

Media Day

Electrical Steel

19 January 2022 | Georgios Giovanakis, CEO
thyssenkrupp Electrical Steel

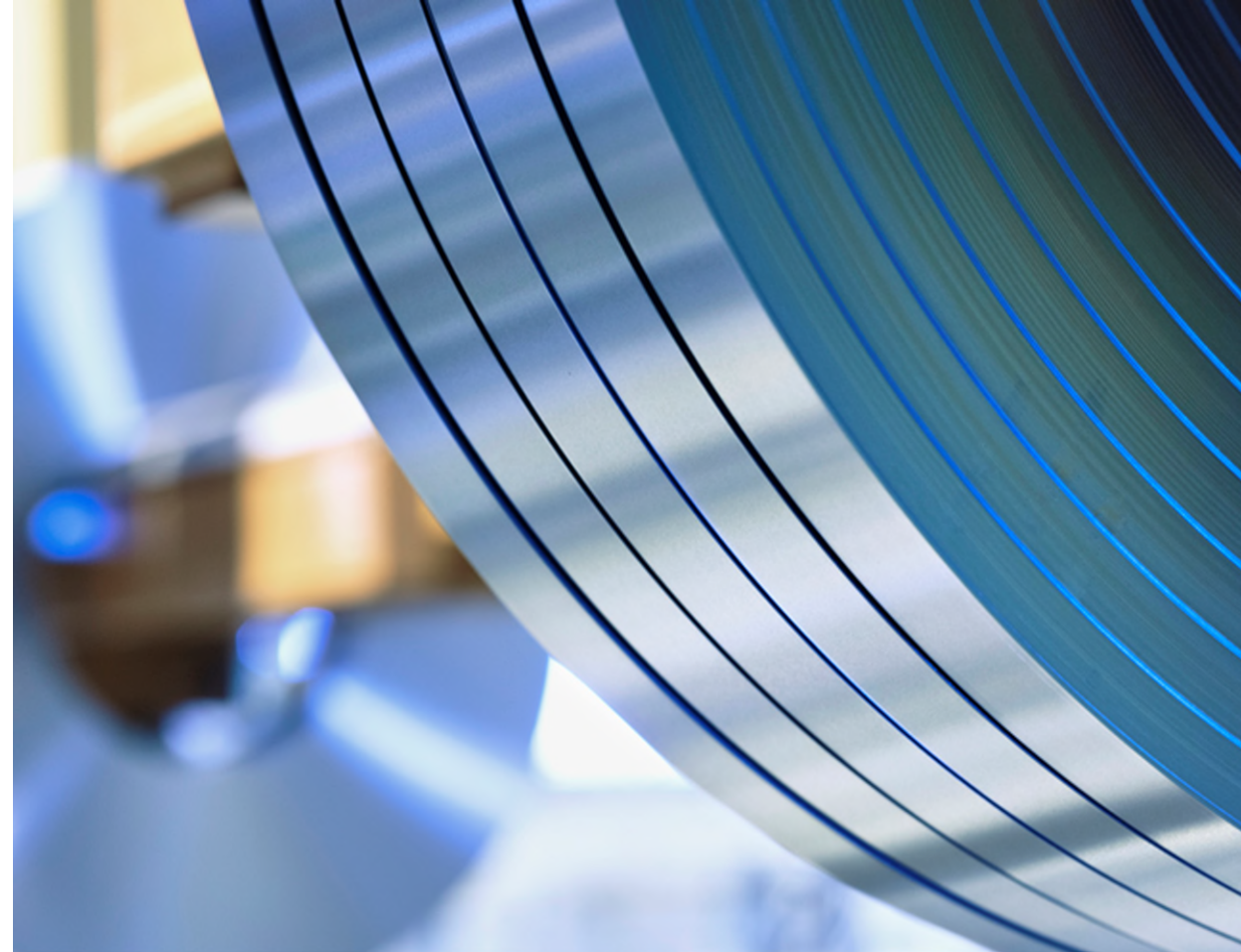
engineering.tomorrow.together.



thyssenkrupp

Agenda

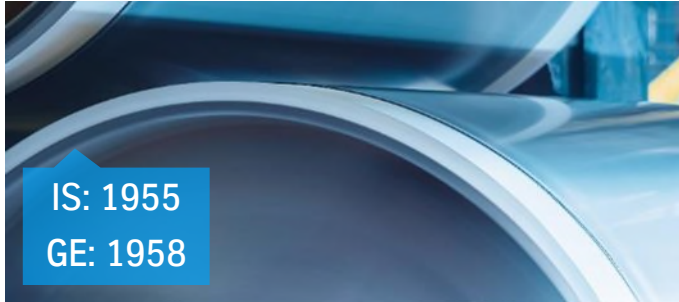
- 1 thyssenkrupp Electrical Steel
- 2 From hot-rolled strip to powercore[®] – The virtual factory tour
- 3 bluemint[®] Steel – steel with reduced CO₂ intensity
- 4 bluemint[®] powercore[®] – For the green energy transition
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Grain oriented electrical steel production with a tradition – the market leader in Europe

Product development at thyssenkrupp Electrical Steel's European plants

Start of GO production



Foundation of thyssenkrupp Electrical Steel



Foundation of the works



Start of HGO production



Development of new top grades



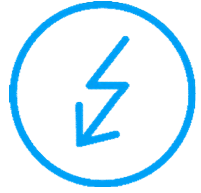
Global hidden champion: successful technical and economic turnaround

- **Grain oriented electric strip** High-tech niche product with less than 0.2% steel market share worldwide
- **tkES** market share in the EU about 50%, one of only 2 manufacturers in the EU. Worldwide (mainly in Asia) only 5 other producers are able to produce top grades
- **Two years ago** there were discussions on closure and sale option. However: We believed in the product, our team and the market – technological leap necessary (until 15 months ago, tkES was not in the Champions League of top-grade producers)
- **Targeted investments and creative engineering** Output of top grades could be increased tenfold within just a few months. This means that tkES is back in the race
- **Top grades** We support our customers to produce highly efficient transformers – thus also saving energy of over 1,000 gigawatt hours, avoiding over 400,000 metric tons of CO₂
- **Investment in the future** We are profitable again and can therefore continue to invest in technology



