What shade would you like your green steel?

Comparing different low emission steel standards

Whitepaper

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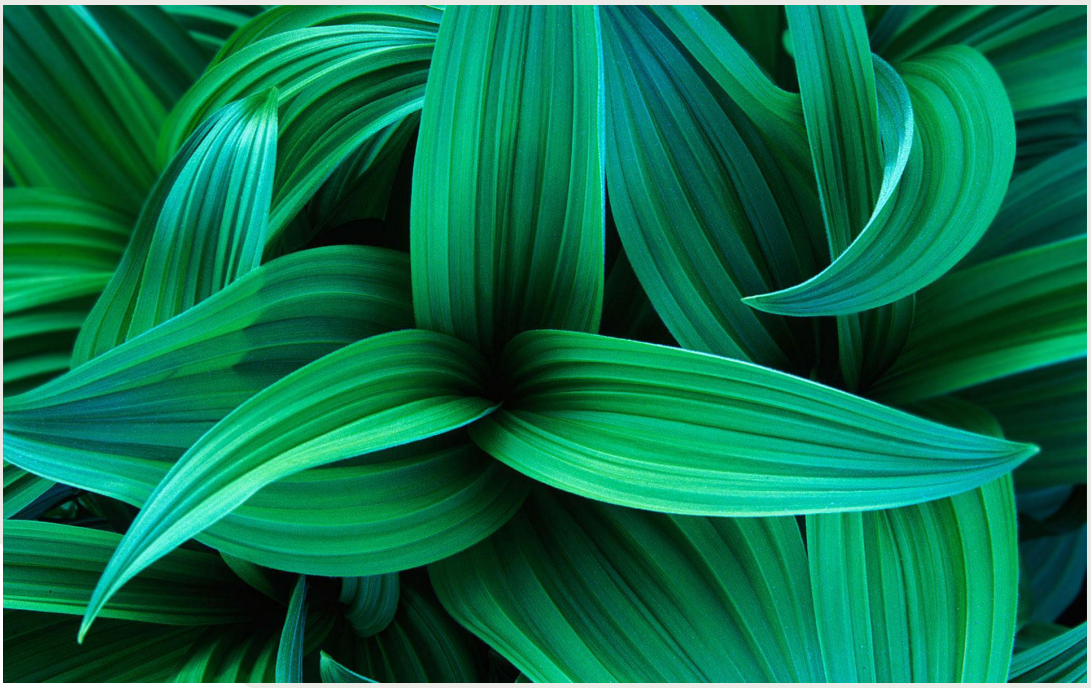

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Global warming is at the forefront of political agendas, and the Paris Agreement has impacted the steel making industry significantly, necessitating large-scale technological changes. Currently, approximately 7% of the global CO2 emissions are created by the steel industry, making decarbonization plans for steel production a critical topic of the discussion[1].

Steel producers can choose different technological pathways leading to different low carbon steel results. These can vary from mass balancing techniques to new production routes like electric arc furnaces partly filled with direct reduced iron produced with green hydrogen or a combination of green hydrogen and natural gas as a reductant. All of these are unofficially categorized as "green steel", even though the per ton CO2 equivalents can vary greatly. "Green steel" is used loosely and can describe this variety of processes, highlighting the importance of a standardized classification system that can be widely adopted. A classification system would allow for a transparent communication for low emission steel types and would allow for consumers to compare and choose their steel, based on comparable criteria.

The steel industry, similar to other industries undergoing a transformation, is in desperate need of a guiding system that will categorize low emission steel. This is especially important in offshore wind, where emissions coming from steel play a significant role. The implementation of low emission steel has already started, as two offshore wind projects have chosen to use low emission steel for its wind towers. To facilitate the adoption of low emission steel in auctions and public tenders in offshore wind and to create stable long-term market expectations, a clear low emission steel classification system must be adopted.

Firstly, this paper will define the requirements that any standard should meet. Secondly, it will describe three different standards that are currently well-known. Lastly, it will compare the benefits of these three standards and place them in the context of offshore wind.

