Responsible Steel standards & certification

LESS LOW EMISSION STEEL STANDARD

The Steel Decarbonisation Scale

A briefing for policy makers in the EU designing a label for low-emission steel

June 2025

Executive Summary

Europe is the world's second largest producer of steel, producing 126 Mt in 2023, and responsible for the emission of 183 Mt of CO_2, around 6% of the European Union's total emissions. The EU has set ambitious targets for steel decarbonisation, aiming for a 55% reduction in net greenhouse gas emissions by 2030 compared to 1990 levels, and for net-zero emissions by 2050. In this context, the European Steel and Metals Action Plan (ESMAP), and related discussion of a voluntary label on the carbon intensity of industrial products, are of critical importance.

An appropriate basis for comparing steel products in terms of their global climate impacts, while also ensuring the competitiveness of European steel production, is fundamental to the success of these initiatives.

There is currently intensive discussion about the design of a voluntary carbon label for steel products, which could also serve as a basis for establishing lead markets for clean steel. We, ResponsibleSteel and the Low Emission Steel Standard (LESS), have developed practical solutions to these challenges that could and should be immediately implemented.

A key issue for the design of any solution relates to the role of ferrous scrap in the decarbonisation of the steel industry, both globally as well as in the European Union. ESMAP acknowledges the constraints on scrap availability. As two leading organisations in this field, we are united in the conviction that labels and definitions themselves have to take proper account of the constraints on the supply of ferrous scrap. The adoption of labels or performance measures that neglect this fundamental point would lead to fruitless competition for access to an inherently limited supply of scrap, driving up scrap prices, creating distortions in steel and scrap trade flows, and disincentivising the decarbonisation of primary production that is essential for achieving European and global climate goals.

This briefing paper elaborates on this conviction in more detail. In particular, this paper explains how a simple modification to take account of scrap content, *in addition* to the measurement of a steel product's carbon footprint or Life Cycle Analysis (LCA), addresses this challenge. We refer to this as the '**steel decarbonisation**' approach.

We urge the European Commission to consider the adoption of an effective steel decarbonisation scale, as discussed in this briefing paper, in relation to:

- The development of a voluntary label on the carbon intensity of industrial products under the Industrial Decarbonisation Acceleration Act;
- The creation of 'Lead Markets', public and private, to de-risk decarbonisation projects and support investments;
- A range of other policy instruments.

Our two organisations welcome further discussion of this critically important issue.

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A. Scrap availability and its limits

All of the iron in steel comes directly from iron containing ores or from recycled ferrous scrap. Despite an estimated steel recycling rate, worldwide, of 85% (worldsteel, 2024), there is currently enough scrap to satisfy just 32% of the world's demand for new steel (IEA, 2021).

The difference between the steel recycling rate (85%) and the average recycled content of new steel (32%) is explained by the long lifetime of steel products in use, which imposes a fundamental constraint on the supply of scrap for recycling[1]. The average lifetime of steel in all products (including infrastructure, buildings and transportation, as well as packaging) is estimated to be about 35 years (e.g. Cooper, 2013). The maximum potential supply of post-consumer scrap available for recycling today is therefore limited to the quantity of steel that was produced, on average, 35 years ago. In 1989, that was 0.78 billion tonnes (worldsteel, 1991). In 2024, it was 1.9 billion tonnes (worldsteel, 2025). The implications for recycled content are illustrated in Figure 1.

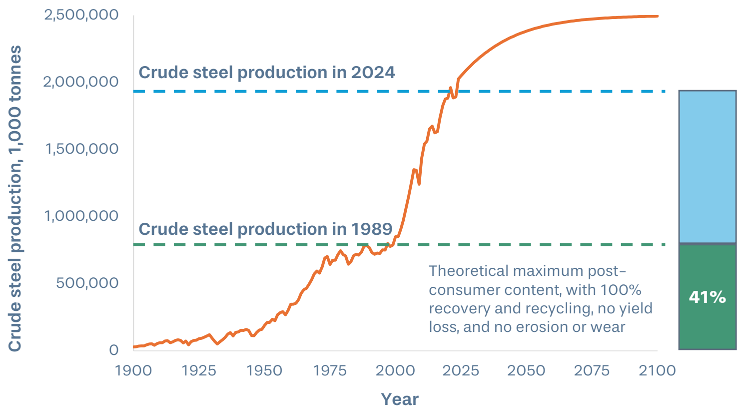


Figure 1. The maximum possible post-consumer recycled content for steel produced in 2024 is 41%. Crude steel production from 1900 to 2024 from worldsteel data, with a theoretical projection to a maximum of 2.5 billion tonnes in 2100.

