, Governments	Stimulates demand for near-zero steel; aligns private sector procurement with credible definitions. Uses IEA definition of near-zero emissions steel.
Worldsteel	SSP, ResponsibleSteel, ISO 20915, SBTi	Industry standards, product certification, global emissions target-setting; informs MPP strategies.
Global Steel Climate Council (GSCC)	Associate member of world steel organisation [22], SCS global services for certification,	SCS is GSCC®'s first approved verifiers for the Steel Climate Standard.
Mission Possible Partnership (MPP) / Net- Zero Steel Initiative	GSCC, Worldsteel, ArcelorMittal, Tata Steel, SSAB, Boston Metal	Provides industry-backed net-zero transition roadmap; collaborates with steel producers and standard initiatives.
Science-Based Targets Initiative (SBTi) – Steel Guidance	GSCC, MPP, Worldsteel	Sets 1.5°C-aligned decarbonisation targets for steel, including Scope 3 coverage.
American Iron and Steel Institute (AISI)	ISO, Worldsteel, SBTi	Provides GHG emissions calculation methodology guidelines for steel; aligns with global standards.

22 https://globalsteelclimatecouncil.org/newsroom/gscc-joins-worldsteel-association/

PART II: EFFECTIVE REGIME COORDINATION



4. WHAT IS EFFECTIVE REGIME COORDINATION?

We propose the purpose of regime coordination is to improve regime quality, where regime quality is measured by its Effectiveness, Efficiency and Legitimacy. Effective coordination of the international GISV regime, therefore, requires:

- for Effectiveness:
  - clarity on the objectives of the regime,
  - design and implementation of the regime to achieve those objectives, and
  - some level of coherence of the regime.
- for Efficiency:
  - a higher level of regime coherence – minimising idiosyncratic differences. Note this is not the same as full harmonisation and elimination of all differences. Rather, remaining differences should be necessary to achieve other governance objectives such as Effectiveness or Legitimacy.
- for Legitimacy:
  - broad participation for process legitimacy:
  - "fairness" in the eyes of stakeholders for outcome legitimacy.

Of course, Effectiveness, Efficiency and Legitimacy will sometimes conflict with each other. For example, in the context of the GISV regime, Effectiveness may require costly information gathering which reduces Efficiency. Similarly, efforts to ensure perceived fairness may compromise ambition and thus Effectiveness. Meanwhile efforts to achieve Legitimacy through allowing a heterogeneity of approaches may compromise Efficiency.

We propose that a structured approach to coordination can help it achieve its objective of simultaneously improving regime Effectiveness, Efficiency and Legitimacy. The remainder of this section introduces one such approach – the top-down design pyramid of Aisbett & Burkitbayeva (2025).

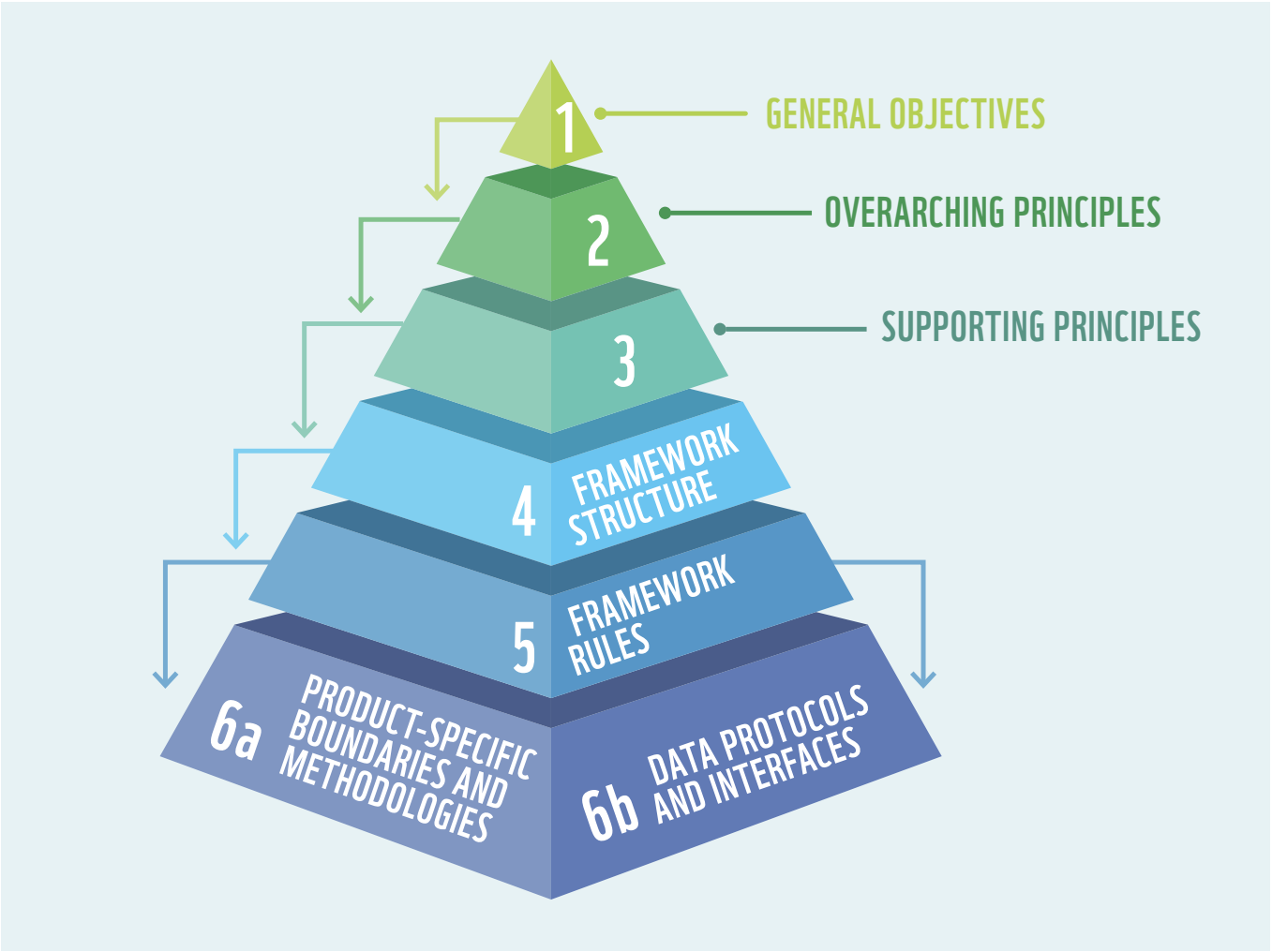


Figure 3: Aisbett & Burkitbayeva's (2025) top-down design pyramid for embedded emissions accounting and verification regimes.

5. A TOP-DOWN APPROACH TO REGIME COORDINATION

Aisbett & Burkitbayeva (2025) (henceforth AB25) propose a top-down approach to the design of product embedded emissions accounting and verification regimes. Their approach is summarised in Figure 3. It begins with the identification of objectives and then moves down to principles, framework structure and rules, and lastly, to details such as product-specific methodologies and data protocols. Of course, different organisations and actors will focus on different levels of the AB25 design pyramid, and not all will start at the top. For regime coordination, however, focusing on the top layers and considering their implications for lower layers is the recommended approach.

