Standards for a net zero iron and steel sector in India

Policy brief

International Energy Agency

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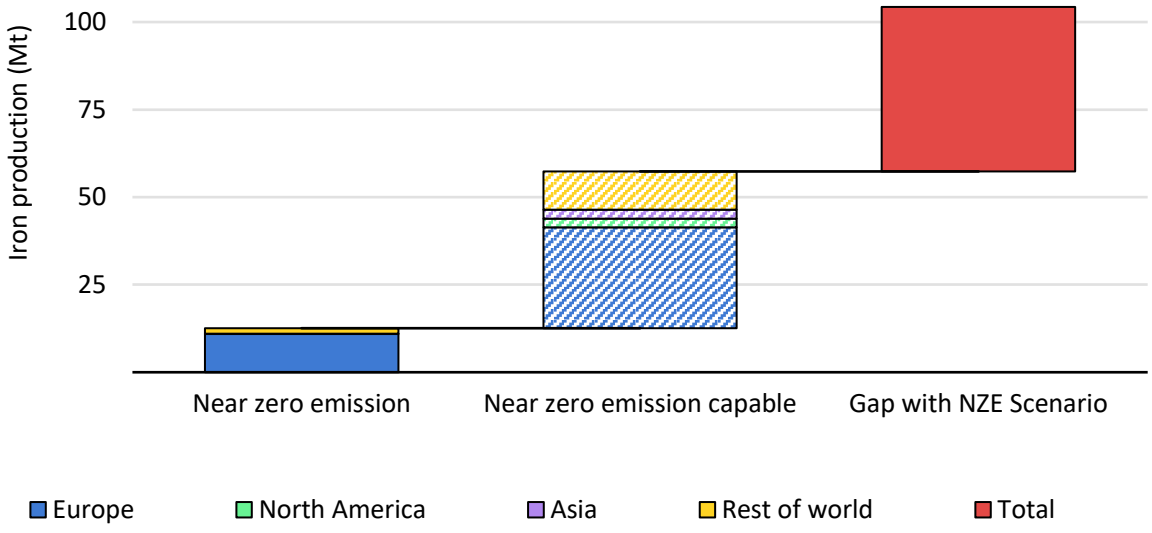
Introduction

India is industrialising rapidly, as its continued development and rising population drive up demand for infrastructure for vital services, housing for urban centres and goods for a modern economy. Steel is at the centre of this development, with demand for steel in India set to triple by 2050 under our Stated Policies Scenario (STEPS). As of 2018, India became the world's second largest producer of steel, with only the People's Republic of China (hereafter "China") producing more. As demand for steel in China peaks, India will be at the forefront of new growth in the sector, bringing huge benefits but also significant challenges.

Foremost among those challenges are the emissions resulting from iron and steel production. The iron and steel sector represents around 7% of global energy-related CO_2 emissions, and emissions intensity has remained relatively flat over the past few decades. Whilst there are nascent signs of a transformation to low and near zero emissions production, the pipeline of announced projects is still far too low compared to what is required under the IEA's Net Zero Emissions by 2050 Scenario (NZE Scenario). As of 2023, announced projects meet just 12% of 2030 near zero emissions iron production needs (see Figure 1). Many more near zero emissions capable plants have been announced, although these need much clearer plans for deep decarbonisation.

Figure 1 Global announced projects versus near zero emission iron production needs in the Net Zero Emissions by 2050 Scenario, 2030



Notes: Near zero emission = projects that, once operational, are near zero emission from the start, according to the definitions in IEA (2022) Achieving Net Zero Heavy Industry Sectors in G7 Members. Near zero emission capable = projects that achieve substantial emissions reductions from the start – but fall short of near zero emissions initially – with plans to continue reducing emissions over time such that they could later achieve near zero emission production without additional capital investment. Production from announced projects shown in the figure excludes near zero emission steel from scrap.

Reducing emissions from iron and steel production is challenging, primarily due to (i) a lack of commercially available technologies for near zero emission production of materials; (ii) the high cost of near zero emission production routes compared to conventional processes; (iii) many of the materials produced by heavy industries are highly traded and pricing is competitive; and (iv) heavy industry facilities are long-lived and capital-intensive, potentially locking in emissions.