In Europe, the post-consumer steel recycling rate is estimated to be 85% (Material Economics, 2020), too. The post-consumer recycling rate for steel is this high because steel is readily recoverable from products that have reached the end of their lives in use, and because ferrous scrap is a valued material for which there is strong demand (e.g. EuRIC, 2020; France Stratégie, 2025). While some increase in recycling is possible, some steel will also continue to be economically unrecoverable (for example, in buried foundations or lost at sea), and the scope for substantial increases in the recycling rate is limited. As an example, a recent study on the recovery of metals from end-of-life motor vehicles in Europe found that the quality of recovered ferrous scrap could be substantially improved, but not the quantity (Öko-Institut, 2025). This is consistent with modelling by the Boston Consulting Group and Steel Institute VDEh on behalf of Eurofer that assumes that overall recycling rates in Europe will remain constant through to 2050 (Wörtler et al, 2013).

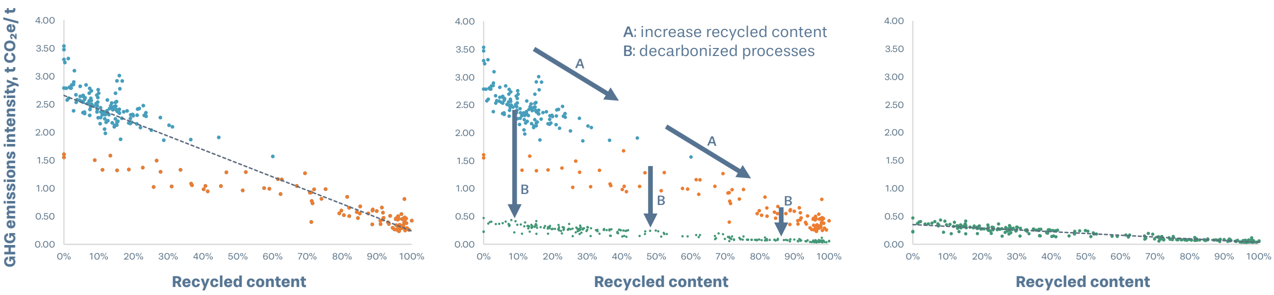
[1] *There is also some loss of iron due to erosion and wear and tear in use, estimated to be <1%, and a loss of about 5% when scrap is converted to steel in an oxygen furnace or electric arc furnace (EAF).*

In Europe, existing plans to increase Electric Arc Furnace (EAF) capacity are expected to lead to scrap shortages from 2030 onwards (e.g. Eurofer, 2023). At the global level, the International Energy Agency (IEA) projects that there will be sufficient scrap to meet only 46% of the demand for new steel in 2050 even in its 'sustainable development scenario', which assumes that increasing demand is significantly limited by improvements in material efficiency (IEA, 2021).

In summary, the potential to increase the supply of ferrous scrap is severely constrained, and the available supply in Europe and globally is expected to continue to be fully utilised through to at least the middle of the century, even as the absolute quantity that is available increases due to the growth of steel production and consumption over the last 35 years. This has highly material consequences for the effectiveness of measures to drive steel decarbonisation, as explained below.

B. Scrap use and greenhouse gas (GHG) emissions

Today, producing steel directly from iron ore (primary production) emits approximately five times as much greenhouse gas (GHG) per tonne of steel as producing steel entirely from recycled scrap. The greater the proportion of scrap used as the source of iron, the lower the GHG emissions, as shown in the graph in Figure 2(i).



(i) 2022 (ii) The transition (iii) 2050 – 2060

Figure 2 (i) shows the GHG emissions intensity of 239 steelmaking sites in 2022. Each dot is a separate mill: blue dots are blast furnace–basic oxygen furnace sites; orange dots are electric arc furnace sites, using a mix of scrap and either pig iron or DRI. These have a weighted average recycled content of 30%. The green dots in Fig 2 (iii) show the same number of sites as in Fig 2 (i) but with scrap content and GHG emissions intensities adjusted to have a weighted average recycled content of 46% and 'near-zero' average emissions, as defined by the IEA (IEA, 2023). The middle panel Fig 2 (ii) illustrates the required transition pathways.