AB25 use the pyramid to communicate their vision of the global regime for product embedded emissions accounting frameworks (EEFs). Although not specific to green iron & steel, their analysis is highly relevant in our context as it speaks to the measurement and methods aspects of the GISV regime.

Level 1 of the AB design pyramid, General Objectives, refers to the regulatory or governance objectives of the regime. Specification of level 1 requires a statement of general regulatory objectives, as well as the specific goal of the regime. AB25 focus on the regulatory objectives of Effectiveness and Efficiency in achieving the goal of "support[ing] decision-making based on product embedded emissions information". The relevant decisions to be supported include those of governments, investors, customers, and producers as summarised in Table 3.

The next two levels of the design pyramid consist of Overarching and Supporting Principles. Drawing on White et al.'s (2024) systematic review of relevant principles, AB25 identify three overarching principles: Relevance, Least Restrictive Means and Non-discrimination. These principles and their definitions in our context are summarised in Table 6.

Table 6. Definitions of Overarching Principles adapted from White et al. (2024) and Aisbett & Burkitbayeva (2025).

Principle	Definition
Relevance	The regime and its components should be designed to support the needs of the intended uses and users.
Least Restrictive Means	Regime components should be designed to meet the requirements of their intended use in the means that least restricts trade, including minimizing regulatory burden.
Non-discrimination	The regime should not generate explicit or implicit advantage or disadvantage for like products, where "like" includes true emissions impacts.*

*In the context of embedded emissions verification for iron & steel, there is debate about additional attributes that should be used to define "like" products. There is agreement from many stakeholders with the IEA's approach of the fraction of scrap used in steel production being considered in this regard.

The second set of principles identified by AB25 are Supporting Principles. These additional principles help align regime design with the Overarching Principles and support achievement of the regulatory objectives of Efficiency and Effectiveness. The eight Supporting Principles are (in alphabetical order): Accuracy, Conservativeness, Comparability, Flexibility, Interoperability, Monotonicity, Subsidiarity, and Transparency; as defined in Table 7.

Table 7. Definitions of Supporting Principles adapted from White et al. (2024) and Aisbett & Burkitbayeva (2025)

Principle	Definition
Accuracy	True embedded emissions should neither be under-estimated or over-estimated.
Conservativeness	Where further accuracy cannot reasonably be achieved, assumptions, default values and alternative methods should be chosen such that the risk of reported emissions (removal) being an underestimate (overestimate) of the true values is minimised.
Comparability	Differences in the information provided by different regime elements about embedded emissions associated with a specified portion of a product's supply chain reflect actual differences in embedded emissions.
Flexibility	Regime elements should be designed to maximise the number of uses and users for which they are relevant.
Interoperability	Regime components should be able to pass useful information to each other.
Monotonicity	Embedded emissions accounting frameworks should not allow actors to decrease their reported emissions in a way that may increase overall emissions. That is, any increases elsewhere resulting carbon leakage must be less than the decreases in the supply chain being verified.*
Subsidiarity	Data collection and accounting should be conducted at the lowest level of aggregation and control that is consistent with meeting its intended use.
Transparency	Information should be provided sufficient to allow stakeholders to assess robustness and reliability.

*An example of a violation of the Monotonicity principle would be a scheme which allows iron and steel makers to claim zero emissions associated with the use of biological carbon feedstocks. This could violate Monotonicity by driving increased demand for these feedstocks which could cause land use change, fertilizer use etc. whose net emissions are greater than those of the fossil carbon source they replace.

Overall, an Efficient and Effective international regime for green iron & steel verification must at a minimum be consistent with the eleven principles identified in Tables 6 and 7.

In contrast to Levels 1-3, the middle section of the AB25 pyramid (Levels 4-5) is concrete, and rules based. Framework Structure (Level 4) includes choices around what elements comprise the EEF and the architecture of how these elements combine. Modular emissions accounting boundaries is an example of Framework Structure. Framework Rules (Level 5) are specific rules, such as the approach to allocation of emissions among products, or determination of global warming potential of greenhouse gases.

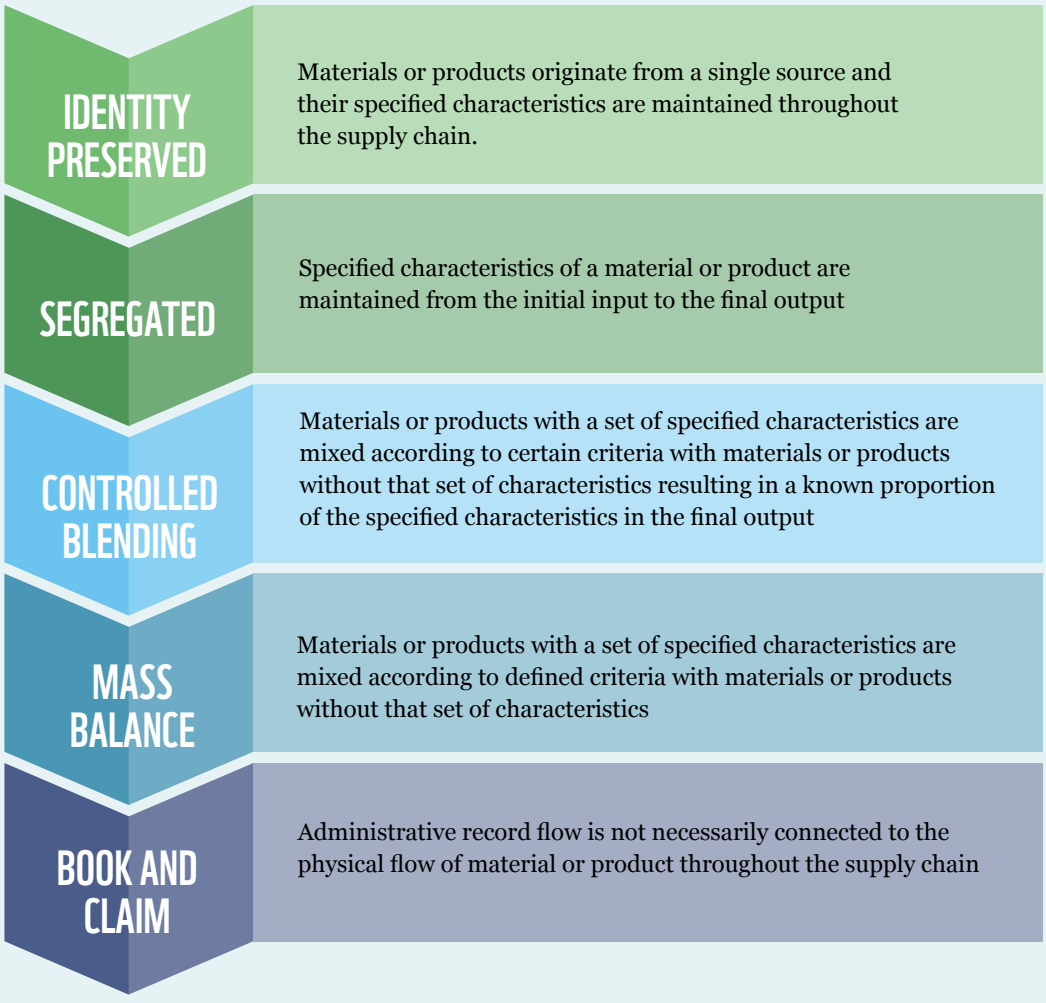
AB25 demonstrate the application of the their top-down design pyramid by using the Objectives and Principles of Levels 1-3 to derive a detailed set of recommendations regarding choice of Framework Structure and Rules for Levels 4 & 5. They also use it to develop recommendations on which of these choices should be prioritised for coordination among different elements of the regime. In the interest of space, we refer the interested reader to AB25 for these recommendations. In the following section here, we illustrate the application of the top-down design pyramid to a specific design question for the GISV regime: the choice of chain-of-custody model.

