SIEMENS energy

Stepping up green steel transition efforts using the mass balance approach

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1. How to transition to greener steel

According to the International **Energy Agency (IEA)**, the steel and iron industry stands as the world's most significant emitter of CO_2 among heavy industries, contributing to approximately 7 % of global emissions (IEA, 2020).

It is known as a hard-to-abate industry because coal is not only used as a heating source, but it is an essential part of the chemical reaction to reduce iron ore into iron in the blast furnace. However, there are different technologies available to reduce the climate impacts related to steel production. There is no doubt, implementing these technologies requires significant investments and time to implement – a green steel transition. A transition requires support from other enabling industries. For the green steel transition two ingredients are urgently needed – renewable energy and hydrogen.

Consequently, the transition can be considered a marathon that needs many steps to get to the finish line. Today, the first steps have already been taken. Many companies in the steel industry are maximizing efficiency, improving circularity, and getting the transition process started while more comprehensive infrastructural changes are being defined and initiated. These intermediary improvements are reflected through the introduction of new low-emission steel or **green steel** product lines by using the mass balance approach.

1.1 The potential of the mass balance approach

The mass balance method is used to assign emission reductions or the share of sustainable feedstocks to a portion of the entire production – a greener product line. The greener products have the same quality and properties as those made from fossil-based materials, but the sustainability improvements are allocated to a specific production segment. This is done because it is often impossible to have a physical segregation of the greener product lines from the traditional product lines. The mass balance approach allows for an allocation of overall emission reductions to a CO_2-reduced product. In support of decarbonization efforts, developing demand for greener products can demonstrate viable business models and de-risks investments, thereby catalyzing the costly transition of manufacturing infrastructure.

However, the mass balance approach comes with its fair share of criticism and is not accepted under some standards. Its potential for double counting and continuation of fossil-fuel-based material feedstocks constitutes the primary reasons for transparency issues and doubts. This lack of alignment and the lack of clarity in the verifiability of a product carbon footprint or life cycle assessment when using the mass balance method for green steel has inhibited the adoption of green steel, and therefore, it has limited the markets' ability to demonstrate support for transition steps for cleaner production.

1.2 The role of mass balancing in supply chain decarbonization

To manage decarbonization along the supply chain, it is crucial to distinguish between corporate and product carbon footprints. The corporate carbon footprint is the sum of all carbon emissions related to the activities of a company along the value chain, while the product carbon footprint is the sum of all carbon emissions related to the lifecycle of an individual product.

While both of them are closely related to defining the actual impact of a company, significant improvements at the corporate level may not always translate directly to the product level or are difficult to allocate back to individual products. Targeting and achieving significant greenhouse gas (GHG) emission reductions at the corporate level is essential and goes beyond simple measures like replacing light bulbs. The mass balancing approach can serve as a mechanism to make investments in the green transition, rewarding and driving the change needed on the product level.

And we can see that mass balancing is neither new nor exclusive to the steel industry. It is well-established within the chemical industry, for bio-based and circular materials, and in the renewable energy sector. For example, renewable electricity markets are essentially a form of mass balancing, demonstrating that renewable quantities are tracked and allocated to a specific product, not resulting necessarily in 100 % renewable electricity reaching end customers' homes or facilities.

To enable a functioning market based on a mass balancing approach, it is of key importance to define clear requirements. **The International Sustainability & Carbon Certification (ISCC)** initiative has defined specific regulations for the chain of custody tracking and reporting for sustainable inputs and the attribution of these to a specific product line (ISCC, n.d.). Additionally, a mass balance tracking system is prescribed in the **EU Renewable Energy Directive (RED)** for bio-based fuels used to reach clean energy targets (European Union, 2018).

These examples demonstrate the potential to apply the mass balance approach to quantify sustainability attributes in a systematic manner that is transparent and verifiable.

2. Leading the change at Siemens Energy

At **Siemens Energy Grid Technologies,** we play a vital role in this transition as early adopters of emerging greener product lines to fulfill our decarbonization commitments and the commitments from our industry. Through our products and procurement, we link our customers' demands for improved product sustainability with our suppliers' initiatives to reduce GHG emissions and steadily advance towards our goal of a 30 % reduction in supply chain emissions by 2030.

Our world cannot wait any longer, and we need to drive incremental improvements along the supply chain step by step. Therefore, as a company with high requirements for steel in our products, we have established a strategic partnership with **thyssenkrupp** for bluemint steel, their steel with lower carbon emissions, which is based on the mass balance method. We understand the shortcomings of the mass balancing approach. However, as an original equipment manufacturer (OEM) linking raw material suppliers and transmission system operators (TSOs), we want to help find the appropriate methodology that recognizes the suppliers' decarbonization steps while ensuring environmental impact claims are transparent and verifiable for ourselves and our customers.