Steel production has to reach 'near-zero' GHG emissions by mid-century, as illustrated in Figure 2(iii), if the goals of the Paris Agreement and the European Climate Law are to be met.

There are two aspects to this: the first is to use more scrap, as indicated by the arrows labelled 'A' in Figure 2(ii). As discussed in the previous section, scrap recovery and the use of scrap for steelmaking are well established and commercially competitive. Demand for scrap is projected to continue to greatly exceed the maximum available supply beyond 2050, ensuring that available scrap will continue to be fully utilised, even as the absolute quantity increases.

The second aspect is to decarbonise iron and steelmaking processes themselves, for both iron-ore-based and scrap-based production, as indicated by the arrows labelled 'B' in Figure 2(ii). This requires the use of alternative fuels such as natural gas, hydrogen or bio-carbon, and/or new processes such as direct electrolysis to convert iron ore into iron; carbon capture and storage; the capture and re-use of process gases; low emission sources of electricity; and any combination of these and other methods (see e.g. Eurofer, 2019; Somers, J., 2022). These processes are often technically challenging and costly, and will require effective policy support if European steelmaking is to both decarbonise and remain competitive.

C. 'Low carbon' steel and carbon leakage

To date, policy measures to support the decarbonisation of steelmaking have been based on site-level measurements of GHG emissions, or on 'carbon footprints' based on life cycle analysis (LCA). These approaches are likely to be ineffective because they do not take account of the fundamental constraints on the availability of scrap, as we explain below.

When the supply of any material is limited and the available supply is fully utilised – as is the case for ferrous scrap – use of that material cannot be increased, it can only be redistributed. The implications for the specification of steel based on its carbon footprint are illustrated in Figure 3. The figure shows how steel products with a low carbon footprint are produced by allocating more scrap to their production. However, because the supply of scrap is already almost fully utilised, this means that there is less scrap available for production elsewhere, or for other products. The carbon footprint of these products increases, accordingly. Specifying steel based only on its carbon footprint is, therefore, a highly ineffective mechanism for driving reductions in overall GHG emissions.

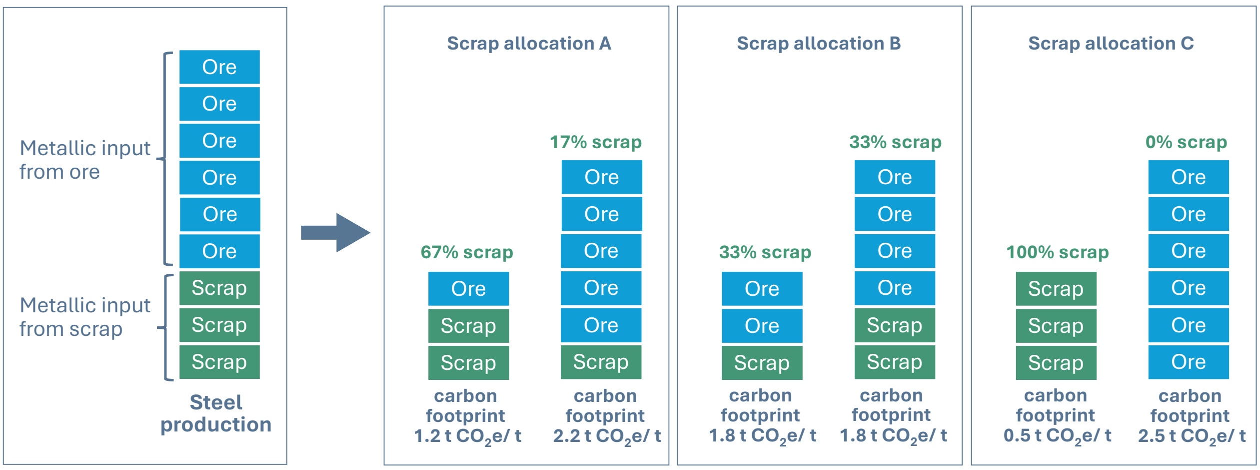


Figure 3. When the overall supply of a material is constrained, and the available supply is fully utilised (as for ferrous scrap), its use can be re-allocated but it cannot be increased. In this case, specifying steel according to its scrap content, or its carbon footprint only, is a highly inefficient driver of steel decarbonisation, and increases the likelihood of carbon leakage. (modified from Arnold et al, 2023). CO_2e per tonne steel values are illustrative. The exact value in reality depends on the practices of the site and the GHG measurement methodology used.