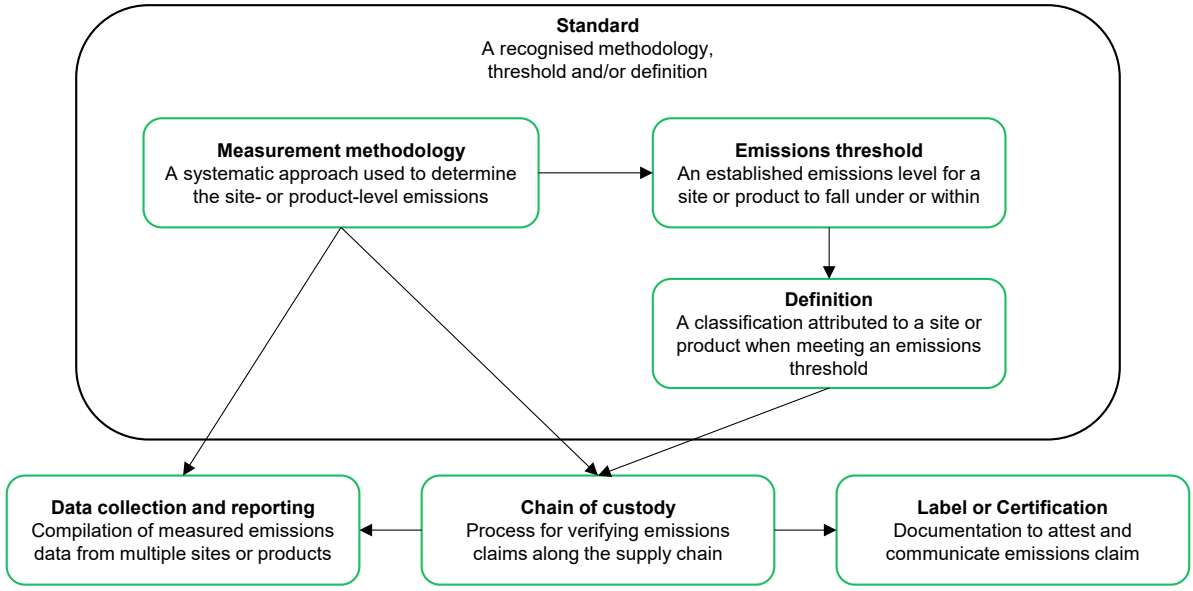
There are many levers which governments, business and civil society can work together on to help accelerate the iron and steel sector's path to net zero emissions. These include setting clear timelines for emissions reduction, using emissions measurement methodologies and definitions, creating early markets for low-emissions materials and products, developing novel emissions reduction technologies, adopting supply-side policies to support commercial-scale low-emissions production and limit the growth of high-emissions production, mobilising finance and investment, accelerating material efficiency and circularity, and implementing measures to ensure a just and inclusive transition for workers and communities.

In this policy brief, we focus on standards for low and near zero emissions steel, including an overview of emissions measurement methodologies and of definitions or emissions thresholds.

It is important to note that standards are just one part of a wider policy toolkit and that they should be focused on areas that align with their intended uses. They cannot be a tool to address all the challenges associated with transforming the steel sector, but rather can be vital in helping to unlock other associated policies, such as procurement, access to finance, carbon pricing and emissions trading systems.

We define a standard in this context as including both a formalised and shared methodology, as well as a threshold or definition for what constitutes low and near zero emissions steel (see Figure 2). The emissions measurement methodology is a systematic approach used to determine the emissions of production or a specific product. An emissions threshold is defined as an emissions level for production or a product to fall under or within, and a definition within a standard is a classification that is attributed to intermediate or final products when meeting an emissions threshold.

Figure 2 Terminology related to emissions measurement, data and definitions



Note: Arrows indicate flow of information between the different processes.

The IEA has focused increasingly on standards in recent years, as increased international collaboration in this area can have several major benefits. Notably, many materials and products – including those in the iron and steel sector – are sold in international markets. Each country establishing their own system in isolation could lead to confusion, whereas the interoperability of standards and approaches could minimise trade barriers. Industrial producers and consumers along the supply chain would also benefit from a simplified process, increasing the acceptance of emissions-related measures. For policy makers, working together and sharing experience can help minimise the duplication of efforts, in turn accelerating policy development and learning. International collaboration on this issue can also help improve verification, with a common understanding on the approach being agreed among multiple actors.