Grain oriented electrical steel for the electrified world

Our material as the motor driving the energy transition



Energy-efficient transformers



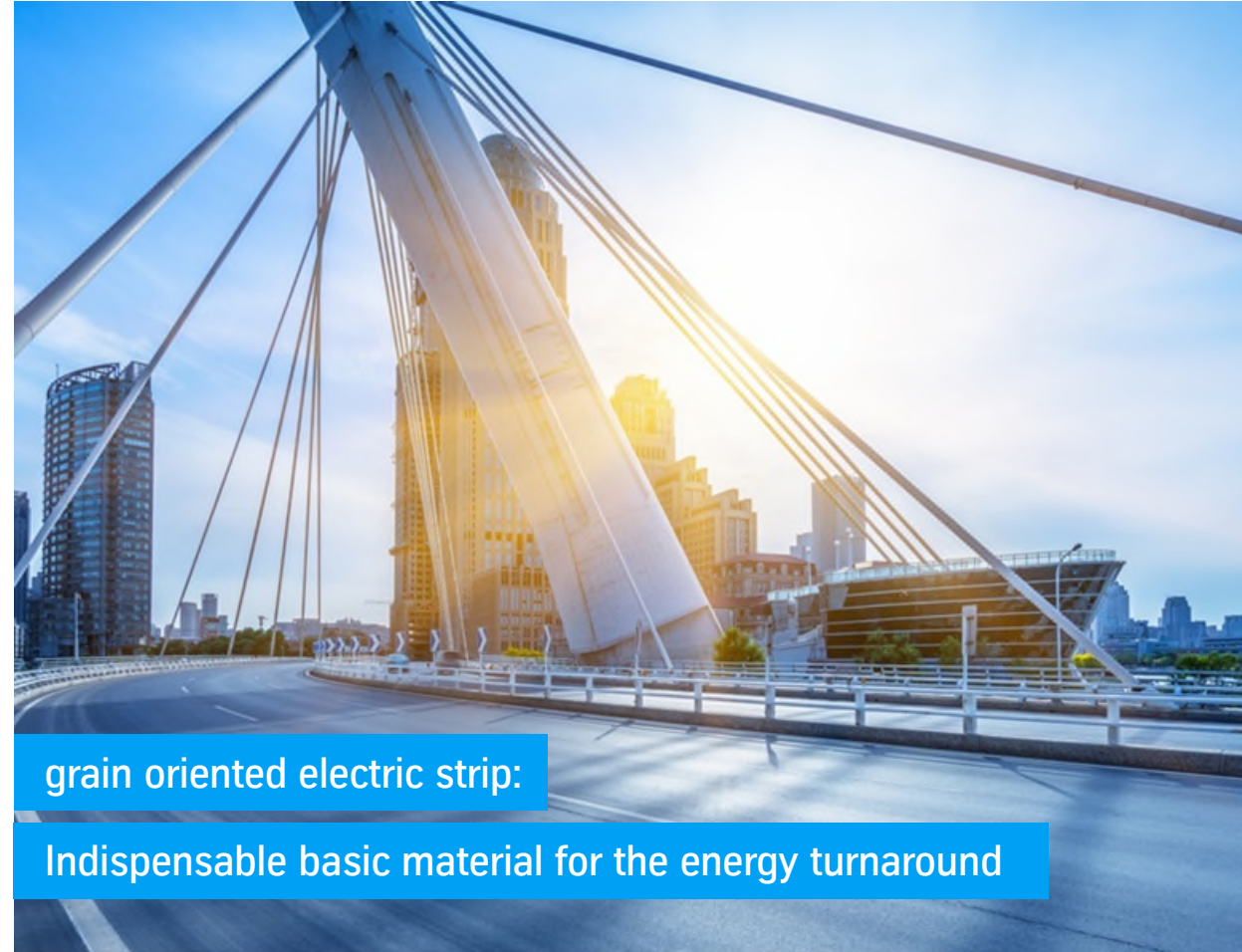
Urbanization
Low-noise transformers



Renewable energies need smart grids with
intelligent transformers



E-mobility with new drive concepts (e.g. axial-
flux technology)



grain oriented electric strip:

Indispensable basic material for the energy turnaround



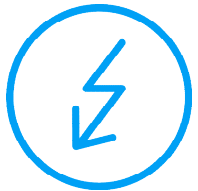
Grain oriented electrical steel as the optimum material for the heart of transformers