6. A TOP-DOWN APPROACH TO CHAIN-OF-CUSTODY MODELS

6.1 WHAT ARE CHAIN-OF-CUSTODY MODELS?

According to ISO22095:2020, Chain-of-custody (COC) is the "process by which inputs and outputs and associated information are transferred, monitored and controlled as they move through each step in the relevant supply chain" and COC models "refer to the approach taken to control inputs and outputs and associated information in a particular chain of custody system". ISO22095:2020 identifies five broad types of COC model as summarised in Figure 4: ISO Chain-of-custody model types.

Figure 4: ISO Chain-of-custody model types.



Importantly, a wide range of approaches are covered by what ISO22095 refers to as "Mass balance" models. Furthermore, the Worldsteel "mass balance" model is a Book & claim model according to ISO definitions.

6.2 WHY ARE COC MODELS FOR THE GISV REGIME CONTENTIOUS CURRENTLY?

Current debates about Chain of Custody (COC) approaches provide an example of the utility of a structured top-down approach to regime design and coordination.

COC models can have a substantial impact on the reported emissions for some iron & steel producers and production pathways – and hence on their products' EPDs and certifications. As a result, international norms about the COC models used in the GISV regime have substantial impact on the competitiveness of these products, as well as incentives for investment in alternative pathways. Ultimately, norms around these models could determine both competitiveness of different production locations (even at the country level) as well as the climate impact of heavy industry over the coming decades.

Discussion of COC models is timely, because key greenhouse gas accounting and climate standards are currently being revised, including the Science-Based Targets Initiative (SBTi), Greenhouse Gas (GHG) Protocol, International Organisation for Standardization (ISO) standards and the World Steel Association Chain of Custody Guidelines. ISEAL have also recently released Version 2.0 of their reference document on Chain of Custody Models and Definitions (ISEAL 2025).

6.3 TOP-DOWN ANALYSIS OF COC MODELS FOR THE GISV REGIME

Method

Following the ISO's definition of COC as the "process by which inputs and outputs and associated information are transferred, monitored and controlled as they move through each step in the relevant supply chain", our discussion below considers a single supply chain step. Inputs (source materials) and outputs (products) are defined relative to that step. In complicated supply chains such as iron and steel, the products of one step become the inputs for the next one downstream. Correspondingly, the attributes of the product as determined by the COC model employed for its supply chain step become the attributes of the inputs for the next step.

We apply the AB25 framework to analyse alternative COC models for the international GISV regime. Our analysis covers the top three levels of the AB25 design pyramid: General Objectives, Overarching Principles, and Supporting Principles (see Section 5). COC model choice can impact alignment with all these objectives and principles. Our analysis also considers one of the Framework Rules (pyramid level 5): Emissions allocation rules.

Although AB25 cover more than ten different Framework Structure and Framework Rules in their discussion, Emissions allocation rules are the most relevant to the question of COC model. As detailed in AB25, the accepted norm for embedded emissions frameworks has two key components. Firstly, consistent approaches should be used to define "products", "co-products", and "wastes" and to allocate emissions among these streams. Secondly, that segregating processes and measurement as far as possible to avoid the need for allocation should be used where possible. For example, emissions from different production sites should not be aggregated, and within a production site, emissions from different processes or production streams should be accounted separately. Where segregation is not possible, some consistent and logical rule should be chosen to allocate emissions. The logical rule can sometimes vary depending on the type of product, but allocation based on mass or economic value are most common. Free allocation of emissions according to what suits the producer's interests is not an accepted norm. The same argument is made in relation to lifecycle analyses (carbon footprinting) by Holzapfel et al. (2025).

In the following discussion, we consider the consistency of different COC models with the AB25 recommendations for objectives, principles, and emissions allocation.

Identity preserved COC model

The Identity preserved COC model is mostly used for products with high unit value and short supply chains; such as wine or merino wool clothing. Nonetheless, we begin with the Identity preserved model as its simplicity helps demonstrate our methodological approach. As illustrated in Figure 5, the Identity preserved model does not allow any mixing of products from different sources. This means, for example, that iron ore used in iron-making must all come from the same site (and have the same embedded emissions), and similarly, iron or scrap used in steelmaking must all come from the same source.

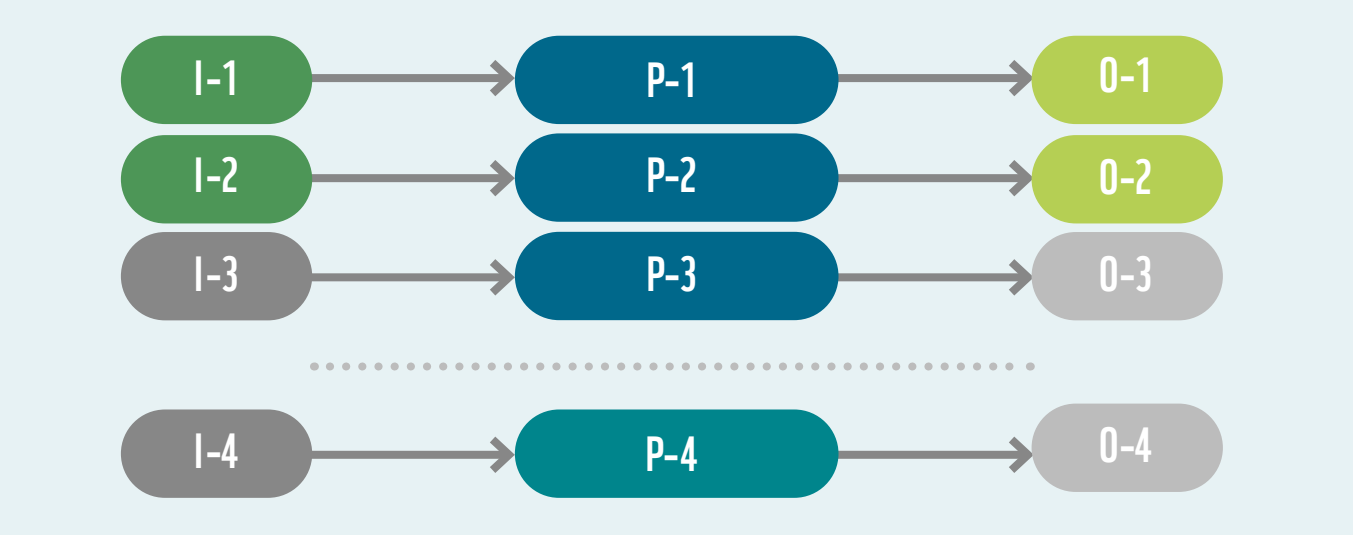


Figure 5: Schematic of Identity preserved COC model. Adapted from Holzapfel et al. (2025).