Emissions measurement methodologies

International status

Whilst there are many organisations who have developed emissions measurement methodologies for steel (at both at the site- and product-level), there are relatively few of these methodologies that have strong global coverage and are in wide use today. The table below provides an overview of key emissions measurement methodologies that are specific to the steel sector. There are many other generic emissions measurement methodologies, which can be applied to different products, but they are not covered here.

Table1 Summary of emissions measurement methodologies for the steel sector

Measurement standard	Current status and frequency of review	Focus of the standard	Verification and accreditation
worldsteel CO_2 methodology	Latest guidance published in 2023, regular review is possible.	Production (all routes)	NA
worldsteel LCI methodology	Latest guidance published in 2017, regular review is possible.	Product (covering 17 finished products)	NA
ISO 14404 series	Part 1 and 2 under review from 2023, part 3 under review from 2022, part 4 under review from 2025. Systematic review every 5 years.	Production (all routes, specific standards for BOF, scrap EAF, DRI)	NA
ISO 20915: 2018	Under review from 2023. Systematic review every 5 years.	Product (exact products not specified)	NA
ResponsibleSteel	V2.0 published in 2022; V2.1 published in Q4 2023 following a test phase. Standard revision at least every 5 years; next version due Dec 2024.	Production (all routes) and products	Independent verification
WRI GHG Protocol Corporate Standard	Last published in 2008, no plans for update.	Production BOF, scrap EAF, DRI	Independent verification

Measurement standard	Current status and frequency of review	Focus of the standard	Verification and accreditation
Emissions trading systems, e.g. EU ETS	Last update published in 2018.	Production (all routes)	Independent verification
Science Based Targets initiative	Under consultation.	Production (all routes)	Under development
Sustainable STEEL Principles	Launched in 2022.	Production (all routes)	Under development
CBI Steel Criteria	Launched in 2022.	Production (all routes)	Standard body

Notes: LCI = Life Cycle Inventory; BOF = basic oxygen furnace; EAF = electric arc furnace; DRI = direct reduced iron; WRI = World Resources Institute; EU ETS = European Union Emissions Trading System; CBI = Climate Bonds Initiative.
Source: IEA (2023), Emissions Measurement and Data Collection for a Net Zero Steel Industry.

Two of the most widely used are those from worldsteel (both the LCI and CO_2 methodologies) and from the International Organization for Standardization (ISO) (including several different standards). For example, worldsteel's current data collection process (2022) includes data from more than 220 sites. These represent approximately 485 Mt of steel production, or 25% of global production. The potential coverage of such a data collection programme, assuming all worldsteel members submitted data, would total around 1 600 Mt of steel production.

The ISO 14404 series, which covers emissions from steel production by process route, includes 27 participating members and 40 observing members, with members in this case being represented national standards bodies. ISO 14404 has been adopted as a national standard or is available for purchase under the national standard body of 18 of the 67 members (in addition to the European Committee for Standardisation [CEN]). Use by companies varies significantly by country. Should all members of ISO Technical Committee (TC) 17 adopt ISO 14404, this would cover around 1 750 Mt of steel production, or close to 90% of global steel production.

To help coordinate these various international efforts, at COP26 in 2021 the UK launched the Steel Breakthrough, under the Breakthrough Agenda[1]. This process is now co-led by the UK and Germany, including India and a total of 33 countries endorsing the programme of work. Standards and definitions are a priority action

[1] The Breakthrough Agenda represents a commitment to work together internationally this decade to accelerate the development and deployment of the clean technologies and sustainable solutions needed to meet our Paris Agreement goals, ensuring they are affordable and accessible for all.

area under the Steel Breakthrough, with a focus on emissions measurement methodologies in the near-term.

In line with the Steel Breakthrough efforts, a group of organisations launched the Steel Standard Principles at COP 28 last year. The statement sets out agreed principles for the ongoing harmonisation and development of low/near-zero emissions steel definitions and measurement methodologies. More than 35 key steel producers, industry associations, standard setting bodies, international organizations and initiatives have endorsed these principles.

Current status in India

India is at an important moment in the development of domestic approaches to emissions measurement for the iron and steel sector, with work being carried out by both public and private organisations.

