



The Need for Collaborative Approaches:

Securing a Resilient and Sustainable Supply Chain for Transformers

June 2024 | Marcel Hilgers, VP Customers, Markets & Technology
thyssenkrupp Steel | Electrical Steel

engineering.tomorrow.together.



Overview

- 1 GOES – market, demand and supply
- 2 Green transformation at thyssenkrupp Steel Europe – Short introduction
- 3 Green steel label & green lead market concept
- 4 Let us take action now



Electrical Steel for the energy transition

ENERGY GENERATION

Non grain-oriented (NGO)



Non grain-oriented electrical steel for
GENERATORS

ENERGY DISTRIBUTION

Grain-oriented (GOES)



Grain-oriented electrical steel for
TRANSFORMERS

ENERGY UTILIZATION

Non grain-oriented (NGO)



Non grain-oriented electrical steel for
ELECTRIC MOTORS

thyssenkrupp Electrical Steel at a glance

thyssenkrupp AG

thyssenkrupp Steel Europe

thyssenkrupp Electrical Steel

Plant Gelsenkirchen



Employees: 694

Area: 17 ha

Production volume: 75 kt/a



Plant Isbergues



Employees: 520

Area: 11 ha

Production volume: 75 kt/a



Plant Nashik



Employees: 498

Area: 62 ha

Production volume: 45 kt/a



Top grades GOES – further
development of low loss
grades



Low noise performant
GOES



Decarbonization strategy
implementation

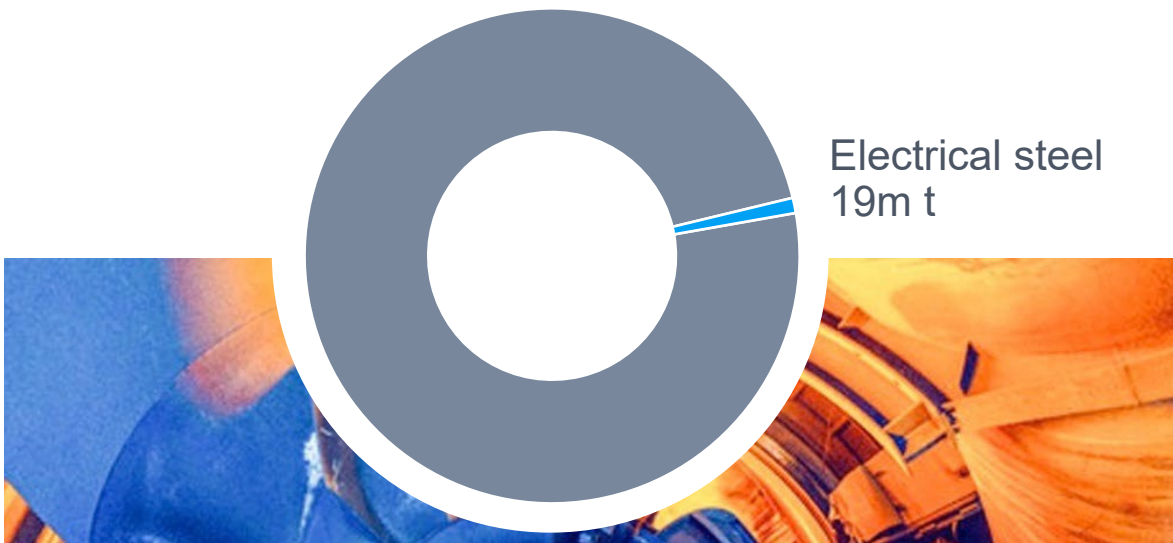


E-mobility with
new drive concepts

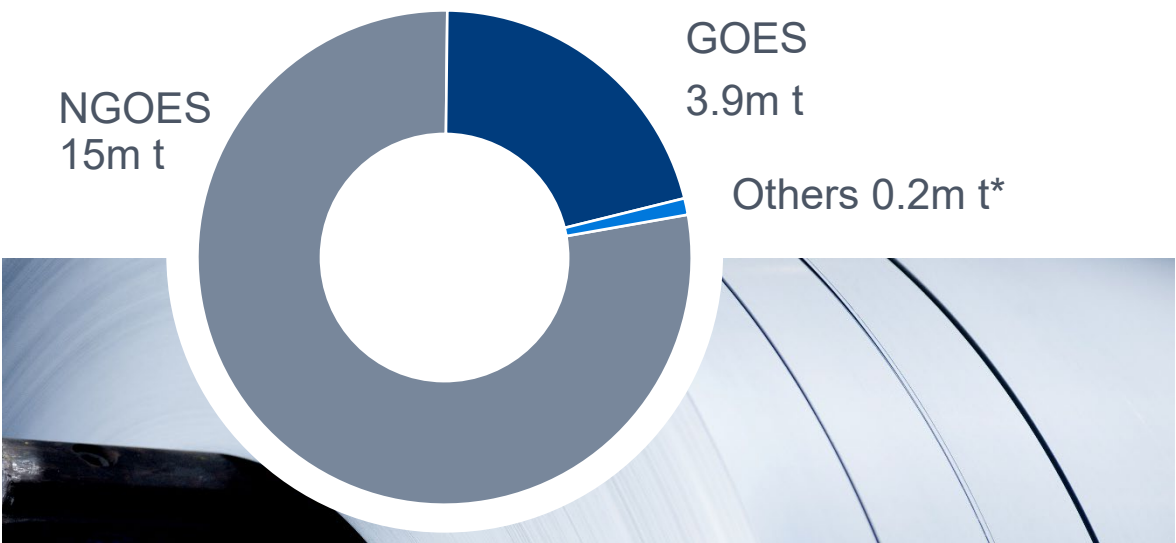
Electrical Steel - a strategic and fast growing niche product

Indispensable material for the electricity value chain - from generation over transmission/distribution to use

Global Steel production 2023 1.9b t



Global Electrical Steel production 2023 18m t



Non grain oriented electrical steel



Motors, drives



Hydro, wind, power generators



Fans, ballasts



Pump motors



Alternators

Grain oriented electrical steel



Power transformers



Distribution transformers



Wound core transformers



Power generators



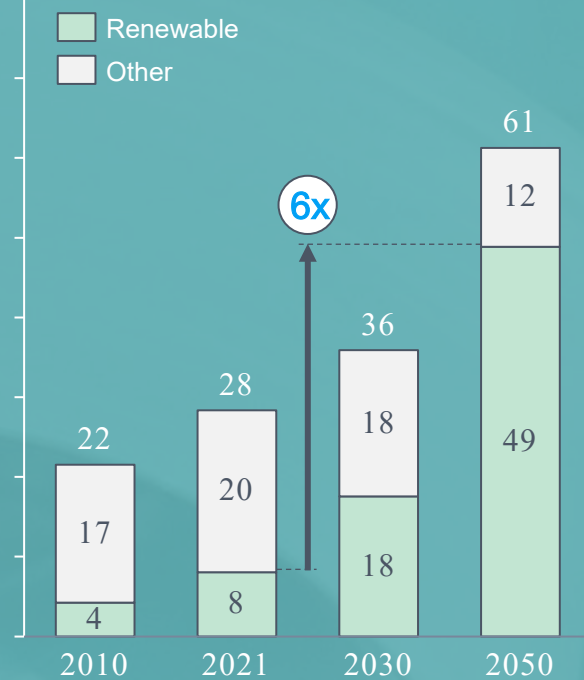
Rectifiers

*Powder Ferrites, Cobalt based alloys, Nanocrystalline etc .

Integration of renewables and a decentralized grid needs more transformers...

