SMS insights
Stories of transformation 2025—1

The minimill journey

SMS group

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ELECTRIC ARC FURNACES

Powering the green transformation

Our electric arc furnaces are at the forefront of eco-friendly steel production. Trusted by green steel leaders like Saarstahl, SSAB, Stegra, Hybar, Big River Steel, and Nucor, our cutting-edge technology merges unparalleled productivity with efficiency and reduced emissions. Partner with SMS group to embrace the future of sustainable steelmaking and elevate your operations today.

#turning**metals**green

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Dear reader,

It is my pleasure to welcome you to this edition of SMS insights, where we highlight an innovation that continues to shape the steel industry: the minimill.

Many companies claim that innovation is part of their DNA. However, my experience as Chief Technology Officer has shown that true innovation is not a matter of mindset, but the result of consistent, focused, and often demanding work. At SMS group, we pioneered CSP technology and helped lay the foundation for the minimill concept. Yet innovation does not stand still. Over the years, others have entered the field with new ideas and new approaches.

This is why we have made substantial and sustained efforts to evolve this technology, translating customer needs into future-oriented solutions while integrating digital tools and artificial intelligence into our systems. It has always been our goal to create tangible value for our customers and to improve the performance of their operations throughout the entire lifecycle of their plants.

This same commitment to innovation drives our work in the field of long product minimills. A recent milestone we are particularly proud of is the commissioning of our first CMT plant at Hybar in the United States just a few weeks ago. It's a powerful example of how rebar can now be produced more efficiently and sustainably.

Innovation, however, also requires the right organizational structures and infrastructure. A prime example is our digital classroom at the SMS Campus in Mönchengladbach. This space brings together the expertise of our developers, engineers, and technologists, enabling them to collaborate directly on 3D construction models and, in many cases, work alongside customers to address their challenges and create innovative solutions. I warmly invite you to experience it firsthand.

Thomas Hansmann
CTO SMS group

FOCUS

Technology

LIFECYCLE PARTNERSHIP

GREEN METALS

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Oliver Tjaden

The minimill story

The introduction of the minimill concept in the late 1960s marked a revolutionary shift in the steel industry, offering a more flexible, efficient, and sustainable alternative to traditional integrated steel mills. What are the advantages of the concept? What were the key drivers? And most importantly, what does the future of the minimill look like? Join us as we dive into the past, the present, and the future.

MAIN ADVANTAGES OF MINIMILLS

— A much smaller footprint, allowing more flexible production and lower capital investment
— Significantly lower energy consumption, using scrap as the starting material and processing the steel in a connected casting and rolling process
— Quick adjustment of production levels and product types to meet market demands

A minimill is defined as a type of steel complex that produces steel from scrap metal using electric arc furnaces (EAF) and processes the steel in a combined casting and rolling process to create a finished product. The development of the minimill technology was inspired by both German and American entrepreneurs and engineers. In 1961, the German Willy Korf started construction of a first rolling mill at Badische Stahlwerke to produce the material for his welded wire mesh plant.

Confronted with obstacles in expanding his business, he decided to set up his own electric steelmaking facility. The meltshop's Demag continuous caster with in-line reduction enabled the mill to manufacture billets of varying sizes. In 1969, Korf exported the minimill idea to the US and built a plant in South Carolina, boasting three 60 t electric furnaces, two casters, and a wire rod mill with an annual capacity of 500,000 t. At the same time, Nucor developed its own minimill concept. Dissatisfied with the prices of construction steel used in the production of steel joists, Nucor built its first minimill in South Carolina with an annual production capacity of just 200,000 t. This new concept brought significant momentum to the long products market. Using scrap as raw material, manufacturers were able to establish themselves outside the traditional steelmaking regions, closer to their customers, leading to a gradual shift in the American steel industry from north to south over the past five decades. Today, 71 % of US steel production comes from about 100 minimills operated by 50 different companies.

CSP: The breakthrough for flat products

After this successful introduction, technology suppliers and steel producers strove to adapt the concept for flat products. SMS was the first company to solve the technological issues. The key was the newly developed funnel-shaped copper mold and the optimized submerged entry nozzle that made near-net-shape slab casting possible. The slabs, just 50 mm thick, passed through a short tunnel furnace before being directly rolled down to their final dimensions in a finishing mill. As a result, the energy-intensive slab reheating and roughing processes were no longer required.

Yet finding the first customer for the revolutionary plant concept proved to be just as difficult. Nucor decided to take a chance on it and in the summer of 1989, SMS and Nucor put the first thin slab casting-rolling plant into operation. The technology was called Compact Strip Production, or CSP for short.

Integration of electric steelmaking, casting, and rolling is the key of minimill technology.

Every new CSP plant brought with it a further enhancement, and CSP quickly developed into a technology that enabled the production of modern, sophisticated steel grades. Before long, CSP customers were producing strip for the automotive industry, high-strength grades, and tube steels. At the same time, CSP expanded the product range to include ultrathin (down to 0.8 mm) and thick strip (up to 25.4 mm).

Electric steelmaking and beyond

The success story of the minimill began in markets with a mature industrial landscape, as these could offer an essential prerequisite, the availability of steel scrap in sufficient quantities. Around 1990, around 200 million t of steel scrap were available every year, with 75% of this volume generated in North America and Europe. However, due to the advantages of minimills in terms of investment and operational costs, other regions with a lower availability of scrap soon started to adapt the concept. In the Middle East and Northern Africa, DRI (direct reduced iron) plants were added as a primary stage of production due to the availability of low-cost natural gas. Additionally, integrated steel producers with existing converter meltshops adapted the casting-rolling technology, notably in India and China.

Continuously evolving: Minimills for long products

Following the basic rationale of the minimill concept, producers and suppliers focused on increasing efficiency and eliminating further production steps. The idea was to directly connect the casting plant and the rolling mill without intermediate furnaces. The first minimill of this type for deformed bars went into operation at CMC Arizona in the early 2000s with a high-speed single-strand caster connected directly to the rolling mill.

This direct connection between casting and rolling places the highest demands on the coordination of the two processes, as all fluctuations in the casting process, e.g., a reduction in the casting speed, affect the process parameters during rolling. To overcome these restrictions, most minimill concepts, such as our CMT (continuous minimill technology) plant, feature an induction heater that connects the caster and the mill to increase and equalize temperatures as required and thus ensure a stable process. With an annual capacity ranging from 350,000 to 700,000 t of rebar, wire rod, or heavy section, CMT plants are a perfect fit to serve dedicated regional markets, mainly the construction sector (see our article on CMT on page 18).

The CMT concept has been designed for minimum CAPEX and OPEX. CMT only requires small property sizes, thus reducing the initial costs of the investment. By integrating steelmaking, casting, and rolling into a single, reliable process, CMT is highly energy efficient. By replacing conventional reheating furnaces with induction heating, carbon emissions can be reduced to a minimum.

Flat products: Flexibility is king

Minimills for flat products also adapted the trend to facilitate endless production, albeit driven by a different motivation. Here, endless rolling was primarily aimed at producing thin strip as a high-margin product. CSP technology was perfectly capable of rolling thin hot strip between 1.2 and 0.8 mm thanks to very stable process conditions. As a first step, SMS introduced so-called semi-endless rolling in 2003, where a jumbo slab is cut by the pendulum shear, rolled, and subsequently divided into several coils by the high-speed shear upstream of the coiler.

In 2009, the first casting and rolling plants dedicated to endless production went into operation. With this process, the slab caster is followed by in-line roughing stands and inductive heaters, before the slab is rolled to its final thickness in the finishing stands. When producing ultrathin strip (<1.0 mm) in particular, the endless rolling technique benefits from increased stability. However, with respect to the vast majority of the product spectrum, endless casting and rolling proved to be inefficient due to the additional heat input necessary to meet all process requirements.

To overcome the limitations of the endless process and to expand the possibilities of CSP technology, SMS developed the CSP Nexus concept. Key features include a caster with a throughput of 8 t/min and more, a decoupled rolling process with additional powerful roughing mill stands, and a flexible furnace concept that is operated with natural gas, hydrogen, or electricity alone.

A major advantage of CSP Nexus is that it offers both real batch and endless rolling. The rolling mode can be selected to achieve the ideal process →

Minimill timeline

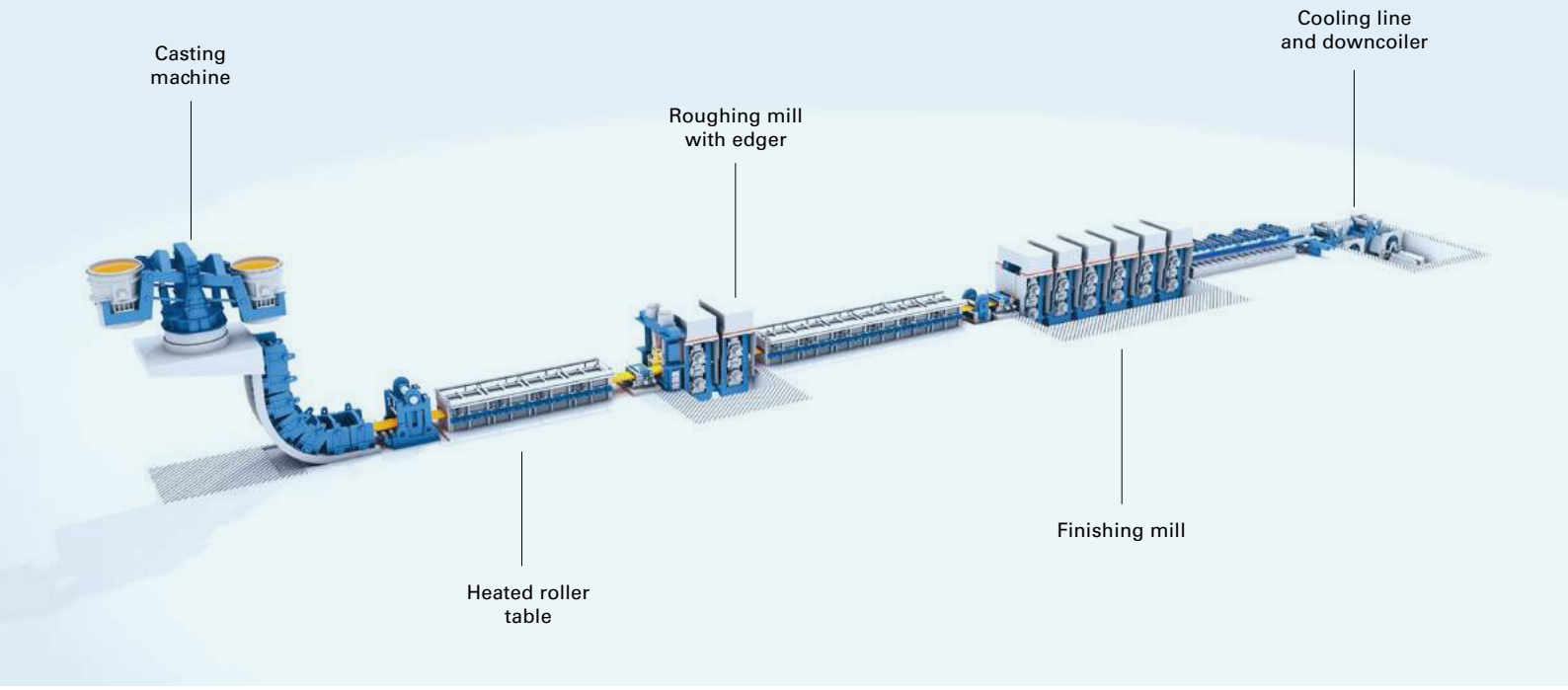
1960s
Minimill technology for long products starts to evolve

