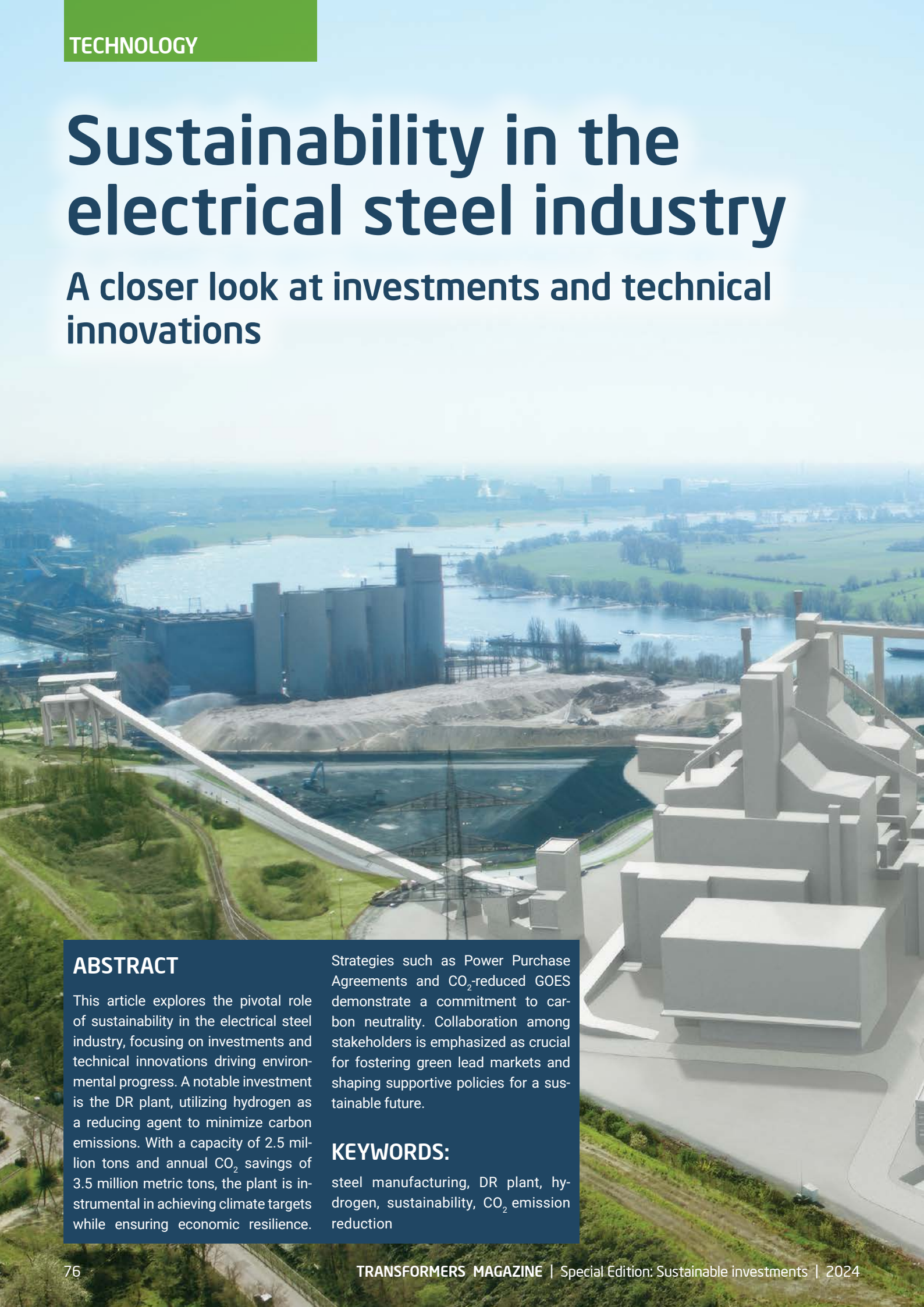
Sustainability in the electrical steel industry

A closer look at investments and technical innovations



ABSTRACT

This article explores the pivotal role of sustainability in the electrical steel industry, focusing on investments and technical innovations driving environmental progress. A notable investment is the DR plant, utilizing hydrogen as a reducing agent to minimize carbon emissions. With a capacity of 2.5 million tons and annual CO_2 savings of 3.5 million metric tons, the plant is instrumental in achieving climate targets while ensuring economic resilience. Strategies such as Power Purchase Agreements and CO_2-reduced GOES demonstrate a commitment to carbon neutrality. Collaboration among stakeholders is emphasized as crucial for fostering green lead markets and shaping supportive policies for a sustainable future.