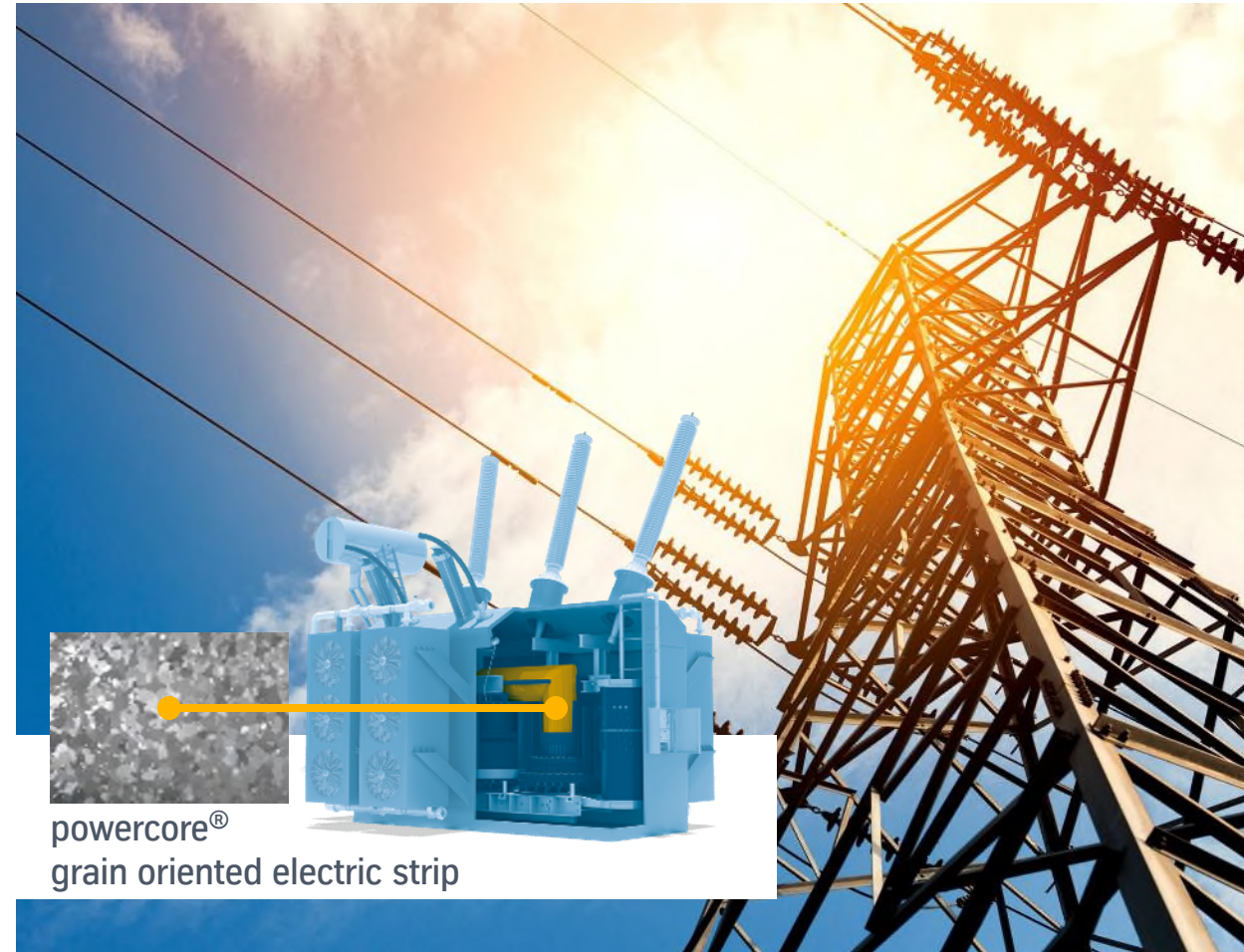
Soft magnetic properties form the basis for highly efficient magnetization of the transformer core



Grain oriented: Highly complex manufacturing process for aligning the crystal axes of the grains in one direction



Thin top grades (0.23 mm) enable maximum energy efficiency and a smaller transformer size



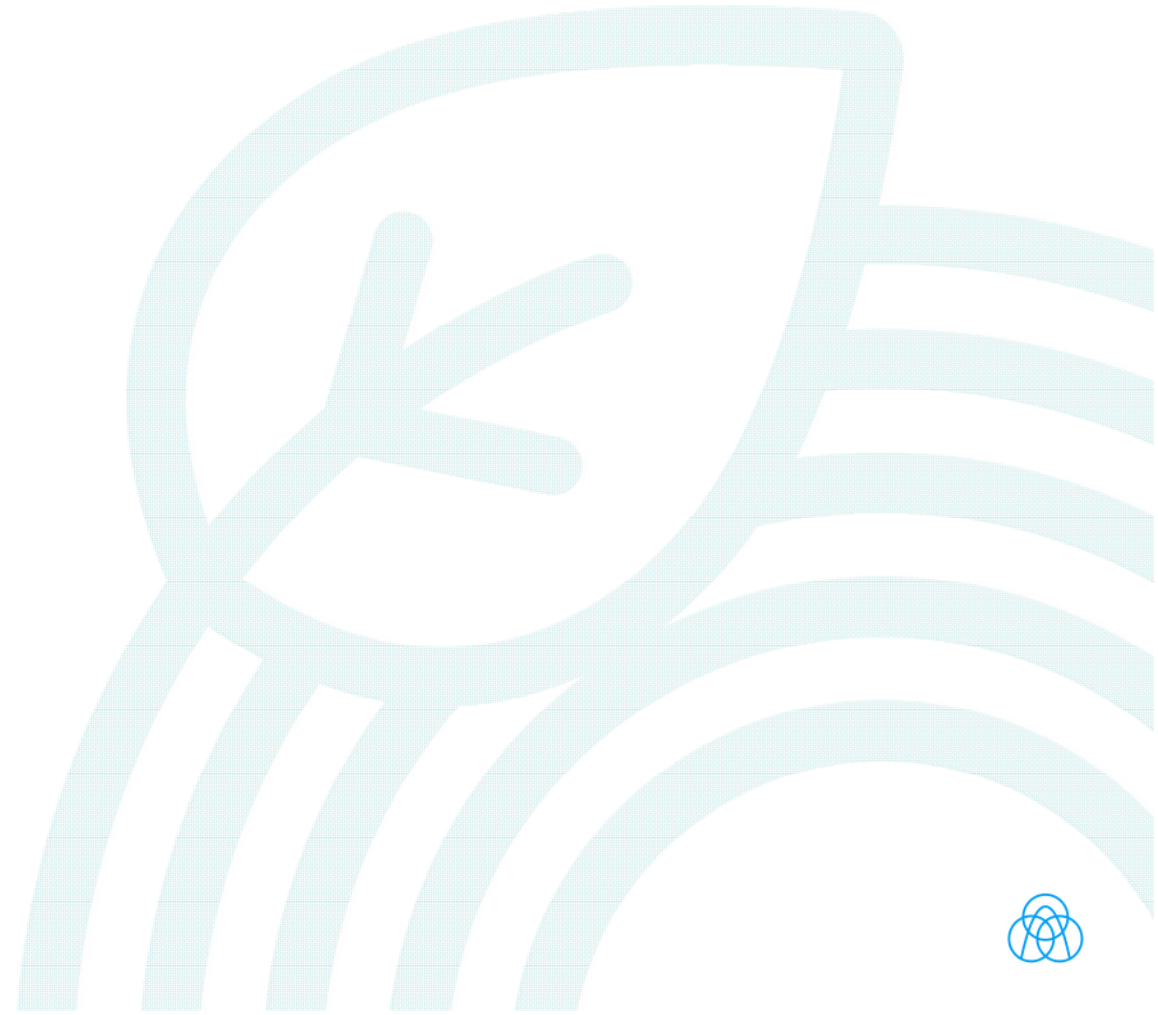
The virtual factory tour





bluemint[®] Steel

High quality. Less CO₂.