1989
SMS invents CSP technology – the first minimill for flat products

EARLY 2000s
First fully continuous minimill for long products

2009
First endless casting and rolling plants for flat products

THE CSP NEXUS CONCEPT



CSP Nexus offers both real batch and endless rolling for ideal process conditions and maximum efficiency.

conditions as well as maximum energy efficiency for all steel grades and product dimensions. In real batch mode, roughing and finish rolling are two separate phases, similar to conventional hot strip mills. To retain as much heat in the process as possible, two or three powerful roughing stands enable roughing to take place at the highest speeds. This means that energy consumption is reduced further, and that the product mix can be expanded to include products with high added value, such as thin-gauge, high-strength automotive grades.

At the opposite end of the spectrum, heavy-gauge HSLA for line pipes can also be covered with CSP Nexus, as it features a process capable of fully utilizing thermomechanical rolling. Only the complete separation of the roughing and finishing phases provides maximum flexibility when it comes to controlling the material speed, temperature, and time profile over the complete process. CSP Nexus is also capable of rolling thin gauges in batch mode. When moving to ultrathin strip, CSP Nexus utilizes the endless mode.

The first CSP Nexus plant started operation at Steel Dynamics Inc. (SDI) in Sinton, Texas, USA, in 2022. Stegra in Sweden will be the second reference. As the world's first near-zero carbon steel complex, the plant relies on electricity as the sole source of power for heating processes by applying a combination of resistance heating furnaces and inductive heating modules. The third CSP Nexus plant is being built for JSW Steel in India. With thicknesses ranging from 2 to 32 mm, a maximum width of 2,600 mm, and an annual capacity of 4.0 million t, this plant offers an unmatched level of flexibility and productivity.

A concept for the future

The story of minimills is set to continue, and for many reasons. As the concept is built on scrap-based steelmaking, it is a perfect match for decarbonizing steel production. If the electricity for steelmaking comes from renewable sources and the heating between casting and rolling is done inductively, near-zero carbon production of flat and long products can be realized. In addition, scrap availability is expected to almost double within the next two decades.

In the long products sector, minimills have their greatest potential as "market mills" in regions with significant investments in infrastructure and residential construction. With a typical annual capacity of around 500,000 t, they offer low investment and operating costs. In the flat products sector, minimill concepts such as CSP Nexus are approaching the capacity and product range of conventional hot strip mills. The CSP Nexus plant by JSW Steel will set the benchmark here with an annual capacity of 4 million t and a maximum strip thickness of 32 mm. At the same time, the "classic" CSP plant will continue to find its market due to its significantly lower operating and investment costs.

Advanced solutions to increase performance

What's more, all our plants are provided with advanced solutions for automation, digitalization, and services, including performance-based business models. By implementing intelligent tools such as the SMS DataFactory, the QES quality management system, the Genius CM condition monitoring software, or the Viridis energy management, producers can make major improvements in terms of energy minimization, production forecasts, and condition monitoring. The X-Pact automation system provides integrated control from level 2 to level 0 across the entire plant. This system ensures seamless coordination of all processes from melting to rolling. At the same time, automation forms the foundation for our "lights-out" concept for highly dynamic, resource-saving, autonomous plant operation. This will mark a huge leap forward for all plants producing metals, not just minimills.

2022

Start-up of first CSP Nexus plant at Steel Dynamic Inc., USA

2025

Start-up of first CMT minimill for rebar production at Hybar, USA

2026

Start-up of first near-zero carbon CSP Nexus plant at Stegra, Sweden

Induction heaters are essential elements in CMT and CSP plants to connect casting and rolling.

A new generation of electric steelmaking

As reflected by recent projects, electric arc furnaces in minimills have to cope with new requirements concerning input material, energy supply, and capacity.

Electric arc furnaces (EAF) have played an essential part in the minimill success story over the past decades. Based on the availability of steel scrap and inexpensive electricity, electric steelmaking offers an energy-efficient and cost-effective alternative to integrated steel production, even in locations away from traditional industrial regions.

As scrap availability increases and green energy becomes more accessible, EAF technology will continue to play a central role in the years to come in achieving sustainable steel production while satisfying growing demands. Nevertheless, the requirements for electric arc furnaces are changing and becoming more challenging, both inside and outside the scope of minimill projects.

Flexible raw material input

EAFs are uniquely suited to processing diverse raw materials, including scrap steel, direct reduced iron (DRI), and hot briquetted iron (HBI). This flexibility ensures their adaptability to varying resource availability levels. For example, while scrap availability in China is expected to surge by the 2040s, the US and Europe are already benefitting from reliable scrap resources and stringent environmental regulations. By 2050, experts expect a total of up to 1.4 billion t of scrap to be available each year.

When recycling steel scrap in an EAF, tramp elements such as copper, tin, and lead cannot be eliminated by the melting process, which in turn compromises the final product's quality by reducing ductility and causing brittleness. To produce high-quality steel from scrap, advanced sorting, blending, and processing techniques are essential for meeting stringent quality standards and thus enabling premium-grade steel production.

For a backward analysis of scrap composition, SMS group's X-Pact Sampler provides reliable operation for sampling, optimizing the charge mix, and improving yield thanks to the process control system. This advanced robotics application automates liquid steel sampling, including sample handling and lance deformation compensation, and is fully integrated into the main automation system.

When using HBI or DRI as input material, the steel quality is more predictable and shows a more uniform composition, with minimal impurities. With 90% to 94% of metallic iron content, DRI and HBI are ideal for producing high-quality steel, but this requires additional energy input to reduce the iron oxide, melt it, and remove impurities.

In many projects, we see the need for greater flexibility regarding input materials, ranging from 100% scrap to 100% hot briquetted iron / direct reduced iron (DRI). This requires more electrical energy and advanced integration with existing equipment, while at the same time maintaining productivity levels through a balance of mechanical and electrical design. An example of this flexible raw material input is the new AC EAF we are supplying to Stahl-Holding-Saar (SHS). This 185 t EAF, with a transformer capacity of 300 MVA, will be capable of processing a flexible mix of scrap and cold DRI/HBI and will contribute significantly to SHS's strategic plan to reduce carbon emissions by utilizing a mix of natural gas and hydrogen. The plant will produce various steel grades, including bearing steel and spring steel, enhanced by SMS group's advanced automation technologies such as X-Pact Autotap and Genius CM for predictive maintenance.

The three 180 t EDGE DC EAFs for Stegra in Sweden are also designed for hot and cold DRI charging. DRI will be supplied continuously from the directly linked Midrex plant. Based on these input materials, Stegra will produce advanced automotive steel grades. The EAF will be part of the world's first green steel plant, setting a new industry benchmark.

Energy supply

Energy-intensive steelmaking processes require innovative solutions to minimize consumption and maximize efficiency. A key focus area is the comparison between DC and AC technologies, where SMS group's DC EAFs stand out due to their superior energy efficiency, operational cost savings, and environmental benefits. The natural stirring effect in the DC EAF ensures temperature and chemical homogenization, reducing "power-on" times and electrode consumption. Additionally, the longer arc of the DC design enhances heat transfer, further lowering energy requirements while reducing flicker. This design also improves the operator environment, cutting noise levels by up to 40% compared to AC designs. The bottom electrode pins, engineered for extended lifespans of up to 2,000 heats, minimize handling costs and contribute to operational reliability.

Complementing this technology is SMS group's X-Pact AURA platform, which leverages IGBT (insulated gate bipolar transistor)-based power →

AC VS. DC TECHNOLOGY

AC EAF
- Lower initial cost
- Greater production flexibility
- Simpler start-up/shutdown
- Higher energy use and electrode wear

DC EAF
- Higher energy efficiency
- Reduced electrode wear
- More precise temperature control
- Quieter, less flicker
- Higher installation cost, more complex maintenance

The 190 t AC EAF for SSAB will be one of the largest EAFs globally (©: SSAB)

electronics to address challenges in weak grid environments. Designed with modular architecture, X-Pact AURA delivers maximum efficiency, reliability, and dynamic response, with power ratings ranging from 5 to 350 MVA. This innovative platform improves power quality parameters, achieving a power factor above 0.95 and a 30% reduction in flicker against most modern compensation systems. Its modular design enables seamless integration into high-power melting units, even within constrained grid conditions, setting new benchmarks in energy-efficient steelmaking.

Integration of AURA-based DC EAF technologies will be central for the project of Hybar LLC in Osceola, Arkansas, USA. Here, Hybar and SMS are advancing green rebar production through their collaboration on the first CMT (continuous minimill technology) minimill. X-Pact AURA enhances energy efficiency and sustainability, utilizing up to 100% renewable energy from a solar park. The minimill is expected to reduce its carbon footprint by 35% compared to conventional minimills. It will operate on solar energy for up to twelve hours daily, supported by advanced energy management systems.

Capacity

Just as the input materials and the type of energy supply vary, the capacity of electric arc furnaces also differs in many projects today. Long products minimills remain "market mills" with limited capacity (0.3 to 1.0 million t/year) based mainly on 100% scrap. One example is the new electric arc furnace for the CMT minimill for Future Forgeworks in Australia, which will have a capacity of 350,000 t/year and feature an AllCharge EAF that is focused on efficiency and sustainability and equipped with technologies to minimize emissions and enhance safety.