KEYWORDS:

steel manufacturing, DR plant, hydrogen, sustainability, CO_2 emission reduction

Unlike traditional methods that rely on coal as a reducing agent, our DR plant will harness the power of hydrogen as a reducing agent to efficiently produce iron while minimizing carbon emissions

With a capacity of 2.5 million tons and an annual saving of up to 3.5 million metric tons of CO_2 the DR plant is an indispensable asset towards achieving the climate targets

Introduction

In the quest for a sustainable future, industries worldwide are transforming and adapting their operations to embrace environmentally friendly practices. We also recognize the pivotal role of the steel industry in shaping a greener tomorrow. Our investments in a DR plant underscore this commitment to reducing carbon emissions and fostering sustainability within the transformer industry. This article delves into the technical innovations and environmental implications of our investment, highlighting the transformative impact on the electrical steel sector.

Investing in sustainability: The role of DR plants

The construction and operation of a DR plant with two electrically powered melters at our Duisburg thyssenkrupp Steel Europe site signify a bold investment in sustainability and technological advancement. The DR plant is designed to produce Direct Reduced Iron, or so called "sponge iron", a solid product with a high iron content obtained through the reduction of iron ore. Unlike traditional methods that rely on coal as a reducing agent, our DR plant will harness the power of hydrogen as a reducing agent to efficiently produce iron while minimizing carbon emissions.

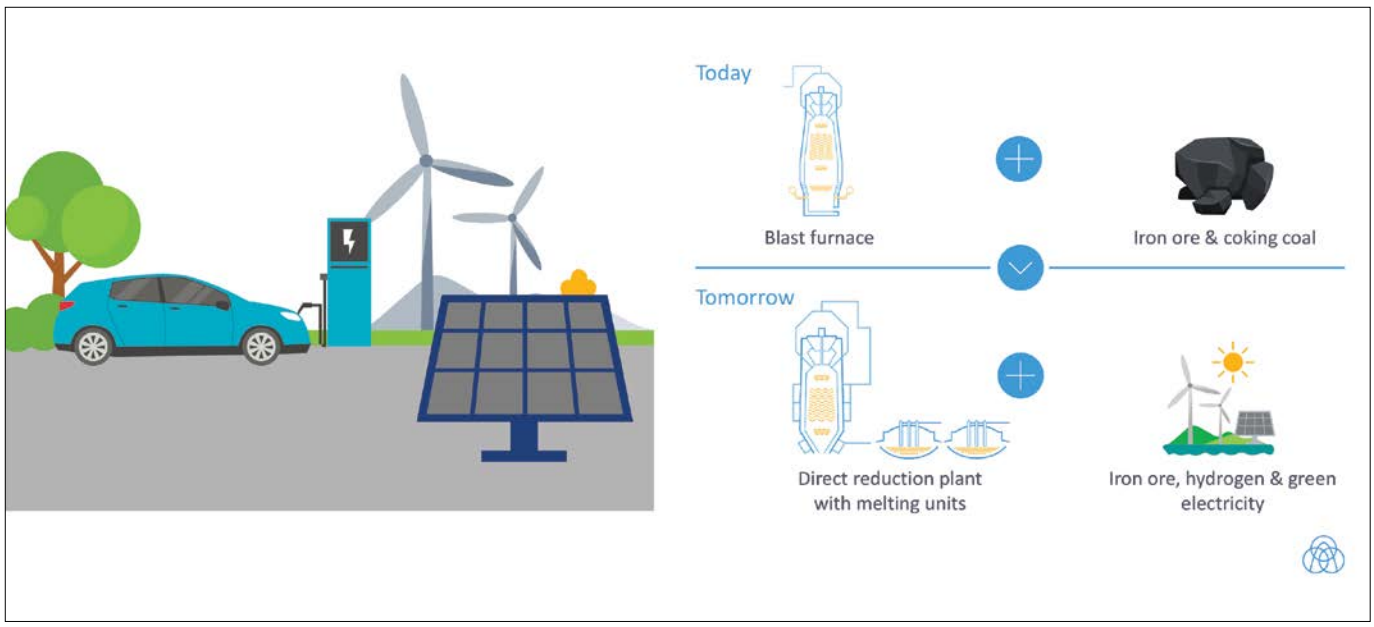
This transition pathway from conventional blast furnaces to DR plants powered by hydrogen represents an important step forward in steel production technology. By doing so, we aim to eliminate carbon emissions from our manufacturing processes by 2045 at the latest. Central to this effort is the utilization of hydrogen as a primary reducing agent in the DR plant.