Attributes of a classification standard

There needs to be clear and internationally adaptable definitions and rules for classifying products. A classification system for low emission steel should have the following attributes:

- It should be ***objective and transparent*** (e.g. third party verification);
- It should use ***relevant criteria*** that reflect sustainability efforts;
- It should have a ***broad scope*** and one should be able to compare a variety of decarbonization strategies (including different scrap ratios);
- It should be ***clear and simple*** to understand for consumers to facilitate decision-making;
- It should be ***ambitious*** and encourage continuous improvement;
- It should be ***globally applicable*** by using an international approach.

Comparing three 'green' steel standards

The three renown standards for low emission steel are the International Energy Agency (IEA) standard, LESS standard and ResponsibleSteel standard. They all take different approaches in trying to classify the different shades of green.

[1] https://www3.weforum.org/docs/WEF_NetZero_Industry_Tracker_2022_Edition.pdf

2 https://iea.blob.core.windows.net/assets/c4d96342-f626-4aea-8dac-df1d1e567135/AchievingNetZeroHeavyIndustrySectorsinG7Members.pdf

IEA standard

The IEA standard is widely embraced as the basis for defining green steel. IEA is aimed at providing guidelines and recommendations for achieving near-zero emissions in the steel sector. For instance, the First Movers Coalition uses the IEA standard to define its near-zero emission steel guidelines [2].

The analytical scope for emissions is bounded by crude steel production and does not include all of the upstream or downstream activities. IEA has chosen this approach to cover the main emission-intensive steps (figure 1) [3].

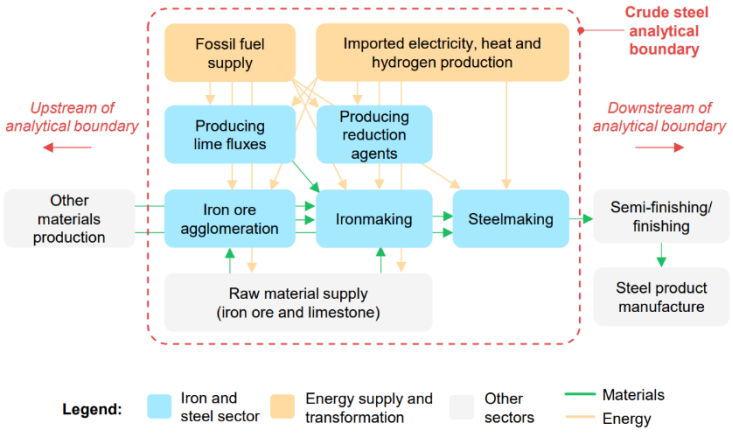


Figure 1: IEA emission scopes [3]

Figure 2 shows the sliding scale emissions threshold as defined by the IEA, taking the scrap ratio into account. The performance level is based on reference values for different decarbonization routes (*see appendix 1*). The scale provides two groups: 'in scope' and 'out of scope', where the former defines the threshold for near-zero steel. Neither does the scale cover different nuances for low emission steel, nor does it show the current average of the industry or give a step by step improvement route through other categories.

This makes the IEA base more difficult to understand for consumers that want to differentiate between sustainability efforts. IEA serves as a sound basis for defining low emission steel, as it provides a clear methodology for defining a threshold values. However, it does lack the details for consumers that want to make a sustainable decision.

[2] https://initiatives.weforum.org/first-movers-coalition/home

[3] https://iea.blob.core.windows.net/assets/c4d96342-f626-4aea-8dac-df1d1e567135/AchievingNetZeroHeavyIndustrySectorsinG7Members.pdf

3 https://iea.blob.core.windows.net/assets/c4d96342-f626-4aea-8dac-df1d1e567135/AchievingNetZeroHeavyIndustrySectorsinG7Members.pdf