In contrast, minimills for flat products challenge the capacity of conventional mills with more than 3 million t/year. We are ready for large-scale EAFs, as shown by the reference facility at SSAB. The 190 t AC EAF will be one of the largest EAFs globally, with an upper shell diameter of 9.3 m. This underscores the trend toward larger installations, also driven by the need to replace the traditional BF-BOF route with electric steelmaking. This project is pivotal in handling large amounts of direct reduced iron, requiring more electrical energy and advanced integration with existing equipment. SMS group's design enables the charging of scrap and cold DRI from 0% to 100%, maintaining productivity through a balance of mechanical and electrical design, supported by modern solutions such as an automatic slag door and digital scrap logistics. ●

Upgrading CSP casters

The modernization of CSP casters can bring significant economic benefits in terms of reducing production costs and extending the product range. At the same time, digitalization solutions ensure more precise process control, minimize scrap, and improve efficiency.

The steel industry is confronted with a major challenge: On the one hand, the pressure to reduce CO_2 emissions is increasing, and on the other hand, the demands on flexibility, product quality and cost optimization are growing. It is therefore essential for operators of CSP plants to continue upgrading their existing production lines in order to remain competitive.

Cost and energy optimization

Energy is one of the largest cost factors in steel production – and at the same time a central lever for sustainable efficiency increases. Operators of CSP plants are faced with the need to optimize their processes in such a way that the energy consumption level per ton of steel is reduced without affecting productivity. A decisive approach here is the introduction of the X-Pact Integrated Process Model, which enables higher-level control and allows all relevant process steps to be adapted to current requirements.

In combination with the Microstructure Property Model (MPM), the Integrated Process Model enables the use of alloying elements to be reduced through predictive process control. Further process optimizations ensure that productivity can be maximized by adjusting the settings for the casting thickness, intermediate slab thickness, or the temperatures, →

for example. Optimizing the production method to extend the service life of critical plant components is also planned.

Enhancing productivity

The production capacity of a CSP caster is a crucial competitiveness factor. By increasing the casting thickness and casting width, more material per sequence can be processed, thus increasing the plant's overall capacity. The extension of the strand guide system also plays a major role. Depending on the plant concept, it can be implemented either by an additional segment or by a combination of a segment and separate pinch roll unit. An extended strand guide system improves the solidification conditions of the steel and allows higher casting speeds without jeopardizing process stability.

Expanding the product mix and improving quality

The demand for highly specialized steel grades is growing continuously. In particular, electric steels

Exchange of a caster segment

for e-mobility and energy-efficient applications are gaining importance. To remain competitive, CSP casters must become more flexible and supply a wider range of steel grades with an optimized internal structure and consistent surface quality. A key technology in this area is electromagnetic stirring (the SEMS system). By selectively influencing the solidification structure, SEMS improves the internal properties of the slabs and reduces segregation in the centerline. The result is a uniform microstructure with a higher proportion of equiaxial solidification, which is especially advantageous for silicon steels. In addition, modern casting technologies such as soft reduction can be employed to further enhance internal quality, with which soft reduction plays just as important a role. This is a technological process where the strand shells are compressed together in the final solidification zone. This compensates for volume shrinkage caused by solidification and the minimization of segregation and porosity in the slab center. By combining these measures, new products can be efficiently integrated into the existing CSP line without the need for extensive new investments.

In addition to the geometry of the product, another focus is on the internal and external quality of the slabs. The optimization of the surface quality already starts in the continuous caster. Switching from conventional roller grids to roller cassettes thus ensures uniform support of the strand and prevents mechanical damage to the surface. Technologies such as electromagnetic stirring and soft reduction play a pivotal role in improving internal quality. Both systems help to reduce segregations and porosities and ensure more homogeneous solidification.

Intelligent digital systems make the difference

The ability to precisely control process parameters provides for consistent quality, higher reproducibility, and minimal manual interventions. An essential element is the further development of the level 2 automation system. By integrating advanced process models as part of a modernization project, temperature curves, casting speeds, and cooling strategies can be dynamically adapted.

Data analyses and tools for predictive servicing supplement the process automation. By continuously recording the machine conditions, maintenance measures can be planned in a targeted manner and unscheduled shutdowns can be avoided. At the same time, the state-of-the-art control systems enable greater flexibility during product changes and ensure that plant owners can adapt more quickly to changing market and production requirements.

Sustainability: The strategic advantage

Through targeted, efficient modernization measures, CSP plants offer huge potential for reducing energy consumption and producing more efficiently. An important lever here is the installation of digital control systems to optimize processes and reduce energy requirements. The optimized temperature control system means less fuel is consumed in the heating furnaces, thus cutting CO_2 emissions. In addition, SMS group technologies contribute to sustainability by reducing scrap and material losses. A further measure is the targeted adaptation of cooling strategies to minimize water consumption and reduce the overall ecological footprint of the plant.

Successful upgrades

Numerous modernization projects show how targeted investments in CSP casters increase competitiveness and improve production performance.

Since the mill at Nucor Crawfordsville was commissioned back in 1989, it has undergone a series of ongoing revamps to enhance its productivity and flexibility. The most important measures include the extension of the strand guide system, the introduction of new casting technologies and the implementation of advanced automation systems. These measures have helped to increase production capacity and reduce production costs at the same time.

At its Berkeley site, Nucor opted for a comprehensive modernization of the CSP caster to expand its product range. By increasing one casting strand by 200 mm as well as installing a liquid core reduction (LCR) system and new oscillation technology, it was possible to include new steel grades in the production process. The upgrade was supplemented by an induction heating system, which also significantly improved the flexibility of the production process.

At JSW Dolvi, the focus was on increasing productivity. The extension of the metallurgical length of the strand guide system by 2.5 m, combined with new bending and leveling systems as well as electromagnetic brakes, enabled a capacity increase of more than 10% and, at the same time, improved the internal quality of the slabs. ●

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The energy-efficient minimill for long products: CMT

Our continuous minimill technology integrates steelmaking, casting, and rolling into one reliable process to make rebar production energy efficient and more profitable.

Steel producers are facing increasing pressure to balance growing infrastructure demands with sustainability goals. As a full-system provider, SMS group delivers tailored solutions that incorporate practical innovations to enable the efficient production of straight bars, compact coils, and wire rods for construction and infrastructure development.

Our continuous minimill technology (CMT) creates an energy-efficient production system by integrating three processes: steelmaking, casting, and rolling. The process begins with scrap metal charged into an electric arc furnace (EAF) for melting and refining. The liquid steel feeds directly into a high-speed caster that connects to the rolling mill, eliminating the need for conventional fossil fuel-fired reheating furnaces.

We engineered the CMT (continuous minimill technology) minimill to maximize production capability while minimizing the installation footprint. This space-efficient design has dual advantages: lower initial investment costs and reduced operational expenses throughout the plant's lifecycle.

CMT produces a comprehensive range of products, from straight rebars to vertical compact coils (VCC) weighing up to 8 t. Our integrated X-Pact automation solutions coordinate every production aspect – from scrap yard logistics to finishing area operations – while managing maintenance schedules to enhance productivity and control costs.

Low-emission steelmaking

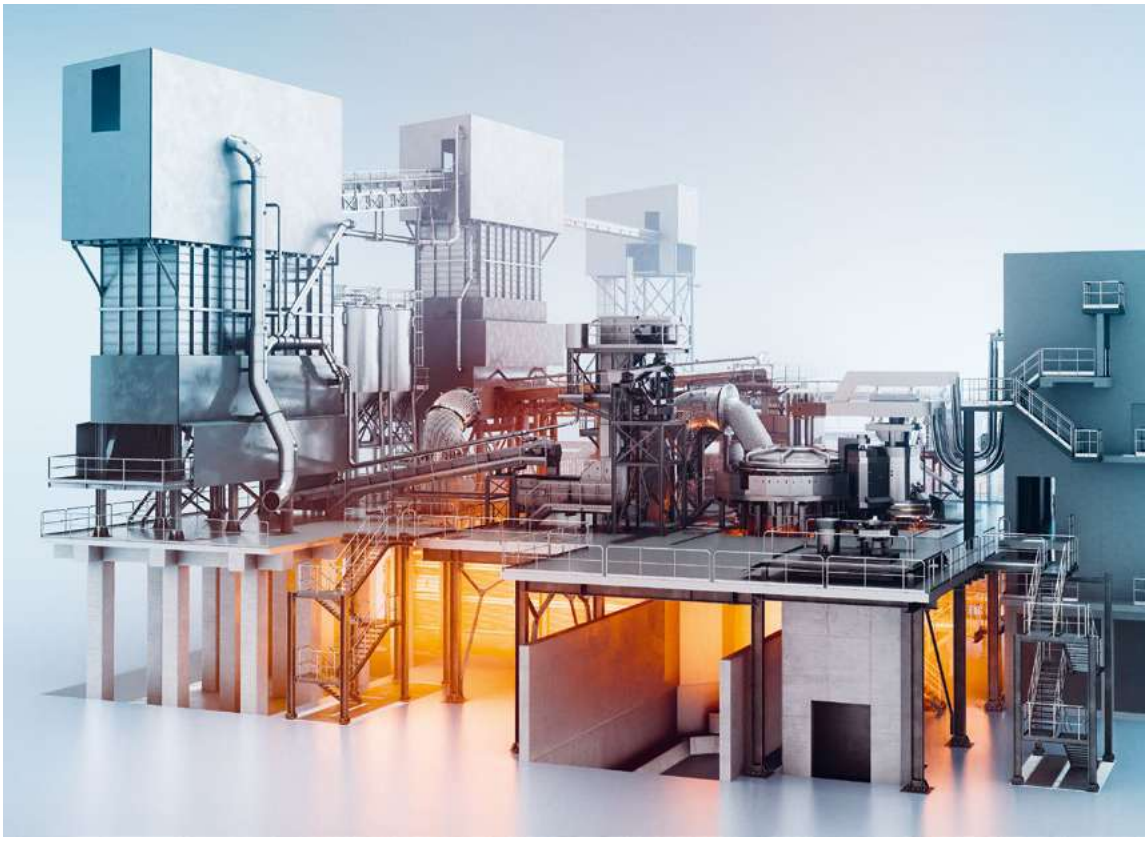
The AllCharge technology employed at the beginning of the CMT process combines continuous scrap charging with flat bath operation, eliminating furnace roof openings during production. This design decouples off-gas extraction from scrap conveying, significantly reducing CO_2 emissions while improving control of pollutants such as NOx and VOCs.

Closed-roof flat bath operation delivers significant electrical savings and maintains higher off-gas temperatures, enhancing emission control quality. AllCharge also minimizes water and refractory consumption, reducing maintenance requirements and operating costs. Integration with our X-Pact automation platform ensures precise material flow tracking and immediate anomaly detection throughout the process.

High-speed continuous casting

Precise synchronization is essential in combined casting and rolling operations. The tundish slide gate control system maintains optimal steel flow and mold level stability. We employ specialized entry shrouds

The AllCharge furnace with continuous scrap charging



and lubricating powder to enable uninterrupted high-speed submerged casting.