The same flaw applies at the level of projects, customers, steelmaking sites, companies or national or regional boundaries: redistributing scrap redistributes rather than reduces GHG emissions.

D. The Steel Decarbonisation Scale

This problem is readily addressed, however, by taking account of the ratio of scrap and primary iron used as inputs for steelmaking (the data for which is already collected by steelmakers), *in addition* to the measurement of greenhouse gas emissions.

Doing so removes the effects on the product carbon footprint of allocating more, or less, scrap for different steel products or for supplying different markets. Differences in performance levels then reflect real differences in progress towards steel decarbonisation, rather than differences in the distribution of scrap between product groups, steelmaking sites, customers, countries, or regions.

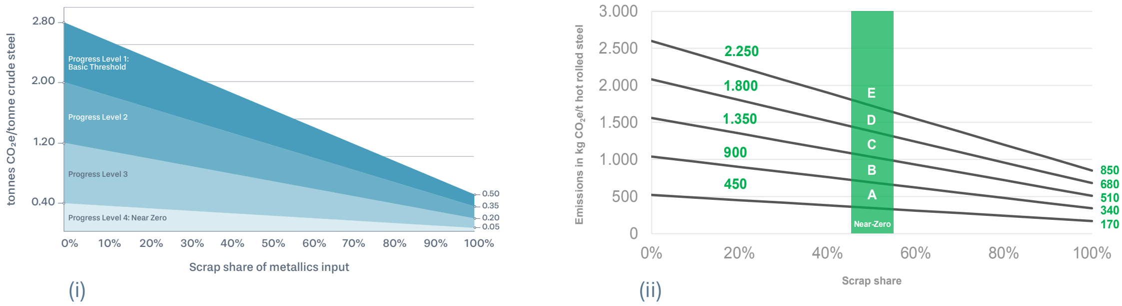


Figure 4. Examples of steel decarbonisation scales developed by i) ResponsibleSteel, and ii) The Low Emission Steel Standard.

This is the basis of the 'steel decarbonisation' approach recommended to the G7 by the IEA (IEA, 2022), and recognised by the G7 as a robust starting point for measures to drive near-zero steel production (G7 Germany). Scales based on this approach have been incorporated into the Low Emission Steel Standard (LESS) developed by the German Steel Association (LESS, 2025), the ResponsibleSteel International Production Standard (ResponsibleSteel, 2024) (see Figure 4), as well as the China Iron and Steel Association (CISA) draft standard.

The approach has also been adopted by private sector steel decarbonisation initiatives such as the World Economic Forum's (WEF) First Movers Coalition (WEF, 2023) and Climate Group's SteelZero programme (Climate Group, 2024). Observers have also indicated how such an approach could be applied within the EU Ecolabel family in a design inspired by the EU Energy Label (e.g. BCSA, 2023).

The steel decarbonisation scale approach has a number of important advantages in comparison to the use of simple GHG emission measurements or product carbon footprints to define performance:

- Above all, it promotes the allocation of scarce funds and resources towards the real challenges of steel decarbonisation, rather than to increasing competition for access to an inherently limited and already fully utilised supply of ferrous scrap.
- It incentivises the decarbonisation of both scrap-based and primary steel production.
- It prevents steelmakers in Europe or elsewhere from masking less carbon-efficient production through higher scrap use.

- It is applicable to all steel production routes (BF-BOF, DRI, H_2DRI, EAF, direct electrolysis), possible combinations (where, for example, scrap and DRI can be used alternatively), and all categories of steel products. This is in contrast to the use of measures that specify different performance standards for different technologies or product categories (e.g. EAF vs BF-BOF production or 'flat' vs 'long' products).
- It meets World Trade Organization (WTO) obligations to pursue the least trade-distorting and most technology-neutral approach to address a specified environmental objective (climate change), and would therefore reinforce rather than undermine the application of the WTO rule-based system for international trade and the EU's commitment to avoiding unjustifiable discrimination.