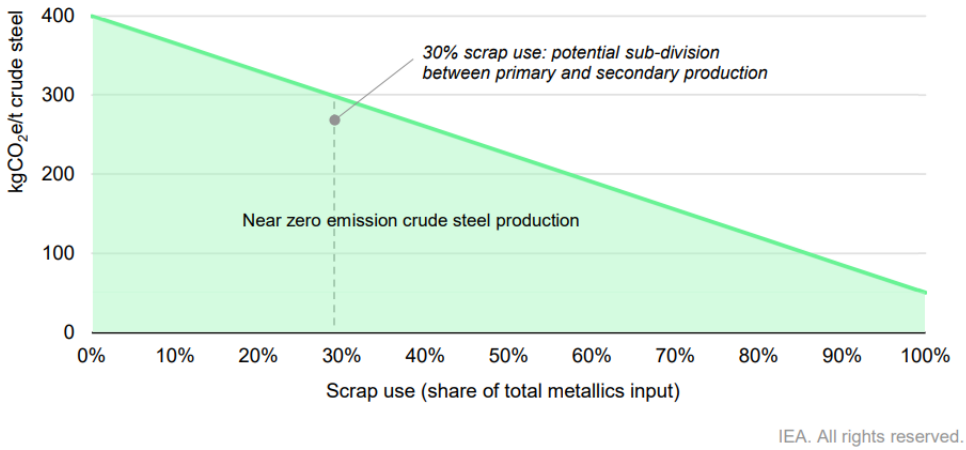


Figure 2: IEA definition near-zero steel [3]

The 'in scope' standard provides a very ambitious target for reducing GHG emissions from steel production, promoting the adoption of innovative technologies. This makes the IEA standard future-proof for new technologies. The basis data for defining the threshold is sound. IEA lacks the scope to embrace different technological paths. Also, It needs more details to be defined as consumer-friendly. IEA provides detailed information and several extensive road maps, that make IEA a good basis, on top of which other parties can define more details to make it consumer friendly.

The Low Emission Steel Standard (LESS)

LESS is an initiative created by the German Steel Association, supported by the German Federal Ministry for Economic Affairs and Climate Actions. It builds on the proposal of the International Agency for Energy and can be used by companies that want to map their emissions during steel production.

LESS includes emissions from all scopes from physical processes, meaning that Scope 1 and Scope 2 emissions are always included [4]. A cradle-to-gate approach with regard to scope 3 emissions, meaning that none of the downstream emissions are considered. Regarding upstream emissions, only essential drivers are considered: raw materials that flow directly into steel production or are required for this purpose, upstream energy, and transportation of these materials to the required site. This approach covers at least 90% of total emissions, leaving little room for mass balancing (figure 1) [4].

[4] https://www.stahl-online.de/wp-content/uploads/20240422_Rulebook_Classification-System-for-LESS_v1.0.pdf

4 https://iea.blob.core.windows.net/assets/c4d96342-f626-4aea-8dac-df1d1e567135/AchievingNetZeroHeavyIndustrySectorsinG7Members.pdf

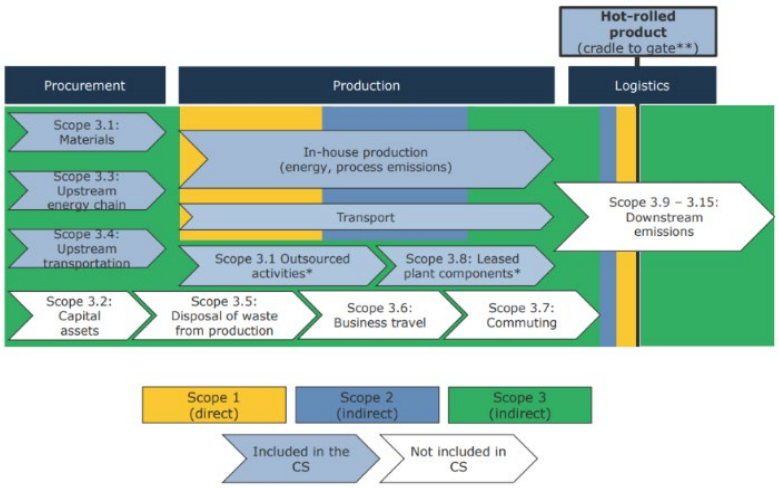


Figure 3: Emission scope LESS

LESS categorizes low carbon steel products into different categories. Here, category A-C can be achieved with Near Zero production technologies, whereas categories D and E can be achieved with regular technologies (BF-BOF route). Near-zero is defined according to IEA and even goes beyond as alloying agents are reported here (figure 5) [5]. The system leaves enough room for ambitions and newer technologies.