The Identity preserved model is consistent with best-practice emissions allocation rules and supports high-integrity product embedded emissions accounting. On the other hand, its information and traceability demands are high and its restriction of mixing feedstocks and process streams is clearly incompatible with practice at many iron and steel-making facilities. As a result, requiring this approach would either exclude many producers or force them to undertake costly process and monitoring changes. As shown in Table 8, we therefore consider the Identify preserved model to be highly consistent with most of the AB25 recommendations, but inconsistent with the objective of Efficiency, or with the principles of Least-restrictive means, Non-discrimination and Flexibility.

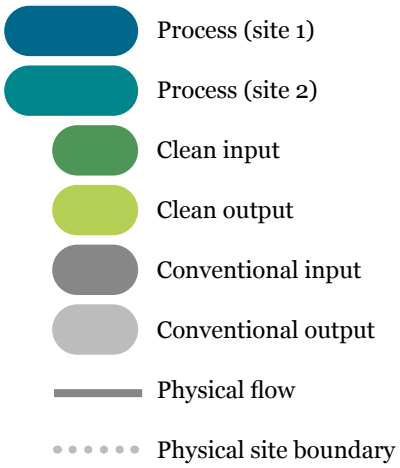


Table 8: Assessment of Identity preserved and Segregated COC models against the AB25 recommendations.

Design level	Consistency of COC model with design recommendations		
	High	Acceptable	Low
General objectives	Effectiveness		Efficiency
Overarching principles	Relevance		Least-restrictive means Non-discrimination
Supporting principles	Accuracy, Comparability, Conservativeness, Interoperability, Monotonicity, Subsidiarity, Transparency		Flexibility
Framework rules	Emissions allocation rules		

Segregated COC model

As illustrated in Figure 6, the Segregated COC model is similar to the Identity preserved model, though slightly less restrictive. Where Identity preserved does not allow any mixing, Segregated allows mixing of input streams at the same process site, provided they have essentially the same embedded emissions characteristics. Unlike the Identity preserved model, the Segregated model would allow use of scrap from different sources at the one site. Nonetheless, efficient mixing of other input streams (such as iron ores) may be discouraged.[23] Overall, our assessment of the Segregated model is the same as that of the Identity preserved as summarised in Table 8.

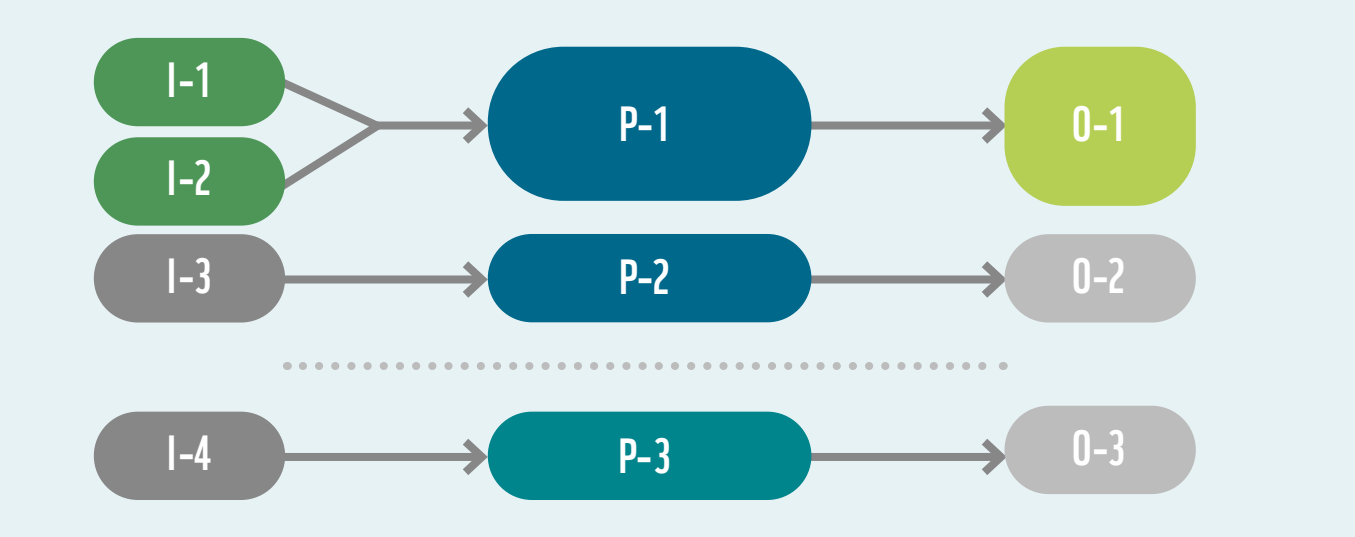


Figure 6: Schematic of Segregated COC model, adapted from Holzapfel et al. (2025).

23 Technically the use of electricity from a mixed grid would also be problematic under the Segregated or Identity preserved models.

Controlled blending COC model

The Controlled blending model allows mixing of inputs with different characteristics at the same facility (see Figure 7). As such, it does not place the same limitations on iron and steelmaking processes as the previous two models: ores from different sources may be combined in ironmaking processes; scrap and iron may be combined in steelmaking processes. The resultant product will then have embedded emissions that include a weighted average of the embedded emissions of the input streams. Importantly though, embedded emissions cannot be shared across processes that are not physically linked (either at the same or separate sites).

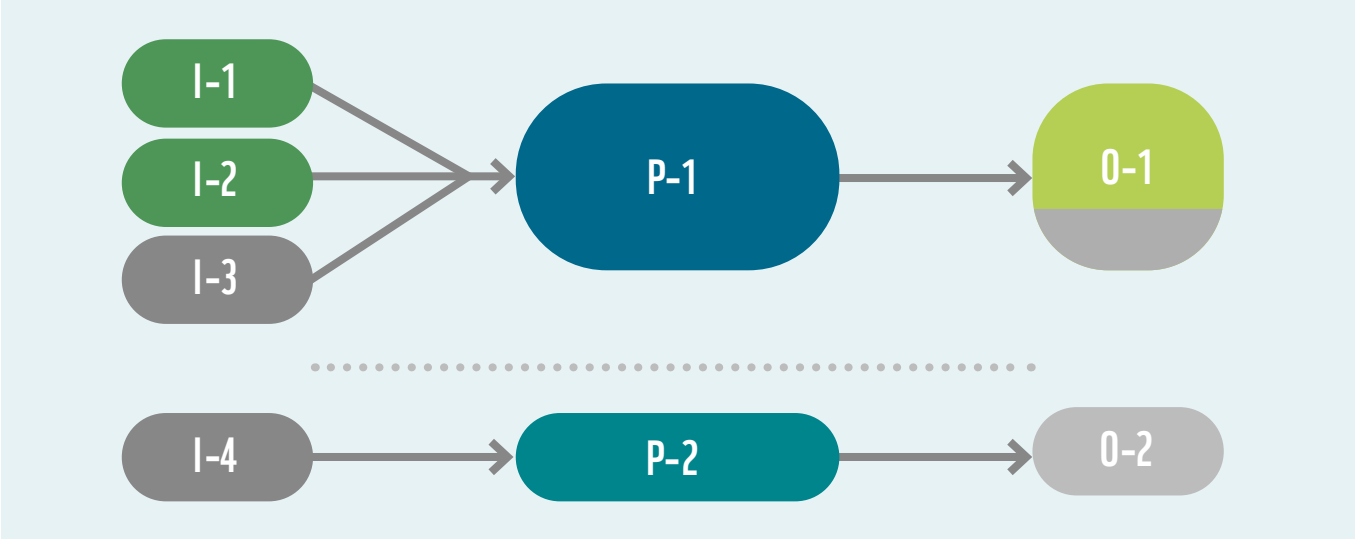


Figure 7: Schematic of Controlled blending COC model, adapted from Holzapfel et al. (2025).