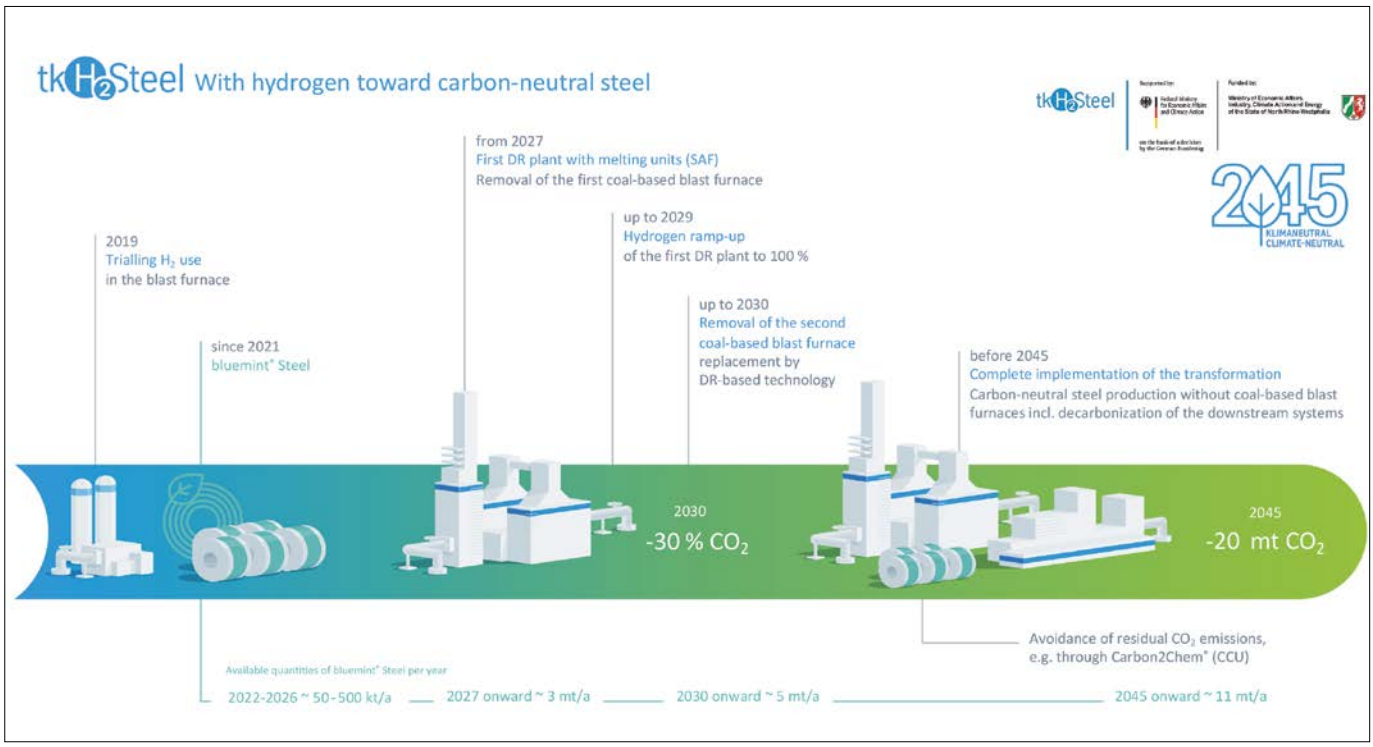
Our hydrogen ramp-up initiatives development of a cross-border hydrogen economy

With a capacity of 2.5 million tons and an annual saving of up to 3.5 million metric tons of CO_2 – equating to almost five percent of the emissions accounted for by the Ruhr region – the DR plant is an indispensable asset towards achieving the climate targets and, at the same time, towards securing the economic resilience of Germany as an industrial location. The key to the transformation project lies in our ambitious hydrogen ramp-up, which will quickly make for large CO_2 savings. The plant is scheduled to begin operation as early as 2029 with around 143,000 metric tons of hydrogen per year – the electricity needed to produce this amount of hydrogen corresponds to the output of around 800 wind turbines is planned for 2027.