Renewable electricity to 6x

Announced Pledges Scenario, kTWh

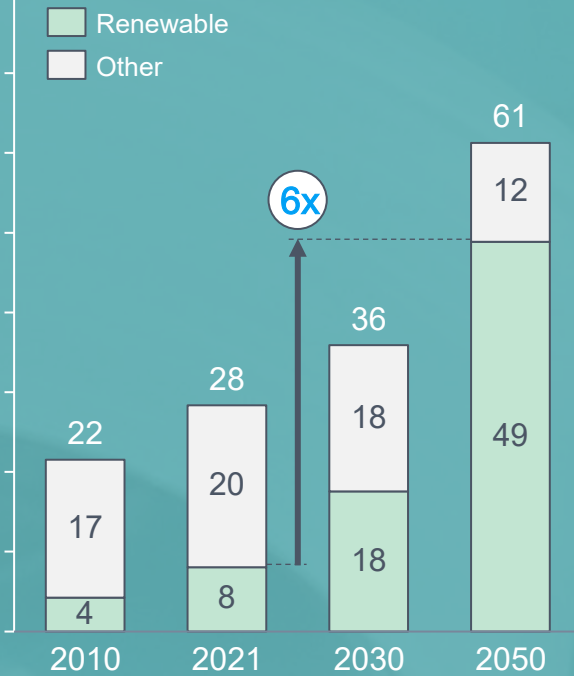


... and additional grid connections, new HVDC and interconnector lines...



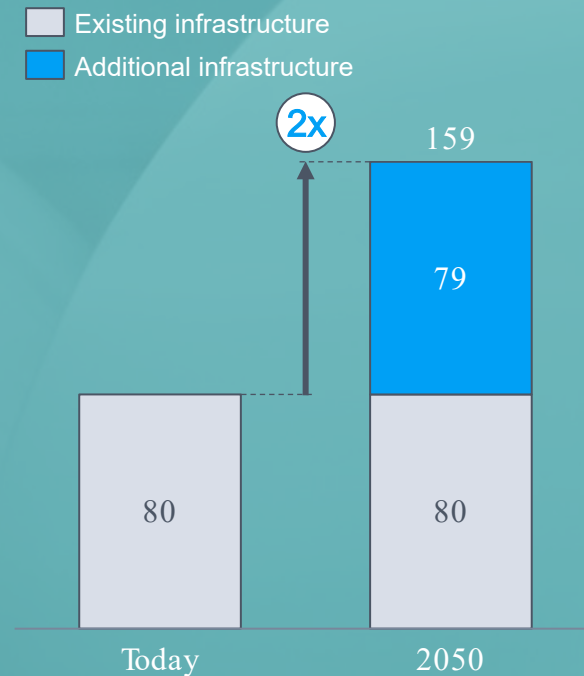
Renewable electricity to 6x

Announced Pledges Scenario, in TWh



Electricity grid km to double

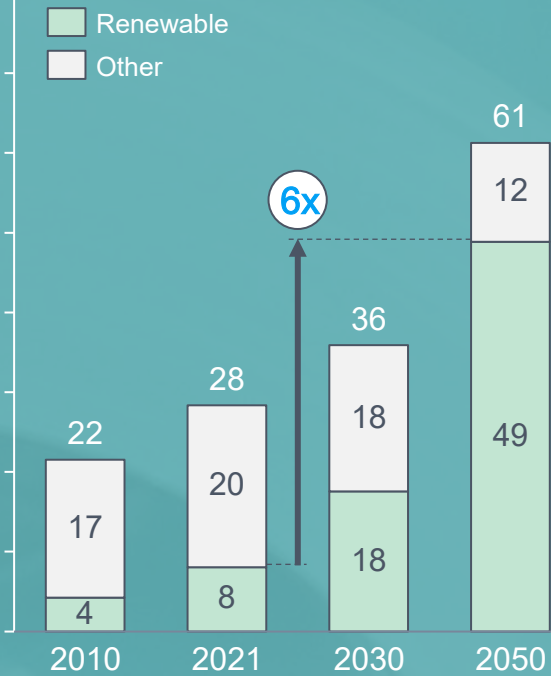
in million km



...which will triple the annual invest in electricity grids...