Our Conrex mold technology addresses the increased heat loads associated with high-speed casting. This advanced system optimizes cooling, reduces thermal stress, and maintains lower operating temperatures. Its design minimizes the containment length while reducing roll wear. Grooves on the mold tube enhance heat transfer for improved cooling efficiency. The Condrive system ensures precise mold oscillation through torque drive technology, allowing real-time adjustments while reducing operational costs compared to conventional hydraulic systems.

Ultra-flexible rolling mill

The CMT rolling mill operates continuously, with the cast strand running directly into the mill. We position an induction heater before the mill to provide supplementary heating or temperature equalization when required. The rolling line accommodates both deformed bar production and VCC coil winding within the same product range.

The system produces straight bars from 8 to 63 mm and wound bars from 6.3 to 32 mm. With additional equipment, it also handles wire rod from 5.5 to 26 mm (28 mm) and light sections, delivering maximum operational flexibility and production versatility.

Comprehensive automation

Our X-Pact automation system provides comprehensive control across the entire plant from level 2 to level 0. This integration ensures seamless coordination between melting, refining, casting, and rolling processes and offers advanced system tools for production planning, scheduling, and optimization. Built-in business intelligence capabilities deliver detailed statistical analysis and product certification to facilitate data-driven decision-making throughout the process.

Sustainable by design

From its conception, we engineered CMT to minimize energy consumption and the carbon footprint. The system delivers proven sustainability benefits for the entire production process.

Our innovative EAF technology significantly reduces the carbon footprint of steel production. Advanced power electronics minimize fossil fuel usage, electrode consumption, and electrical energy requirements during the melting process. →

Continuous minimill technology (CMT)

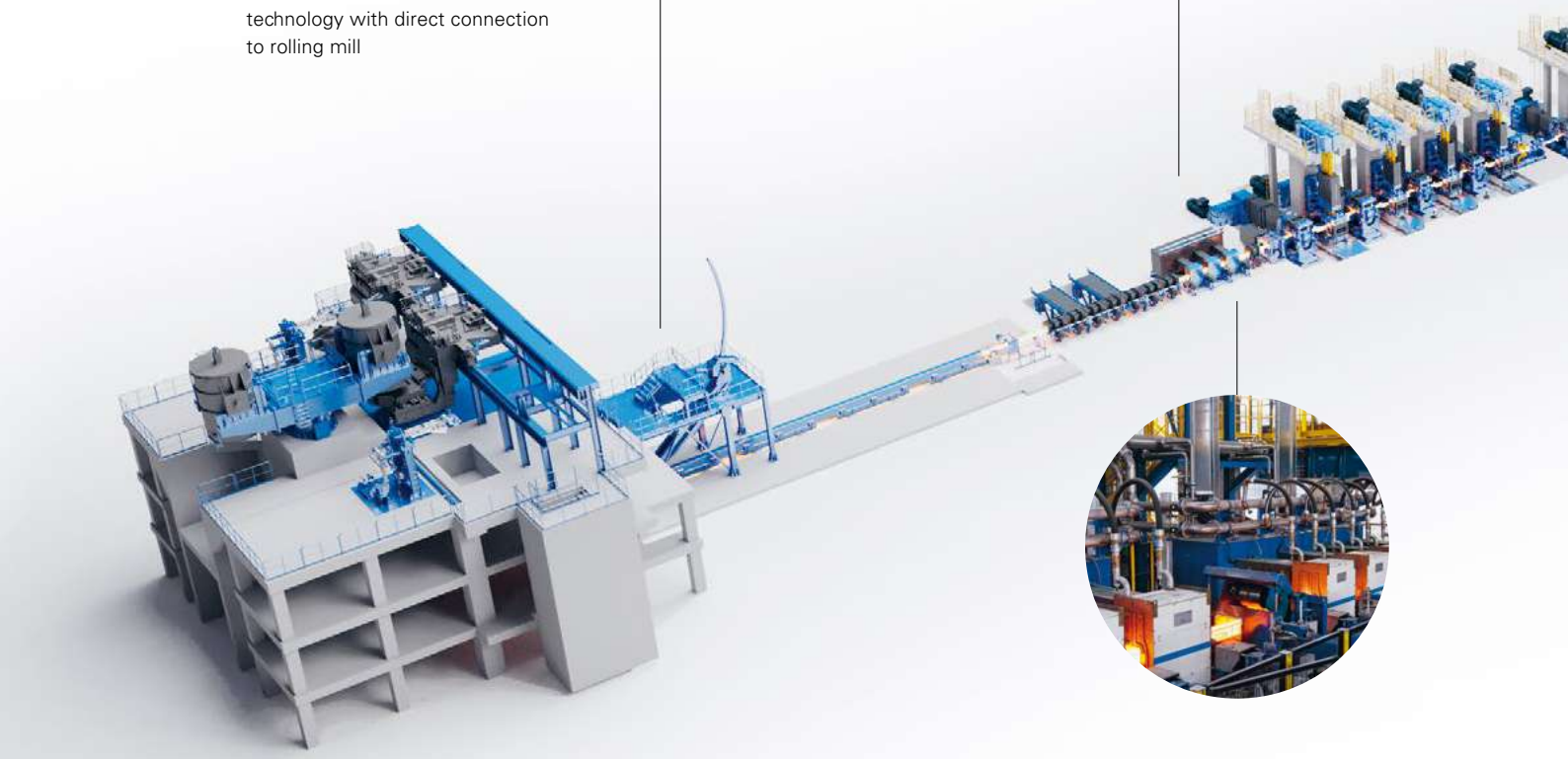
A powerful concept for capacities between 350,000 and 700,000 t/year

Induction furnace EloLong

Eco-friendly inductive heating with zero NOx emissions and limited scale formation

Continuous caster

Single strand, submerged casting with 10.25 m radius and Conrex technology with direct connection to rolling mill



Housingless stands (HL)

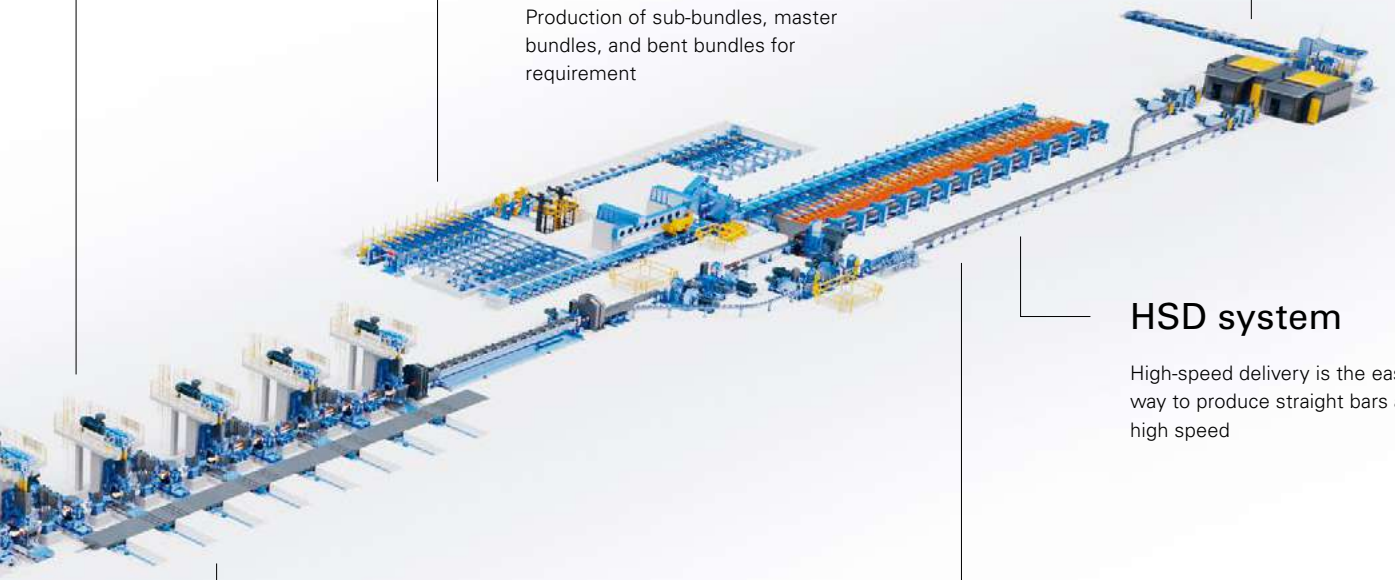
A unique solution in terms of stiffness, reliability, and performance. Over 2,000 units installed worldwide since 1969

VCC system

Highly productive and cost-effective system for torsion-free wounded bars production for customized coils from 1.5 t up to 8 t

Finishing area

No more overlapped/tangled bars with the SMS bundling system. Production of sub-bundles, master bundles, and bent bundles for requirement



HSD system

High-speed delivery is the easiest way to produce straight bars at high speed

PRODUCTS

	DIAMETER	WEIGHT	SUPPLY
STRAIGHT BARS	8–63 mm	Max. 5 t	Bundles 6–24 m
WOUNDED BARS	6.3–32 mm	1.5–8 t	Customized coils
WIRE ROD	5.5–26 mm	1.5–3 t	Customized coils

The X-Pact Lights-Out concept moves operations toward autonomy, improving efficiency and safety while reducing emissions. Innovations like the Condoor automatic slag door and X-Pact Sampler automate slag removal and ensure precise sampling for optimal charge mixes, thereby enhancing performance. These technologies contribute directly to decarbonization by saving energy and improving carbon and lime injection yield, resulting in measurably lower CO_2 emissions.

We equip DC EAF technology with our X-Pact AURA digital power-feeding system. This combination of modular electrical panels and state-of-the-art electronics ensures high efficiency and power density with minimal grid impact. Key advantages include:

— Reduced power losses
— Enhanced electric arc regulation through fast control power electronics
— Improved arc stability for consistent operation
— Minimized network disturbances even on weak power lines
— Enhanced reliability thanks to our one module full redundancy concept

A dedicated water treatment plant is integral to the CMT process. This facility employs advanced technologies that reduce water consumption and eliminate discharge – achieving a 70% reduction in make-up water requirements and a 100% reduction in process water discharge.

Optimized rolling mill operations

The CMT rebar mill features our eight-pass MEER-drive high-speed finishing block, which delivers substantial energy savings. This technology reduces roll ring inventory by 60% compared to conventional finishing blocks through flexible gear ratio selection. The individual drive concept lowers energy consumption and operating costs by approximately 30%. Our MEERarms ring-changing system enables module changes in just ten minutes, further improving operational efficiency. The "one-family-rolling" concept sequence optimizes production, reducing both downtime and energy usage. ●

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Inductive heating allows to control the rolling temeperature.

