2024

قمة الصلب العربي الـ 17
و المعرض الدولي للحديد و الصلب

17th Arab Steel Summit
and International Iron and Steel Exhibition

قطر ستيل
QATAR STEEL
Regional Host Sponsor

SMS Group Technological Pathways to Decarbonize the Global Iron & Steel Making Industry

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SMS group technological pathways to decarbonize the global iron & steel making industry

1 **SMS group and Decarbonisation Strategy**

2 **Ore-based production technologies**
DRP-EAF route: *Project H2 Green Steel with Midrex H2 and Electric Arc Furnace*
DRP-OBF route: *Project thyssenkrupp with Midrex Flex and Open Bath Furnace*
BF-BOF route: *Blue Blast Furnace; EASyMelt Technology*

3 **Scrap Based production technology**
EAF- Conventional mill with RHF: H2 to replace NG, partial electrification of RHF

4 **“Green Steel” Technology for downstream**
Flat Products
Long Products

5 **Non- Ferrous**
E- Waste & Battery Recycle

6 **Summary and the Key Takeaways**

Founded in 1871 - Headquartered in Germany

SHAPING THE FUTURE OF METALLURGY

THEN AND NOW

150

Experienced partner
Family business with a history of more than **150** years as a technology leader

Worldwide
More than **14,400** employees

Local
5 workshops, **33** service centers and **90** sites globally

Full-liner
For the entire metallurgical chain

Comprehensive services
Lifecycle services for equipment, automation and digitalization

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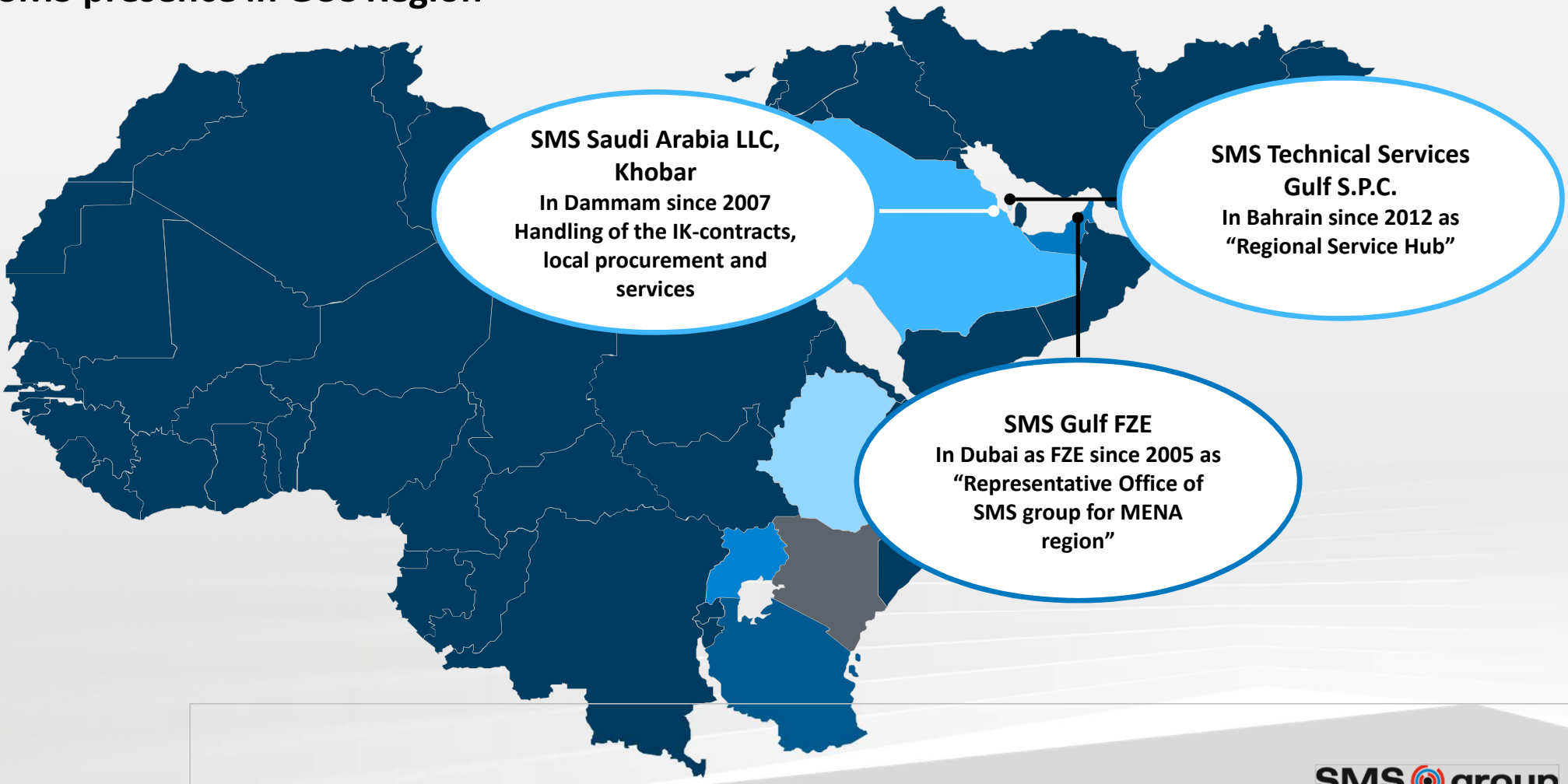
SMS presence in GCC Region



#turningmetalsgreen at SMS group

Taking on the leading role in the transformation to a greener metals industry

Decarbonization of the metals production

- Greenfield
- Brownfield
- Less scrap

Circular economy

- Use of steel scrap in primary and secondary route
- Battery recycling
- Urban mining