We are actively exploring diverse strategies to address our growing hydrogen needs. The hydrogen requirement is being put out to tender in a transparent and broad-based procedure, with the aim of operating the DR plant fully on hydrogen by as early as 2029. These include near-site production, which allows for rapid delivery but poses challenges in scaling up and participation in European projects with pipeline access for streamlined distribution. We recognize that each approach offers unique advantages and challenges, and we are committed to finding the right blend of strategies to establish a resilient and sustainable hydrogen supply chain for the future.

Additionally, with a future electricity demand of ~ 14 TWh by 2030 solely for hydrogen production, which corresponds to 120 % of the electricity demand of the city of Hamburg, Power Purchase Agreements (PPA) play a crucial role in providing a sustainable and reliable energy supply to power our operations. By securing long-

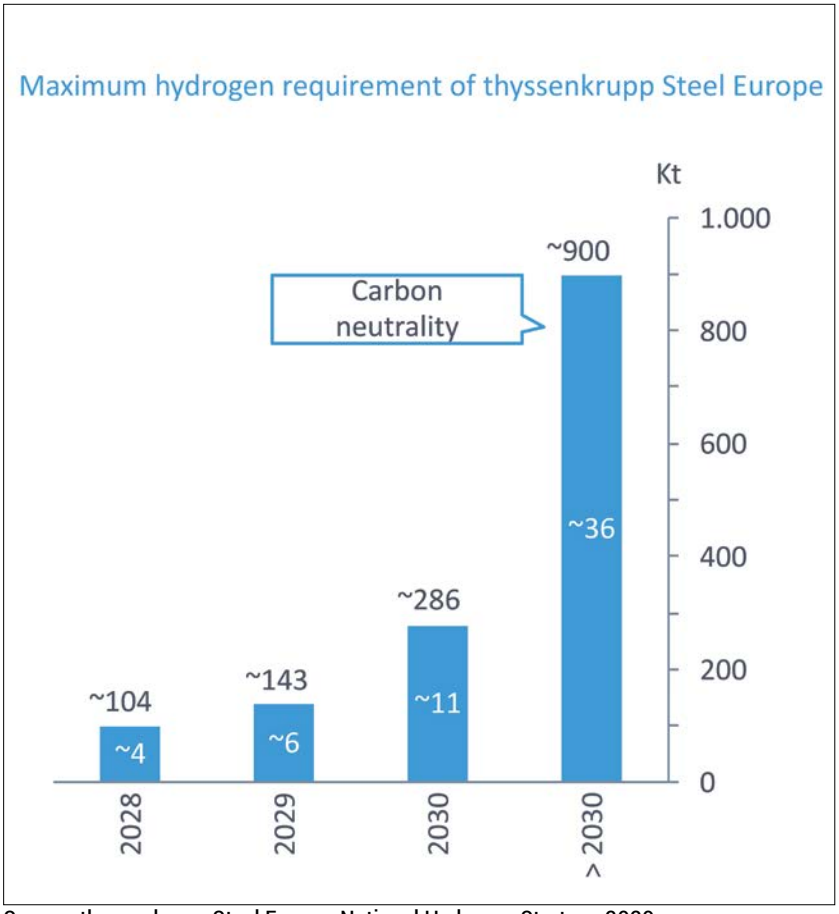




The hydrogen requirement is being put out to tender in a transparent and broad-based procedure, with the aim of operating the DR plant fully on hydrogen by as early as 2029

term access to renewable energy sources through PPAs, a solid foundation for our journey towards carbon neutrality can be created. We have just recently signed a long-term PPA to supply green electricity to the first DR plant at the Duisburg location. The electricity will be generated by an offshore wind farm 35 kilometers off the coast of Heligoland. This means offshore wind energy will make a significant contribution to supplying the energy for the tkH2Steel transformation project in the future and will help achieve climate goals. Additional contracts with green electricity producers will be required to

By adding specially prepared scrap to the blast furnace, the amount of charged iron ore and coke and the associated CO_2 emissions are reduced



Source: thyssenkrupp Steel Europe, National Hydrogen Strategy 2020

With the processing of bluemint® recycled, we already offer a CO_2-reduced grain-oriented electrical steel (GOES) bluemint® powercore® with up to 50% improved CO_2 emission factor of 1.9 kg CO2eq./kg GOES

fully supply the system with green electricity.