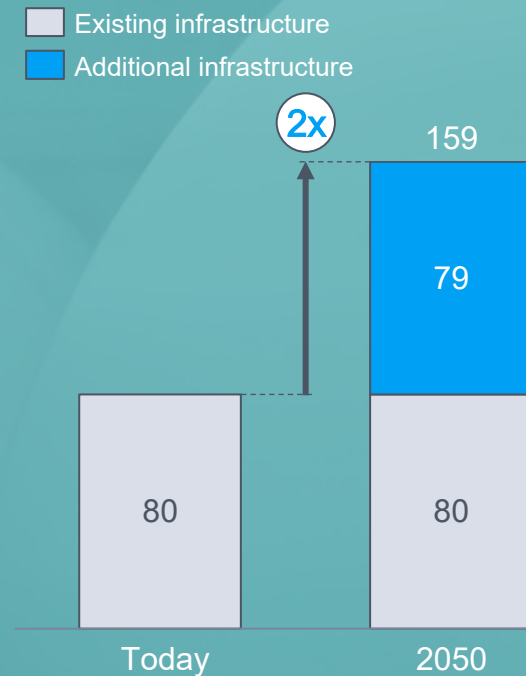
Renewable electricity to 6x

Announced Pledges Scenario, *kTWh*



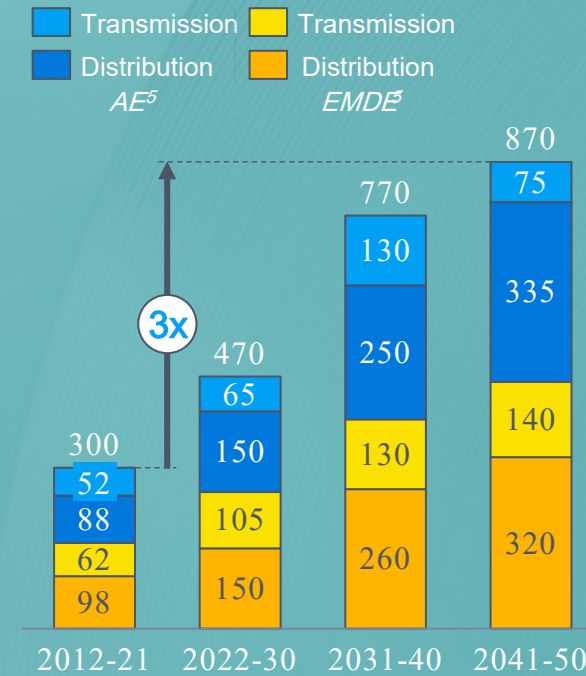
Electricity grid km to double

in million km



Annual grid investments to 3x

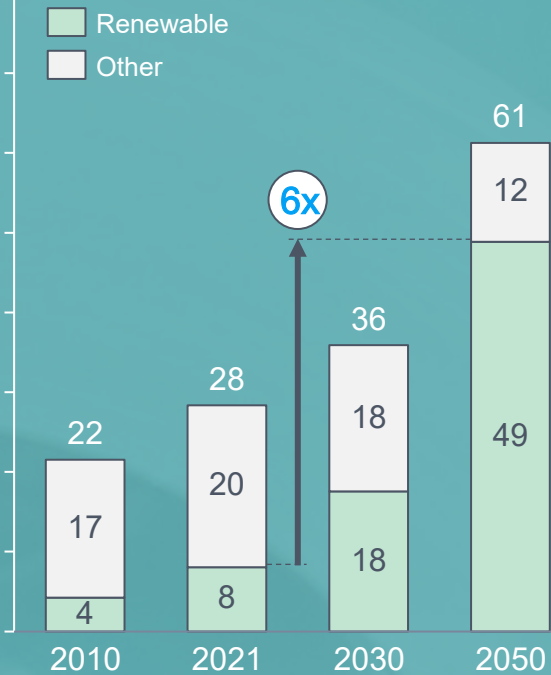
in billion USD



...and leads to a massive increase in transformer- thus GOES demand

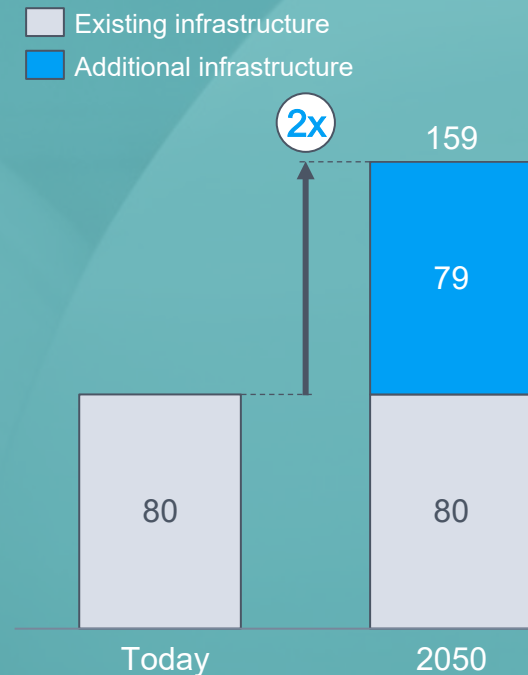
Renewable electricity to 6x

Announced Pledges Scenario, $kTWh$



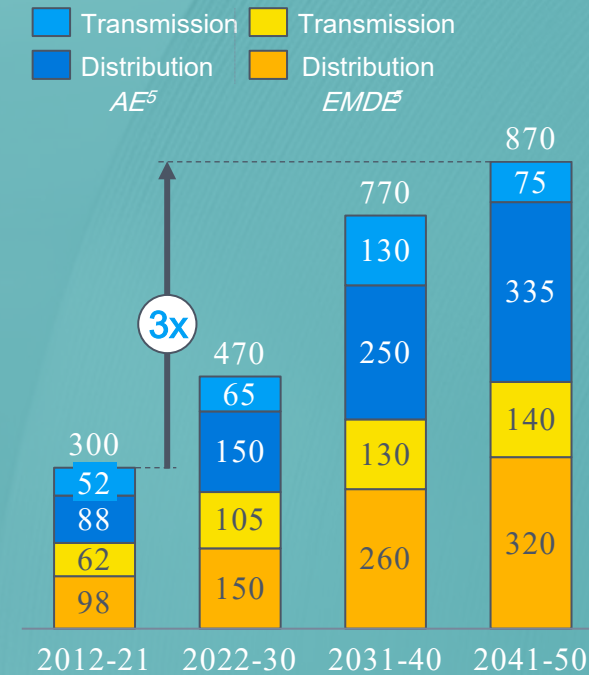
Electricity grid km to double

in million km



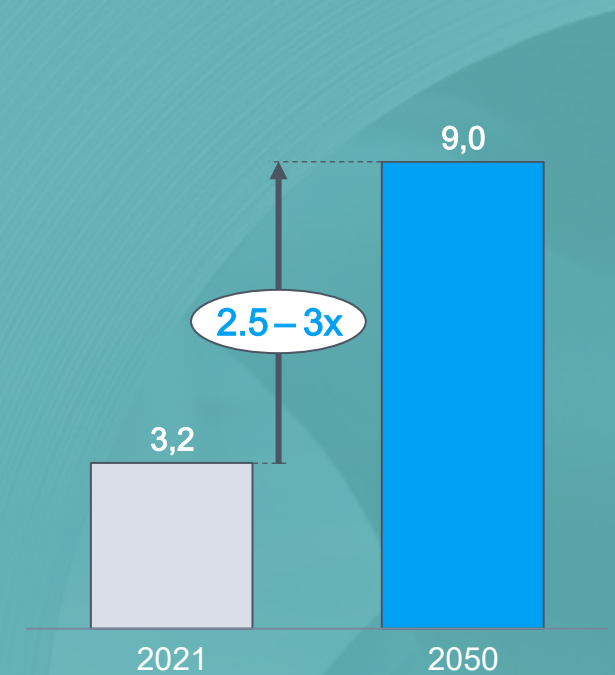
Annual grid investments to 3x

in billion USD



Global GOES demand to ~235⁴

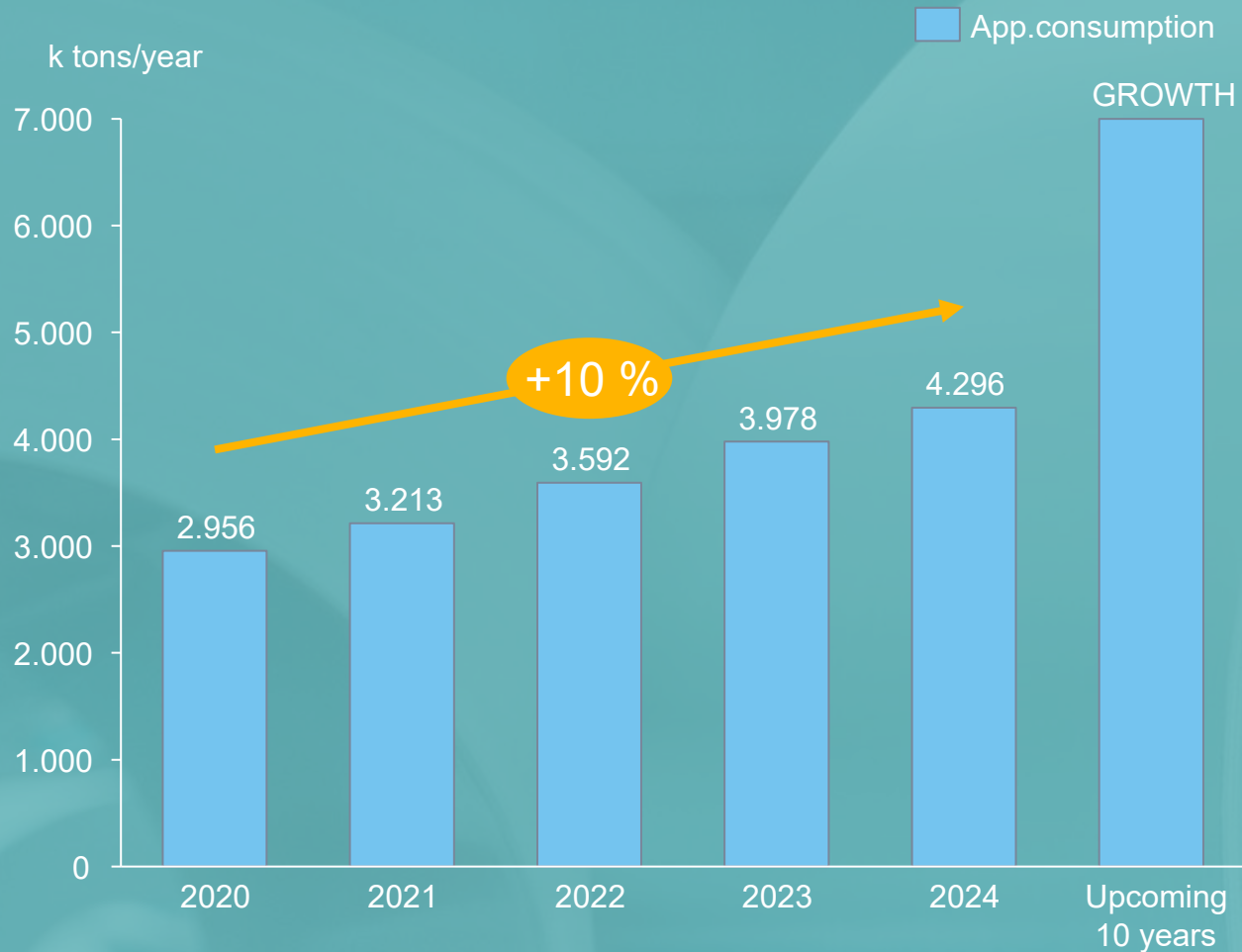
in million tons



- ✓ Global megatrends fuel growth: shift to (decentral) renewable energy generation requires massive electricity grid investments
- ✓ Global GOES demand is expected to grow 2.5x – 3x until 2050
- ✓ EU GOES demand is projected to increase significantly