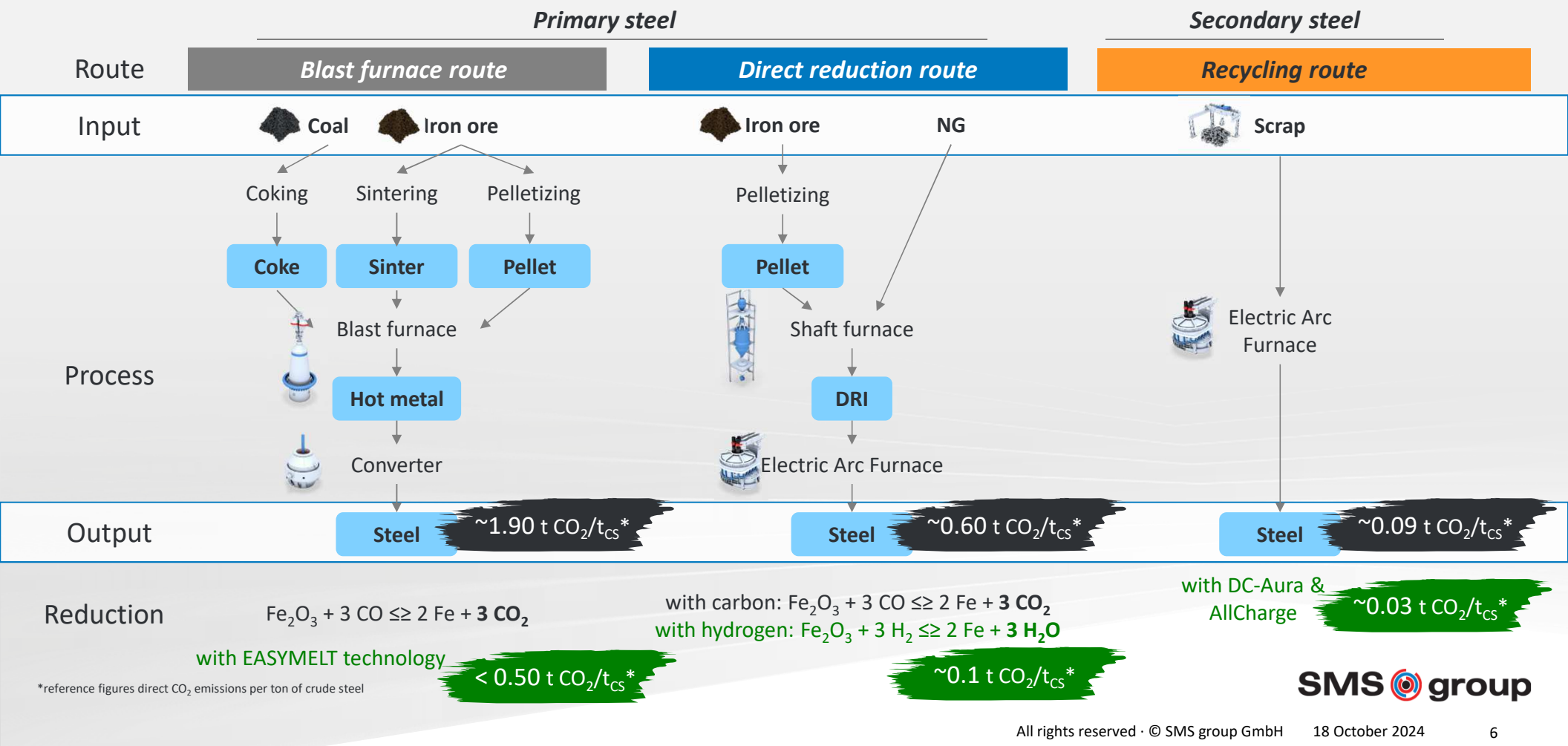
Power-to-X hydrogen

- Gamechanger
- Procurement & deployment
- Shareholding in sunfire

Lifecycle partnership & digitalization

- Service = sustainability
- Energy savings
- Reducing repairs
- Digital twins

Archetypical primary and secondary steel making routes



*reference figures direct CO_2 emissions per ton of crude steel

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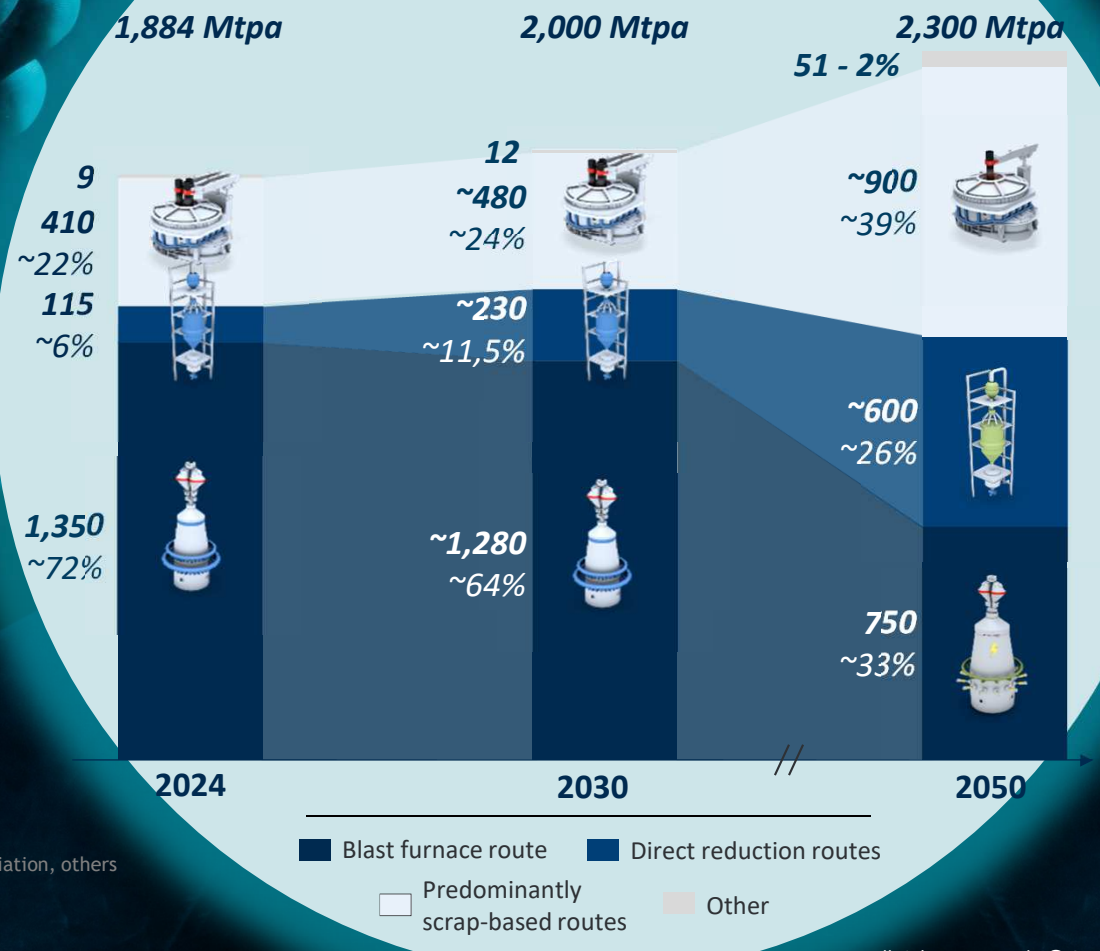
Tech Roadmap 2050

Global Crude Steel Production



Source: SMS group analysis, World Steel Association, others

Enabling Factors for low-carbon iron- and steel production

IRON ORE

Three quarters of today's offering are not in the form of pellets or lump ore

High-grade DR pellet demand in 2050 will be almost double the estimated supply (750 M tons)

GREEN ENERGY

Two-thirds of current renewable energy generation capacity will be required for steel

Overall demand for electricity will more than double by 2050 for reaching net zero targets in all industries and sectors

SCRAP AVAILABILITY

Doubling of the global scrap pool from current levels required (to 1.3 B tons)

Stagnating growth in mature economies and likely trade barriers for scrap exports

TRANSITION SPEED

Transition is limited by plant supplier capacity and funding availability

How many DRP per year required vs current built DRP per year

Wood Mackenzie, McKinsey, IRENA

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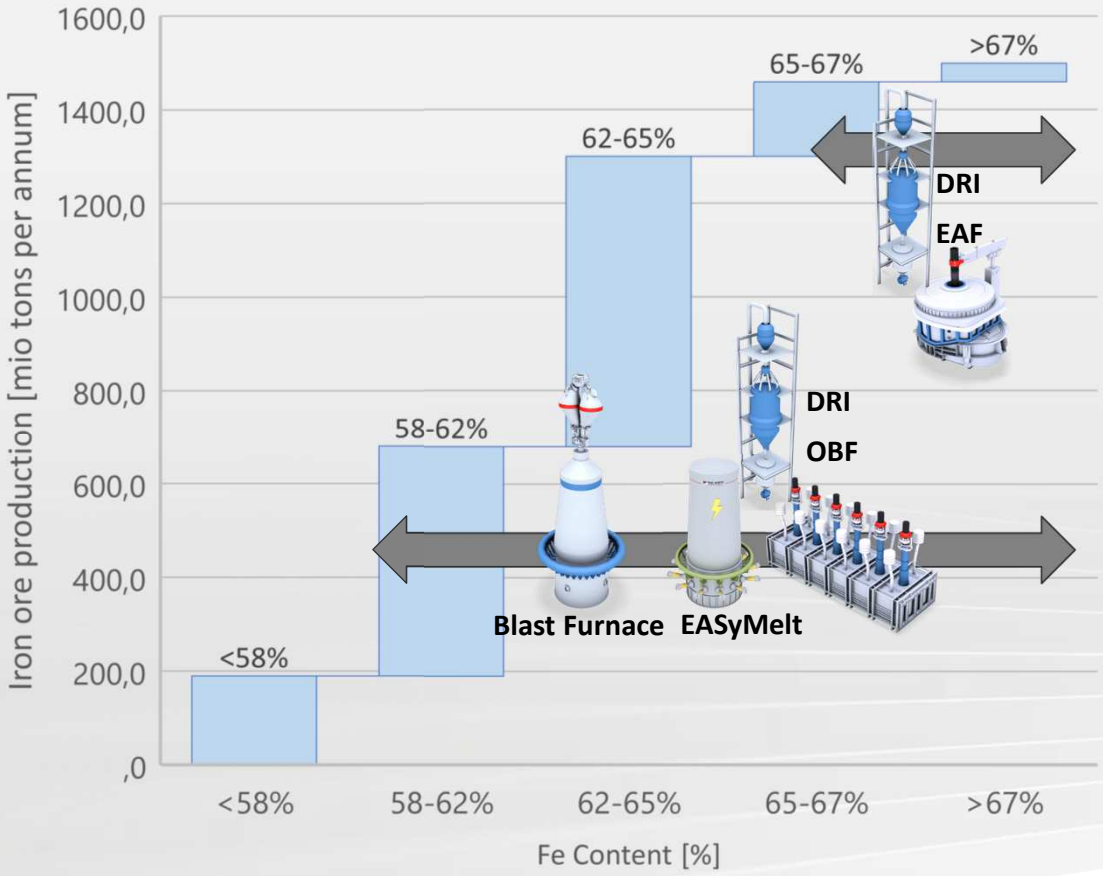
The Iron Ore processing challenge is met with suitable technologies



Any process benefits from high grade ore!