bluemint[®] Steel – steel with reduced CO₂ intensity

Genuine CO₂ savings through changes in blast furnace charge materials



Certified accounting approach allows allocation of CO₂ savings to a product



Complete portfolio of grades can be produced with the usual high quality

bluemint[®] pure

Use of hot briquetted iron (HBI) in the blast furnace
Use of biomethane as a natural gas substitute and prospects for H₂ use in the blast furnace

1.5 t CO₂ (70%)

GHG protocol for product accounting, DNV

Carbon intensity of 0.6 t CO₂/t hot strip

bluemint[®] recycled

Use of a specially processed scrap product in the blast furnace

1.35 t CO₂ (64%)

DIN EN ISO/IEC 17029 TÜV SÜD VERISteel standard

Spec. CO₂ emissions of 0.75 t CO₂/t hot strip



Measure

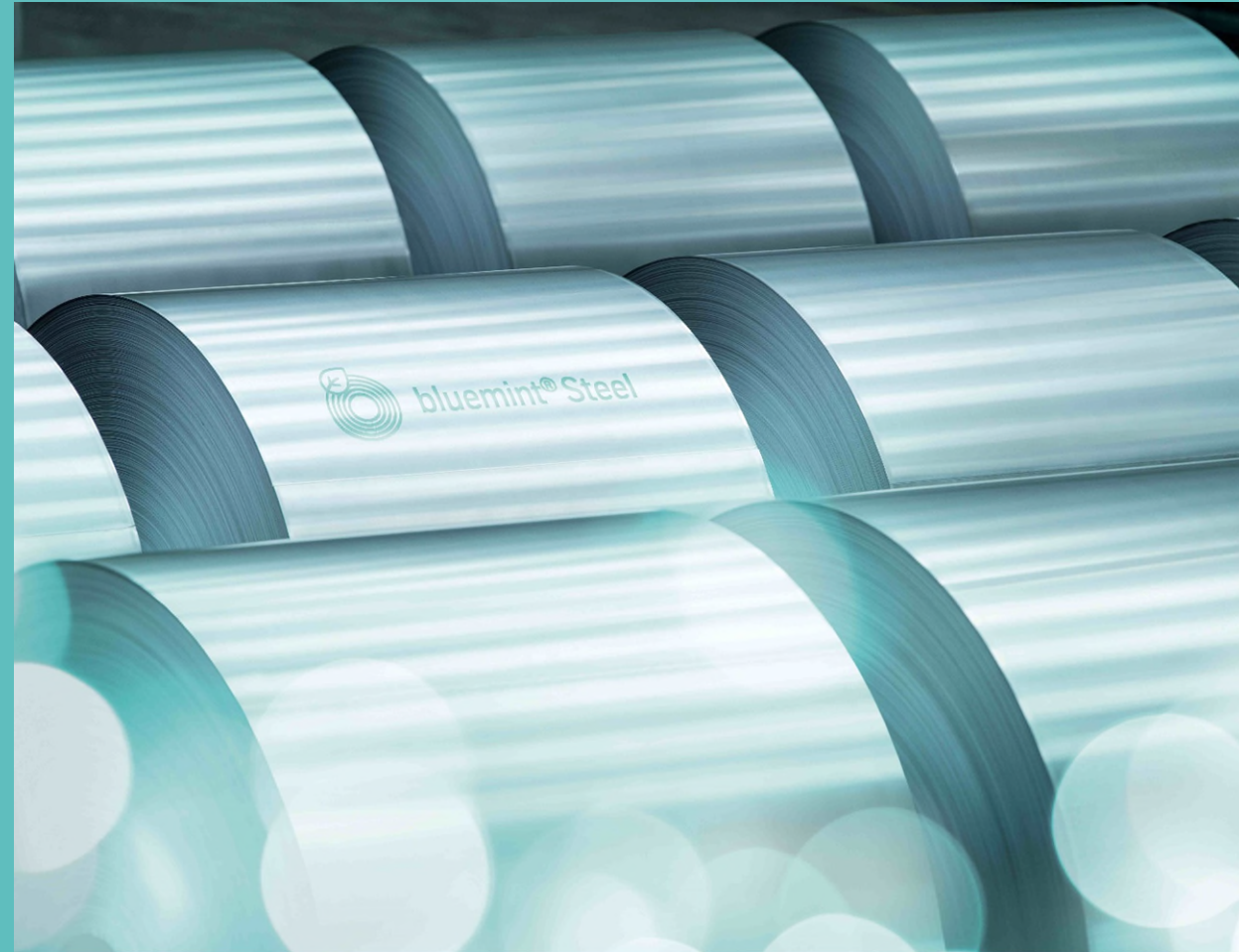
CO₂ saving

External certification

Carbon footprint of conventional steel
2.1 t CO₂/t hot strip



bluemint[®] Steel explained in simple terms.



Conventional hot strip

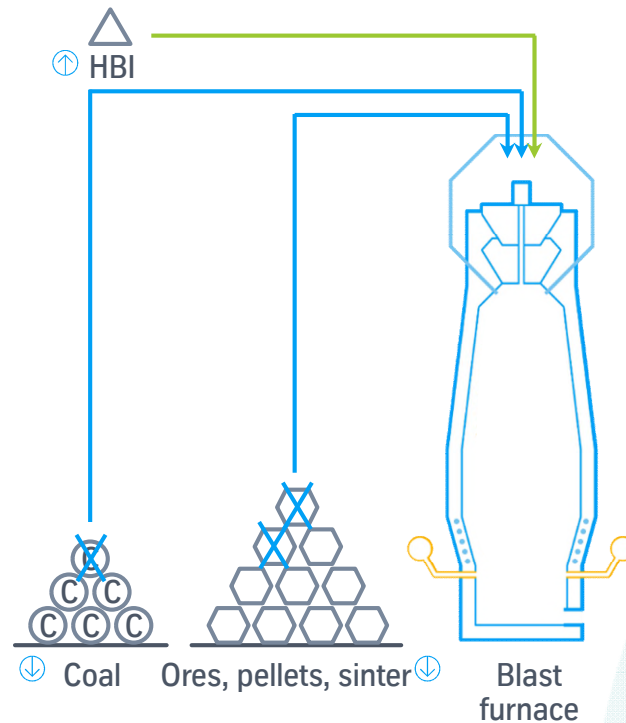


2.1 t CO₂/t hot strip

Change of input materials

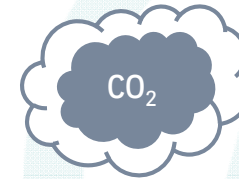
Less coal due to the use of a pre-reduced sponge iron. Less coal = Less CO₂

The sponge iron (HBI) is only smelted and does not have to be reduced by coal.