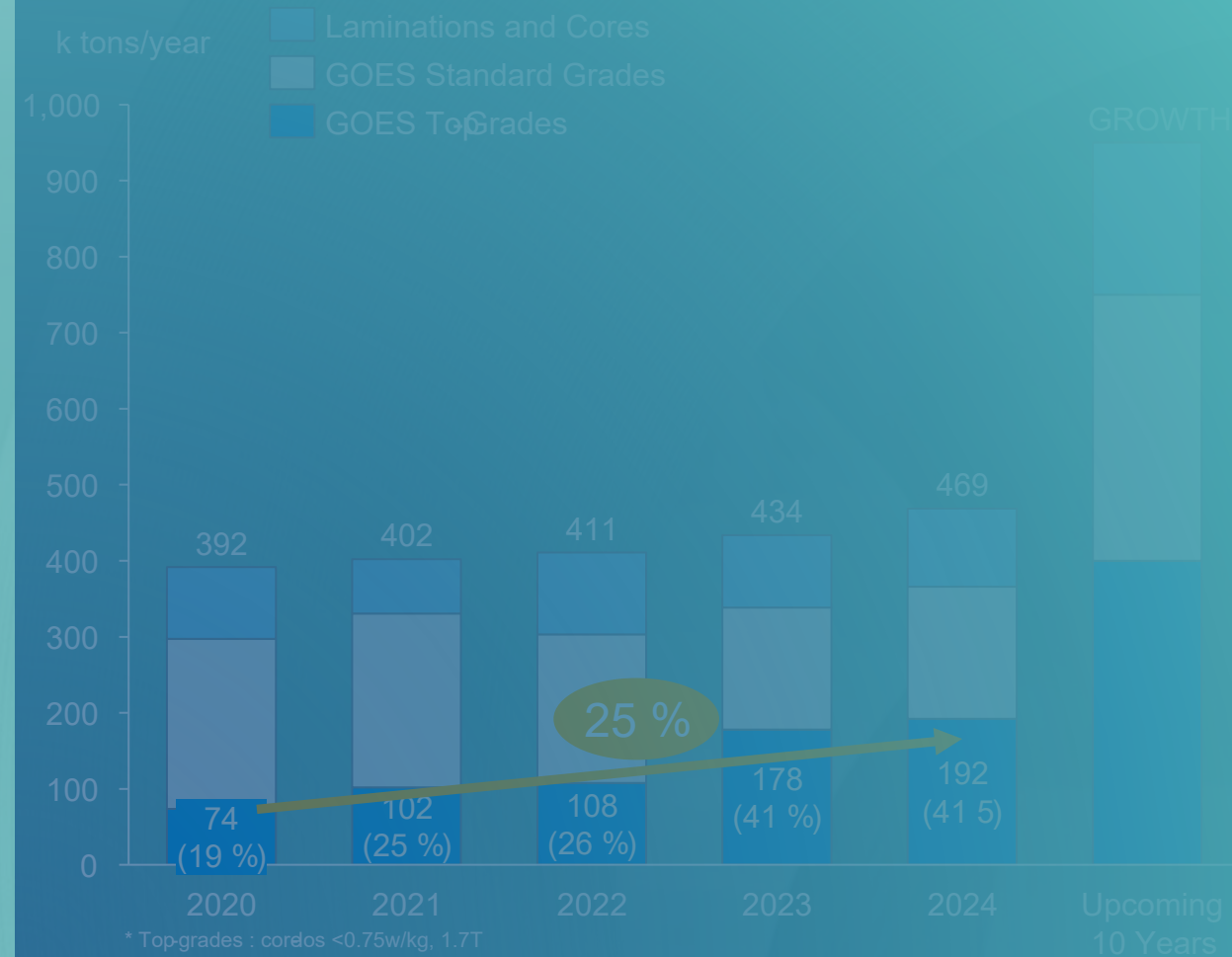
Demand for transformers and thus GOES is growing fast...