- less energy requirement overall
- higher throughput
- lower GHG footprint

- **BF, OBF and EASyMelt flexible concerning Fe content**

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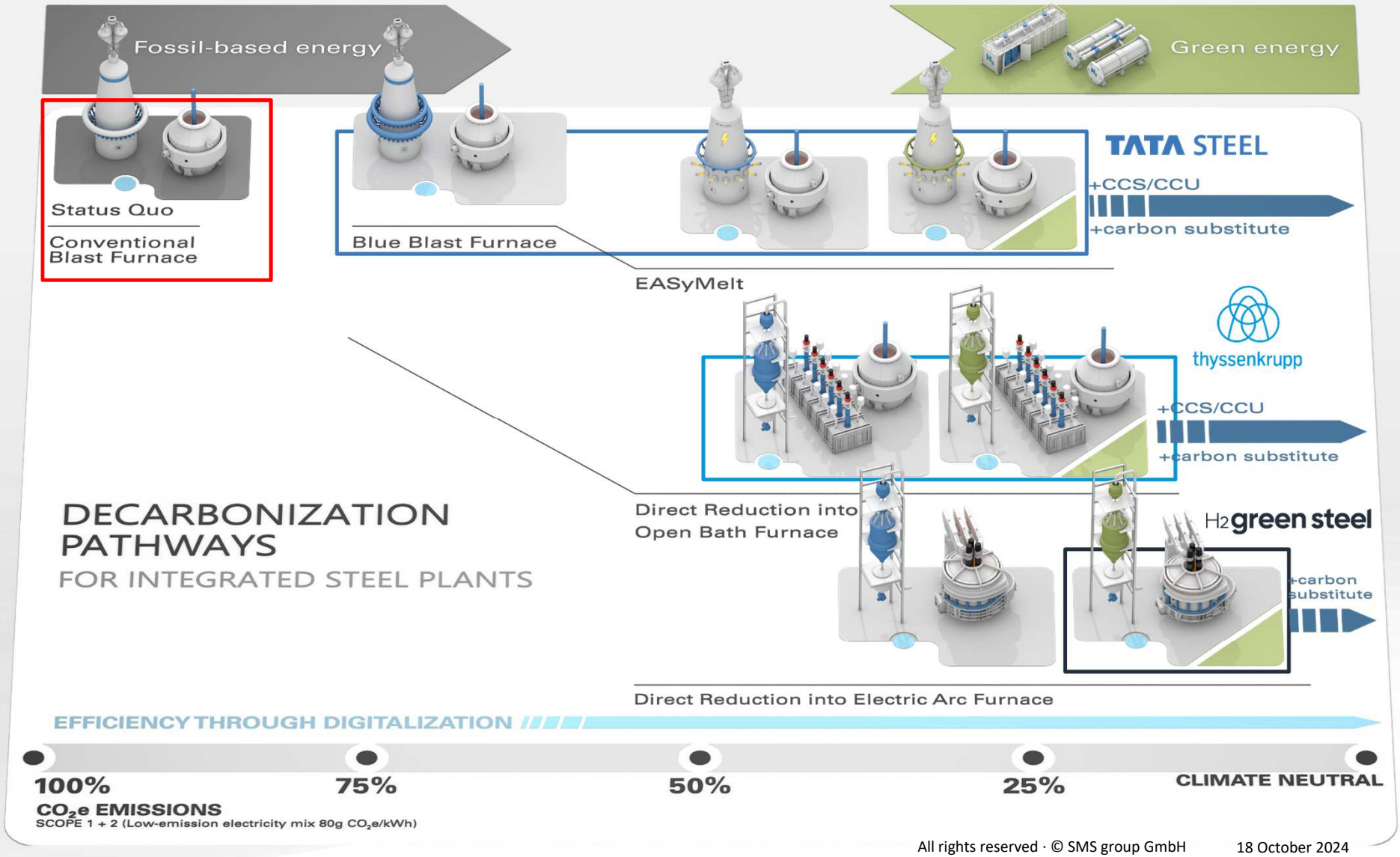

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Fossil-based energy

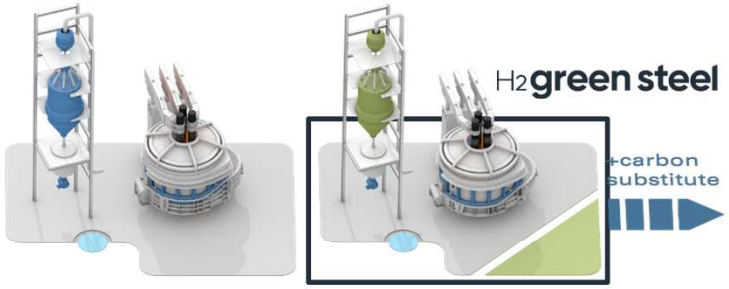
Green energy

Status Quo

Conventional
Blast Furnace

DECARBONIZATION PATHWAYS

FOR INTEGRATED STEEL PLANTS



Direct Reduction into Electric Arc Furnace

EFFICIENCY THROUGH DIGITALIZATION

100% **75%** **50%** **25%** **CLIMATE NEUTRAL**

CO_2e EMISSIONS

SCOPE 1 + 2 (Low-emission electricity mix 80g CO_2e/kWh)

H2 Green Steel
The world's first 100% hydrogen-based steel plant

WE Make Green Steel!
- The real one -

- **CO_2 emission** reduction up to **95%**
- Based near **Boden, Northern Sweden**
- Start-up of first plant: **Q1-2026**
- Capacity of phase 1: **2.5 million t/year,** phase 2**: 5 million t/year**
- **Fed with high grade Iron ore (Fe>67%)**
- SMS group supply- Complete plant from **melt shop to the finishing lines along with our partner Midrex for H2- DRI.**

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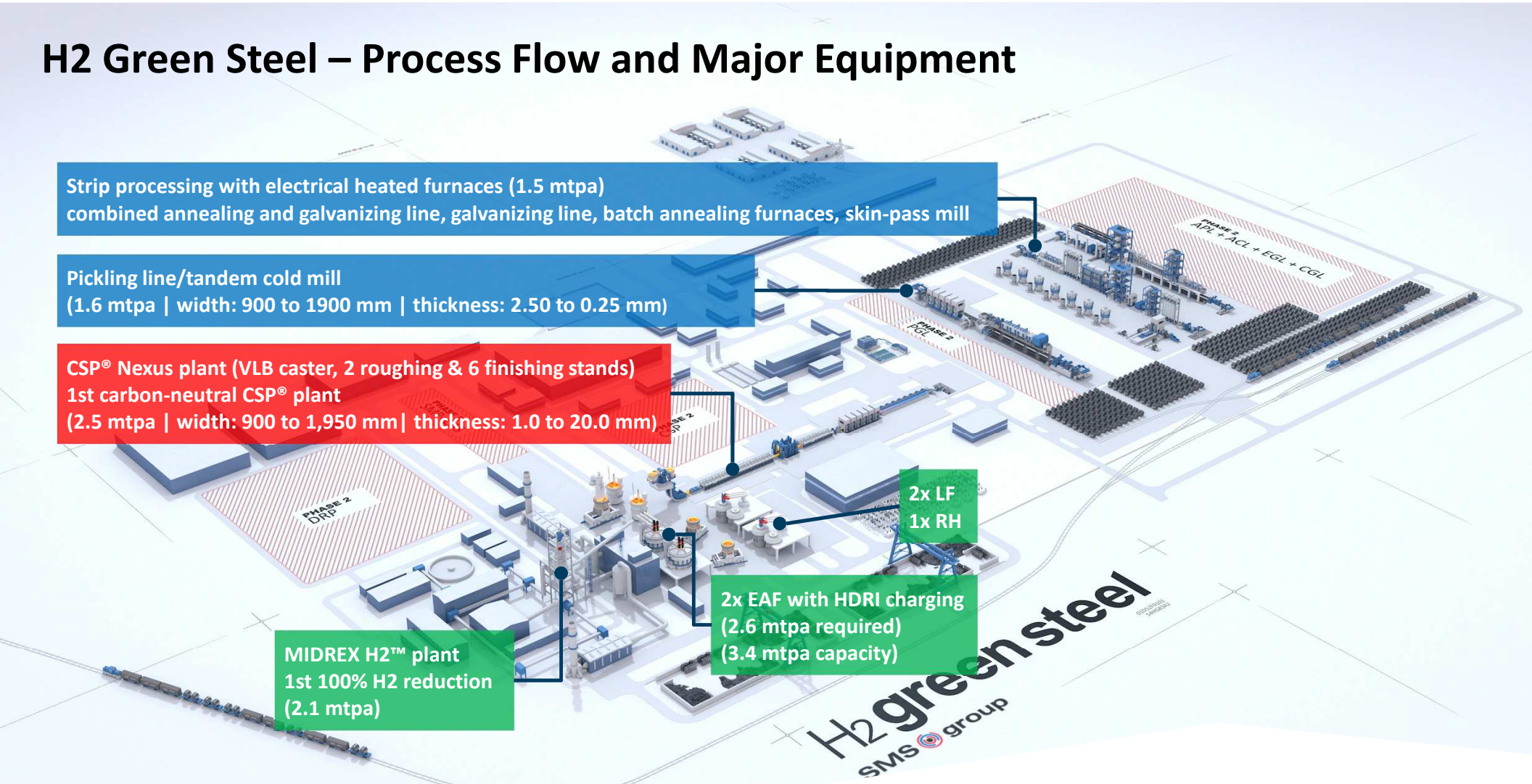
H2 Green Steel – Process Flow and Major Equipment



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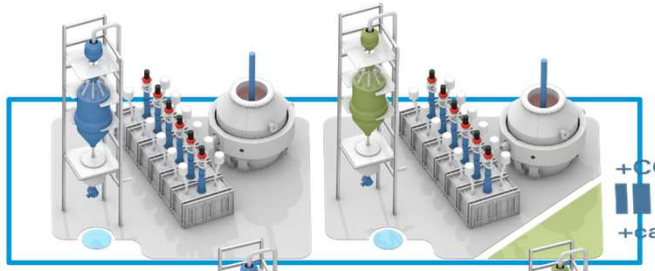

thyssenkrupp

+CCS/CCU

+carbon substitute

Direct Reduction into
Open Bath Furnace

H2green steel

+carbon substitute

Direct Reduction into Electric Arc Furnace

EFFICIENCY THROUGH DIGITALIZATION

100% CO_2e EMISSIONS
SCOPE 1 + 2 (Low-emission electricity mix 80g CO_2e/kWh)