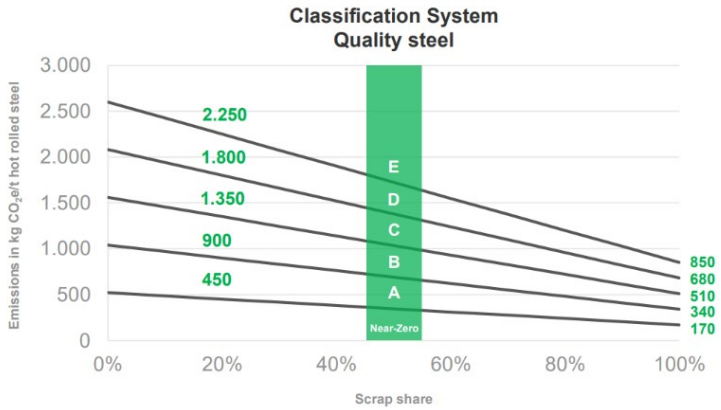


Figure 4: The LESS classification system

The LESS standard was one of the first to adopt a full rulebook that allows for international adoption. LESS uses third-party certifiers to conduct independent assessments and audits of steel producers to verify their compliance with the LESS standard[5]. This involves evaluating the emission data provided by the companies, ensuring that it meets the criteria set forth in the standard, and issuing certifications based on their findings. The emission scope by LESS is also broader in comparison to IEA.

Also, LESS created a labeling system for decarbonized steel products. The labeling system is aimed at providing oversight between the different low-emission alternatives. It also includes Product Carbon Footprint or Greenhouse Gas Protocol measures. The label makes it easy for customers to categorize products, making it very transparent. It also goes beyond reporting mere emissions that result from steelmaking.

[5] https://www.stahl-online.de/wp-content/uploads/20240422_concept-paper_LESS_final.pdf

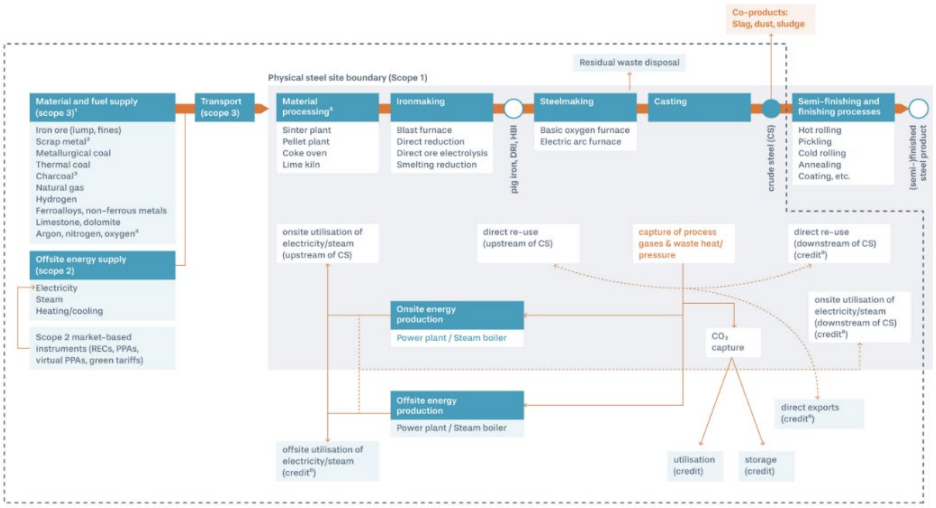
5 https://iea.blob.core.windows.net/assets/c4d96342-f626-4aea-8dac-df1d1e567135/AchievingNetZeroHeavyIndustrySectorsinG7Members.pdf

Figure 5: LESS label [3]

ResponsibleSteel

ResponsibleSteel has been widely embraced by different associations and organizations such as SteelZero and is known to be the most progressive and rigorous classification system for low emission steel. ResponsibleSteel aims at providing an aligned framework for the definitions "lower embodied carbon, near zero, net zero, responsible and green steel. This is done by establishing different levels based on GHG emissions. ResponsibleSteel takes a holistic approach, incorporating 13 ESG principles that cover a wide range of topics including sourcing of raw materials, leadership and labor rights on top of GHG emissions[6].