Global - GOES apparent consumption



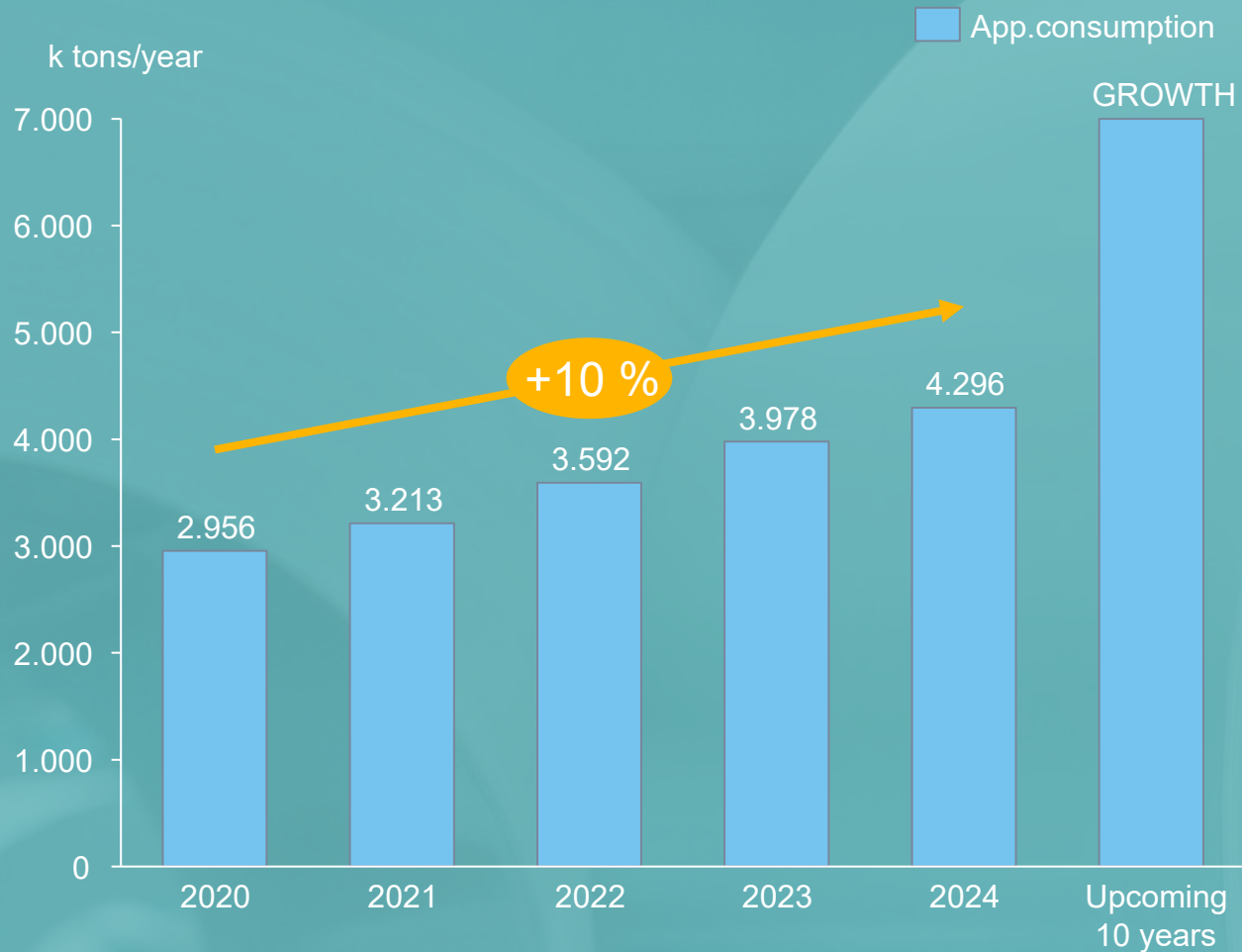
Source: Wv StahlkES

EU – GOES apparent consumption

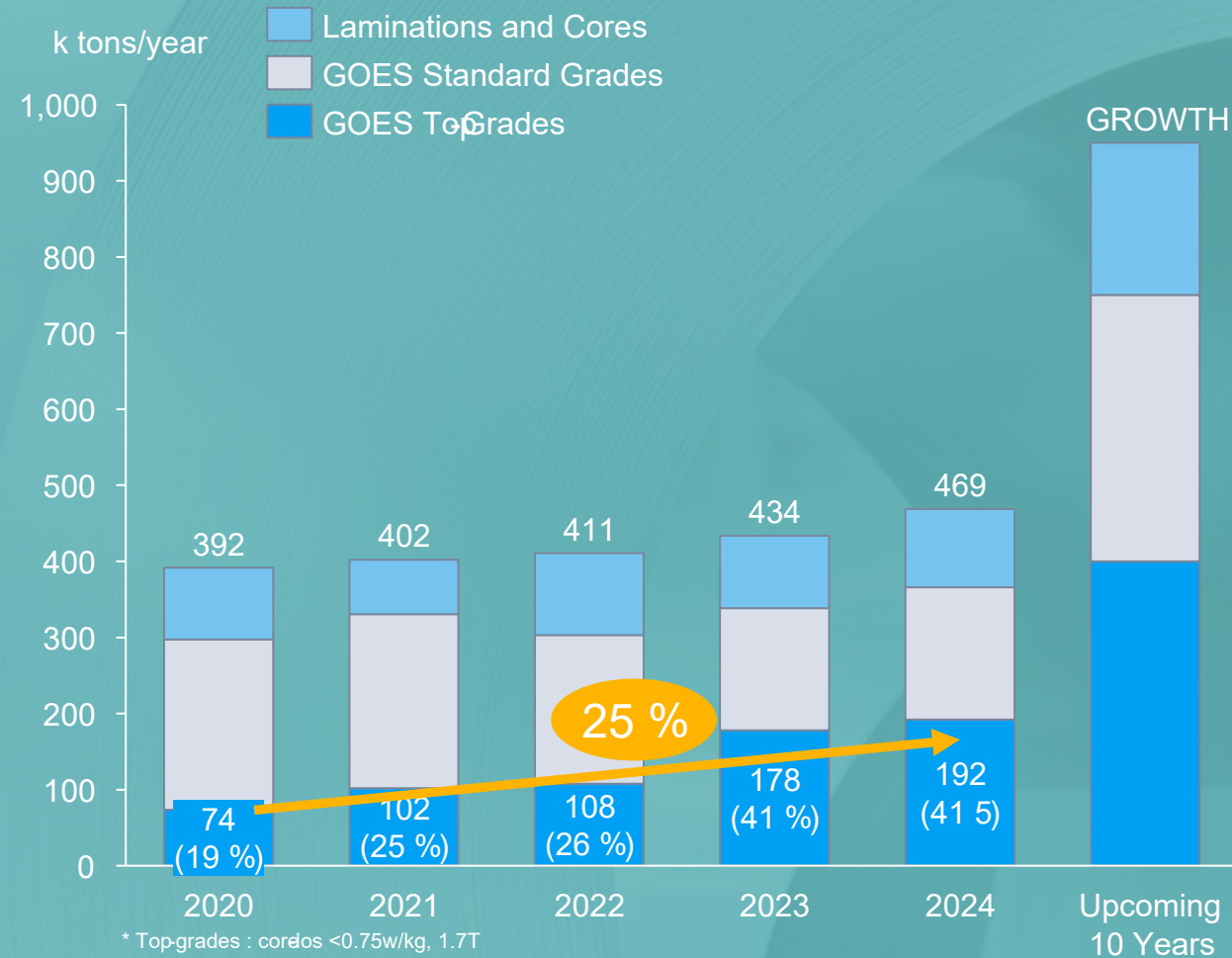


...especially Top Grades with CAGR 25 %+

Global - GOES apparent consumption

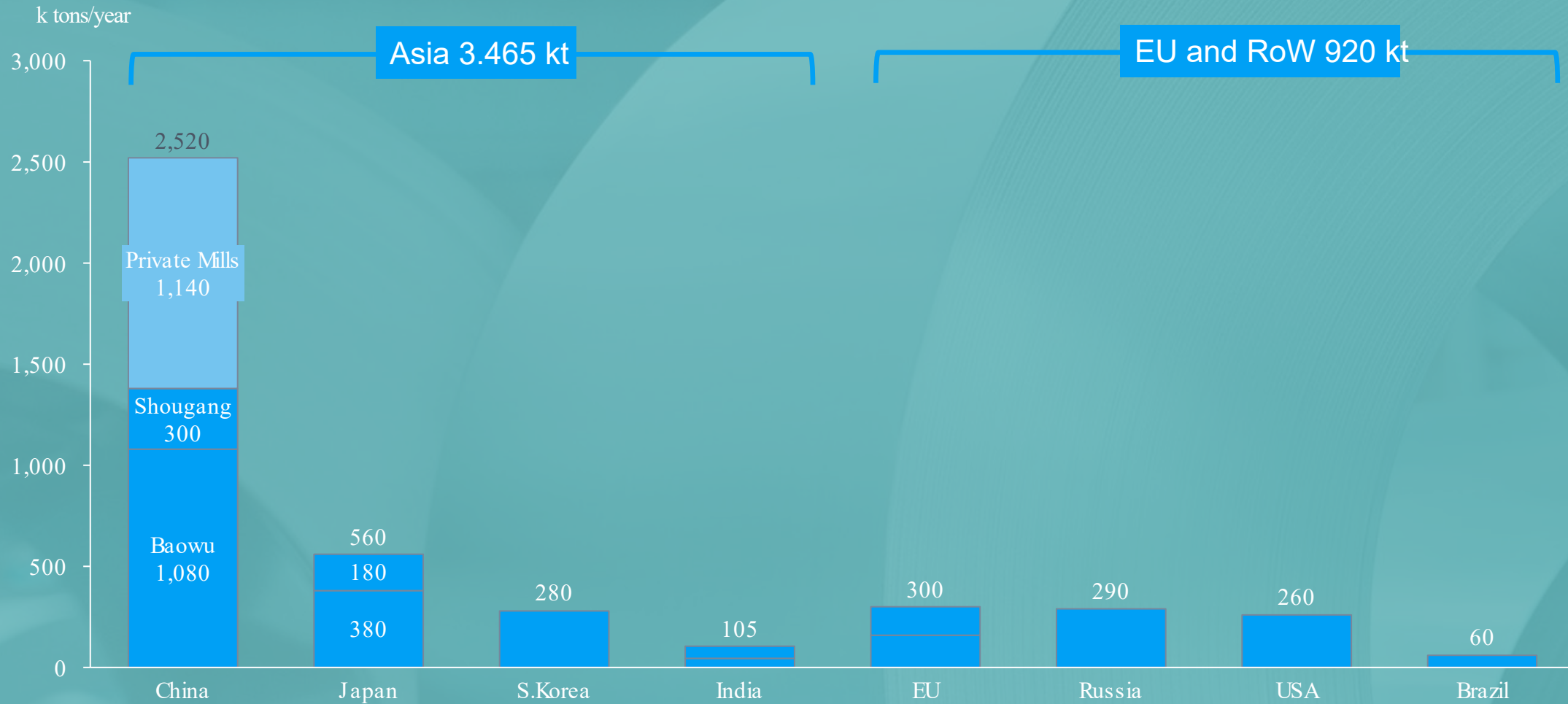


EU – GOES apparent consumption



China dominating GOES capacity – a resilient and sustainable supply base?

GOES production capacity per country in 2023



Overview

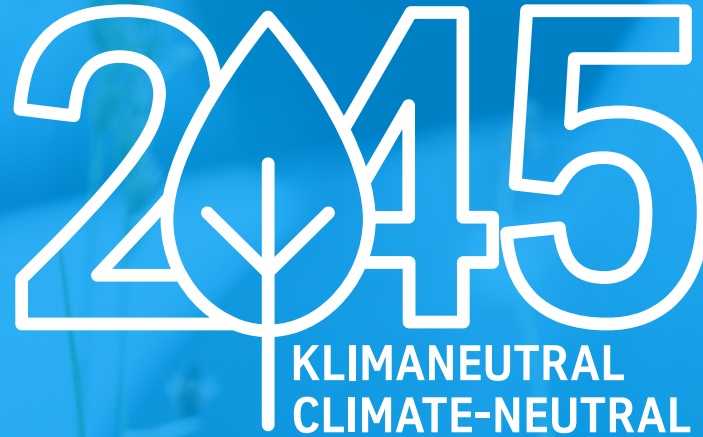
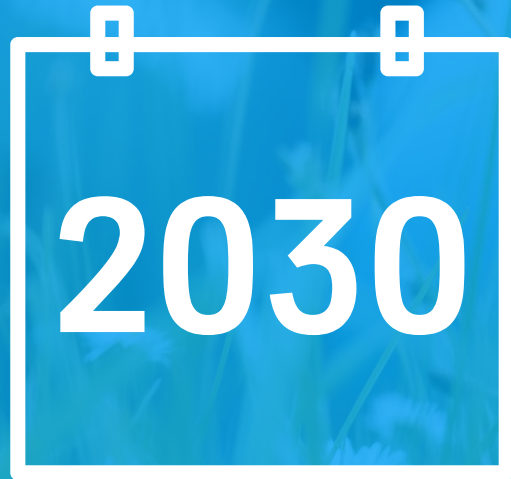
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Our climate goals

>30%

Reduction of
CO₂ emissions¹
(6 Mio. t)



-100%

Reduction of CO₂ emissions
(20 Mio. t)

Our memberships in various
climate initiatives underline
our engagement



¹ – 30 % CO₂-Emissionen im Jahr 2030 bezieht sich auf Scope 1- und Scope 2-Emissionen (Referenzjahr 2018).