CMT references

The teams of Future Forgeworks and SMS celebrate the signing of the contract.

Future Forgeworks: Australia's first CMT mill

Future Forgeworks – a pioneering producer of low-carbon steel for the construction industry – has partnered with SMS group to deliver the first CMT 350 mill for rebar production to Australia. Scheduled for completion in 2027, the facility eliminates natural gas for billet reheating, reducing CO_2 emissions by up to 30% compared to traditional processes.

SMS will provide the complete plant as a single-source supplier, ensuring seamless integration. The turnkey solution includes the engineering and procurement of steelmaking facilities featuring an electric arc furnace optimized for efficiency and sustainability. The 350,000 t/year facility incorporates a fume treatment plant, ladle furnace, caster, and rolling mill – all designed to minimize environmental impact while maximizing production capability.

Rohan Richardson, Managing Director, Future Forgeworks: "We are excited to bring SMS group's leading steel manufacturing technology to the city of Ipswich. With CMT, powered by renewable energy, our carbon footprint could be reduced by as much as 90% when compared to other Australian rebar manufacturers."

See the video about the Future Forgeworks project:

Hybar: Pioneering green rebar production

The world's first CMT plant is being built for Hybar LLC in Osceola, Arkansas and started operation in June 2025, only 22 months after the groundbreaking. This new facility will produce low-emission, energy-efficient rebar using up to 100% renewable energy from a dedicated solar park. The renewable power integration reduces the carbon footprint by 35% compared to conventional minimills.

Using advanced energy management systems, the Hybar facility will operate on solar energy for up to twelve hours daily. The plant features our energy-saving eight-pass MEERdrive high-speed finishing block and dual finishing lines for both straight bars and coils weighing up to 8 t, enabling production flexibility to efficiently serve diverse markets.

David Stickler, CEO of Hybar: "We are going to produce long products at Hybar, using high-yield, low-emission, and energy-efficient CMT technology from SMS group. We see the opportunity to set worldwide standards in terms of carbon emissions and labor efficiency."

David Stickler, CEO of Hybar at Metec 2023

El Marakby: A minimill designed for growth

In less than a decade, El Marakby Steel has transformed itself from a re-roller into one of Egypt's leading steel producers. The minimill technology and support provided by SMS group played a pivotal role in this story.

El Marakby wire rod line outlet

A strategic expansion plan

This partnership began in 2016 with the establishment of an electric meltshop and casting plant, featuring a 45 t AC EAF (electric arc furnace) with a capacity of 350,000 t/year, a ladle furnace, and a three-strand billet caster. Located in 6th of October City near Giza, this new facility was designed to enhance El Marakby's competitiveness by expanding its range of steel grades and enabling more flexible rebar production. Yet behind this lay a more strategic plan, as the layout of the casting plant allowed for the delivery of hot billets to a future rolling mill, setting the stage for further expansion.

It took only three years until this next phase was launched. In 2019, the new rebar and wire rod mill supplied by SMS went into operation, taking advantage of the hot connection with the caster. This mill, which started with square 130 mm billets heated by a modern pusher furnace, was designed to produce rebars ranging from 10 to 32 mm and wire rod coils from 5.5 to 12 mm. A key feature of the mill is the high-speed delivery system (HSD), which facilitates the production of straight bars without the complications of slitting, ensuring closer tolerances and better rolling control. The high-speed finishing block, with modules in ultra-heavy-duty design, produces quality wire rod at minimal operating costs, all managed through a level 2 automation system provided by SMS group.

Following its start-up, the minimill achieved exceptionally successful results, with yield improvements of between 97.5% and 98%. This performance, coupled with lower natural gas consumption, significantly reduced the cost per ton. In an interview at the wire and tube trade fair in 2024, Hassan El Marakby, CEO of El Marakby, emphasized, "We are one of the efficiency leaders in the market. We achieve a very high yield, and a very high utilization rate. Long products are a very competitive market and thanks to SMS we are able to compete on a global level."

Taking the minimill to the next level

With the continued success of El Marakby's products, the minimill gradually reached its capacity limits. In 2023, an SMS team conducted a comprehensive efficiency analysis of the minimill, identifying opportunities for optimizing the meltshop, plant operations, production processes, and raw material supply chains.

This analysis gave rise to a strategic plan focused on operational improvements. Additionally, El Marakby decided to invest in scrap preparation equipment, as scrap density had already been previously identified as an action point. By optimizing the key areas of the meltshop, El Marakby was able to increase its production capacity by around 10%.

Nevertheless, these optimizations alone could not bring the minimill to the level needed to drive El Marakby's ongoing growth. That's why in 2024, the electric arc furnace, the caster, and the rolling mill were modernized by SMS group.

Upgrades to the meltshop included the installation of a 55 MVA transformer, two new-generation Conso systems for lime and carbon injection, and the Condoor automatic slag door. The Condoor guarantees enhanced efficiency by reducing the power-off time and electrode consumption while increasing the metallic yield. Automatic cleaning cycles not only enhance safety but also minimize the risk of refractory damage. The Conso system in the EAF provided the additional chemical energy needed for charge melting and liquid bath superheating.

To expand the product portfolio and boost the production capacity of the minimill from 400,000 to 460,000 t of rebar and wire rod per year, a new 150 mm square billet cross-section was introduced in the continuous casting plant. The introduction of Convex mold tube technology for 150 mm square billets also enhanced the production process by improving heat transfer and surface quality, ensuring consistent dimensions, and reducing defects.

In the rolling mill, the roughing mill area will be equipped with two additional cartridge housingless stands, one in a horizontal design (H) and the other vertical (V), thus increasing flexibility and efficiency and allowing the mill to accommodate the new billet size. This will enable El Marakby to increase material yield and achieve a coil weight of 2 t in its wire rod line.

In our interview at the wire and tube trade fair, Hassan El Marakby looked back on the cooperation with SMS group, commenting, "Dealing with SMS was very impactful on our growth." When we asked him why the collaboration is so powerful, he replied, "We share the same values with SMS: We both are absolutely customer centric." ●

Hassan El Marakby,
CEO of El Marakby

El Marakby
rolling mill

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"Dealing with SMS was very impactful on our growth."

—Hassan El Marakby,
CEO of El Marakby

Lifecycle partnership

Our integrated lifecycle services increase competitiveness in a challenging market environment. Technologies, services, and business models support a plant throughout its entire lifecycle, from the very start to ongoing optimization and lifecycle management.

“It’s not only about ESG. It’s also about sustainability driving profitability.”

SMS group’s innovative tools and its green services approach empower customers to meet growing ESG requirements, improve transparency, and drive both sustainability and profitability.

CERTIFICATE

SMS group

Certificate-ID:	C01-2025-04-21265254
Certificate for:	Product Carbon Footprint Methodology Viridis Carbon
Certificate holder:	SMS Group GmbH Am SMS Campus 1 41069 Mönchengladbach
Review Report:	CF-2025-04-21265254
Applied Standard:	ISO 14067:2018 The Greenhouse Gas (GHG) Protocol – Product Life Cycle Accounting and Reporting Standard (2011)
Accounting Scope:	Automated Product Carbon Footprint tool for the calculation of carbon footprints in metal industry companies, developed by SMS group
System boundary:	Cradle-to-Gate
Valid until:	2026-04-30

TÜV Rheinland hereby certifies that SMS Group’s Product Carbon Footprint Methodology, Viridis Carbon, developed in conformity with ISO 14067:2018 as well as GHG Protocol- Product Life Cycle Accounting and Reporting Standard is scientifically based and reflects the state of art. For the future, TÜV Rheinland recommends continually enhancing the methodology in line with developments in science and technology and adapting the methodology accordingly. Specifications and assessment limits can be found in the review report. The validity of this certificate can be viewed by scanning the QR code or entering the test mark ID at www.certipedia.com.

Cologne, 17 April 2025

Ran Tao
TÜV Rheinland Energy & Environment GmbH
Carbon Services

Jocelyn Sobiech

TÜVRheinland®
Precisely Right.

TÜV Rheinland certificate on PCF calculation method

Download the PCF certificate:

ESG (environmental, social, and governance) has become a core business requirement for many companies in the metals industry. As governments further develop regulations, investors are incorporating sustainability into their strategy with customers expecting production transparency, companies are called upon to reduce CO_2 emissions, energy usage, and water consumption, while at the same time meeting robust social governance and safety standards. The willingness of end customers to pay a premium for green steel products directly correlates with investments in green technologies and emission monitoring tools.

At SMS, we are advancing our own ESG journey by establishing an efficient ESG organization, guided by a challenging roadmap, robust processes, a focus on mindset, and external benchmarking. Drawing on our own experience, we are eager to support our customers on their journey. Our aim is to assist in creating the necessary conditions for our customers’ initiatives and sustainability goals, building a collaborative path towards sustainable growth that is both enduring and mutually beneficial.