GHG emissions are included with scope 1 scope 2 and scope 3 (emissions associated with the extraction, processing and transportation of input materials) [6]. The further processing of steel such as hot rolling, cold rolling or coating are not included (figure 6). In comparison to IEA and LESS, this offers the approach with the biggest



scope.

[6] 669944ee100030cfac39a949_ResponsibleSteel_International_Production_Standard_V2.1 (3).pdf (website-files.com)

6 https://iea.blob.core.windows.net/assets/c4d96342-f626-4aea-8dac-df1d1e567135/AchievingNetZeroHeavyIndustrySectorsinG7Members.pdf

Figure 6: ResponsibleSteel emission scope

In its model, ReponsibleSteel defines a basic threshold at a level that represents the current global average emissions of crude steel production. Lower embodied carbon steel falls into levels 2 and 3, while near-zero steel is defined by performance level 4. A slider scale that incorporates the proportion of scrap is used for visualizing the levels (figure 7).

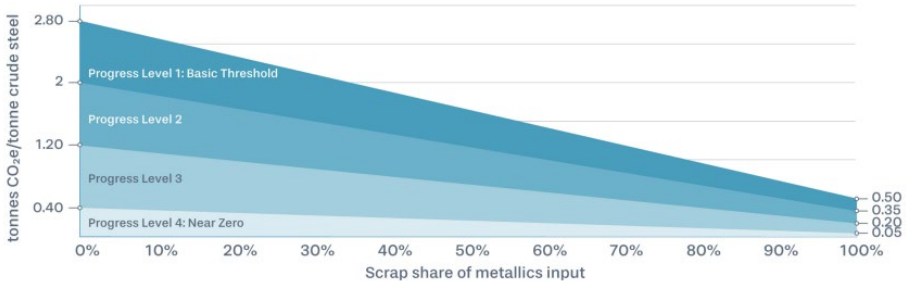


Figure 7: ResponsibleSteel levels [6]

ResponsibleSteel advocates for a broad approach that low emission steel should not only cover reduced emissions but also if social and environmental concerns are addressed, embracing a broad long-term vision. ResponsibleSteel employs independent third-party auditors (TÜV. SGS, Bureau Veritas) to assess steel producers against its certification criteria. These auditors evaluate compliance with the ResponsibleSteel standard, which includes various environmental, social, and governance (ESG) criteria.

On top of that ResponsibleSteel also provides a clear label for consumers. The label provides information that shows the commitment of steel producers in regard to sustainability. The progress levels define the production standard and the progress on materials sourcing [7]. Even though there are 13 principles defined by ResponsibleSteel, the label is clear and lets consumers rank the commitments (figure 8).

[7] https://www.responsiblesteel.org/certification-process

7 https://iea.blob.core.windows.net/assets/c4d96342-f626-4aea-8dac-df1d1e567135/AchievingNetZeroHeavyIndustrySectorsinG7Members.pdf

Figure 8: ResponsibleSteel label [8]

Comparing standards in the offshore wind context

There are several well-known standards that try to give foot to the phrase “green steel”. Two classification systems, IEA and LESS, have a tailored approach mainly focusing on emissions. Here, IEA provides stable guidelines as a basis for a near-zero threshold, but lacks details to make it consumer-friendly. LESS is in line with the principles defined by IEA and provides a clear label that can be internationally adopted. LESS forms a clear and transparent classification system for comparing GHG emissions. It is straightforward for end-consumers to see the score and understand the difference in emission-levels. It also offers enough room for steel producers that have the emission to decrease their emissions in the future. The implementation in public tenders or auctions could therefore be straightforward as either mininmal requirement or bonus system.