Certification of the genuine CO₂ savings by DNV

Genuine CO₂ savings are allocated to a product on a balance sheet basis.



Genuine CO₂ saving

bluemint[®] pure

CO₂ saving
1.5 t CO₂/t



0.6 t CO₂/t hot strip

Corresponds to the emissions from preliminary sequences of the conventional hot strip.

The CO₂ savings are aggregated and then distributed so that 1.5 metric tons of CO₂ are saved per metric ton of bluemint[®] pure. This corresponds to the specific CO₂ emissions from the Duisburg site.





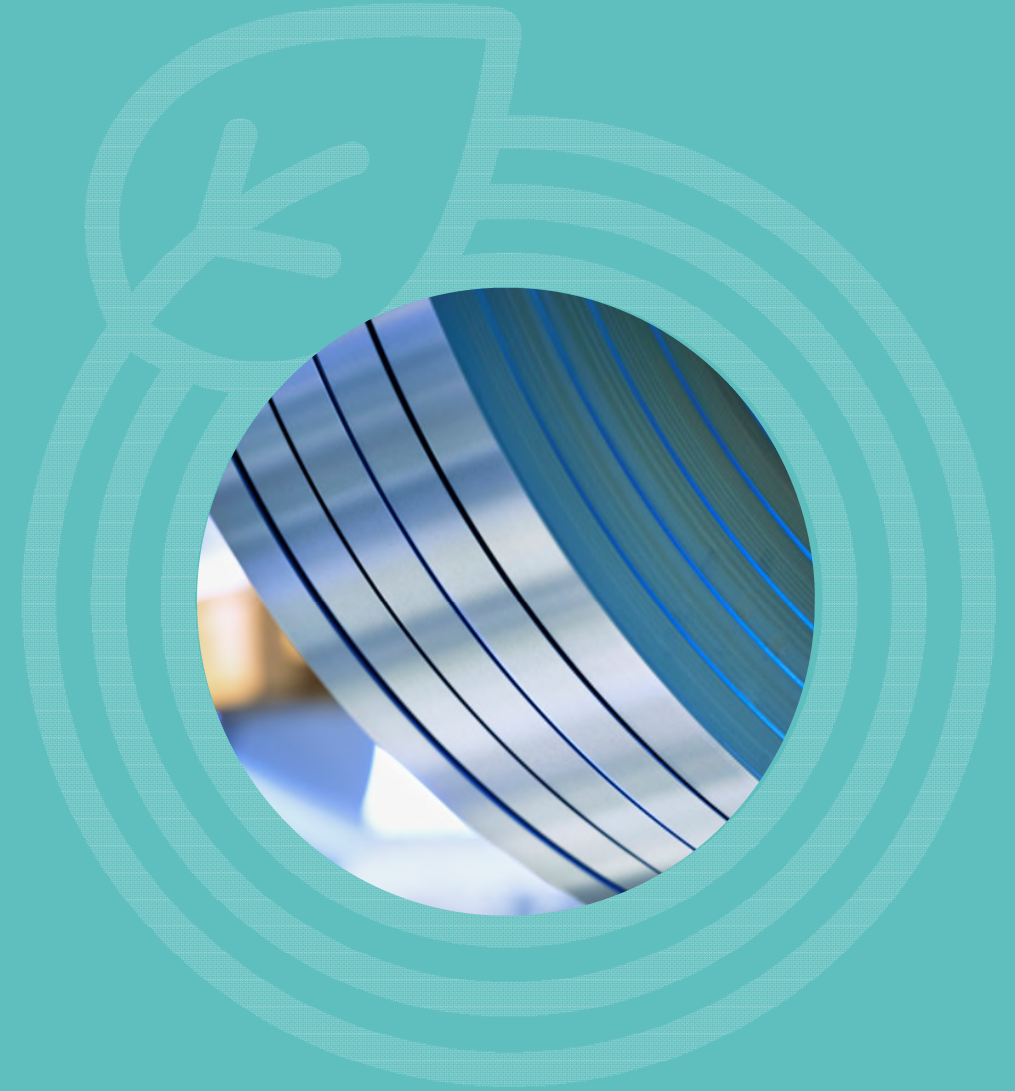
bluemint[®] Steel
» pure

- Primary steel – all qualities can be produced
- Approx. 70% reduction in CO₂ emissions (30% residual CO₂ from preliminary sequence)
- Additionality criterion met/genuine additional CO₂ reductions in the global context
- Consideration and certification of the entire process chain
- No compensation certificate
- Applicable to our customers' Scope 3 emissions and usable for a holistic consideration of CO₂ emissions
- CO₂ is reduced at the Duisburg site, certified and a certificate is sent with the product



Further processing of bluemint[®] Steel into highly efficient grain oriented electric strip

- Further processing of bluemint[®] Steel at Electrical Steel to bluemint[®] pure powercore[®]
- CO₂ intensity of bluemint[®] powercore[®] reduced by over **50%** compared to powercore[®] (1.8 t CO₂ e/t instead of 3.7 t CO₂ e/t)
- **Further significant reduction in CO₂ emissions** this year through use of green electricity and biomethane (instead of natural gas) at thyssenkrupp Electrical Steel
- Differentiation from the competition through the use of the **world's first CO₂-reduced grain oriented electric steel strip**
- thyssenkrupp Electrical Steel customers can **significantly reduce Scope 3 emissions in their products** with the help of bluemint[®] powercore[®]



SGB-SMIT Group

A brief overview



- Vision 2045 film



SGB-SMIT Group



A brief overview

- The transformer specialist from Europe with the highest customer orientation and exclusive focus on transformers (30 kVA to 1,200 MVA).



1913

HISTORY

The SGB-SMIT Group was created in 2008 from the merger of Starkstrom-Gerätebau GmbH, founded in 1947, and the transformer factory SMIT Transformatoren B.V., in existence since 1913.