This includes updating emissions measurement methodologies to support the launch of a domestic Carbon Credits Trading Scheme (CCTS) from 2026, which will include the iron and steel sector, alongside other industry sectors such as petrochemicals, chemicals and aluminium. This will be administered by the Bureau of Energy Efficiency (BEE), who in October 2023 issued a draft procedure for compliance under the future CCTS. This will build on the existing Perform, Achieve and Trade (PAT) Scheme, which enables the trade of energy saving credits and has been in place since 2011.

BEE is currently consulting on the different emissions measurement methodology approaches for the sectors that will be covered by the CCTS. This includes taking into account various factors, such as the administrative burden on companies, the quality of existing data, importance of data for overall emissions and consistency of approach across sectors.

In April 2023, the Ministry of Steel also formed 14 Task Forces to support the development of its “Roadmap for Green Steel”. This included a Task Force on emissions reporting, which brought together key experts from across Indian industry to understand the trade-offs between different approaches. The findings of this Task Force also fed into the work BEE is carrying out for the establishment of the CCTS.

In the private sector, many companies already gather detailed emissions data as part of worldsteel’s Climate Action Data Collection, which primarily includes the CO_2 methodology (covered above). This includes major Indian steel producers, such as Jindal Steel & Power, JSW Steel, Vizag Steel, Steel Authority of India (SAIL) and Tata Steel. This has provided a useful means for Indian companies to benchmark their own facilities against one another and indicate year-to-year progress on emissions reduction.

Net zero emissions measurement principles

To guide future work on emissions measurement methodologies for the iron and steel sector, the IEA has developed a series of "net zero measurement principles".[2]

A GHG emissions measurement methodology that is fit for purpose for a net zero steel industry must:

- Facilitate like-for-like comparison between production from all facilities, including innovative near zero emission routes, noting the production route, the quantities of scrap and iron used, and the types of steel produced.
- Produce coherent and interoperable results for both crude steel production and finished/semi-finished steel products (whether in separate or combined standards for each case).
- Have an emissions boundary and scope that covers – as a minimum – the following sources, whether on-site or off-site: energy-related and industrial process emissions (CO_2, methane [CH_4] and nitrous oxide [N_2O] GHG emissions[3]) from ironmaking, steelmaking, iron ore agglomeration, the production of reduction agents, the use of lime fluxes and electrodes, raw material supply, fossil fuel supply, low-emissions fuel and electricity supply. For steel products, the relevant semi-finishing/finishing processes and alloying elements should be included.
- Apply accounting rules for emissions credits and co-products that are compatible with a global pathway to net zero emissions for the energy system.
- Incentivise the use of site- and product-specific auditable measured data, as opposed to generic emissions estimates and other factors (for example through conservative default values).

It is important to note that principles and guidelines relating to other areas of the net zero transition, such as corporate financial reporting rules (e.g. General Sustainability-related Disclosures), corporate pledge guidelines (e.g. Net-Zero Emissions Commitments of Non-State Entities), guidelines for developing international standards for trade (e.g. the World Trade Organization [WTO] Technical Barriers to Trade [TBT] Six Principles) and broader standards guidelines (e.g. ISO Net Zero Guidelines), which are beyond the core scope of this report, should also be considered during the development of emissions measurement methodologies.

[2] IEA (2023), Emissions Measurement and Data Collection for a Net Zero Steel Industry.
[3] Other GHG emissions are likely to be small enough that they could be excluded to reduce the reporting burden.