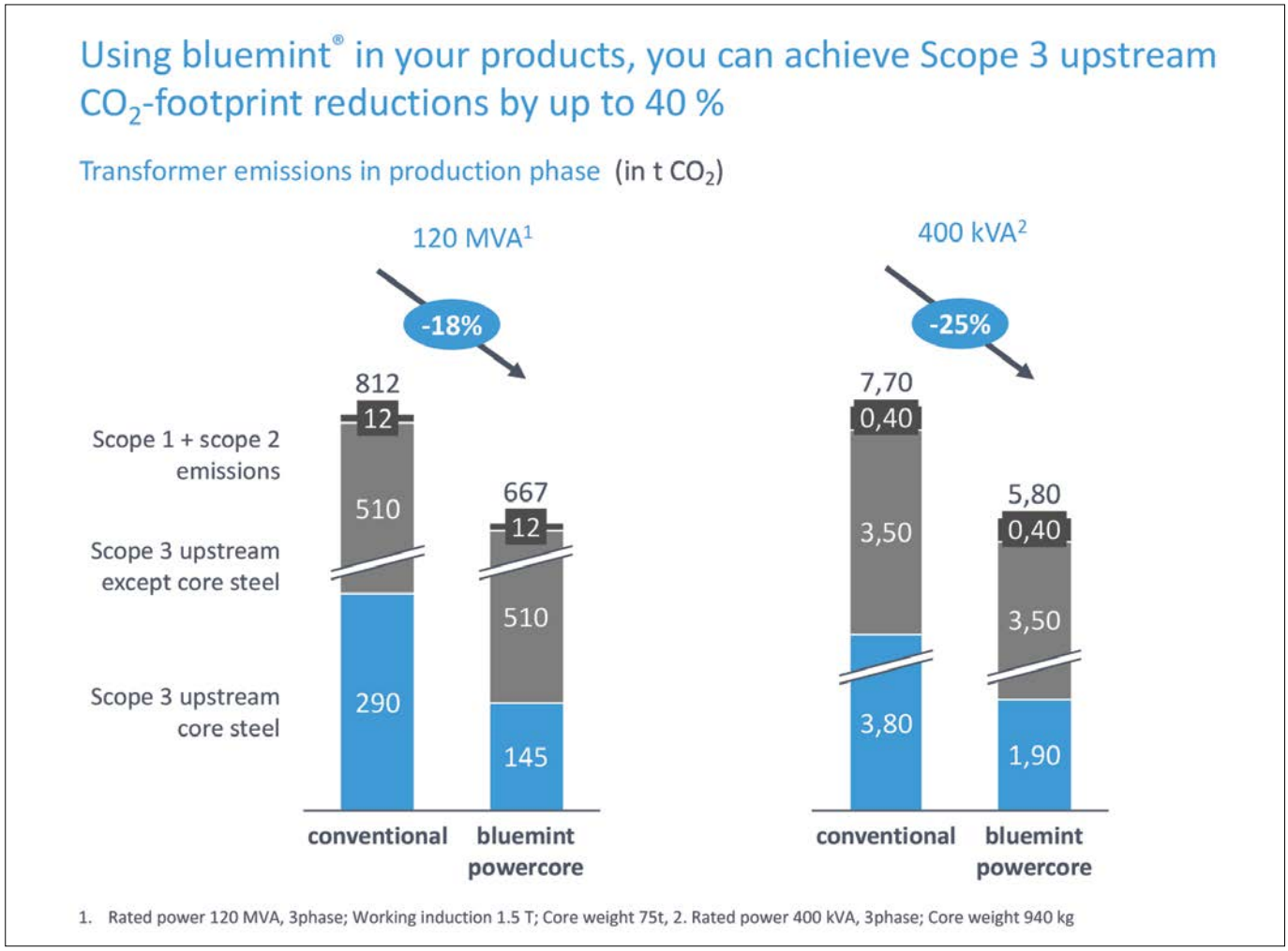
Before the first DR plant's commissioning, we are already using methods to reduce CO_2 emissions in existing blast furnaces. By adding specially prepared scrap to the blast furnace, the amount of charged iron ore and coke and the associated CO_2 emissions are reduced. We call the hot strip produced with this measure bluemint® recycled. The CO_2 emission factor of bluemint® recycled is determined based on the mass balance approach. In this way, the feedstock of the blast furnace process consists of a standard feedstock (iron ore) and a CO_2-reduced feedstock (scrap). The mixed inputs are allocated into two products, a conventional hot metal from iron ores and a mass balanced hot metal from scrap.