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LOCATIONS

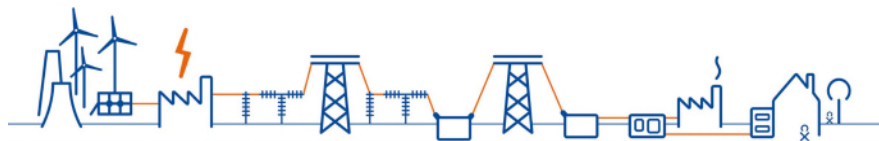
We are one of the world's leading manufacturers of power transformers



3,500

EMPLOYEES

... are the key to our success



Transformatoren

A brief description of the function

Transformers perform an important task in the nodes and switching points of the electrical power grid:

- They enable the transport of energy over long distances and
- The distribution of the electrical energy to the end customers and
- They adjust the voltage individually for all conceivable devices and machines.

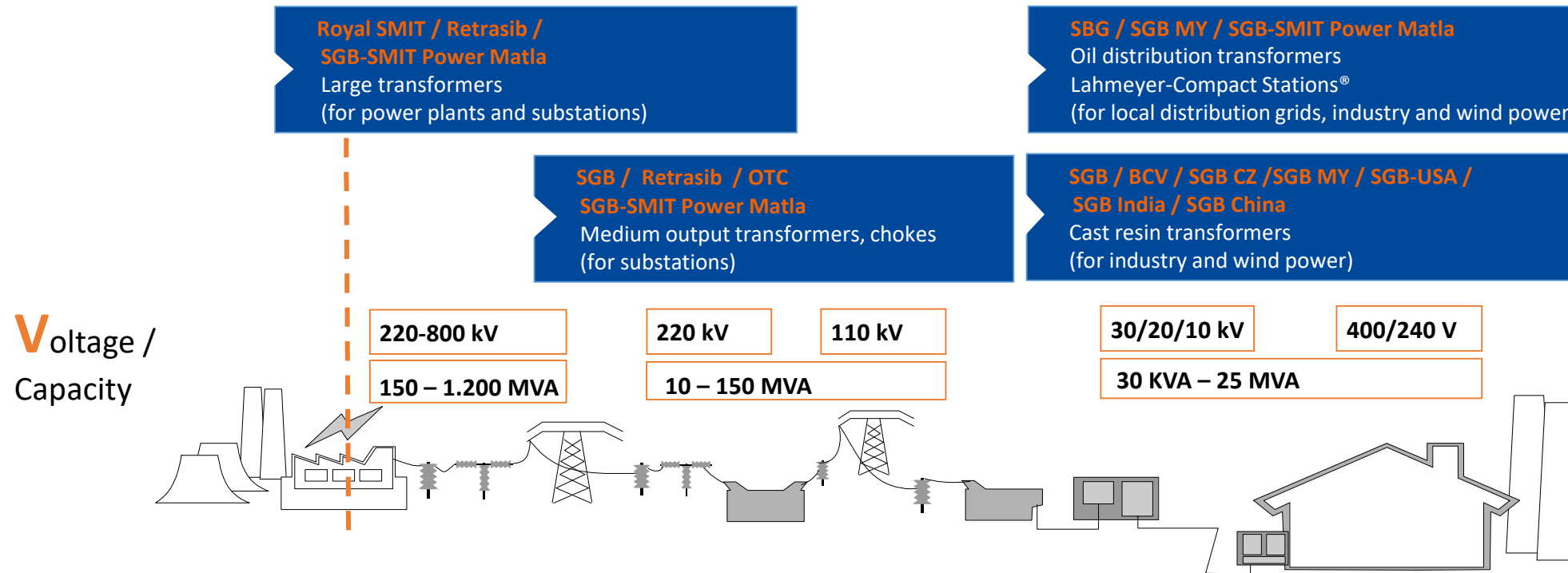
The basic design is the same for all transformers:

- An iron core carries at least two windings: the primary and the secondary winding
- The windings are magnetically coupled by the iron core
- If alternating voltage is applied to one of the windings - only alternating current can be transformed - a current flows in the winding, which generates a magnetic field that which induces a voltage in the second winding.



Transformers

Energy transport: Generation > Transmission > Distribution



Royal SMIT / Retrasib / SGB-SMIT Power Matla
Large transformers
(for power plants and substations)

SBG / SGB MY / SGB-SMIT Power Matla
Oil distribution transformers
Lahmeyer-Compact Stations®
(for local distribution grids, industry and wind power)

SGB / Retrasib / OTC SGB-SMIT Power Matla
Medium output transformers, chokes
(for substations)

SGB / BCV / SGB CZ / SGB MY / SGB-USA / SGB India / SGB China
Cast resin transformers
(for industry and wind power)

Voltage / Capacity

Customers

Generation	High voltage	Medium voltage	Low voltage
<ul style="list-style-type: none"> Energy producer <ul style="list-style-type: none"> conventional regenerative 	<ul style="list-style-type: none"> Energy companies Grid companies Industry 	<ul style="list-style-type: none"> Industry Energy supplier Infrastructure 	<ul style="list-style-type: none"> Industry Energy supplier Infrastructure