Definitions for low and near zero emissions steel

International status

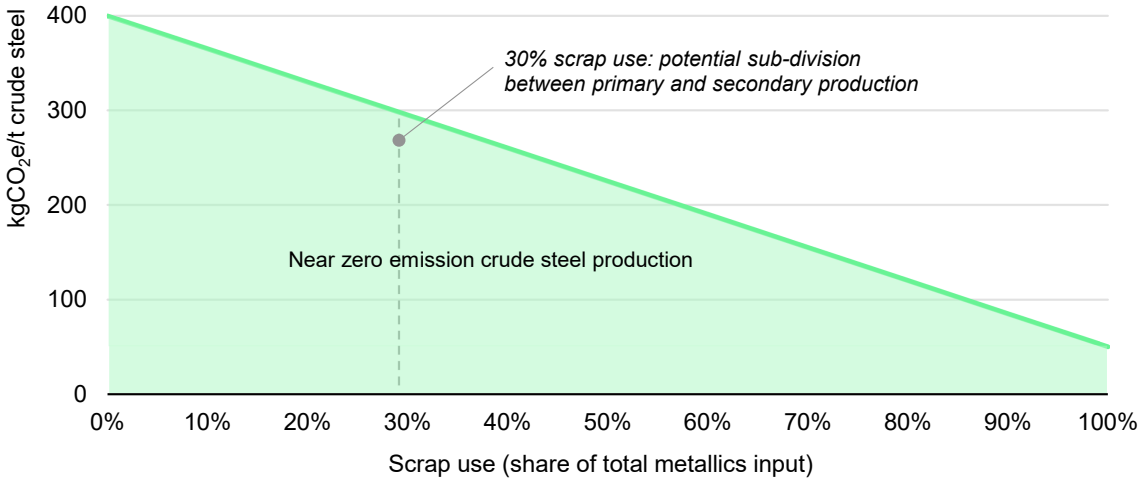
There has been a rapid increase in recent years in the number of proposals aimed at defining low and near zero emissions steel. These are largely private sector-led efforts, with some early instances of government involvement via consultation with industry at the national level.

In 2022, the IEA set out a proposal for definitions for low and near zero emissions steel in Achieving Net Zero Heavy Industry Sectors in G7 Members. The analytical basis for these quantitative thresholds is derived from the IEA's Net Zero by 2050 Roadmap.

Figure 3 summarises the near zero emission crude steel production threshold for the full spectrum of scrap use (zero to 100%). The threshold is stable, absolute and ambitious. It is stable because it is not dependent on a single scenario context that is subject to frequent revision, and it is compatible with the end goal of the Net Zero Emissions by 2050 Scenario. It is absolute because there are no varying degrees of near zero. Finally, it is ambitious: the intention is to send a clear signal of what needs to be achieved in the long term, in a sector where returns on investments occur over decades. A commercial-scale plant built in the coming few years that operates at or below this threshold will remain so in perpetuity, unless the threshold itself is revised.

The near zero emission threshold does not address the degrees of incremental progress that are made on the way to meeting it. For this purpose, we propose a separate evaluation for interim measures that result in meaningful emissions intensity reductions but fall short of the near zero emission threshold, through definitions for low emission steel production.

Figure 3 Near zero emission steel production threshold as a function of scrap use