With the processing of bluemint® recycled, we already offer a CO_2-reduced GOES bluemint® powercore® with up to 50% improved CO_2 emission factor of 1.9 kg CO2eq./kg GOES. Because of the huge impact of GOES, the PCF of a transformer can be reduced by up to 40 % with the use of bluemint® powercore® (Cradle-to-Gate).

The mass balance approach to promoting green products is well established for complex industrial production processes in the chemical and steel industry. The methodology is questioned because it is explicitly not accepted by the EPD standard (ISO 15804). We tackle this issue by a clear and transparent communication demonstrating that no double-counting takes place, the attributed CO_2 savings are linked directly to CO_2 savings in the production process or the used raw materials and providing confirmation about the achieved savings from external certifiers. Moreover, we are extending the methodology to other product categories required by the EPD.

Meaning and implications for the transformer industry

A closer look at the transformer market specifically reveals a crucial observation: the reduction of emissions in purchased transformers is a strategic must,



Here, CO_2-reduced grain oriented electrical steel will be a critical lever in achieving our customers' aspirations for sustainably sourced transformers as our product represents an important key component of transformers

and GOES is a core part of high-power transformers. Lowering CO_2 emissions throughout the entire lifecycle of these transformers becomes instrumental for the industry. Here, CO_2-reduced grain oriented electrical steel will be a critical lever in achieving our customers' aspirations for sustainably sourced transformers as our product represents an important key component of transformers. This is especially true with the growing demand for high-quality, thin, and sustainable electrical steel amidst grid expansions.

In essence, the commitments of steel producers to sustainability and carbon-neutral products represent more than just a paradigm shift; they signify a transformation in the way industries approach sustainability. As we continue to invest in sustainable practices and form new partnerships, we are proud to support the transformer industry on its journey towards a greener, more sustainable future.

We all need to work closely together

The path to a successful energy transition is not just of solitary nature. It is something that demands collaboration, shared learning, and, most importantly, joint industrial projects. This combination of efforts not only drives innovation but paves the way for real green lead markets, exemplified by collaborations like Siemens Energy and Siemens Gamesa, where around 700 transformers made of the lower CO_2 emission material are installed in the nacelles of offshore wind turbines for Siemens Energy's wind power business Siemens Gamesa. We need more of these success stories in Germany, the EU and globally to prove the high practicability and gain further trust for such projects, not only in our industry and markets but also in political institutions and the broader public.

Creating a common understanding and framework is imperative. Joint industry projects and working groups foster a shared lexicon and understanding, essential for communicating with policymakers to shape a supportive environment for flourishing green markets. This collaborative mindset and the resulting actions mitigate risks like not having enough standardized approaches and low trust in green markets due to a lack of successful use cases.

Moreover, it lays the foundation for fruitful political dialogues. What all of us need to succeed is a supportive political framework, advocating for fair competition in European and global markets, regulatory support for climate-neutral technologies, and incentivizing the purchase of green products.

Green lead markets need a sustainable and resilient supply chain - the above-mentioned cornerstones are essential to making this possible. The past has shown that a diversified market environment is crucial for long-term stability, especially regarding potential shortages, steady pricing or potential material shortages.

In this transformative environment, joint endeavours and a harmonized approach will not only define the success of the energy transition but also herald a new era of sustainability, innovation, and trust in green markets.

The will of companies, communities, and governments to invest in our renewable future and, consequently, the electricity grid is unmissable – we must ensure that the very means of manufacturing essential equipment, such as transformers, align with the sustainability goals.

In this transformative environment, joint endeavours and a harmonized approach will not only define the success of the energy transition but also herald a new era of sustainability, innovation, and trust in green markets

Author

Marcel Hilgers is Vice President of Customers, Markets & Technology at thyssenkrupp Electrical Steel. He believes in listening to his customers and creating solutions to serve their true needs. With over 20-year of experience in the global steel business, and thereof over 10 years serving the transformer industry, he now works intensely on the green transformation of both steel and transformers.
Marcel leads the sales, technical customer engineering and communications team at thyssenkrupp Electrical Steel – the European and Indian market leader in grain oriented electrical steel.
His key priority today is to inform the electricity industry about options to decarbonize the grid and to form alliances across raw material suppliers, transformer makers and electric utilities.