75%

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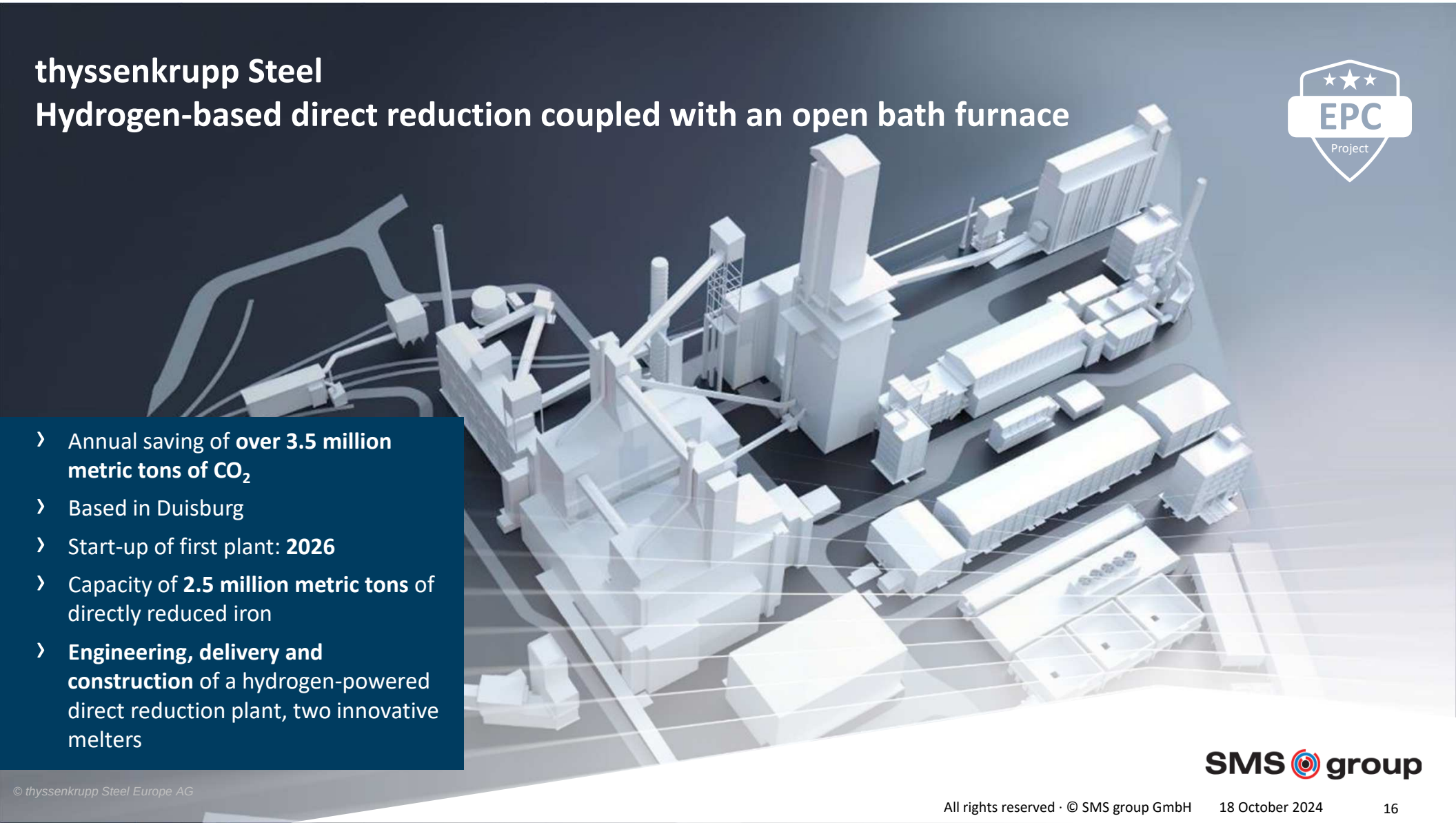
25%

CLIMATE NEUTRAL

thyssenkrupp Steel
Hydrogen-based direct reduction coupled with an open bath furnace

EPC Project



- Annual saving of **over 3.5 million metric tons of CO_2**
- Based in Duisburg
- Start-up of first plant: **2026**
- Capacity of **2.5 million metric tons** of directly reduced iron
- **Engineering, delivery and construction** of a hydrogen-powered direct reduction plant, two innovative melters

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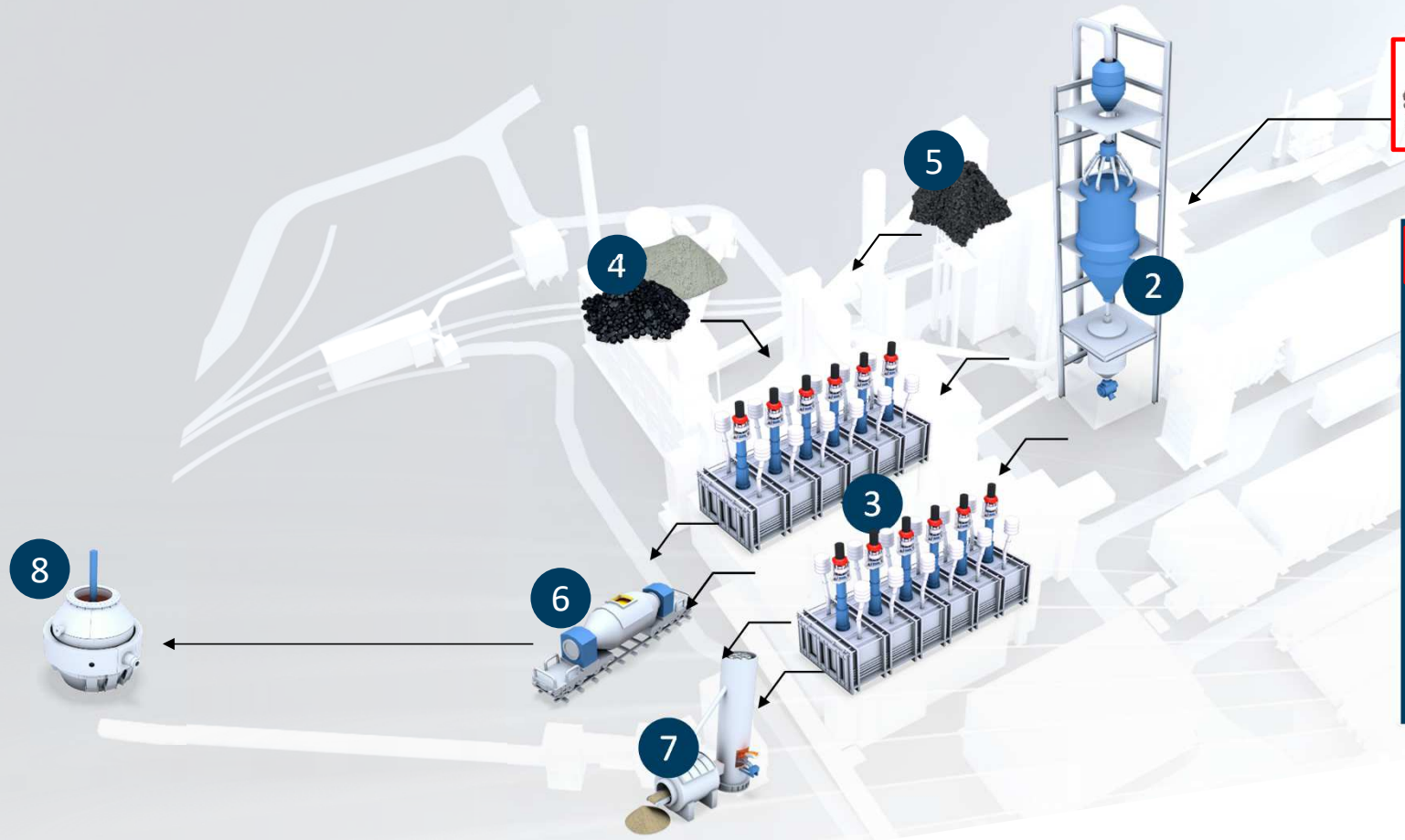
Thyssenkrupp Steel technology

Natural gas based –Hydrogen ready- direct reduction coupled with an open bath furnace