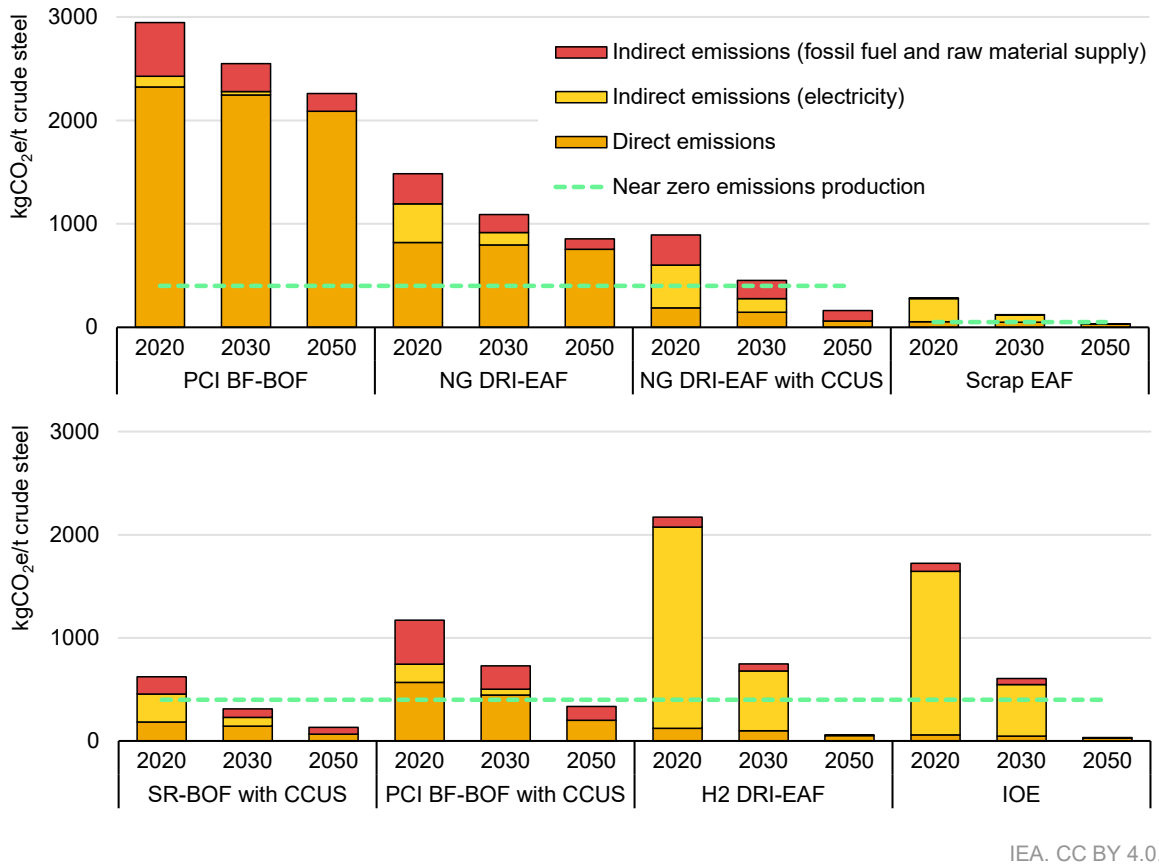


Notes: $kgCO_2e/t$ = kg of CO_2 equivalent per tonne. See the Technical Annex of Achieving Net Zero Heavy Industry Sectors in G7 Members for the specific function used to formulate the series on the graph.
Source: IEA (2022), Achieving Net Zero Heavy Industry Sectors in G7 Members.

Applying the near zero emission definition to a series of both conventional and innovative process routes, we can observe conventional production technologies – including production based on blast furnaces, coal-based direct reduced iron, and gas-based direct reduced iron – fall well short of achieving near zero emissions production (Figure 4). The exception being the scrap electric arc furnace route, for which the majority of indirect emissions stem from electricity generation. Note that production via coal-based direct reduced iron – which is not shown in the figure but is a prominent route in India – has roughly comparable emissions to production via the blast furnace-basic oxygen furnace with pulverised coal injection route.

For innovative production technologies, hydrogen and direct electrification achieve the lowest emissions intensities once the electricity sector is decarbonised. Carbon capture, utilisation and storage (CCUS)-equipped routes lead to immediate reductions in direct emissions, with the smelting reduction with basic oxygen furnace route reaching near zero emissions by 2030 under the NZE Scenario.

Figure 4 Global average direct and indirect emissions intensities of crude steel production via key production routes in the Net Zero Emissions by 2050 Scenario



Notes: PCI BF-BOF = blast furnace-basic oxygen furnace with pulverised coal injection; DRI-EAF = natural gas-based direct reduced iron-electric arc furnace; Scrap EAF = scrap-based electric arc furnace; SR-BOF = innovative smelting reduction-basic oxygen furnace; CCUS = carbon capture utilisation and storage; H2 = hydrogen-based; NG = natural gas-based; IOE = iron ore electrolysis. Best available technology (BAT) energy intensities used for all process units. All process routes use zero scrap, apart from the scrap EAF route, which uses 100% scrap. The near zero emission production thresholds are imposed on a direct + indirect emissions basis.