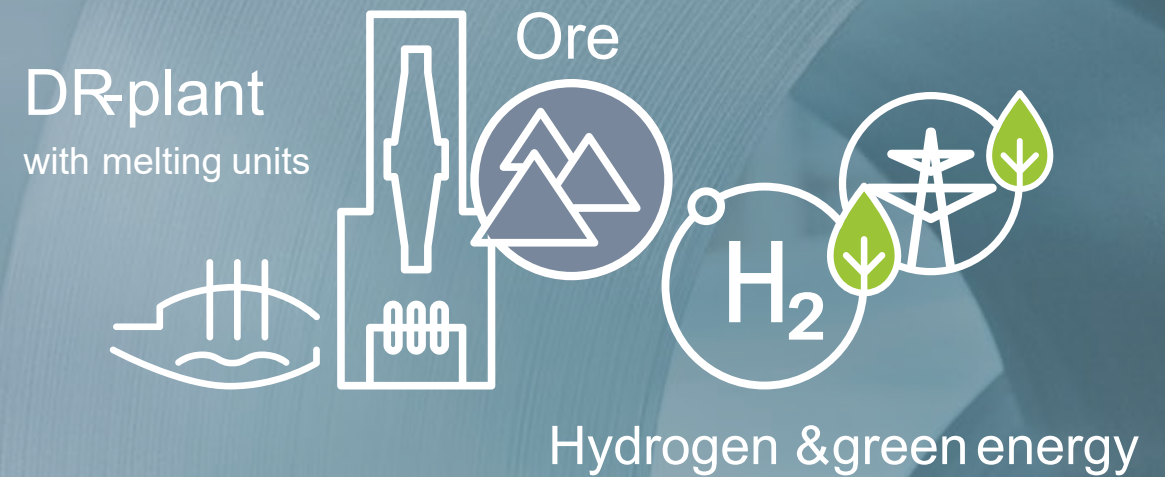


Steel is an essential component for a **SUSTAINABLE ENERGY TRANSITION**

Today

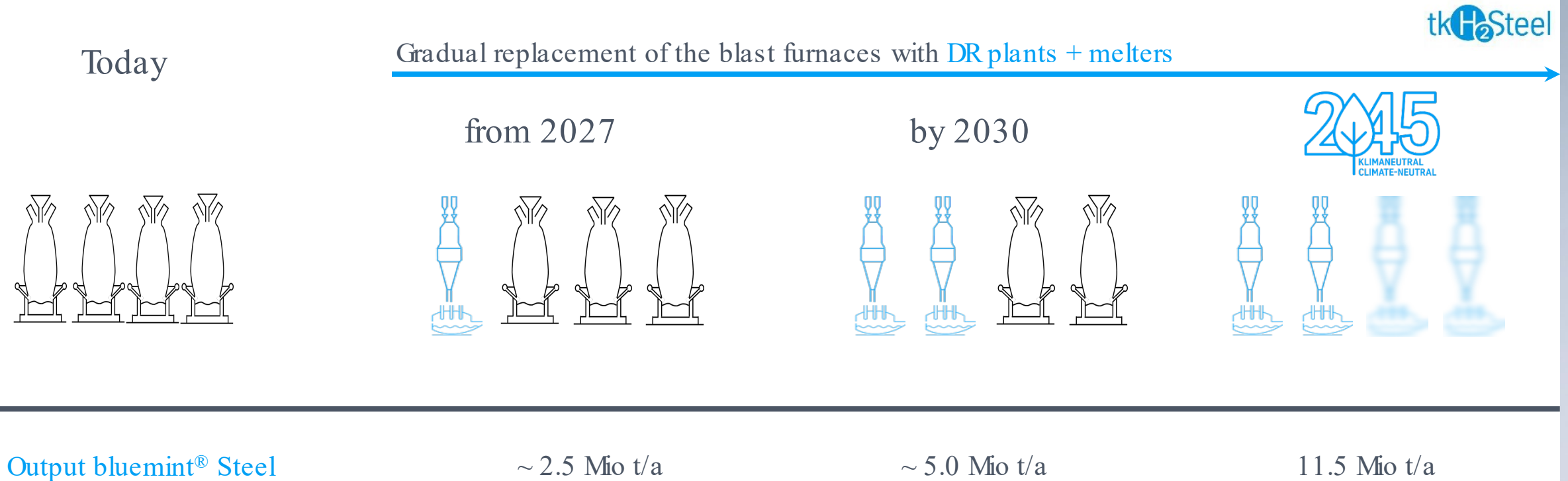


Tomorrow



The core of our transformation is the switch from blast furnaces and coal to direct reduction (DR) plants and green hydrogen. In short: tkH2Steel®.

Transformation only possible step-by-step...

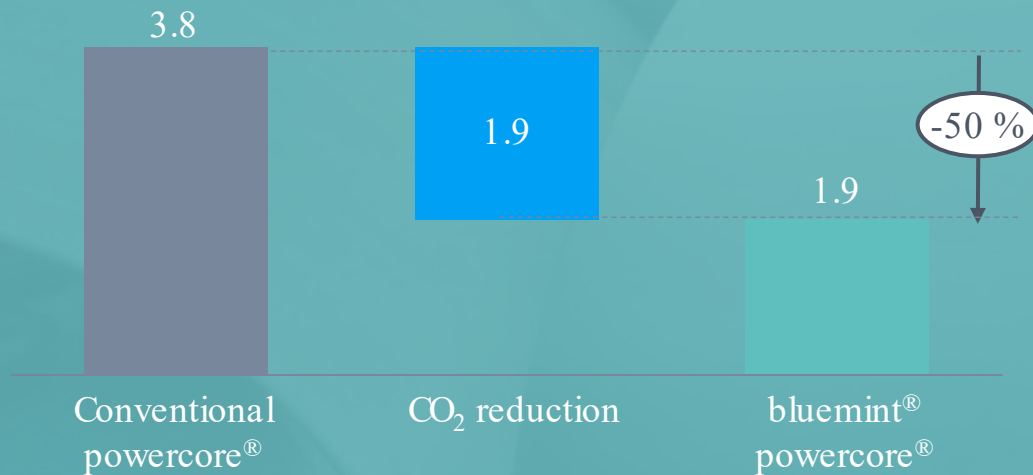


⇒ Mass balancing necessary during transformation process



Until the first DR plant is running, bluemint® powercore® provides you with numerous advantages and opportunities to reduce upstream emissions along the supply chain

CO₂ intensity in grain oriented electrical steel
(t CO₂-equ/t powercore®)