1 BF grade - Iron Ore Pellets (Fe ≈62- 65%)

2 MIDREX Flex® Direct Reduction Plant

3 Electrical Open Bath Furnaces

4 Reductants and Fluxes

5 Cold DRI

6 Hot Metal Torpedo Ladles

7 INBA® Slag Granulation

8 Steelmaking converter

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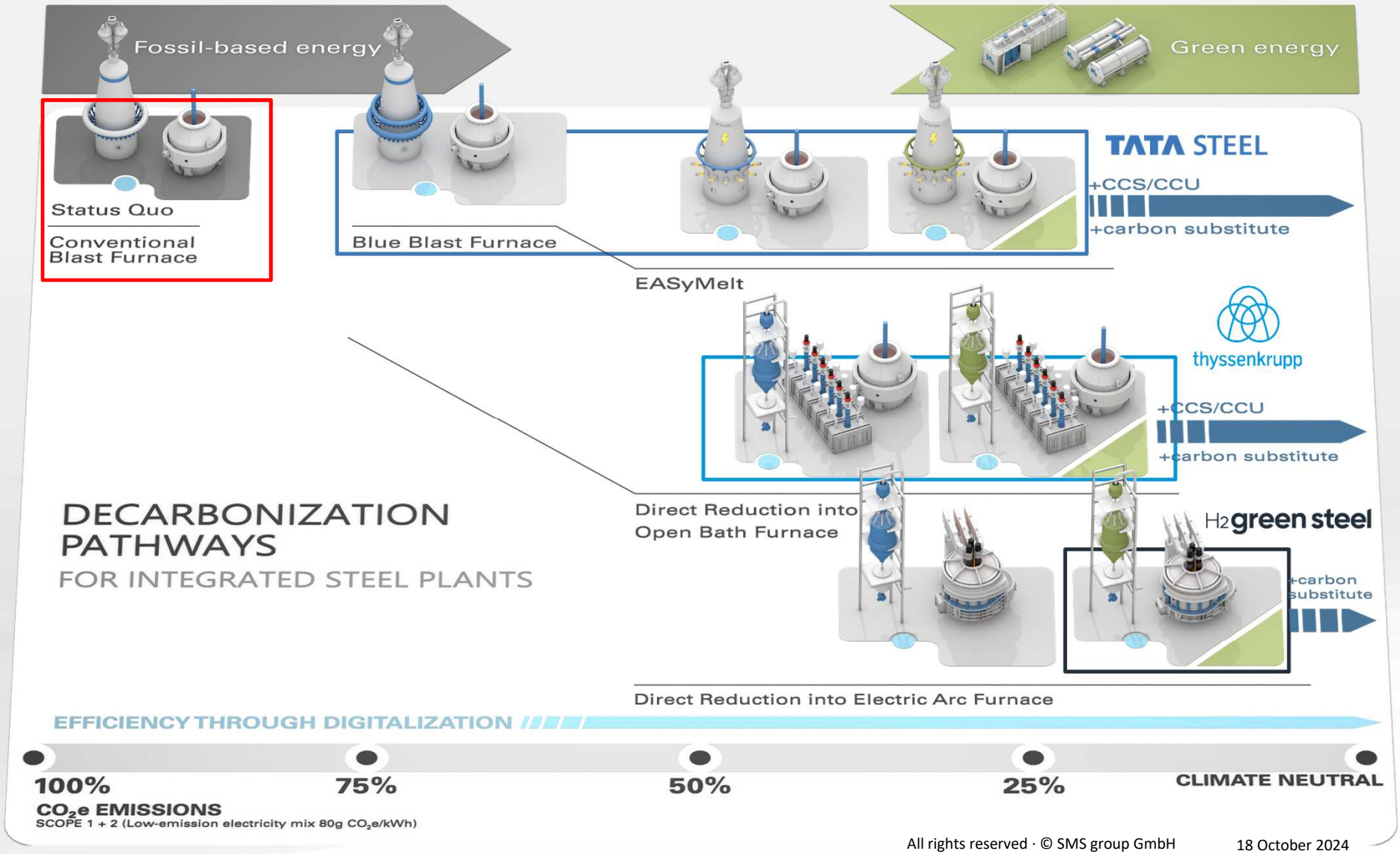

EASyMelt

The Leading Partner in the World of Metals

Worlds first EASyMelt Installation will be in INDIA with TATA

- **Tata Steel & SMS group have signed an MoU to install the first EASY MELT on one of TATA´s existing Blast Furnaces**
- **Pre-engineering underway**

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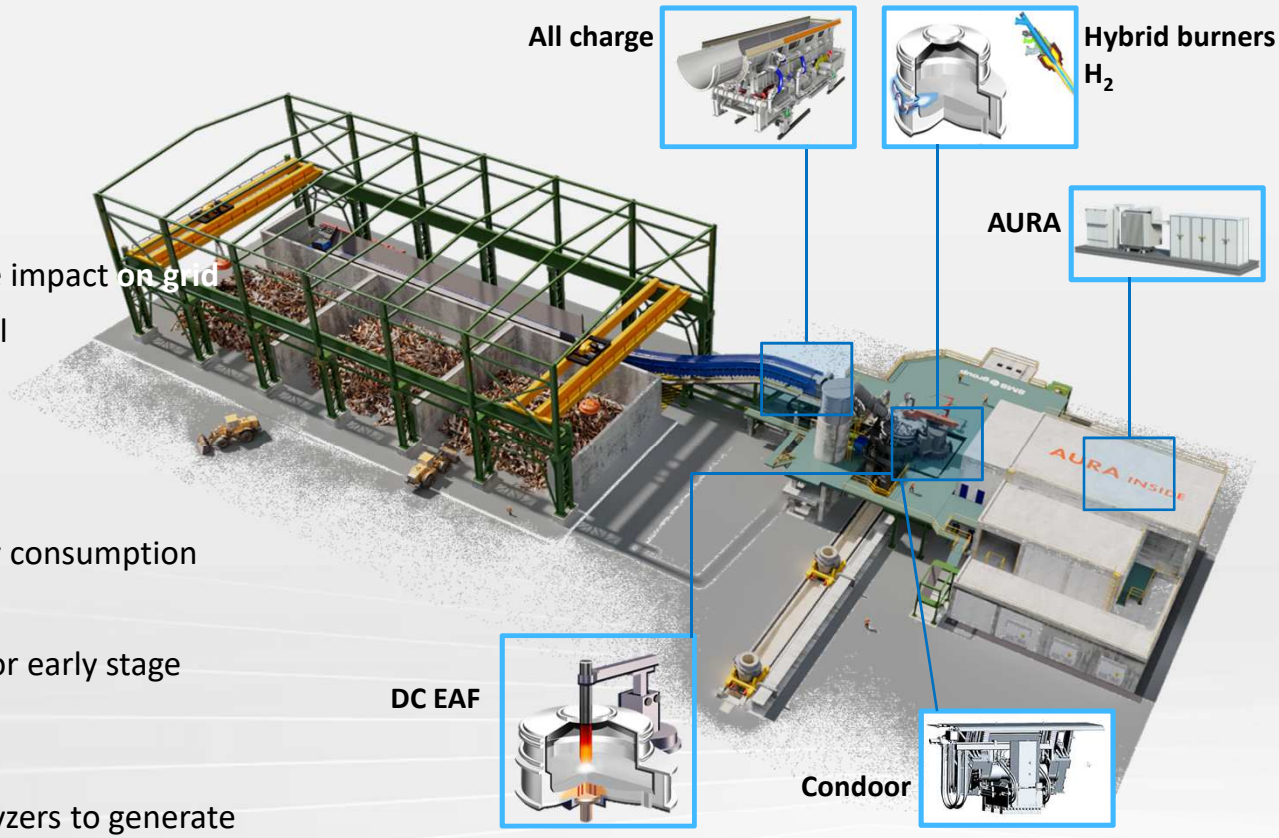
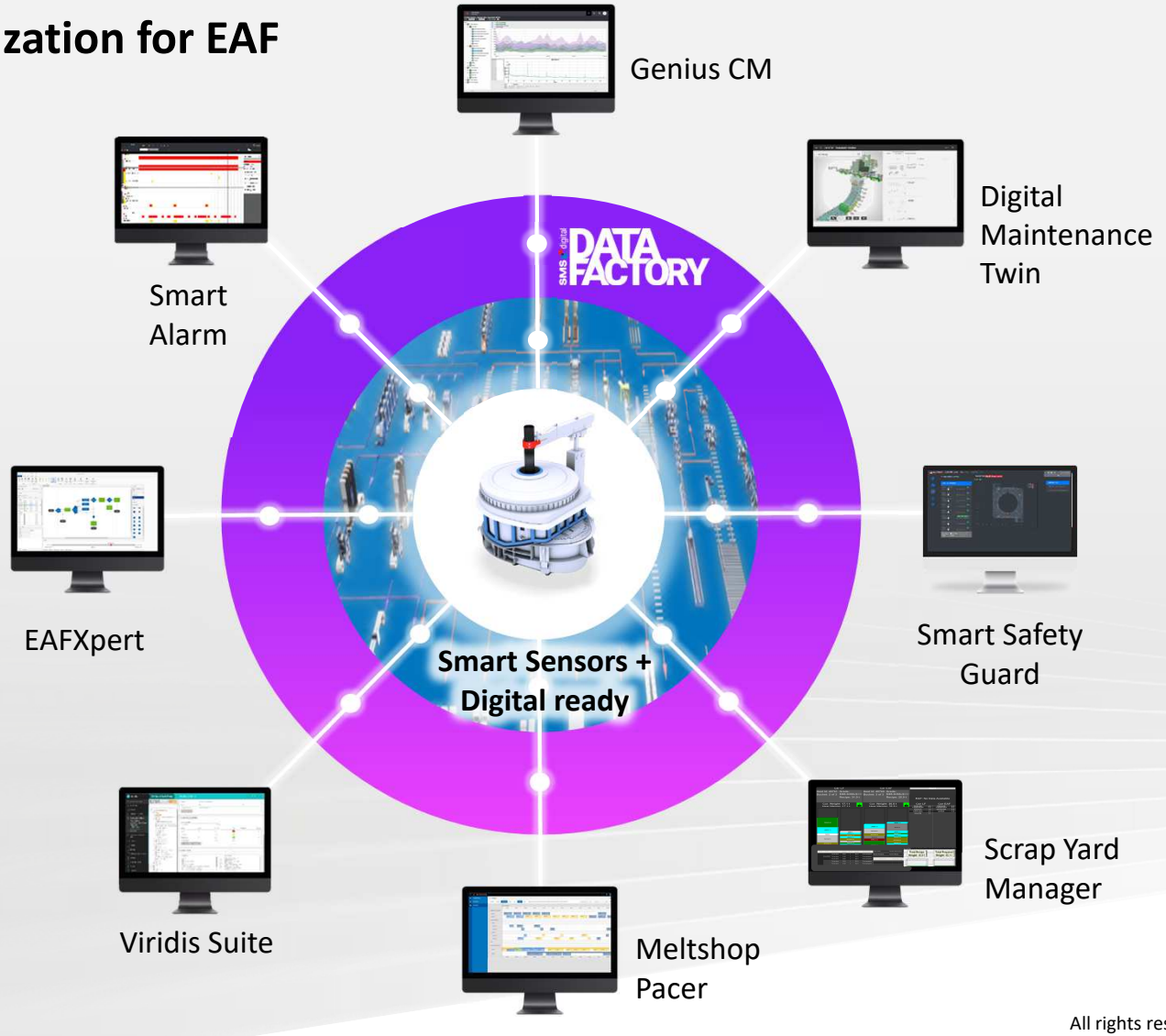
EAF Efficiency Increase Options