Accordingly, this is our motivation for taking proactive steps to advance our decarbonization efforts, which include writing together with our steel supplier, thyssenkrupp, a **CIGRE** paper about the use of low-emission steel in transformers and its impact evaluation, supporting with a thesis project to establish a transparent reporting framework and participating in a joint industry project with DNV to standardize Lifecycle Assessments for large power transformers.

It is critical to note that the mass balance approach is just one tool in the transition to a more circular and climate-responsive economy. Without long-term decarbonization commitments, roadmaps, and actionable plans, these intermediary steps are insufficient. Ultimately, mass balance calculations and associated product lines must function as a near-term step on a dedicated path towards full decarbonization

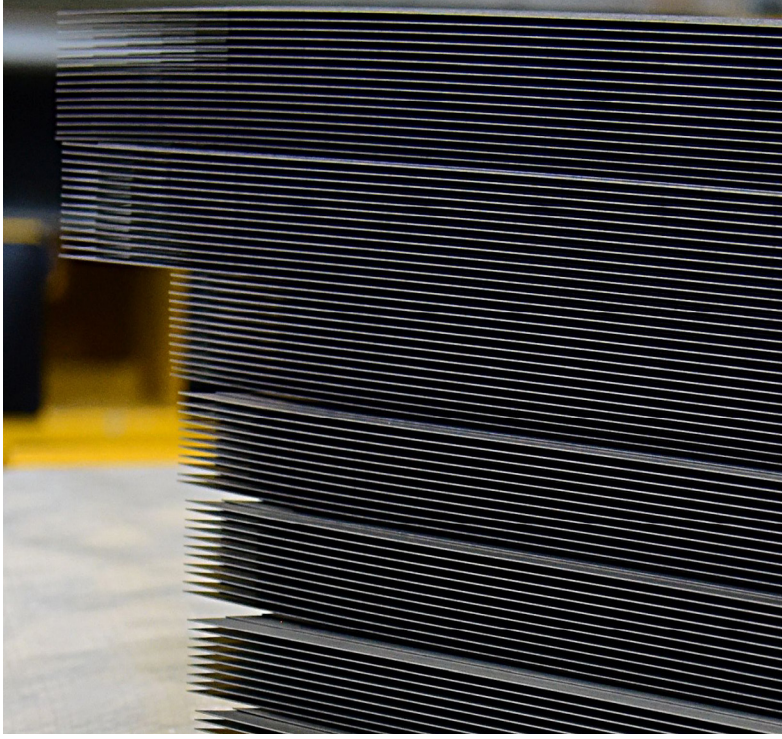

Figure 2 The mass balance approach along the green steel supply chain

and environmentally responsible production. It is therefore imperative for all stakeholders to collaborate closely to overcome the technological and economic challenges and create the market conditions necessary for a successful green steel transition.

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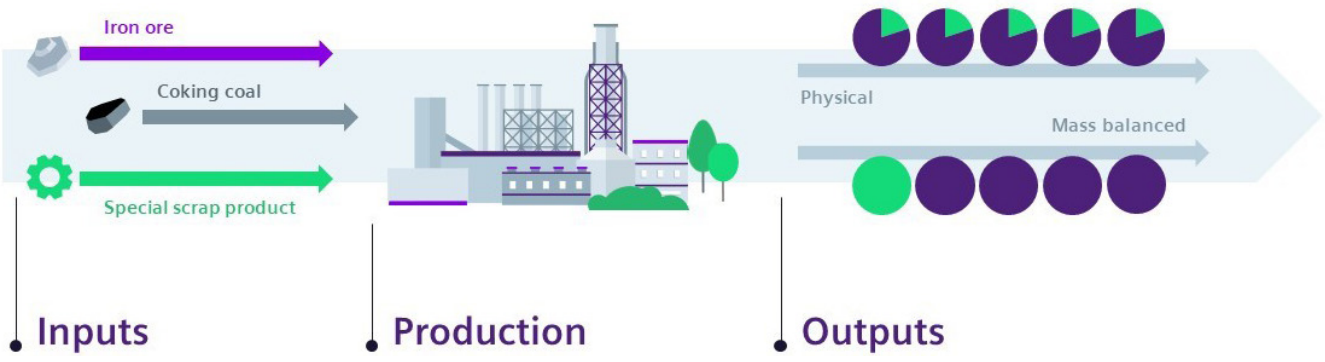

Figure 2 The mass balance approach along the green steel supply chain

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Grid Technologies
Siemenspromenade 9
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Germany

For more information, please visit our website:
siemens-energy.com/transmission

or contact us: support.energy@siemens-energy.com

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Siemens Energy, Inc.
Grid Technologies
4912 Green Road
Raleigh, NC 27616
USA