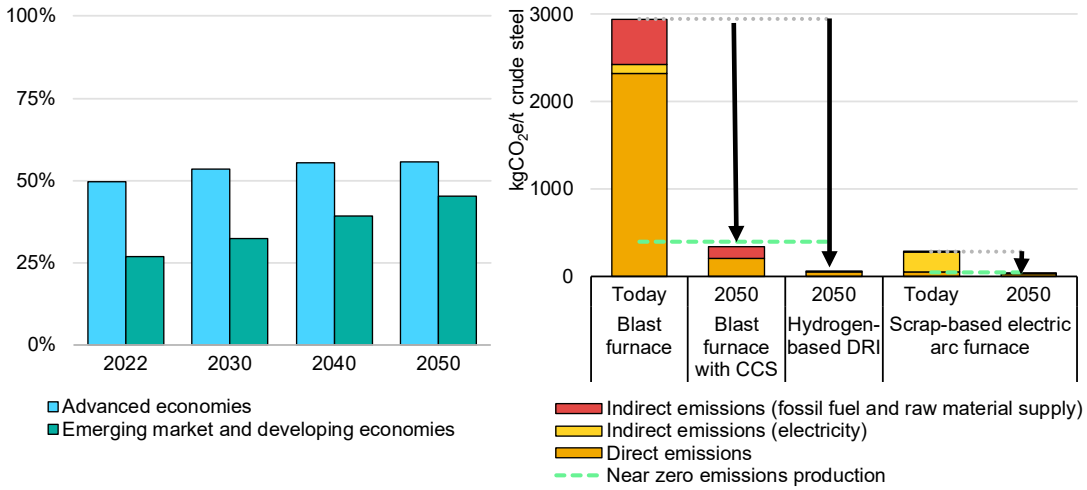
Source: IEA (2022), Achieving Net Zero Heavy Industry Sectors in G7 Members.

A key feature of the definition is a progressive threshold according to the scrap share of metallic inputs. Despite a strong push on material efficiency strategies resulting in increased scrap use and reducing total growth in steel demand, scrap only provides about half the metallic inputs to steel production globally in 2050 in the NZE Scenario (Figure 5). In other words, scrap-based production alone is not sufficient to achieve the emissions reductions needed for the steel sector in the NZE Scenario. A progressive near zero emission threshold based on the scrap share reflects limits on scrap availability and the difficulty of abating emissions from the iron production required.

Furthermore, this is an approach that takes equity into account. Emerging market and developing economies have a lower scrap share of metallic inputs on average, given that their stocks of steel in society are younger, and so there is

comparatively less end-of-life scrap becoming available for use. The higher near zero emissions threshold for iron-based production helps to avoid penalising countries that simply do not have as much scrap available due to their stage of development. Additionally, if a progressive threshold were not used, there would be a higher likelihood of causing unintentional distortions in scrap market prices, as producers seek to buy up scrap as a considerably easier way to achieve near zero emissions. This could disproportionately impact scrap-only producers.

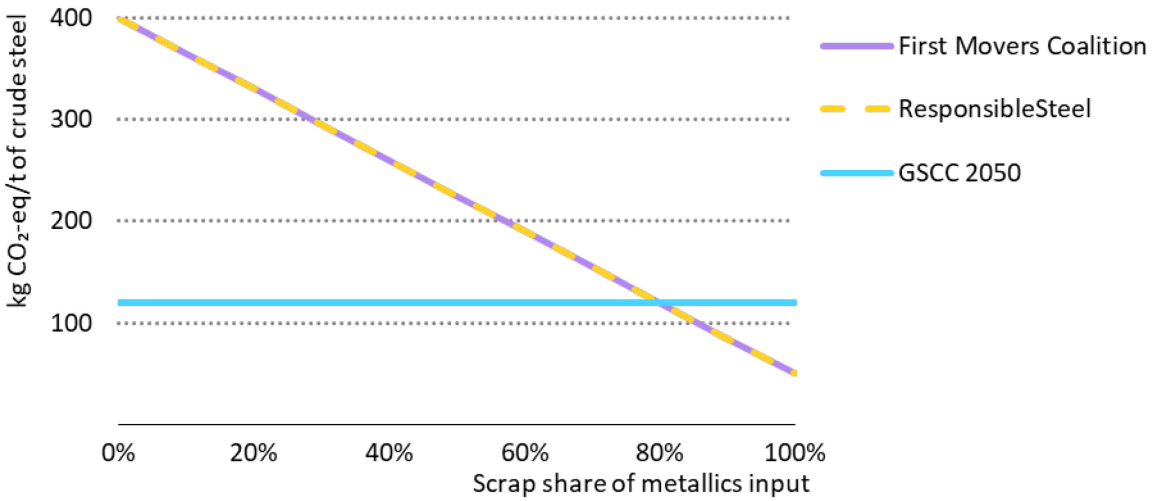
Figure 5 Steel scrap share of metallic inputs (left) and emissions intensities of crude steel production via key production routes (right) in the Net Zero Emissions by 2050 Scenario



Notes: Right hand side: BAT energy intensities used for all process units. All process routes use zero scrap, apart from the scrap EAF route, which uses 100% scrap. The near zero emission production thresholds are imposed on a direct + indirect emissions basis.