Transformers

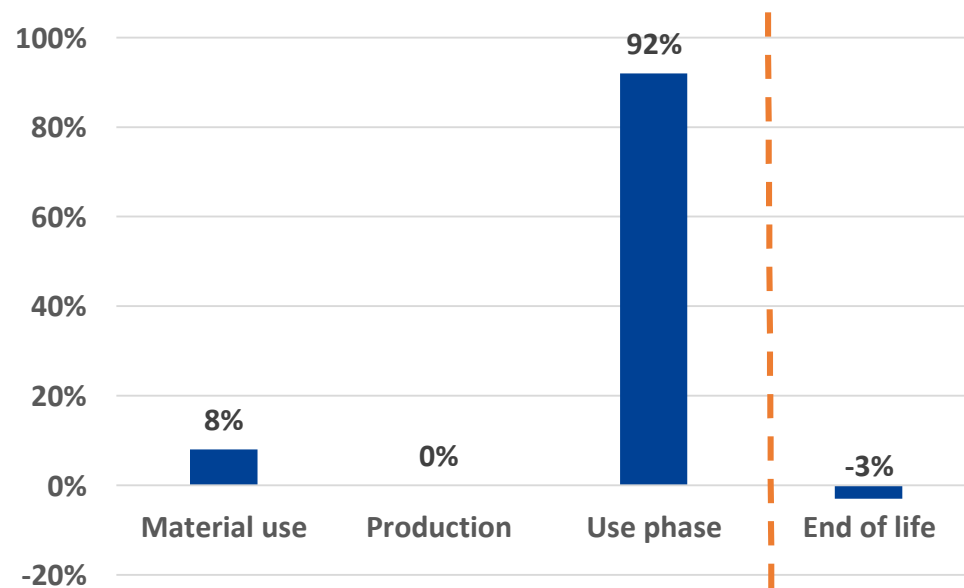
Core plate

- The transformer core is comprised of grain oriented electric steel strip
 - In order to make optimum use of the volume within the windings and to minimize losses, the core is not made of solid iron but of a large number of very thin (0.2 mm – 0.3 mm) electric steel sheets of different widths.
 - The electric steel sheet coils from tkES are split lengthwise and crosswise at SGB-SMIT and then folded together to form a core.
- No-load losses:
 - A key component of the efficiency of a transformer is influenced by what are known as the no-load losses.
 - These no-load losses are generated by the remagnetization in the core and are predominately determined by the quality of the electric steel sheets.
 - Consequently the quality of the electric steel sheets plays a key role in the construction of an efficient transformer. A high sheet quality means lower no-load losses and hence high operating efficiency.



The carbon footprint of a transformer

Proportionate carbon footprint* of a distribution transformer in the different life cycle phases when transforming energy with 50% share of renewable energy sources (= German energy mix 2019)

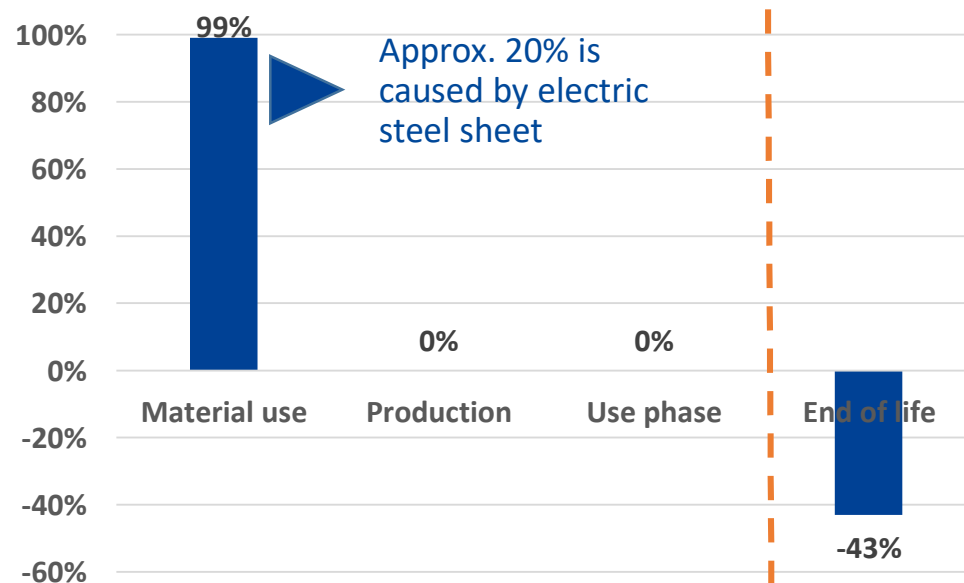


- Over 90% of the carbon footprint is generated in the utilization phase, since the transformer cannot transform the energy completely loss-free.
- The energy lost during the service life of a transformer is by far the determining factor for the carbon footprint, since a significant part of the energy was also generated from fossil energy sources.
- Energy production from fossil energy sources causes very high CO₂ emissions. The loss of some of this generated energy is reflected in the footprint during the transformer's use phase.

* The carbon footprint is calculated with a transformer utilization phase of 40 years and conventional electric steel plate

The carbon footprint of a transformer

Proportionate carbon footprint* of a distribution transformer in the different life cycle phases when transforming energy from 100% renewable energy sources



- Energy production from renewable energy sources causes practically no CO₂ emissions; accordingly, the footprint in this phase is reduced to almost zero.
- This makes the use of materials the clearly dominant factor at 99% and the central point of attack for reducing the carbon footprint.
- On the materials side, electric steel sheet is responsible for about 20% of the carbon footprint and is therefore a very significant factor in the carbon footprint, along with the other types of steel used, as well as copper, aluminum and insulation materials.

* Carbon footprint is calculated with a transformer utilization phase of 40 years and conventional electric steel plate

The influence of bluemint pure powercore®



The carbon footprint of bluemint pure powercore® is reduced by a good 50% compared to conventional electric steel sheet.

- A typical 630 kVA distribution transformer contains a good 800 kg of electric steel sheet. One metric ton of electric steel sheet from tkES carries 3.7 t of CO₂ equivalents as standard; the bluemint® variant only 1.8 t of CO₂ equivalents.
- Depending on the type of electric steel sheet (standard or bluemint® pure powercore®), the carbon footprint of the 630 kVA distribution transformer for the electric steel sheet is thus approx. 3 t CO₂ equivalents (standard) or only 1.4 t CO₂ equivalents (bluemint®).



The influence of bluemint pure powercore®



The carbon footprint of bluemint pure powercore® is reduced by a good 50% compared to conventional electric steel sheet.

- The SGB-SMIT Group installs approx. 45,000 t of electric steel sheet every year, so that up to 85,500 t of CO₂ can be saved per year through the use of bluemint® pure powercore®.
- Alternatively, to offset 85,500 t of CO₂, you would have to plant 6,840,000 trees. This number of trees would cover an area equivalent to around 6,000 soccer pitches.
- The SGB-SMIT Group will be the first European transformer manufacturer to install bluemint® pure powercore® in transformers for our partner E.ON, thus making a further active contribution to CO₂ reduction.



Connecting everyone to good energy

**Achim Hübner, ICL Transformers
Gelsenkirchen, 19 January 2022**

e.on



"E.ON is now launching a comprehensive growth and investment campaign to establish a CO₂-free, digital energy world. In 2030, E.ON will be bigger and greener, more digital and more diverse."