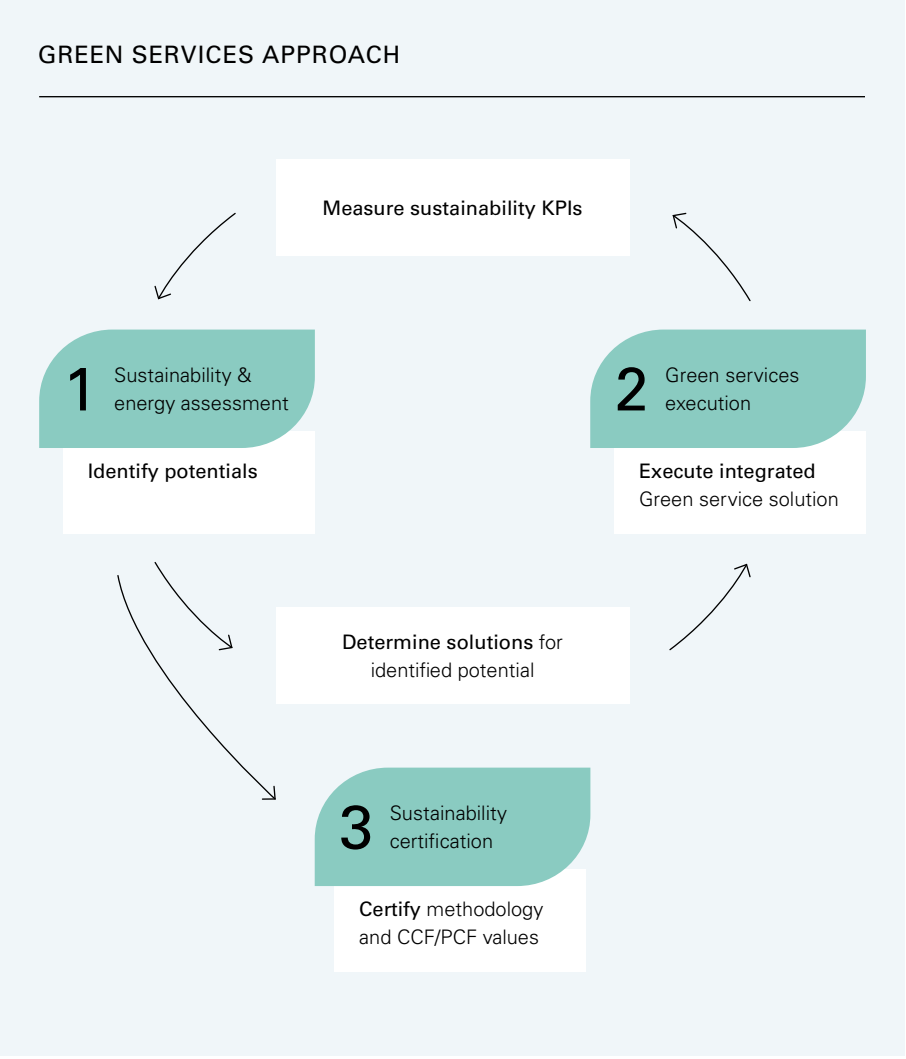
From greenfield to green services

The discussions around decarbonization and compliance with environmental regulations often evolve around large-scale greenfield projects. When developing entirely new facilities, the latest technologies and innovations are integrated from the outset, allowing plant layouts to be designed for maximum efficiency and minimal environmental and social impact. The Stegra project in northern Sweden is a compelling example, where – based on the use of hydrogen and SMS technology – carbon emissions will be reduced by up to 95% compared to conventional plants.

Despite these visionary projects, it is clear that the majority of savings must come from existing facilities. In every plant, there are numerous opportunities to reduce emissions as well as the environmental and social footprint. From a sustainability perspective, in particular, utilizing available facilities is a sound approach, as these do not require large-scale soil sealing and benefit from the infrastructure and logistics already in place. With our green services approach, we aim to help customers unlock these potentials to simultaneously meet ESG requirements and enhance their own profitability. These services address emerging issues, optimize operations, and ensure ongoing regulatory compliance.

Transparency as a matter of principle

We are establishing green services as a vital component of our service approach. The goal is to engage with our customers over the long term and encourage them to identify opportunities for optimization in terms of sustainability and cost-efficiency. Green services encompass regular sus-



tainability audits, process optimization, and support for compliance with evolving regulations. As Frank Jansen, EVP Automation, Digital & Service Solutions, Region Europe, states, "The starting point for our growth-based solutions approach is a sustainability and performance audit that identifies the potential for sustainability improvements within each value creation step. When customers realize that ESG can enhance their profitability, it truly transforms the conversation. With our green services, we offer more than just compliance – we help them build a sustainable and profitable future."

The overarching principle of our green services is transparency. Improvement is impossible without measurement. Many of our customers require assistance in analyzing their processes and understanding their environmental footprint in real time. Josephin Elsemann, Senior Sales Manager Sustainability Partnerships and Solutions, Region Europe, notes, "Our advantage is our deep expertise across the entire metals production lifecycle. We're not just a tech provider – our involvement spans research and development, plant engineering, metallurgy, and digitalization. Green services exemplify this, drawing on our extensive technical know-how and applying advanced digital tools to provide real-time insights."

Carbon footprint certifications

Our Viridis solution plays a pivotal role in enabling green services. By integrating with existing customer systems, Viridis provides real-time tracking of key ESG metrics such as carbon emissions, energy use, and water consumption. This transparency allows customers to make immediate improvements to meet sustainability targets while enhancing production efficiency. As Frank Jansen highlights, "The speed of implementation is one of Viridis' strengths. Viridis uses data from existing customer systems, which means we don't need to start from scratch. Once it's operational, it provides real-time tracking and sustainability reports that empower our customers to make immediate improvements." This approach identifies growth areas on a customer-specific basis and ensures a need-based solutions approach. Ideally, sustainability audits are conducted regularly to continuously optimize customers' operations in terms of sustainability.

The Viridis Carbon module calculates the corporate carbon footprint (CCF) and product carbon footprint (PCF) in real time and with high precision, analyzing emissions in every process stage. SMS group's partner in this endeavor is TÜV Rheinland, the German authority for technical certifications, which has certified SMS group to verify that our CCF and PCF certifications comply with global standards, such as the GHG Protocol and ISO 14067. These certifications not only enhance product marketability but also meet regulatory requirements, attract sustainability-focused investors, and unlock opportunities for green financing.

We are confident that green services will become increasingly important for our industry, and we are committed to creating additional value for our customers through our initiatives. As Josephin Elsemann concludes, "We've always been focused on providing value across the entire lifecycle of a plant, and that's especially true now with ESG. Our customers seek partners who can guide them through these new challenges. With our combination of technical expertise, digital tools, and comprehensive service offerings, we're uniquely positioned to do that. Sustainability isn't just a requirement; it's an opportunity for innovation and growth." ●

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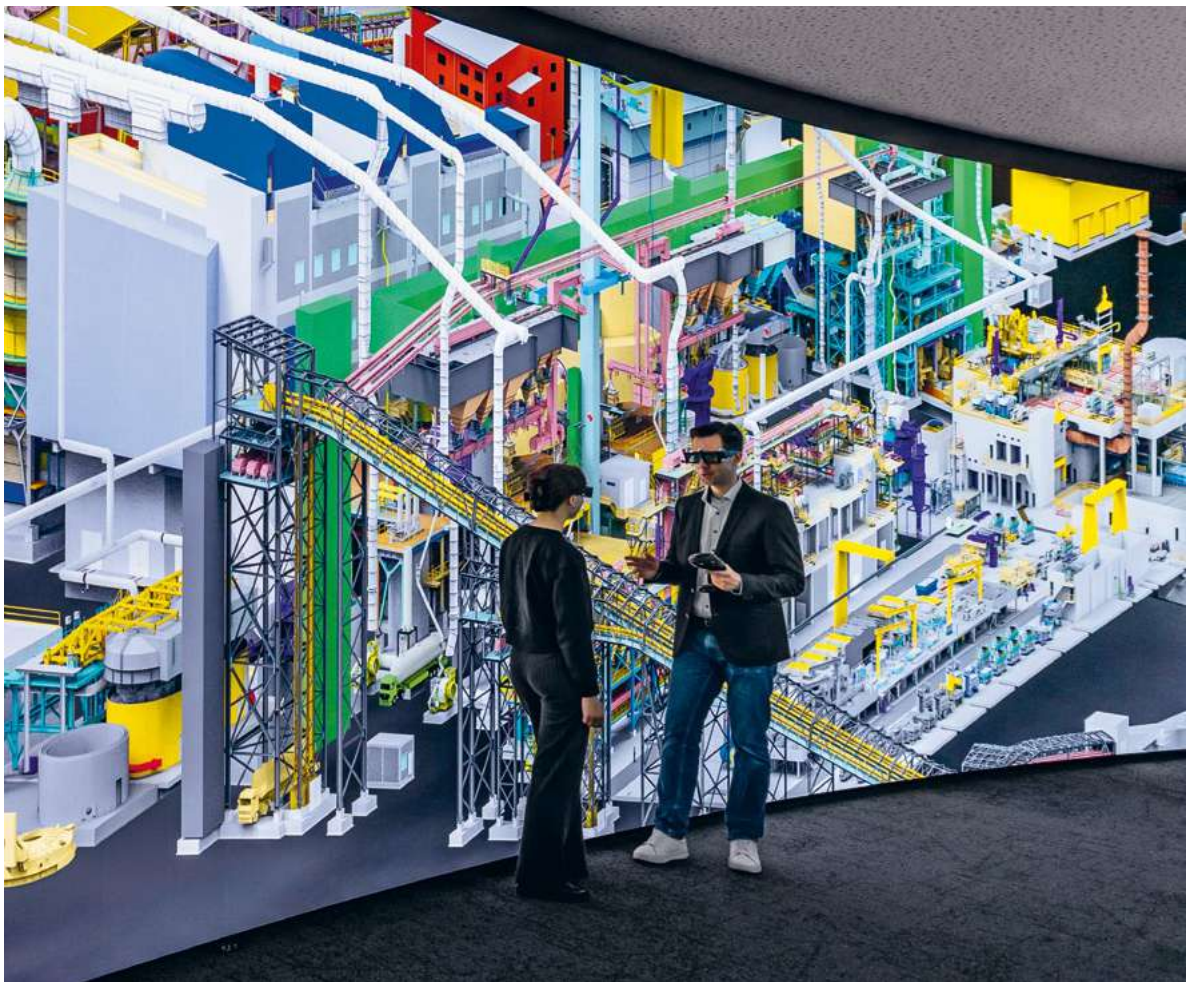

The screen is over 12 m wide and provides incredibly detailed views of the equipment.

A new world of training

The new SMS Campus in Mönchengladbach is home to what is currently the world's biggest curved LED screen with multi-user tracking. This "digital classroom" is part of the training courses offered by our SMS TECademy and is utilized in many different ways.

Behind an inconspicuous door on the ground floor of the SMS Campus in Mönchengladbach, visitors are greeted by a fascinating high-tech world. A huge LED screen dominates the room, and in front of it are two rows of workstations and monitors recessed in the tables. "Right now, this is the largest curved LED screen with multi-user tracking worldwide," explains Eugen Bolotin, a member of the SMS TECademy team. "It is 12.2 m wide and almost 3.5 m high and consists of 800 LED tiles. Thanks to its enormous size and high resolution (2x4k), the screen offers us entirely new possibilities when it comes to creating training content. Combined with the use of shutter glasses, the screen also enables stereoscopic (spatial) vision. Thanks to a refresh rate of 240 Hz, we can even display separate images for two groups at the same time."

The digital classroom is part of the SMS TECademy, where experts are on hand to train our customers' employees. Typical examples include hydraulic system training. "By covering everyday maintenance situations in such precise detail, the training is extremely effective. For example, virtual tours through the pump station are an integral part of the training." Alongside the LED screen-based training, our digital classroom also offers VR training with interactive self-learning modules.