Effortless technical implementation

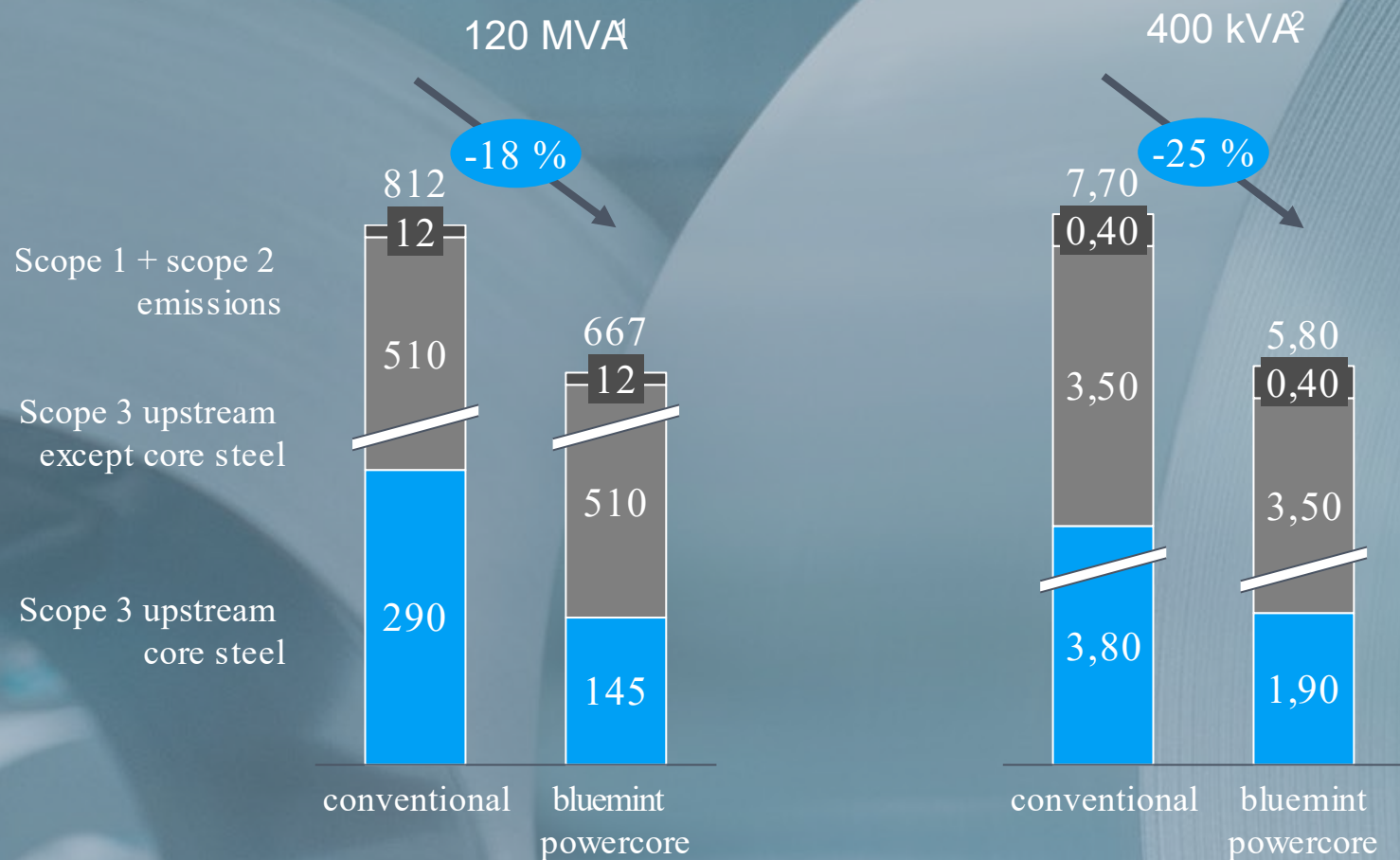
Continuation of existing processes means there is no need for (re-) qualification

Continuous commitment to excellent magnetic and low-noise performance



Using bluemint® in your products, you can achieve scope 3 Upstream CO₂-footprint reductions by up to 40 %

Transformer emissions production phase (in t CO₂)



Up to -40 %

CO₂ emissions per transformer when using bluemint® powercore®

Certified by DNV

CO₂ savings and resulting specific CO₂ emissions of bluemint® powercore® are already externally certified by DNV, no additional effort needed

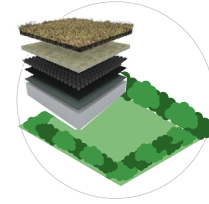
You will receive a certificate for bluemint® powercore® confirming carbon intensity and savings of CO₂ emissions (Scope 3)

1. Rated power 120 MVA, 3phase; Working induction 1.5 T; Core weight 75t; 2. Rated power 400 kVA, 3phase; Core weight 940 kg

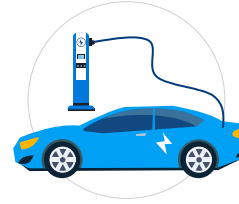
bluemint® is a major and a most cost-efficient lever for reducing CO₂ emissions



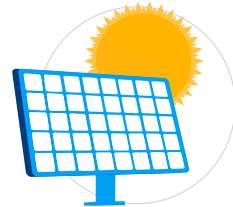
Switching ~9,600
light bulbs to LED



Greening roofs of
>790 transformer
houses (functioning
for 10 years)



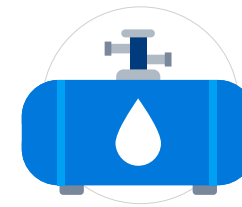
Driving 1.4m km with
electric vehicles instead
of combustion engines
(~36x around the earth)



Installing ~48 solar
PV panels operating
for 25 years



Replacing ~84
transformers to
more energy
efficient models



Sourcing ~2.4mn MJ
biomethane instead of
natural gas (heating
~83 single-family
homes for one year)



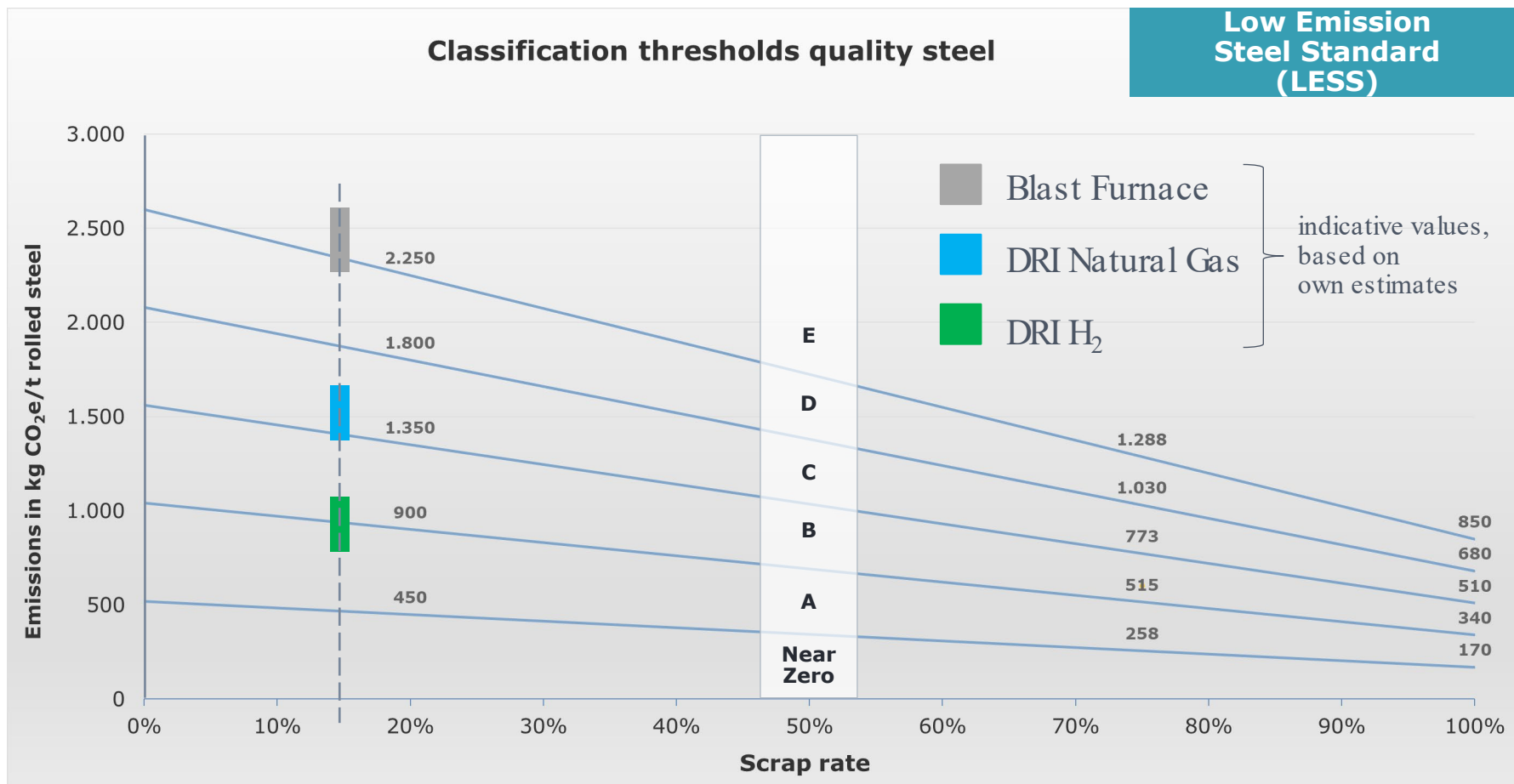
Producing 1 Power
transformer
(135 t core weight)
with bluemint®
powercore®