ResponsibleSteel take it further by implementing a holistic approach. Here, scores are not given on the basis of emissions only, but also other sustainability aspects are taken into account. Steel producers are held responsible for other sustainability aspects that fall into ESG. Even though many aspects are used for classifying steel producers, ResponsibleSteel provides are clear label for consumers.

Offshore wind auctions have started to implement qualitative criteria. These standards could support sustainable sourcing of steel. There has been increasing focus on the environmental impact of offshore wind and qualitative criteria are included in the form of biodiversity and carbon footprint reduction. On top of that, there are social responsibility criteria such as the IRBC Agreement in Dutch auctions. The standard that is most suitable for offshore wind depends on the project’s goal and stakeholder priorities. The LESS standard provides clear guidelines for the reduction of carbon emissions in steel production. If projects are focused on minimizing carbon footprint and enhance sustainability in sourcing, this would be a good fit. A broad standard that encompasses also social and governance aspects of steel production is offered by ResponsibleSteel. If a project embraces a holistic approach to sustainability, the ResponsibleSteel standard would be more suitable. In both cases, the supply side and timelines for the availability of steel according to a specific standard needs to be taken into account. For instance, a certain level of availability could be set as minimum requirement (when broadly available) and a higher ambition could receive bonus points.

Conclusion

The journey towards decarbonizing the steel industry is crucial and steel producers will choose different routes that lead to decarbonization. Hence, different shades of green will remain and it is important that a classification system crystallizes these differences. The comparison of the LESS, ResponsibleSteel, and IEA standards highlights the diverse approaches and the need for a unified classification system. By adopting a clear system that defines low emission steel, we can make significant progress on green steel and ensure its adoption in future offshore wind auctions.

Implementing a clear and internationally adaptable standard will not only facilitate the integration of green steel into public tenders, particularly in offshore wind projects, but also create stable long-term market expectations. By embracing a consistent methodology, the steel industry can ensure transparency, accountability, and progress towards a sustainable future. Depending on the auction approach, LESS and ResponsibleSteel both offer clear and transparent system that can easily be implemented in auction design, where the latter offers a holistic approach beyond the scope of emissions.

8 https://iea.blob.core.windows.net/assets/c4d96342-f626-4aea-8dac-df1d1e567135/AchievingNetZeroHeavyIndustrySectorsinG7Members.pdf

As we move forward, it is essential for stakeholders to collaborate and adopt these standards, ensuring that green steel becomes a cornerstone of our efforts to mitigate climate change and promote environmental responsibility.

9 https://iea.blob.core.windows.net/assets/c4d96342-f626-4aea-8dac-df1d1e567135/AchievingNetZeroHeavyIndustrySectorsinG7Members.pdf

Appendix

Emissions source	IEA reference values ($kgCO_2e/t$ crude steel)		Near zero emission production thresholds ($kgCO_2e/t$ crude steel)	
	PCI BF-BOF	NG DRI-EAF	Direct	Direct + indirect
Fossil fuel use in iron ore agglomeration	235	40	400	400
Producing reduction agents	110	700		
Fossil fuel use in ironmaking	590			
Fossil fuel use in steelmaking	0	25		
Lime fluxes and electrodes	70	50		
Off-gases	1 320	0		
Imported electricity, heat and hydrogen	105	375	N/A	
Fossil fuel supply	435	210	N/A	
Raw material supply	80	80	N/A	
Total	2 945	1 485	400	400

Notes: PCI BF-BOF = blast furnace-basic oxygen furnace with pulverised coal injection; NG DRI-EAF = natural gas-based direct reduced iron-electric arc furnace. All values rounded to the nearest 5 $kgCO_2e/t$. See Box 3.3 for a description of the

Figure 9: Details IAE

10 https://iea.blob.core.windows.net/assets/c4d96342-f626-4aea-8dac-df1d1e567135/AchievingNetZeroHeavyIndustrySectorsinG7Members.pdf