Yet the room is not only used for training. Eugen Bolotin: "The giant screen is perfect for showing our plants in their entirety as well in incredibly fine detail. This means you can gain an overall impression of the whole facility while simultaneously studying its technical details." The renderings are based on the 3D design data for specific customer projects. This makes the room ideal for internal design reviews or meetings with customers. Complex topics can be discussed specifically on the 3D model and clarified early on. The tool is particularly valuable for elaborate modernization projects. The 3D model of the plant can be embedded in a specific environment, if, for example, a suitable laser scan has been created in advance. "This enables us to better integrate new equipment into the existing infrastructure and avoid time-consuming and expensive modifications during the revamp phases," adds Eugen Bolotin. ●

See the program of SMS TECademy:

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Performance partnerships in China

The performance partnership approach reflects our promise to help our customers progress and drive their business forward. Two recent examples illustrate how we are implementing this model in the largest steel market in the world.

The modernization of the mechanical and automation equipment in the laminar cooling system enables Ningbo to produce new steel grades.

Enduring collaboration with Ningbo Iron & Steel

Since the start-up of its 1,780 mm hot strip mill (HSM) in 2007, which was supplied locally by CFHI (China First Heavy Industry), Ningbo Iron & Steel Co., Ltd. has been committed to continuously improving the line's performance and product quality. To expand the product range and improve product performance, constrained by the existing laminar cooling section, Ningbo Steel signed a contract with SMS group in 2018 to upgrade the whole cooling system. Our scope of supply covered the mechanical and electrical equipment, including spray headers, pumps, valves, and X-Pact process control models. This project aimed to enhance cooling efficiency and deploy the cooling strategies required for different steel grades. Once upgraded, the plant was able to produce hot strips with the appropriate mechanical properties. This collaboration not only strengthened Ningbo Steel's market competitiveness but also laid a solid foundation for subsequent technological improvements in the years ahead.

Ongoing collaboration: Modernization of the CVC roll bending and shifting system

In September 2022, Ningbo Steel placed an order to upgrade the CVC blocks in its finishing mill to reduce the plant maintenance workload, improve product quality, and achieve better cost efficiency. This project marked the first complete seven-stand CVC upgrade contract for SMS group in China, reflecting the client's full confidence in our technology and equipment to control the strip flatness and profile in a more efficient and effective way. Production on the hot strip mill was stopped on December 5, 2023, and, working in conjunction with the construction company, we completed the upgrade in just 13 days, setting a domestic record for similar projects and demonstrating our exceptional technical expertise and project management skills. The estimated annual cost savings amount to approximately 30 million RMB. This modernization significantly enhanced the line's performance, further cementing Ningbo Steel's position in the hot strip market.

Shaking hands after signing the TOS agreement with Qinghai Xigang New Materials, with Zhang Boying, Executive Deputy General Manager of Xining Special Steel, and Peter Langner, President and CEO of SMS group China.

Extended collaboration: Cooling model services

Based on this successful cooperation, Ningbo Steel and SMS group signed a contract for laminar cooling model services again in 2024 with the purpose of securing the customer's production capability for high-strength steel grades. This partnership not only optimized the production process in the cooling section, but also improved product quality and yield. Upon service completion, Ningbo Steel's hot strip mill was smoothly producing DP800 dual-phase steel. Our professional services helped Ningbo Steel achieve new breakthroughs in production efficiency and product quality.

A series of successful collaborations have made Ningbo Steel more determined to maintain a full performance partnership with SMS group. To further enhance the performance of the plant, Ningbo Steel has now assigned SMS group to optimize the plant on an ongoing basis, despite the fact that we were not the OEM supplier. Going forward, this relationship will ensure that high operational standards are maintained in the hot strip mill throughout its lifecycle.

Technical outsourcing for Qinghai Xigang New Materials

A contract for a similar partnership was recently signed with Qinghai Xigang New Materials Co., Ltd., a subsidiary of Xining Special Steel. Xigang and SMS agreed a comprehensive package of maintenance services, where we will actively provide ongoing support as a partner to maintain and boost the performance of the PSM380 precision sizing mill, which is used to roll special steel bars. Given Xigang's increasing maintenance demands for this mill, SMS will provide a comprehensive service package. This marks a new milestone for us in the field of technical outsourcing services (TOS) in China, effectively addressing customers' concerns regarding equipment maintenance and providing effective support for their strategic goal of improving product quality.

The order also comprises a comprehensive upgrade of the PSM380 that is aimed at enhancing the mill's production efficiency and product quality, thereby satisfying the end user's requirements and further boosting Xigang New Materials' competitive position in the special steel market in China.

Once implemented, the upgraded mill will improve the products' dimensional accuracy and effectively reduce labor costs in downstream processing stages. Additionally, process adjustments will be made to ensure that the mill meets the production demands of more diversified steel grades, particularly a better microstructure and higher quality standards in low-temperature rolling processes. These improvements are set to enhance Xigang's product quality and increase its order volume in the future.

Upon project completion, the mill will be substantially more efficient in terms of changing specifications, downtimes will be reduced, and overall output increased. Moreover, the revamp will guarantee more consistent product quality, significantly reduce bar head and tail cropping, and improve yield, thereby boosting the line's annual output. ●

Green

metals

Our goal is to create a carbon-neutral and sustainable metals industry. We supply the technology to produce and recycle all major metals. This gives us a key role in the transformation towards a green metals industry.

How SMS group is shaping the green transformation of the steel industry

Interview with Thomas Hansmann
member of the Managing Board (CTO)
of SMS group

Creating a sustainable global steel industry brings with it major challenges for both plant owners and plant builders. As the transformation progresses, this calls for a long-term plan and the right technologies to respond to local market conditions, while at the same time ensuring the lasting economic success of companies operating in the steel industry. Our CTO Thomas Hansmann explains SMS group's approach to shaping the transformation of the steel industry.

Thomas Hansmann

... has been member of the Managing Board (CTO) of SMS group since 2023. Thomas Hansmann holds a PhD in Metallurgical Engineering from RWTH Aachen University in Germany. He brings with him over three decades of experience in metallurgical plant engineering, gained through key roles at Paul Wurth and SMS group.

Mr. Hansmann, how do you rate current market requirements in the steel industry in terms of decarbonization and sustainability?

Thomas Hansmann—The steel industry is about to undergo a fundamental transformation that is characterized by global factors and regional conditions, including, for example, the availability of resources and the energy costs involved. State regulations also play a crucial role, as these have a significant influence on both the pace and the direction of decarbonization efforts.

Take a look at the markets and you see clear differences. Electric steelmaking is predominant in the United States, accounting for around 70% of total steel production. The key to decarbonization lies more in the way the electricity itself is generated. What's more, North America is seeing growing demand for direct reduced iron (DRI) facilities, as these provide the high-purity starting material, which is indispensable for producing quality steels and can also be further processed in the electric arc furnace (EAF).

In Europe, the focus is on replacing blast furnaces with DRI equipment. This is due to ambitious decarbonization targets and specific state funding programs. However, challenges such as the availability of raw materials and high energy costs are currently dampening interest in new investments. A further expansion of EAF capacities is also in sight.

India's strategy is shaped by existing resources. Integrated steel production based on conventional blast furnaces continues to dominate, as local coal and iron ore deposits are widely available.

China is guided by political targets, such as the expansion of renewable energy, to move forward with its decarbonization goals. Industry overcapacity could act as a catalyst for decarbonization, as outdated facilities are increasingly being taken out of service. At the same time, China is investing in direct reduction plants and conducting research into solutions for the gradual decarbonization of conventional blast furnaces.

Japan, South Korea, and other Asian countries are also pursuing long-term decarbonization strategies. These countries are banking heavily on hydrogen as their main energy source in the future, in order to reduce dependence on imported coal. They are investing in innovative technologies and developing strategic partnerships to achieve their ambitious objectives.

How do you see the existing plant and equipment stock changing in view of these market requirements?

The global steel production landscape is facing radical change. It is expected that worldwide steel production will increase to around 2.3 billion tons per year by 2050. As a result, there is a growing need to expand sustainable production capacities. Right now, around 70% of steel is produced using blast furnaces. By 2050, we expect this figure to fall to around 30%. This means that around half of today's 1.35 billion tons per year made by the conventional blast furnace route needs to be decarbonized.

At the same time, the share of direct reduction processes is set to increase considerably. At present, the DRI process accounts for only six percent of annual steel production. By 2050, we expect this to grow to around 25%, corresponding to around 500 million tons. The proportion of scrap-based steel production will also rise substantially. Today, scrap makes up approximately 20% of global steel production, but by 2050 this is set to rise to almost 40%.

Which factors will determine the worldwide introduction of different steel production routes?

The introduction of sustainable steel production processes is influenced, to a decisive degree, by the availability of raw materials and energy sources as well as by national politics. The conventional blast furnace process is based on iron ore and coal, which are available in large quantities around the world. This secures the dominance of this process, especially in countries such as India and China, which have considerable domestic resources and an established infrastructure.

The transition in Europe to sustainable scrap-based steel production using electric steelmaking requires sufficient quantities of high-grade steel scrap and green electricity. Alternatives such as hot briquetted iron (HBI) could supplement scrap, but their production would also have to be sustainable, which in turn requires scarce resources such as green hydrogen and green electricity.

Up to now, direct reduction processes have mainly used natural gas, which has limited their application to regions that are rich in natural gas, including the Middle East, North Africa, and Central America. In Europe, high natural gas prices are hampering the expansion of DRI plants and, in the past, have resulted in the ongoing use of integrated steel production routes. In particular, green hydrogen and green electricity are essential if the direct reduction process is to be introduced successfully in Europe. This will apply especially to countries with favorable conditions for renewable energies, such as Scandinavia, Spain, and Portugal. The Euro- →

pean Union stipulates that 90% of the energy used for green hydrogen production comes from renewable sources, which poses significant challenges in countries like Germany and other Central European nations.

Another key factor is the availability of high-grade iron ore. The global trade in iron ore pellets suitable for DRI currently stands at only around 10 million tons per year, which is by no means sufficient to replace blast furnaces on a large scale. Raw materials account for around 60% of the costs of producing every ton of steel using the DRI process, which underlines the importance of a sustainable supply of raw materials and energy-efficient solutions.

How do current projects for sustainable steel production in Europe fit with the limited availability of raw materials and green energy?

The initial wave of investment in DRI facilities was often guided by the classical minimill model, with the integration of direct reduction and electric steelmaking plants to replace blast furnaces. These projects had significant backing in the form of substantial state support, particularly in Germany. Nevertheless, important questions regarding the availability of raw materials and energy costs still need to be answered. In addition, DRI plants have so far not been operated entirely with hydrogen. The first projects in Sweden and Germany are pursuing this goal, but they must also meet the challenge of scarce resources, including high-quality iron ore and green electricity. One of the consequences of this is a noticeable slowdown in European investment in DRI plants. Steel producers are closely following the results of ongoing projects, in particular the transition to hydrogen-based processes. The financial market is also hesitant, as investors evaluate the performance and outcomes of current projects. Open bath furnaces (OBF) and submerged arc furnaces can help provide a solution here, as these, unlike EAFs, can process larger slag volumes. This allows the use of conventional blast furnace ores, thus reducing operating costs and enabling downstream facilities, such as the converter shop, to be retained.