Since 2022, there has been notable progress towards some convergence on definitions, with subsequent proposals from the private sector, including between ResponsibleSteel, First Movers Coalition, WV Stahl, IDDI and SSAB (see Figure 6). An alternative has been proposed by the Global Steel Climate Council (GSCC) based on an emissions threshold that stays constant as the share of scrap input changes. Several companies have also begun work to label low-emissions products using the mass balance approach, which aggregates emissions reductions across a company's portfolio, to support incremental steps over the near term. Examples include Nippon Steel's NSCarbloex Neutral label and ArcelorMittal's XCarb.

Figure 6 Emission threshold proposals from selected initiatives and organisations



Notes: GSCC = Global Steel Climate Council,; 2050 represents the threshold in the year 2050 in the GSCC proposal.

Current status in India

Organisations in India are at a relatively nascent stage in the development of and agreement around definitions for both low and near zero emissions steel.

Early efforts have begun to be made by the Confederation of Indian Industry (CII), via their GreenPro labelling system. This covers a wider range of factors beyond emissions, including water and land use. A range of steel products are covered by GreenPro, including automotive steel (provided by 3 companies), steel pipes (4 companies), steel rebars (24 companies) and structural steel (2 companies). The stringency of emission reductions varies by product but, for example, a company would receive the highest number of credits by substituting 10% or more of its electricity consumption for renewable electricity.

Many Indian steel companies are also engaging actively in international organisations that are developing definitions for low and near zero emissions steel. This includes ResponsibleSteel, where Jindal Stainless, Jindal Steel & Power, JSW Steel, Rajuri Steels and Tata Steel are all members.

Considerations for net zero definitions

It is important to consider these definitions in the context of their intended purpose. It will not be possible for definitions to address all the challenges associated with transforming today's intensive heavy industry sectors into net zero heavy industry sectors. For example, they cannot substitute targeted policies for incremental energy efficiency gains, material efficiency or over-capacity – even if they are complementary to such efforts. Common definitions are just one – albeit very

important – component of the broader policy approach that is needed. For further information on this broader policy approach, see our toolkit from Achieving Net Zero Heavy Industry Sectors in G7 Members.

To guide future work on definitions for the iron and steel sector, the IEA has proposed some over-arching principles. These include but are not limited to:

- Agreeing a clear purpose for the use of the definition. For example, providing a common vision of a final destination for steel production in a net zero future energy system, to help guide investment decisions and policy support.
- Remain technology and route agnostic, to allow for different country and company contexts.
- Thresholds should be stable, absolute and ambitious, to help build trust among users. The threshold values proposed in the IEA report for steel production are 50-400 kg of CO_2 equivalent per tonne (kg CO_2-eq/t), with the precise values depending on the amount of scrap used. The thresholds for near zero emissions production outlined in the IEA report[4] target levels of emissions intensity that are compatible with reaching net zero emissions from the global energy system by mid-century, as defined in the IEA's Net Zero by 2050 Roadmap.
- Consider globally recognised and commonly understood sets of definitions, which then can be used in different ways within different national contexts, according to national policy objectives.

[4] IEA (2022), Achieving Net Zero Heavy Industry Sectors in G7 Members.

Accelerating progress on standards in India

Following this review of standards for a net zero iron and steel sector, the following are identified as possible steps to help continue advancing on emissions measurement methodologies and definitions in support of the transition in India:

- **Engage proactively in relevant international fora on standards**, to facilitate common solutions and avoid conflicting approaches. This includes collaborative initiatives, such as the IEA's Working Party on Industrial Decarbonisation (WPID) and the Clean Energy Ministerial's Industrial Deep Decarbonisation Initiative (IDDI), as well as ISO and WTO.
- **Build administrative capacity to gather and process emissions data** from the iron and steel sector, in line with a preferred emissions measurement methodology. This also includes providing the necessary support to companies to develop their own capabilities to monitor, report and verify emissions data.
- **Pilot more detailed emissions measurement methodologies** with market-leading companies, to help better understand the trade-offs associated with different approaches. Feed actual data into various international threshold proposals to understand how these would represent and potentially impact Indian iron and steel facilities.

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