Leonhard Birnbaum, CEO of E.ON SE
on Capital Market Day 23 November 2021

Employees

78

thousand

Customers

50

millions

Power grids

1.60

million kilometers

Regulated
asset base

35

billion euros

Renewable
energy plants

900

thousand

Adjusted
EBITDA

6.90

million euros

Who we are

The E.ON Group is one of Europe's largest operators of power grids and energy infrastructure, and a provider of innovative customer solutions. In this way, we are decisively driving forward the energy transition in Europe and, with our business, are committed to sustainability, climate protection and thus the future of our planet.

These are not just words: We act – instead of making promises. We are leading the way – not following. We rely on the power of the community – and not on individual interests without an overriding goal.

Our three strategic priorities



Growth

Growth is necessary to build a CO₂-free Europe with our customers and partners. Growth is also the prerequisite for sustainable entrepreneurial success.

That's why we will invest heavily in growth across the green, distributed energy world.



Sustainability

Sustainability is at the core of our strategy – in every dimension – and will be the benchmark for our actions in the future. We support our customers in their decarbonization and are moving towards climate neutrality ourselves.



Digitization

Digitization is the key to enabling us to fulfill our role as networkers and shapers of tomorrow's sustainable energy world. That's why we are digitizing and standardizing the entire system – grids, products, customer interfaces, and internal processes – and making E.ON the first "All Digital" energy company.

With 100% bluemint[®] powercore[®] E.ON would save 18,000 t CO₂ annually, the equivalent of 1.4 million trees.

Transformers



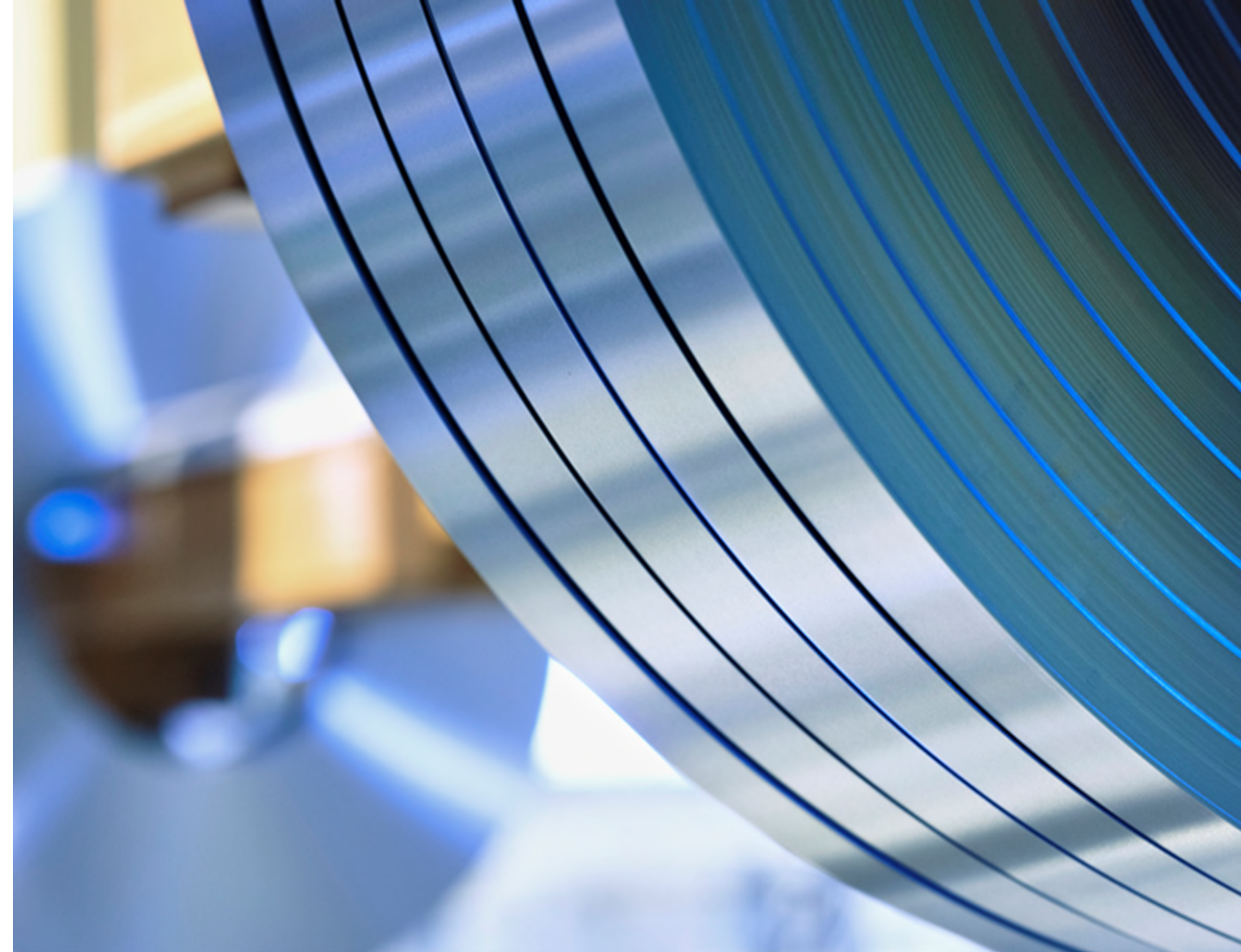
Power transformers Annual demand approx. 200 units → 4,000 t electric steel sheet

Distribution transformers Annual demand approx. 7,000 → 5,000 t electric steel sheet

Total demand for electric steel sheet → 9,000 t per year

Agenda

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What brings us together

- CO₂ savings of 50% per metric ton of bluemint[®] powercore[®] compared to conventional electric steel strip
 - Reduction in the CO₂ intensity of one metric ton of bluemint[®] powercore[®] from 3.7 metric tons to 1.8 metric tons
- Important step towards further decarbonization of the electricity process chain
- Further development of top grades to ever thinner grades and thus low losses
- The more green power is produced, the more important the "green" supply chain becomes



bluemint[®] pure achieves additional CO₂ savings in a global context and accompanies the transformation



Q&A