The input mixing allowed by the Controlled blending model alleviates the restrictions of the previous two models, and therefore alleviates concerns about Efficiency, Least-restrictive means and Non-discrimination. In Table 9, therefore, the Controlled blending model is assessed as highly consistent with most of the AB25 recommendations. For Effectiveness, Relevance, Transparency, Non-discrimination and Emissions allocation, this model is assessed as acceptably consistent with the recommendations.

Our assessments for Effectiveness and Relevance flow on from that for Transparency. These are no longer considered "highly consistent" with recommendations because information about input product characteristics is not fully preserved when blending is allowed. For example, the customer may know the final weighted average embedded emissions, but not know the extent to which this average resulted from the use of scrap versus green-hydrogen direct reduced iron. This distinction could be relevant information for some users. This loss of information could, however, be alleviated by requiring transparency around the proportion of different inputs used.

Regarding Non-discrimination, we note that allowing blending may advantage incumbent producers who have a variety of process streams at a single site. When blending inputs is allowed, incumbents can mix conventional with clean process streams - up to the point the resulting product is just below allowable emissions thresholds for certification. This gives them an advantage compared to new production plants using only clean processes and materials. Note that this is only an issue where the resultant products are certified (and hence threshold values are needed). Controlled blending does not confer any advantage to incumbents for EPDs because the declared emissions intensity will align with the true average emissions intensity of the input supply chains. Hence Controlled blending does not allow "emissions shifting" away from the supply chain.

Regarding emissions allocation rules, we note that separation of process accounting (as per the Identify preserved and Segregated models) is preferable to any allocation rule. However, where that separation is too costly, allocation proportional to mass (as per the Controlled blending model) is acceptable (Aisbett and Burkitbayeva 2025).

Table 9: Assessment of Controlled blending COC model against the AB25 recommendations

Design level	Consistency of COC model with design recommendations		
	High	Acceptable	Low
General objectives	Efficiency	Effectiveness	
Overarching principles	Least-restrictive means	Relevance, Non-discrimination	
Supporting principles	Accuracy, Comparability, Conservativeness, Flexibility, Interoperability, Monotonicity, Subsidiarity	Transparency	
Framework rules		Emissions allocation rules	

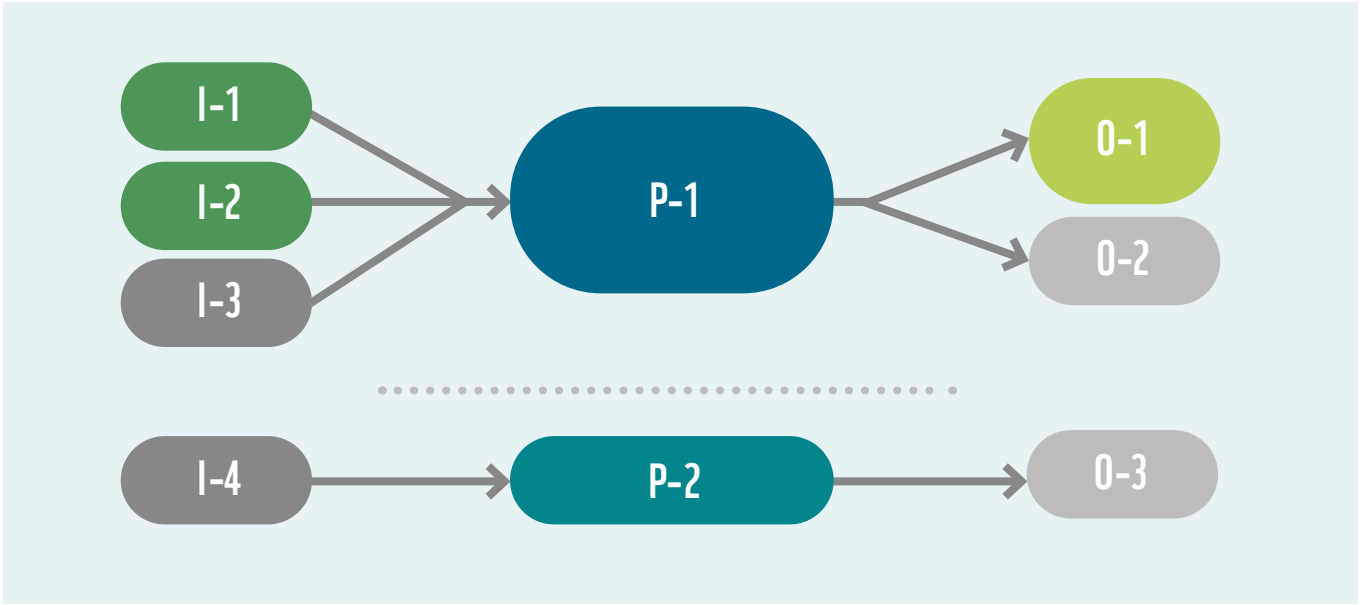
Process (site 1)
Process (site 2)
Clean input
Clean output
Conventional input
Conventional output
Physical flow
Physical site boundary

Mass balance COC model

According to the ISO definition, the Mass balance model is similar to the Controlled blending model in that it only allows allocation of embedded emissions across outputs whose supply chains are physically connected. Note that this is different to the interpretation of Holzapfel et al. (2025) and also different to the way the World Steel Association uses the term "mass balance" COC.[24] In the interest of promoting transparency and consistency, this report follows the ISO definition.

Mass balance COC differs from Controlled blending in that the allocation of emissions to different outputs is flexible. Where Controlled blending requires the same weighted average embedded emissions be applied to all outputs, Mass balance simply requires that some consistent formula be used for the allocation. In Figure 8, we illustrate a mass balance model where all the emissions are allocated to one output (O-2).

Figure 8: Schematic of Mass balance COC model. Note Mass balance allows for a range of different allocation approaches between outputs O-1 and O-2. This figure illustrates the extreme example where all emissions are allocated to O-2.



24 "In the context of the steel industry, the GHG chain of custody approaches outlined in these guidelines cannot strictly follow ISO 22095:2020" (World Steel Association 2024 p.4)

The flexibility of emissions allocation allowed by Mass balance COC models causes serious concerns for consistency with the AB25 design recommendations. Effectiveness, Relevance, Comparability, and Transparency are compromised because products whose supply chains are emissions intensive can be passed off as low-embedded-emissions products. In other words, the system is no longer effectively serving its objective of helping actors make decisions based on the emissions associated with a product's supply chain. Interoperability is compromised because the loss of information about actual embedded emissions in products means that useful information cannot be passed on to other embedded emissions accounting and verification frameworks. Similarly, Flexibility is compromised because the approach is less likely to be acceptable to some uses. For example, it does not provide the information desired by first movers who seek to buy steel from genuinely near-zero emissions processes.