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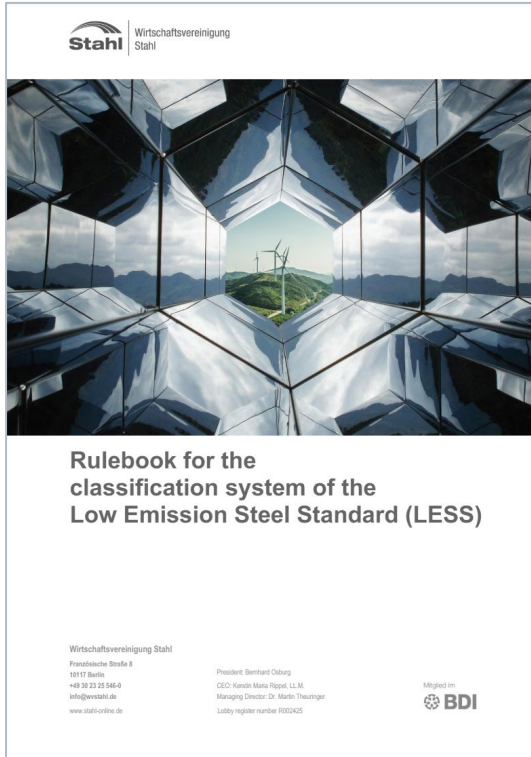
As part of a BMWK stakeholder process for green lead markets, WV Stahl has developed a definition for climate-friendly steel



The journey
towards near-zero
steel

Scrap dependent
emission intensity
thresholds

Labelling system LESS - the foundation for CO2-reduced lead markets



LESS
LOW EMISSION STEEL STANDARD

Classification
Certified according to: LESS-Rulebook
Certificate no.: []

Scrap share
XXX %

Product Carbon Footprint
Certified according to: []
Certificate no.: []
XXX kg CO₂e /t product

Classification
Certified according to: LESS-Rulebook
Certificate no.: []

Scrap share
XXX %

GWP-total according to EPD
Certified according to: []
Certificate no.: []
XXX kg CO₂e /t product

Labelling for CO2-reduced steel supports the transformer supply chain by...

- ✓ creating **transparency** and **comparability** of manufacturing processes and products
- ✓ forming the basis for the creation of **lead markets**

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Workshop on sustainable transformers – Paving the way to create the first green lead market

Joint event with Siemens Energy and TSOs/DSOs to prepare the path for sustainable transformers with the example of Green Steel in the Supply Chain:

Starting from Blast Furnace (future DRI) to Electrical Steel via transformer producers to the national grid infrastructure



We need more of these discussions and they need to be followed by actions.

Given the long investment cycles for stationary transformers, **now is the time to act** to decarbonize the grids towards a net-zero future



- New transformers built today will (to a large extent) still be **part of the infrastructure after 2060 (!)**
- Often **lengthy tender processes** years in advance
- **Project realization** usually takes several years



Early focus on green materials necessary!



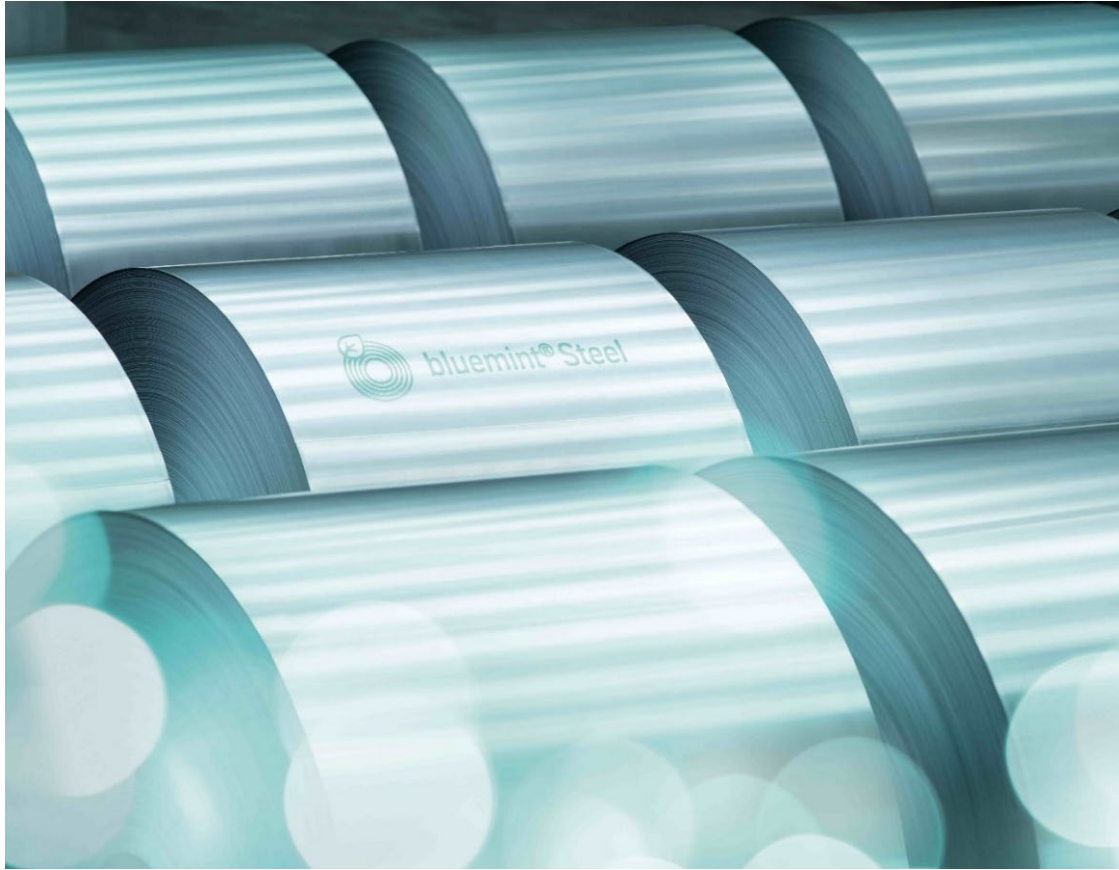
Concept of lead markets for CO₂-reduced raw materials announced!



The BMWK's initiative to create lead markets for climate-friendly basic materials is an approach that integrates innovation, regulation, and collaboration to drive the transition to a sustainable economy.

- ✓ Connectivity on EU and global level
- ✓ Basis to foster collaboration between various stakeholders
- ✓ Encouragement of formation of strategic partnerships in the industry to share knowledge, drive innovation and coordinate efforts in promoting climate-friendly materials

There are numerous opportunities to get involved today's start now!



Implementation of **pilot projects** with CO₂-reduced transformer core laminations



Change in tender processes with (proportion of) green material as an award requirement

- Tender criteria
- Green steel label system (LESS)
- Initiatives for green lead markets (BMWK)
- High efficiency to minimize losses over the life cycle



Cooperation with the regulatory authority to support investments in green infrastructure

We have started the co-creation of the world's first green lead market... join us and be on board!

Thank you for your attention

Let us discuss!

engineering.tomorrow.together.



thyssenkrupp