- **Allcharge** continuous scrap charging
  - efficient flat bath operation
  - Continuous charging of hot DRI (> 800 C)
- **AURA** powered DC EAF
  - DC technology, AURA powered to decrease the impact on grid
  - Modular approach, multiple cabinets in parallel
  - Scale up your plant when you need
- **DC Pin type bottom electrode**
- **Condoor** automated slag door
  - higher lime & carbon yield and reduced energy consumption
- **CONSO Injection System**
  - Hybrid burners suitable HY2 and/or dual fuel for early stage applications.
- **Waste heat recovery**
  - can be combined with SOEC hydrogen electrolyzers to generate own H_2
- **Digital and Automation packages (e.g. auto tapping) for furnace** and **gas cleaning operation**



Digitalization for EAF



Holistic EAF solution portfolio

From **Production Planning** (e.g. Meltshop Pacer) over **Energy Management** (Viridis Suite) to **Asset Optimization** (e.g. EAFXpert) until **Quality Management** (e.g. Scrap Yard Manager).

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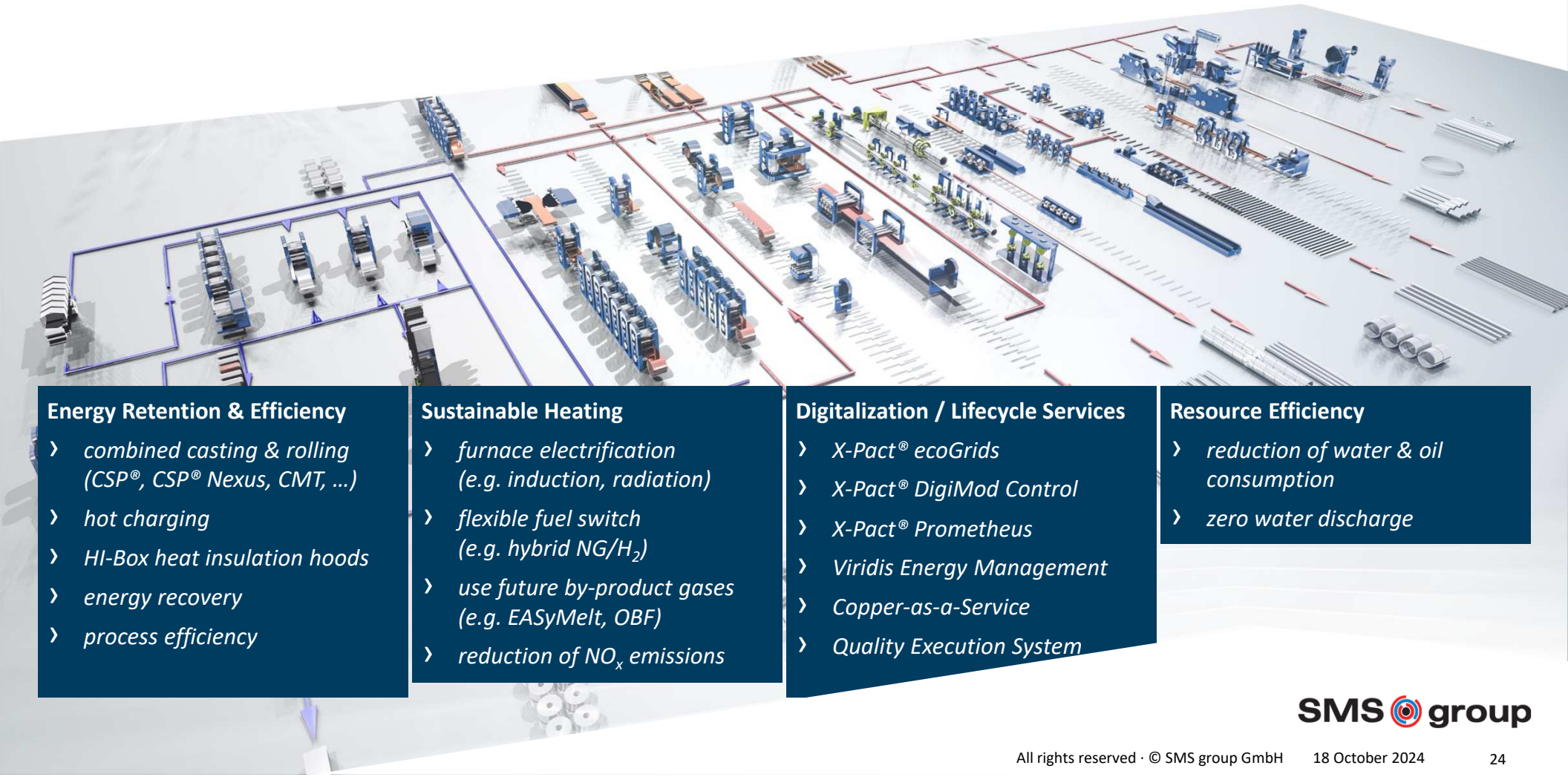
“Green Steel” Technology for downstream

150 YEARS of shaping the future



Energy Retention & Efficiency

- *combined casting & rolling (CSP®, CSP® Nexus, CMT, …)*
- *hot charging*
- *HI-Box heat insulation hoods*
- *energy recovery*
- *process efficiency*

Sustainable Heating

- *furnace electrification (e.g. induction, radiation)*
- *flexible fuel switch (e.g. hybrid NG/H_2)*
- *use future by-product gases (e.g. EASyMelt, OBF)*
- *reduction of NO_x emissions*

Digitalization / Lifecycle Services

- *X-Pact® ecoGrids*
- *X-Pact® DigiMod Control*
- *X-Pact® Prometheus*
- *Viridis Energy Management*
- *Copper-as-a-Service*
- *Quality Execution System*

Resource Efficiency

- *reduction of water & oil consumption*
- *zero water discharge*

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CSP Nexus® | Powerful packages for Green Steel and Energy Saving

HIGH PRODUCTIVITY PACKAGE

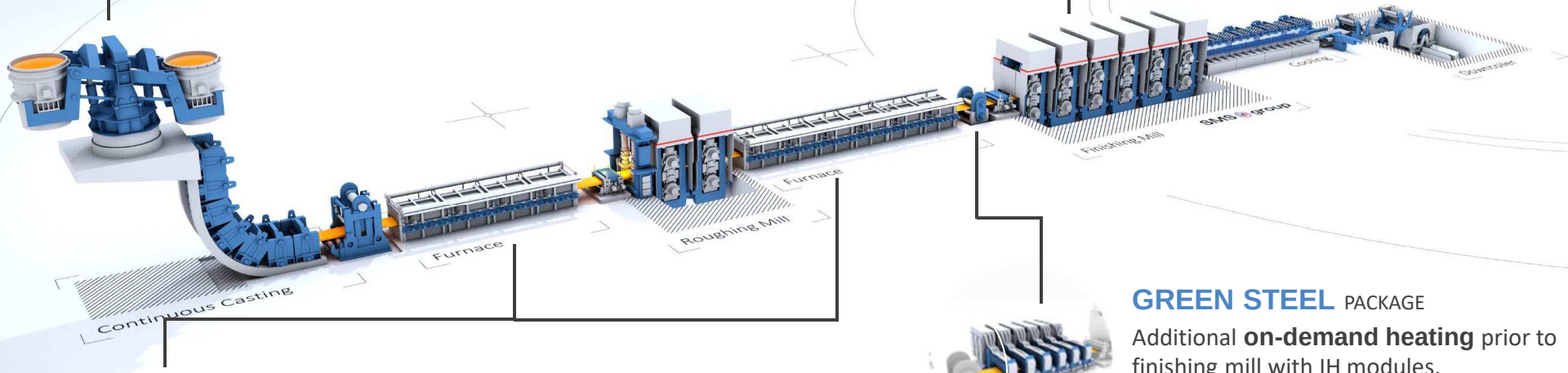
2nd casting strand for record breaking productivity up to 7.0 MPTY.