E. Implications for European steelmaking

The European Union has the lowest average emission electricity grid of the world's ten largest steel-producing countries, and of the countries with over 50% of BF-BOF steel production, the lowest CO_2 intensity (Somers, J., 2021). These are the results of long-term European investments in low-carbon electricity generation (European Environment Agency, 2024) and support for technologies for the decarbonisation of its primary steelmaking.

Europe is therefore well-positioned to benefit from a competitive focus on genuine steel decarbonisation both for EAF production and for primary steelmaking.

A steel decarbonisation scale would serve as an effective basis for a range of policy measures designed to incentivise the decarbonisation and resilience of the European steel sector while also promoting and protecting European industrial capacities in line with Europe's commitment to achieving the goals of the Paris Agreement and the Clean Industrial Deal, and in particular in relation to:

- The development of a voluntary label on the carbon intensity of industrial products under the Industrial Decarbonisation Acceleration Act to drive the adoption of decarbonised steel
- De-risking decarbonisation projects through 'Lead Markets' and forms of public support to investments
- Forthcoming revisions to the Public Procurement Directive (2014/24/EU)
- Complementing the evolving requirements of the Ecodesign for Sustainable Product Regulation (2024/1781).

FAQs

Does the steel decarbonisation scale penalise scrap use?

No, it does not. The steel decarbonisation scale is explicitly neutral with regard to scrap use. Better decarbonisation performance levels are obtained when scrap is made into steel with lower greenhouse gas emissions per tonne of scrap input, and/or when iron ore is made into steel with lower greenhouse gas emissions per tonne of iron ore input, referred to by the Institution of Structural Engineers, IStructE, as 'dual decarbonisation' (IStructE, 2025).

How is the steel decarbonisation scale technology-neutral and WTO compliant?

The steel decarbonisation scale applies equally to all steel production routes, irrespective of whether the iron content of the steel is derived from scrap or iron ore; irrespective of whether iron is produced by blast furnace, direct reduction, or direct electrolysis; and irrespective of whether steel is finished in an oxygen furnace or electric arc furnace. The scale also applies equally to both 'long' and 'flat' steel products. This is in contrast to standards based only on a product carbon footprint or LCA, which require different performance measures to be specified for different production routes and/or product categories.

Scrap availability is projected to increase in the coming years – so how is scrap supply limited?

Scrap availability will increase over time as a consequence of the growth in steel production and consumption over the last 35 years, notably in China. As that steel reaches the end of its life in use, it will become available as scrap for recycling. worldsteel estimates that the quantity of scrap used for the production of new steel will increase from around 500 Mt in 2024, to around 900 Mt in 2050 (worldsteel). Steelmakers are already planning in anticipation of this increasing supply, with investments in new electric arc furnace capacity. Demand for new steel is also projected to increase in the future, to around 2,500 Mt per year in 2050. Scrap will remain a highly valued material for steelmaking, ensuring that the increased supply continues to be fully utilised, without the requirement for subsidies or incentives.

How can it make sense to prefer an (ore-based) steel product with a higher carbon footprint to a (scrap-based) steel product with a lower carbon footprint?

This seems surprising at first, but it is a consequence of the already high recycling rate (about 85%) and full utilisation of available scrap. When all available scrap is already being utilised, allocating more scrap to a particular product, project, steelmaking site, or customer means that there is less available for allocation to other products, projects, steelmaking sites, or customers. The scrap that is available can be redistributed, but its overall quantity does not increase. In these circumstances, what matters is the *decarbonisation of steelmaking processes*, irrespective of the proportion of scrap being used to make a given product – and that is what the decarbonisation scale addresses.

Doesn't the fact that the EU exports scrap show that European scrap is not fully utilised?

No, it does not. Europe exports scrap – but it is still used for steelmaking. The fact that ferrous scrap is extensively traded is evidence of its value, and of robust, international demand. The steel decarbonisation scale would, however, favour the greater use of scrap for steelmaking in Europe, where electricity grid emissions are lower, and where investments in decarbonising steelmaking processes are strongly supported.