Non-discrimination is compromised under the Mass balance model because incumbents can game the model and use it to produce "clean" product at much lower cost than novel, genuinely low-emissions processes. Unlike for the Controlled blending model, this issue applies to EPDs as well as certification because the declared emissions intensity does not necessarily align with the true average emissions intensity of the input supply chains. Hence Mass balance COC allows "emissions shifting" away from the product to which the EPD applies. Even more concerning, the Mass balance model compromises consistency with the Monotonicity principle. Monotonicity is compromised because increasing overall production (and hence overall emissions) provides greater opportunity to shift emissions away from a given amount of "clean" product. Finally, arbitrary allocation of emissions across products is not consistent with accepted norms for embedded emissions accounting or life-cycle analysis.

Table 10: Assessment of Mass balance COC model against the AB25 recommendations

Design level	Consistency of COC model with design recommendations		
	High	Acceptable	Low
General objectives	Efficiency		Effectiveness
Overarching principles	Least-restrictive means		Non-discrimination, Relevance
Supporting principles	Accuracy, Conservativeness, Subsidiarity		Comparability, Flexibility, Interoperability, Monotonicity, Transparency
Framework rules			Emissions allocation rules

Book and claim COC model

The Book and claim model allows allocation of emissions to products whose supply chains are not physically connected. In Figure 9 we illustrate the use of Book and claim to transfer all the emissions that would otherwise have been associated with output O-3 to output O-1. Hence, the fully conventional output O-3 appears to be a fully "clean" output.

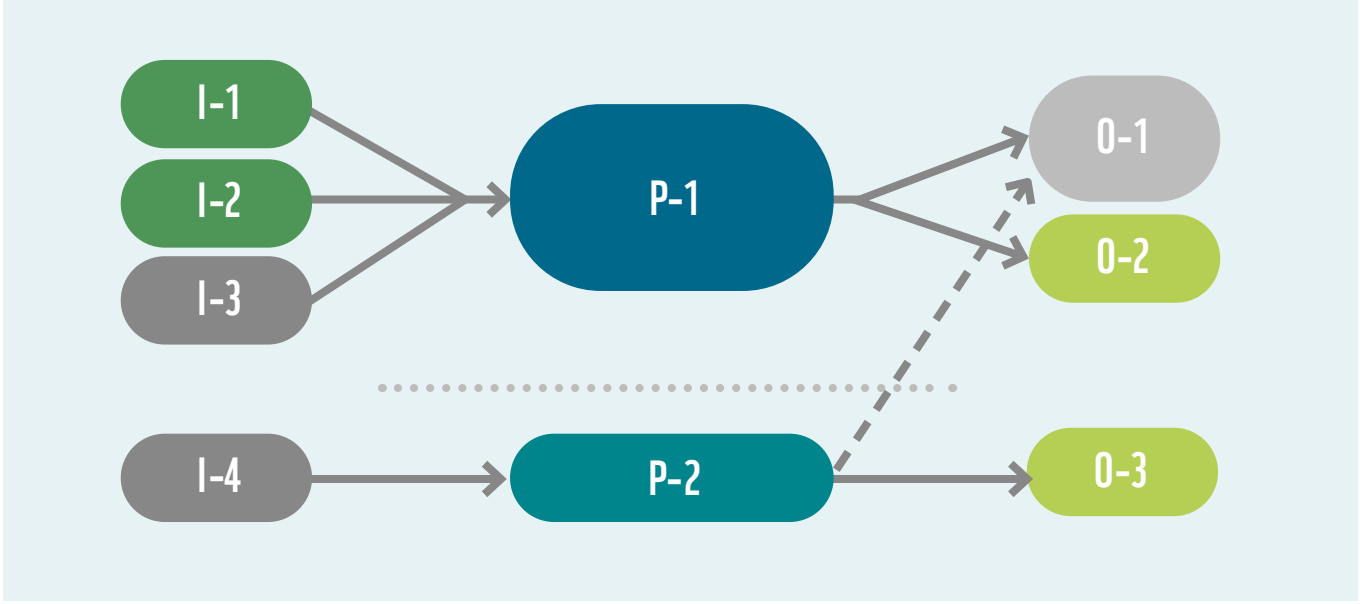


Figure 9: Schematic of the Book and claim COC model being used to transfer all emissions from output O-3 to output O-1 at a separate site.

As summarised in Table 11, consistency of the Book and claim model with the AB25 recommendations is generally low. Book and claim has all the issues discussed for the Mass balance model. Indeed, these concerns are stronger for Book and claim. For example, with regard to Non-discrimination, the physical separation of emissions flows and supply chains allows producers with multiple production sites to take advantage of differences in explicit or implicit emissions prices across jurisdictions.[25] Additionally, Book and claim involves complicated accounting that impacts alignment with Efficiency and Least-restrictive means principles. Separation of physical and virtual emissions flows under Book and claim also compromises consistency with the Subsidiarity principle.

Table 11: Assessment of Book and claim COC model against the AB25 recommendations

Design level	Consistency of COC model with design recommendations		
	High	Acceptable	Low
General objectives		Efficiency	Effectiveness
Overarching principles		Least-restrictive means	Non-discrimination, Relevance
Supporting principles	Accuracy, Conservativeness	Subsidiarity	Comparability, Flexibility, Interoperability, Monotonicity, Transparency
Framework rules			Emissions allocation rules

25 World Steel Association (2024) explicitly says that pooling emissions reductions from across a company's steel supply chains "allowing steel companies to meet rising customer demand for low-carbon products today by pooling their incremental GHG reductions from defined projects for specific customers".

Integration of GHG Reduction Certificates

The World Steel Association proposes that pooled GHG Reduction Certificates from within an organisation be allowed to be used in Book and claim and "Mass balance" models. In other words, the World Steel Association is proposing allowing organisation-level insets (Book and claim) or within organisation supply-chain-level insets (Mass balance) to be used to reduce the apparent embedded emissions of steel products.

Their COC Guidelines state (World Steel Association 2024, p.8) that to use GHG Reduction certificates for product-related attributes:

"An organisation must have one or more steel production facilities and can also include other processes in the steel value chain such as rolling and coating and upstream operations (e.g. mining) owned by the organisation. In addition, projects at subsidiaries / affiliates, etc., where the organisation has sufficient control over the management of those companies (e.g. joint ventures), may be included ensuring no double counting."

Concerns raised above regarding the standard Book and claim and Mass balance models are amplified in this case of allowing reduction certificates. For example, the Non-discrimination principle is further compromised by the fact that incumbents with the highest historical embedded emissions (as well as the largest portfolio of operations) have the greatest potential to generate reduced emissions credits. Effectiveness and Relevance are also further compromised because reduced and avoided emissions are emissions credits, calculated relative to a baseline. As such, they are a different concept to embedded emissions, which are absolute (a type of "inventory accounting" in the language of the GHG Protocol) (Junger 2023). Another way of saying this is that allowing reduced emissions certificates conflates project-based and product-based emissions accounting. This conflation also renders the resulting number an inaccurate measure of actual embedded emissions – compromising the Accuracy principle. Finally, establishing baseline emissions is notoriously complicated and contested, further compromising Efficiency and Least-restrictive means principles. This assessment of Book and claim with avoided and reduced emissions is summarised in Table 12.

IT IS IMPORTANT TO NOTE THAT THE "MASS BALANCE" CURRENTLY BEING CONSIDERED BY WORLDSTEEL WOULD BE DESCRIBED USING ISO TERMINOLOGY AS BOOK AND CLAIM WITH REDUCED AND AVOIDED EMISSIONS.