JSW DOLVI: 1st strand: 4.0 MTPY | 2nd strand 7.0 MTPY

ENERGY SAVING PACKAGE

Convection Roll Cooling for Finishing Mill WR **reduces 90% energy cost.**

H2GS & JSW DOLVI: Finishing Mill WR are equipped with CRC



GREEN STEEL PACKAGE

Additional **on-demand heating** prior to finishing mill with IH modules.

H2GS: 27 MW of on-demand IH heating capacity available

GREEN STEEL PACKAGE

Full electrification of CSP® Nexus with electrical furnaces + inductive heating.

H2GS: All furnaces based on resistance heating + FM entry IH

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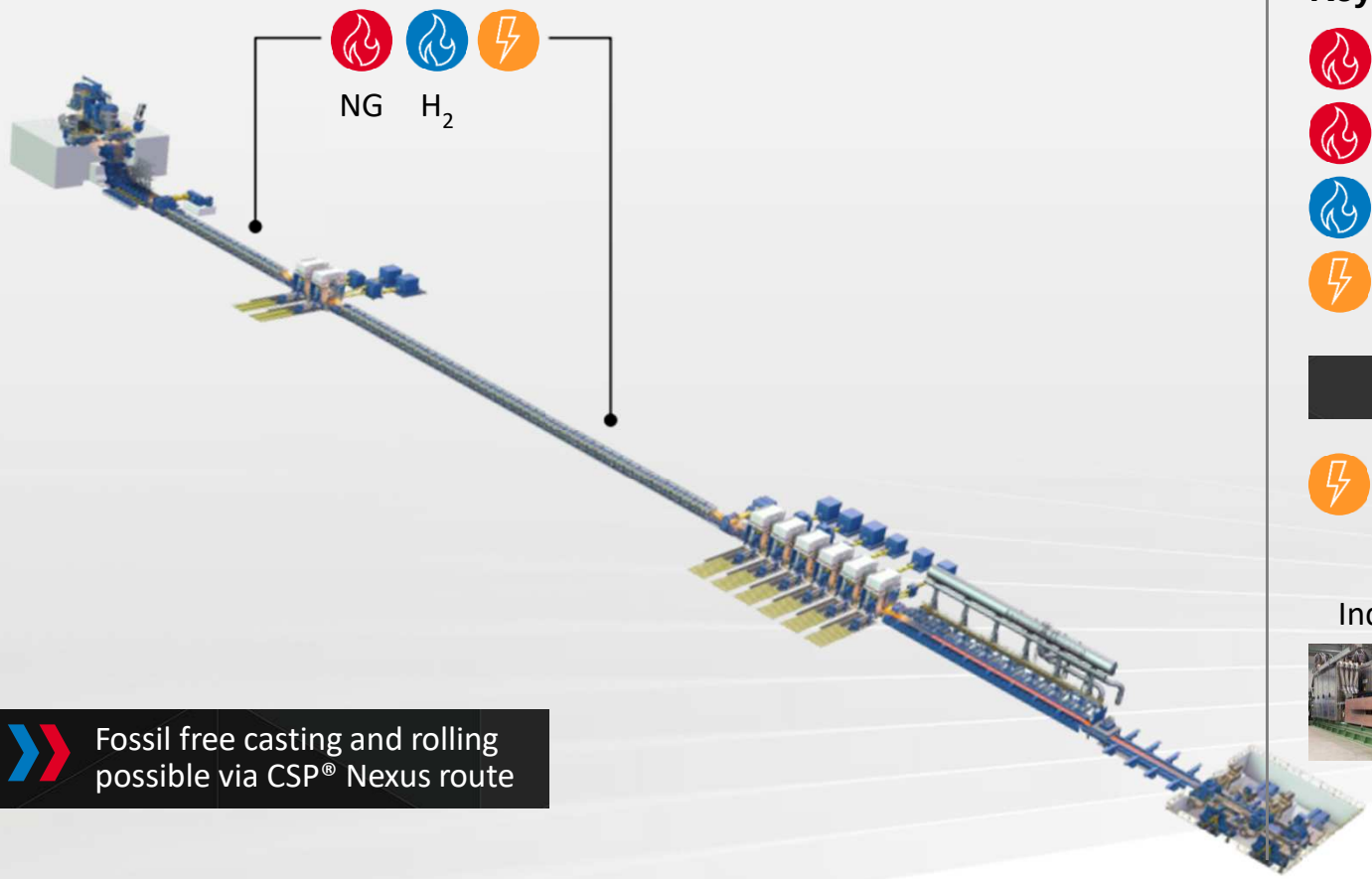
Emission free Casting and Rolling via CSP® Nexus

ZERO FOOTPRINT



Fossil free casting and rolling possible via CSP® Nexus route

Key Factor: Hybrid heating solutions

NG	+	H_2
NG	+	Inductive
H_2	+	Inductive
Conductive	+	Inductive

Alternative heating solutions

- Electrical heating solutions
  - Inductive
  - Conductive
- Hydrogen

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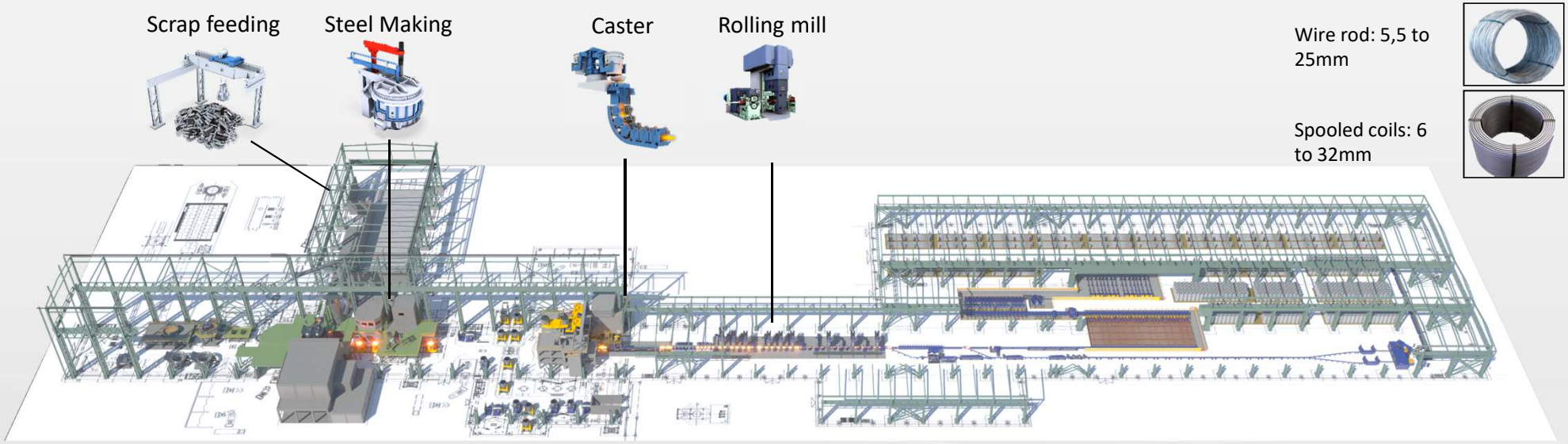
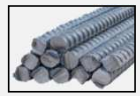
A minimill - endless process (CMT technology)



Straight rebar: 6 to 57mm



Wire rod: 5,5 to 25mm

Spooled coils: 6 to 32mm

Endless process featuring

- - 60% CO_2 emission
- highest productivity and yield
- 23 hours non stop operation per day
- reduced footprint
- - 99% gas combustion usage
- 15% saving in CAPEX
- CMT 350, 550 and 700

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CMT® minimills

The greenest and most efficient production route for steel bar

- **Lowest carbon footprint** per ton of steel produced
- **Lowest water usage**
- **Hydrogen-ready!**
- **120 min** from scrap to product
- 23 hours non- stop operation per day
- **LOW in CAPEX**
- **LOW in OPEX**
- **Flexibility in material charging** with scrap, pig iron, HBI/DRI, depending on regional material availability