Table 12: Assessment of Book and claim COC model against the AB25 recommendations when avoided and reduced emissions can be allocated.

Design level	Consistency of COC model with design recommendations		
	High	Acceptable	Low
General objectives		Efficiency	Effectiveness
Overarching principles		Least-restrictive means	Non-discrimination, Relevance
Supporting principles	Conservativeness	Subsidiarity	Accuracy, Comparability, Flexibility, Interoperability, Monotonicity, Transparency
Framework rules			Emissions allocation rules

Table 13 provides clear summarising comparison of different Chain-of-Custody (COC) models with their consistency against the AB25 recommendations and design: Green legend shows high consistency, yellow shows acceptable, and red displays low consistency.

Table 13: Heatmap of COC models against AB25 pyramid recommendations

COC Models						
AB25 principles		**Identity preserved**	**Segregated**	**Controlled blending**	**Mass balance**	**Book and claim**
Governance	Efficiency					
	Effectiveness					
Overarching	Least-restrictive means					
	Non-discrimination					
	Relevance					
Supporting	Accuracy					
	Comparability					
	Conservativeness					
	Flexibility					
	Interoperability					
	Monotonicity					
	Subsidiarity					
	Transparency					
	Emission allocation rules					

7. RECOMMENDATIONS

Though substantial effort is being invested in regime coordination, Australian leadership could make important contributions by:

R1: FOCUS ON METHODS AND DECLARATION RATHER THAN STANDARDS AND CERTIFICATION

Much of the focus of early regime coordination efforts has been on standards and definitions. Section 3 provides an overview of these efforts. The focus of efforts to date reflects the policy ambition of international market-creation for green iron & steel. Agreement between countries on what constitutes "near-zero emissions" steel is necessary for initiatives such as First Movers Coalition, IDDI, Breakthrough and the Climate Club to obtain and track pledges for procurement and offtake agreements as well as First Of A Kind (FOAK) green steel plants that need to obtain investment and offtake agreements. The timing of the IEA reports on Achieving Net-zero Heavy Industry Sectors in G7 Members (IEA 2022) – which focused on thresholds – and Emissions Measurement and Data Collection for a Net-zero Steel Industry (IEA 2023) and Definitions of Near-Zero and Low Emissions Steel and Cement (IEA 2024) is illustrative. It shows that the importance of aligning measurement and methods was realised after initial efforts related to standards and definitions. Yet collaboration on measurement and methods is crucial.

The devil really can live in the details of embedded emissions methodologies. Numerous studies have documented the differences in emissions estimates that arise through differences in measurement and accounting methods (e.g. accounting boundary definitions). Importantly, these differences in methodologies are difficult for non-experts to identify and understand. Thresholds, in contrast, are comparatively straightforward to understand and interpret. As a result, measurements and methods hold far more potential to enable greenwashing than thresholds.

Focusing on methods and reporting may reduce political-economy threats to the integrity of the regime. Some countries rightfully understand that ambitious emissions thresholds are a threat to their incumbent iron and steel industries.

The focus on standards and thresholds, therefore, poses two threats to regime legitimacy. Firstly, truly global agreement is more difficult for thresholds and standards. Countries whose industries will find transition relatively difficult are less likely to sign on to global agreements about ambitious standards. Yet lowering the ambition of the standards would compromise the regime's effectiveness as ambitious thresholds are essential for initiatives aimed at creating enabling conditions for genuinely low-emissions iron and steel production.

Secondly, ambitious standards that are difficult for incumbent industry to meet create pressure for greenwashing. For example, the World Steel Association justifies its move towards questionable "mass-balance" chain of custody approaches on the basis that there is more demand for near-zero steel than industry can currently meet (Worldsteel.Org, n.d.)

Thirdly, focusing first on standards and definitions is compromising the achievement of comparable and interoperable methods. In particular, the IEA's proposed definitions of "Near-zero" and "Low Emissions" steel differ not only in regard to thresholds, but also allowable methodologies. According to their proposed principles for each definition, emissions accounting for Near-zero steel must be "Physical" – meaning "offsetting emissions from outside the supply chain or aggregation of emissions reductions credits/certificates across multiple units of production and/or supply chains is not permitted" (IEA 2022; 2024b). In contrast, the corresponding principle for Low Emissions steel is "Clear communication on chain of custody" – which allows the use of "alternative chain of custody models (for example, aggregation of emissions reductions certificates)" provided "robust rules [are] followed and the methods used [are] clearly and explicitly communicated on any labelling or certification" (IEA 2022; 2024b). These dramatically different approaches to allowable chain of custody and emissions allocation mean that the emissions accounting methods for Near-zero and Low Emissions steel will not be comparable or interoperable.

R2: EMPLOY A STRUCTURED TOP-DOWN APPROACH TO REGIME COORDINATION

There is evidence of a top-down approach being applied by the leading regime coordination efforts identified in Section 3. For example, all these efforts involve identification of principles. Work by IDDI (2023) also illustrates a top-down approach through the application of principles to help resolve ongoing debates about design choices related to framework structure and rules. Similarly, the IEA uses principles as metrics against which to compare leading emissions measurement methodologies against their "net-zero emissions measurement principles" and three corresponding data collection frameworks against their "net-zero data collection principles". The IEA also highlights the successes of regime coordination efforts, arguing that there is increasing convergence around its proposed principles (IEA 2024b). Nonetheless there is room for a more structured approach to facilitate more efficient, effective and legitimate regime coordination.

Examination of statements of principle suggests there is room to enhance regime coordination through a structured approach. Our analysis of the regime coordination efforts identified in Section 3 found that:

1. Clear statements of the objective of the regime are often missing, or are only implicitly stated as part of a "principle".
2. Statements of principle are not always sufficiently clear regarding which components of the regime they should apply to.
3. Principles are sometimes stated without accompanying definitions.
4. Principles such as "interoperability" and "transparency" are often used in websites and publications as if they are self-evident while not being included in explicit lists of principles.
5. Many different and potentially conflicting principles have been proposed.
6. Statements of principle are often mixed with statements that would better be described as guidance for specific aspects of Framework Structure or Rules.

A structured top-down approach such as AB25 (Aisbett and Burkitbayeva 2025) design pyramid could help clarify these conceptual issues, enhance communication, and facilitate negotiation among stakeholders.

A clear and structured approach to coordination could also facilitate broader participation and enhance regime legitimacy. The current international GISV regime is documented to be complex (IDDI 2023; IEA 2023; Aslam and Aisbett 2024a; 2024b). The current report finds that efforts to coordinate the regime are also increasingly complex and difficult to understand and navigate. These layers of complexity stifle participation and provide advantage to powerful actors – especially incumbent iron and steel makers. In the interests of a fair and efficient transition, it is essential that we facilitate meaningful participation by a range of countries that have potential comparative advantage in genuinely green iron & steel production. A structured approach such as AB25 can help facilitate this broader participation in, and increased legitimacy of, regime coordination efforts.