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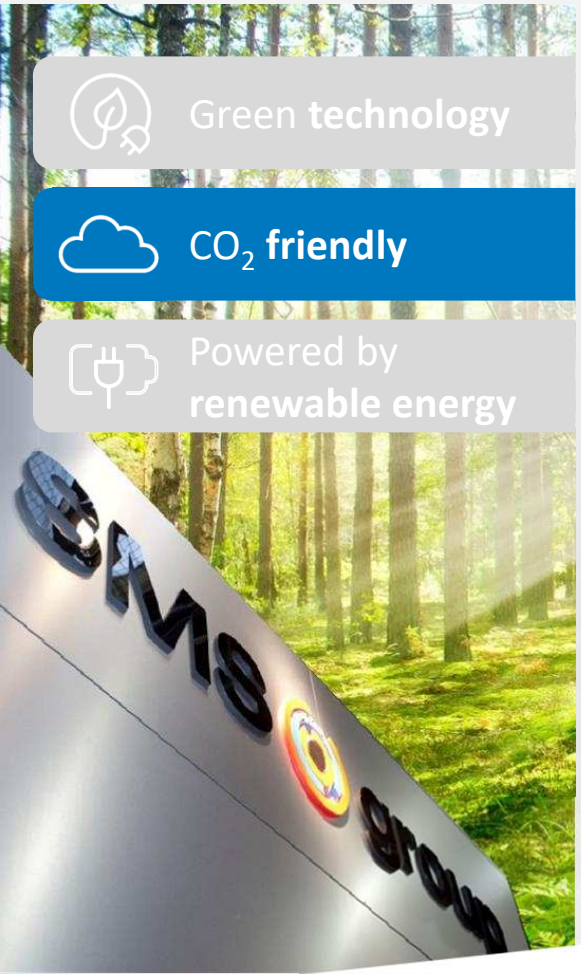
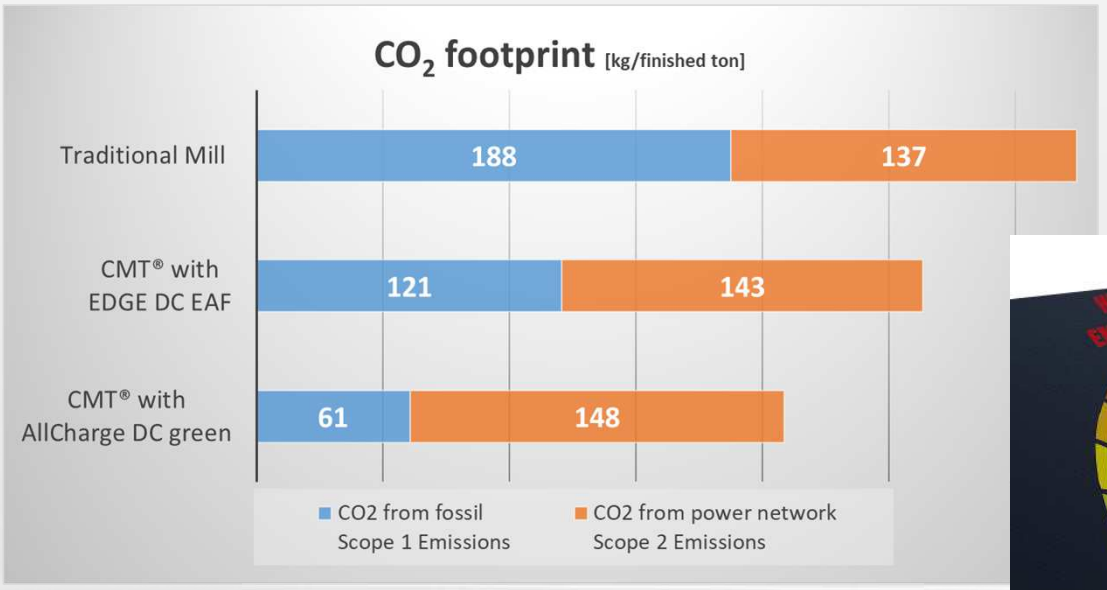
CMT® minimills
The greenest and most efficient production route for steel bar

- **Optimal energy conservation:** no need of reheating process at the rolling mill entry
- **Maximum yield:** highest rolling tolerance thanks to endless process
- **Zero burner concept**: no combustion gas in the entire process: melting, casting and rolling.

CMT® minimills
The greenest and most efficient production route for steel bar





■ Scope 2 depends on the CO_2 footprint of the electrical energy on the selected provider.

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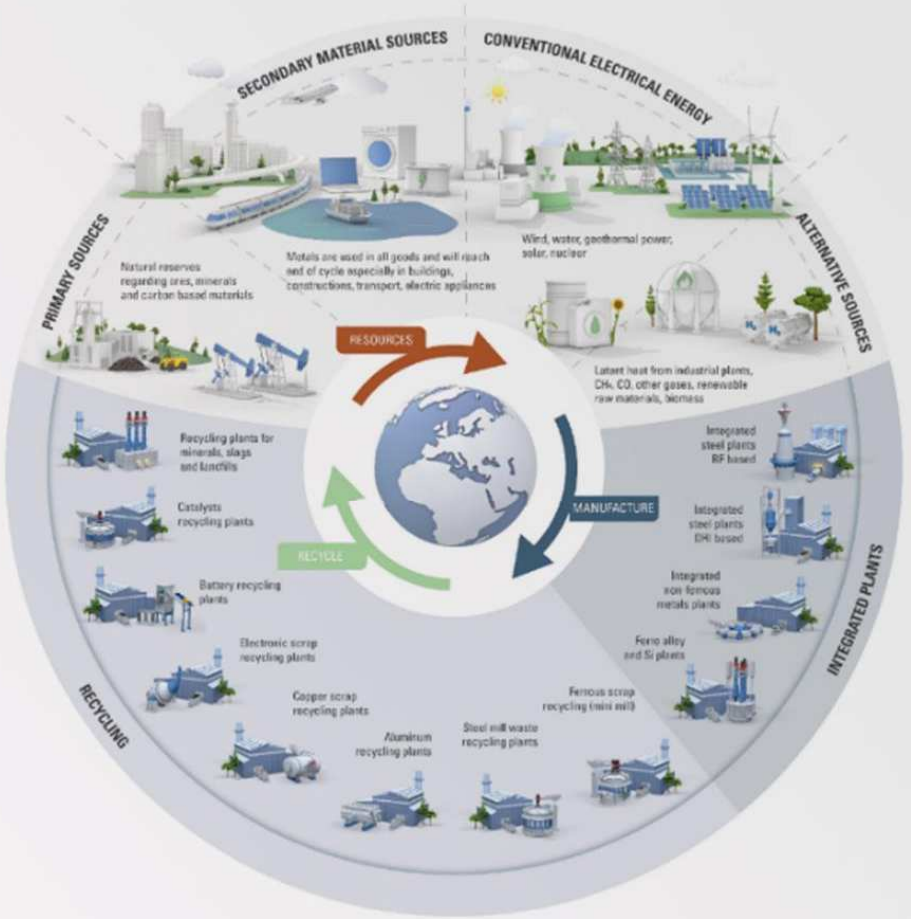
The future of metals is circular…

- SMS group utilizes its wide range of technologies to **shape metal making processes around the world.**
- Alongside the classic, ore-based integrated solutions, the focus today is on **recycling techniques** for scrap, metal-bearing residual materials, and minerals.
- In addition, SMS develops processes for producing **alternative fuels and reducing agents** that are indispensable for the climate-neutral metal production of the future.



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Aurubis
Multi-metal recycling plant for electronic waste

- First secondary smelter for multi-metal recycling in the US
- Recovery of copper, nickel, tin, zinc, precious metals, and platinum group metals from electronic waste
- Based in Augusta, Georgia (USA)
- Recycling capacity: 180,000 t/year
- Start-up stage 1: end of 2024
- Start-up stage 2: 2025

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Spotlight: Primobius

Special process of recycling Lithium-Ion batteries

- JV with Australian NEOMETALS Ltd.
- CO_2-reduced 2-stage recycling process
- Scalable and industrially applicable
- High purity of recovered materials (lithium, cobalt, nickel)
- Pilot plant in Hilchenbach
- Commercial operation (stage 1) since spring 2022

Technology partnership with Mercedes-Benz AG at their battery recycling plant in Kuppenheim, GER.

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Key Takeaways

SMS group takes a **leading role** in the transformation of the metals industry with a strong mission of **“turning metals green”**

We are the leading company in our industry offering climate-neutral technology for all major metals, along the complete process chain and over the complete life cycle of a plant.

We develop tailor-made solutions for our customers need, based on 150 years of experience, a deep understanding of processes, innovative methods for product development and project implementation and a unique network of companies inside and outside SMS group.

We offer the technologies for a fast and massive reduction of CO2 emissions on a global scale considering today’s availability of renewable energy and quality of raw materials. Our solutions and projects cover near-zero emission steelmaking based on hydrogen and green electricity as well as the cost-efficient conversion of existing ironmaking plants into low CO2 emission operations.

SMS group has developed pyrometallurgical and hydrometallurgical metals recycling processes that offer economically and ecologically balanced solutions towards the circular economy.

”Building on 150 years of history and experience, SMS group is your reliable lifecycle partner for Green Steel Transformation”

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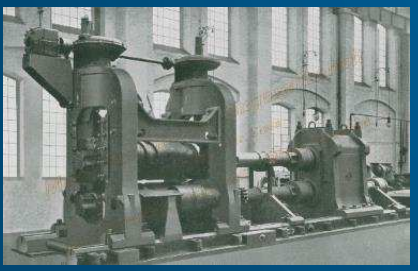
THANK YOU FOR YOUR ATTENTION

1 5 0 YEARS of shaping the future

1871

Many roots – one company
Carl Eberhard Weiss starts a forging business

1904



Global reach and local expertise
We supply our first rolling mill to China

1952

A partner for megaprojects
Building the first integrated steel plant in India

1989

Pioneering solutions
We invent CSP® technology – a revolution in sustainability

2016

Life cycle partner
The Learning Steel Plant – our first fully digital steel production facility

2023

#turningmetalsgreen
Shaping the future of metals and drive the green revolution