IT IS ESSENTIAL THAT WE FACILITATE MEANINGFUL PARTICIPATION BY A RANGE OF COUNTRIES

WITHOUT COMPARABILITY CONSUMERS WILL STRUGGLE TO MAKE INFORMED DECISIONS

R3: ENGAGE INTERNATIONALLY FOR A HIGH-PERFORMANCE REGIME

An efficient and effective international regime for GISV is acknowledged as an essential component of efforts to dramatically reduce emissions from the sector. Even worse than the absence of an international regime for GISV would be a poorly performing one. An inefficient and ineffective regime could slow decarbonisation efforts by helping to further entrench incumbent, high-emissions production. Although the climate impacts of this failure would be broadly felt, the negative economic impacts will be concentrated on countries such as Australia which have potential comparative advantage in genuine near-zero emissions iron and steel supply chains.

Australia's engagement for a high-performance regime should take a two-pronged approach. Firstly, it should support existing ambitious efforts such as IDDI and the Climate Club and help to prevent back-sliding or watering down of ambition – including through preventing introduction of loopholes that help high-emitting incumbents. Secondly, Australia should seek to create a coalition of countries which have a combination of mineral and renewable energy resources that could enable them to be competitive producers of near-zero emissions iron. This coalition could work together to push for a high-performance international regime for GISV. Engagement by this coalition would help broaden participation in regime coordination and enhance the regime's legitimacy. Participation by this coalition could be facilitated by adopting a structured approach to coordination as per recommendation R2.

R4: ENCOURAGE CONSISTENCY WITH EMISSIONS VERIFICATION FOR OTHER PRODUCTS

The international regime for verification of embedded emissions in iron and steel is highly advanced compared to that for most other products. Only concrete and cement, and possibly alumina and aluminum have received similar attention. Iron & steel and cement have been particularly singled out for their combination of high emissions and substantial government procurement – providing a motivation for emissions reduction and a powerful policy lever. Already the interdependencies between emissions accounting in iron & steel and cement have been acknowledged. IDDI (2024) have noted that the use of slag from ironmaking as an input to cement manufacture forces a need for consistency in the approaches for these two sectors. Otherwise, we risk the creation of loopholes where each sector passes the emissions to the other, and neither takes responsibility for the embedded emissions. The interdependency between steel and concrete supply chains is a specific case of a broader issue.

Supply chains of different products are highly interdependent, as products, co-products or even waste from one product become feedstock and inputs for another. This interdependency is only becoming greater with the push towards more circular and zero-waste production. Similarly, the number of products for which embedded emissions accounting and verification is becoming necessary is also growing. An idiosyncratic approach to GISV will ultimately violate the principles of Interoperability and Flexibility. Approaches to GISV need to consider applicability to - and interoperability with - verification for other products.

Consistence between the approach for iron & steel and that of other products is also important to achieve comparability. Without comparability, consumers will struggle to make informed decisions about the choices between steel products and substitutes such as wood or plastic. Similarly, without comparability, policies such as carbon border adjustments may provide unfair trade advantage to some products over others.

Last but not least, aiming for consistency and comparability in embedded emission accounting across products and sectors helps to reduce the influence of any one industry lobby on the regime.

R5: ENCOURAGE INTERNATIONAL COORDINATION ACROSS POLICY DOMAINS

GISV is important to several different policy domains. Government procurement is the domain that has received the most attention to date – primarily through the IDDI. As a specific, positive, market-creating initiative, the IDDI has been able to garner substantial collaborative will from partner governments. Other policy domains, however, may be at least as important to drive the transition to near-zero emissions iron & steel. Sustainable investment taxonomies, for example, can help steer investment. Green innovation and industrial subsidies can help overcome market failures that limit the development and deployment of new, clean production technologies. Carbon border adjustments help ameliorate leakage and competitiveness concerns, thereby reducing political economy barriers to ambitious emissions pricing. All these policy domains rely on embedded emissions accounting and verification, but none of them have seen the same investment in coordination effort as procurement.

International coordination across policy domains is essential if the GISV regime is to be Effective and Efficient. Without it, frictions in one or more domains will undermine the work done in another. It is essential that the goodwill towards coordination that has been developed for government procurement domain be leveraged to other domains. Otherwise, we risk the development of technical barriers to trade and investment, which could dramatically limit the scale and speed of the industry's net-zero transition. Although far more politically challenging, coordination on the approach to verification for carbon border adjustments should be a priority.

GREEN INNOVATION AND INDUSTRIAL SUBSIDIES CAN HELP OVERCOME MARKET FAILURES

R6: LEAD THE ESTABLISHMENT OF A REGIONALLY ALIGNED EMBEDDED EMISSIONS VERIFICATION FRAMEWORK

The Australian Government could lead efforts to establish a regionally aligned embedded emissions verification framework to support the development of a credible and trade-compatible CBAM across the Asia-Pacific. This collaboration could take place under the auspices of a range existing international institutions. A first step would be to consult with other countries in the region to identify which is best placed to encourage participation, legitimacy and integrity of outcomes.

Embedded emissions accounting is essential to the credibility and effectiveness of a Carbon Border Adjustment Mechanism (CBAM). It enables fair comparisons of carbon intensity across imports, supporting a level playing field for Australian producers. However, inconsistent methods and weak verification can undermine CBAMs, creating trade risks and opportunities for greenwashing. A regional CBAM would require harmonised standards and trusted verification frameworks to ensure comparability and reduce reporting burdens. Without robust embedded emissions data, CBAMs risk being ineffective or contested.

R7: CHAIN OF CUSTODY (COC) MODELS USED IN THE VERIFICATION OF GREEN IRON & STEEL SHOULD ENSURE CONSISTENCY WITH THE ACTUAL EMISSIONS ASSOCIATED WITH THE PHYSICAL PRODUCT SUPPLY CHAIN AND TO PREVENT OPPORTUNISTIC ALLOCATION OF EMISSIONS ACROSS PRODUCTS.

Specifically, inventory and credit-based accounting should not be mixed, and Controlled blending is preferred to Mass balance or Book and claim chain of custody models.

Our analysis of the different COC models, summarised in Table 13, highlights the inconsistency of Mass balance and Book and claim models with important principles such as Comparability, Flexibility, Interoperability, Monotonicity, and Transparency. These inconsistencies mean that these models seriously undermine the Effectiveness of GISV in achieving the objective of enabling decision-making based on emissions associated with a product's physical supply chain (i.e. product embedded emissions). These concerns for the Mass balance and Book and claim models are further exacerbated by any approach that seeks to include credit-based accounting in product embedded emissions accounting.

Our analysis also suggests that – for full cradle-to-gate emissions accounting – the Controlled blending COC model offers a good compromise between sometimes conflicting objectives and principles. In particular, it does not cause challenges for principles of Non-discrimination and Least restrictive means (and ultimately the objective of Efficiency) in the same way that Identity preserved and Segregated models do when applied to complex, possibly international, cradle-to-gate supply chains.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8. CONCLUSION

The transition to near-zero emissions iron and steel is both a climate imperative and an economic opportunity. An effective and efficient international verification regime for green iron & steel is essential to underpin regulatory and market incentives and drive investment. While significant progress has been made, the regime remains fragmented and at risk of capture by incumbent interests.

This report argues for a shift in focus for regime coordination efforts: from headline standards and thresholds to the foundational elements of measurement and reporting. It calls for a structured, top-down approach, greater emphasis on consistency across policy domains and sectors, and proactive engagement by countries with a comparative advantage in green iron & steel. Australia, through its COP31 leadership, is well-placed to champion these efforts.

The stakes are high: a poorly designed regime could entrench high-emissions production, while a high-performance regime could accelerate global decarbonisation and create new economic opportunities. The time to act is now.

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