> "Automation and digitalization have a major influence on sustainability."
>
> —Thomas Hansmann

thyssenkrupp Steel will be the place for Europe's first DRI plant to replace a blast furnace.

In January 2025, SMS group and Chinese Ansteel Group signed a MoU to advance green steel technologies and decarbonization initiatives.

How is SMS group prepared to handle such a wide range of different scenarios?

SMS group has a comprehensive technological portfolio covering all areas of sustainable steel production. We are setting standards in blast furnace engineering with our range of Paul Wurth technologies. An excellent example is the Paul Wurth EASyMelt, which is currently being implemented in cooperation with Tata Steel in Jamshedpur in India as part of a pilot project. With the Paul Wurth EASyMelt, existing blast furnaces can be gradually decarbonized in a step-by-step process. Syngas is injected as a reduction gas into the blast furnace shaft to facilitate the direct reduction of iron ore. Syngas is also injected at the tuyere level, allowing hydrogen to be introduced that reduces the iron ore at high temperatures. Tuyere-level plasma torches heat the syngas up to 2,200 °C and electrify the process.

In the field of melting technology, we maintain a leading market position, particularly with OBFs. These are based on submerged arc furnace technology, installed in a large number of references thanks to our Metix brand. The focus is on the reduction of low-grade iron ores in combination with the melting process, in order to produce crude iron that can be used in downstream steelmaking processes, such as blast furnace iron.

We have also made great progress with regard to electric arc furnace technology. To safeguard and expand our market position, we are continuously innovating: AllCharge is an electric arc furnace that is constantly charged without the need for preheating. It features flat-bath operation, made possible by side wall charging, which helps to cut nitrogen oxide emissions and relieves the load on the power grid. This is complemented by our X-Pact AURA technology. It was designed to ensure efficient and stable power control for DC EAFs in all network configurations, including weak networks. In the field of digitalization, too, we are setting industry standards with innovative process and energy management solutions.

Going forward, hydrogen will play an important role with EAFs. We have developed the first burner technology for the application of hydrogen in the EAF melting process. Supported by a European Union research fund, we aim to revolutionize steel production by integrating hydrogen as the main fuel source in EAFs. Our innovative multi-fuel burner is capable of switching from natural gas to full hydrogen use. The initial tests are yielding promising results.

Will that be enough to fully decarbonize the metals industry?

Decarbonizing the metals industry is a decades-long project that will require considerable investment. The installed base is too large to transform it in one go, and global demand cannot be met solely by scrap and hydrogen-based production routes.

CCUS (carbon capture, utilization, and storage) technologies will be crucial to reaching global climate targets. The market for CCUS is huge, but many existing approaches focus on end-of-pipe solutions that capture emissions at the end of the production cycle. We integrate CCUS directly into our processes. Here, too, our Paul Wurth EASyMelt is an outstanding example. Our carbon separation solution enables us to replace conventional syngas reforming with natural gas, which means that no natural gas is required during the process. This increases efficiency and reduces emissions by around 70%.

How do the processes downstream of iron and steel production contribute to CO_2 emissions, and what technologies does SMS group offer to decarbonize these processes?

Our strategy for decarbonizing downstream process stages is based on four pillars: energy recovery, electrification, fuel switch, and digitalization. The CSP Nexus casting and rolling technology, for example, brings together all these areas of action. The integrated casting and rolling process does away with energy-intensive slab reheating. Furthermore, the process-related disconnection of the roughing stand and the finishing mill means that the various process stages can be optimized without having to consider the process as a whole. By using induction furnaces, we are replacing natural-gas operated systems, such as the tunnel furnace, with electrical technologies.

Generally, automation and digitalization have a major influence on the efficiency and sustainability of downstream process stages. Our aim is to enable the autonomous operation of our plants and equipment through self-optimizing processes. Human interventions are thus kept to a minimum. By integrating data from all automation and digital systems, comprehensive insights are gained into the condition of the plants, quality management, production planning, and energy consumption. Predictive solutions enable contradictory KPIs to be harmonized and the value chain as a whole to be optimized.

Our solutions open up significant opportunities for modernizing existing infrastructures and developing innovative service solutions. At the same time, they strengthen partnerships with our customers, as they support their sustainability goals in a far-reaching, efficient way. ●

Decarbonization in Latin America:

Act now or wait?

Every region must align its decarbonization strategy with local resources, energy costs, and regulatory frameworks. In this article, we examine the conditions in Latin America, highlighting opportunities that position the region as a favorable environment for sustainable transformation.

The steel industry is undergoing a profound transformation. While decarbonization is undoubtedly the most critical long-term challenge, it is just one of many pressing issues today. Amid these uncertainties, steel producers – both in Latin America and globally – face a pivotal question: Act now or wait?

In this transformative period, identifying the right pathway is essential. The decision must account not only for investment volumes but also for regional factors, market dynamics, raw material availability, and utility costs. These considerations are key to crafting a strategy that balances sustainability with economic viability.

Smart solutions available

The green transformation of the steel industry hinges on substantial investments. However, significant progress can also be achieved through operational optimizations that reduce both CO_2 emissions and costs. The convergence of automation, electrification, and digitalization is accelerating this transformation by improving energy efficiency, minimizing waste, maximizing recycling, and enhancing overall performance:

— Automation improves process control, reduces energy losses, and optimizes equipment performance.
— Electrification replaces fossil fuel-based systems with cleaner alternatives, directly curbing emissions.
— Digitalization leverages real-time monitoring, predictive analytics, and data-driven decision-making to enhance resource utilization and operational efficiency.

At SMS group, Viridis Energy & Sustainability Suite applies these principles by integrating real-time data collection, advanced analytics, and process optimization to support decarbonization in industrial environments. The solutions focus on enhancing energy efficiency by identifying performance gaps, detecting leaks, optimizing resource distribution, and forecasting energy demand. Additionally, they offer tools for tracking, managing, and reporting emissions, thus providing transparency in energy use and emissions tracking. This empowers companies to take proactive steps in reducing their carbon footprint. By combining automation, electrification, and digital intelligence, these tools enable companies to take proactive steps toward sustainability without disrupting ongoing operations.

Another standout solution is the Paul Wurth BFXpert, an integrated level 2 process control system for blast furnace operations. By optimizing fuel consumption, BFXpert delivers measurable reductions in CO_2 emissions. A recent partnership with Ternium Brazil underscores its potential: By adopting BFXpert, Ternium achieved a fuel rate reduction of over 5 kg/t of hot metal, translating a daily reduction of 130 t of CO_2 emissions for a production scale of 8,000 t/day.

SMS group has a team of specialists covering the overall production process, developing advanced tools to evaluate and compare production pathways, optimizing the carbon footprint, operational costs (OPEX), and electricity consumption. The combination of these factors enables customers to conduct a tailored assessment of possible adaptations and/or evolutions in the production route. With direct access to SMS group's experts, clients benefit from seamless collaboration and technical expertise.

Structural advantages

Latin America offers unique advantages compared to other regions. Brazil, Argentina, and Chile are particularly well placed to accelerate the transition to low-carbon steel production.

Brazil's energy matrix is predominantly renewable, with almost 90% of its electricity generated from clean sources. Investments in wind and solar energy are expanding this capacity annually. Similarly, Argentina generates 36% of its electricity from hydroelectric, wind, and solar sources – outpacing major industrial nations such as China, Japan, and the United States.

The substantial availability of renewable energy, especially in Brazil, combined with existing infrastructure, is considerably beneficial in terms of the capacity to produce green hydrogen at →

a competitive cost. The hydrogen-based reduction of iron ore significantly reduces greenhouse gas (GHG) emissions.

SMS group has been building strategic partnerships, such as with Eletrobras, the largest electric utility company in Brazil and a leader in the generation, transmission, and distribution of electricity. The goal is to accelerate the application of green hydrogen production for industries, particularly mining and steelmaking. Partnerships with state governments, embassies, and development agencies such as CIT SENAI in Minas Gerais and GIZ (German Agency for International Cooperation) further support these efforts.

In addition to renewable energy, Latin America benefits from significant biomass availability. The substitution of fossil fuels with carbon-neutral biomass, such as charcoal, is a viable alternative in Brazil. Various players in the steel sector invest in production units for charcoal derived from sustainable eucalyptus cultivation. SMS group in Brazil has experience in designing pulverized charcoal injection installations in small blast furnaces, an interesting alternative aimed at reducing costs and the carbon footprint. There are other applications where biomass can be used for bioelectricity generation and biochar production, contributing to carbon emission reductions.

Private sector initiatives are also gaining momentum. For example, Vale, Eletrobras, and Porto do Açu are jointly developing decarbonization hubs, while ArcelorMittal is investing in renewable energy and green hydrogen projects at the Pecém complex in Ceará, Brazil.

In this complex regional and geopolitical context, Brazil has also made progress in carbon market regulation, creating a favorable environment for investment in sustainable technologies. Recently, the Federal Senate in Brazil approved a bill regulating the carbon credit market in Brazil. This legal framework establishes the foundations for a regulated carbon market, like the one currently operating in the European Union, encouraging companies to adopt more sustainable practices and contributing to lower greenhouse gas emissions.

All these conditions present a favorable scenario for decarbonized technologies, like the Paul Wurth EASyMelt, which relies on the availability of industrial gases in a first stage and takes a gradual approach to move progressively to green hydrogen and a renewable electricity supply.

Act now or wait?

Latin America is uniquely positioned to lead the global decarbonization of the metals industry. Its abundant renewable energy resources, green hydrogen potential, and biomass availability provide an unparalleled foundation for sustainable steel production. The region's progress in renewable energy investments and carbon market regulation further solidifies its position.

The question remains: Act now or wait? By acting now, companies can capitalize on these advantages, reduce emissions, and secure long-term economic and environmental benefits. Waiting, on the other hand, risks missing out on these opportunities.

SMS group is the ideal partner for this journey. With a comprehensive suite of digital solutions, technologies, and technical expertise, SMS group offers tailored support to help customers in Latin America achieve their decarbonization goals. The time to act is now – together, we can pave the way for a cleaner, more sustainable metals industry in Latin America. ●

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89

percent of Brazil's electricity comes from renewable sources.

8

is Argentina's position among all countries when it comes to clean electricity.

1

Brazil is the country with the highest share of electricity from renewable sources.

Green steel: An investor’s view

Discussions about the decarbonization of the steel industry are often limited to a technical viewpoint only. Taking an investor’s perspective helps forecast the most-likely future, based on capital-driven decision-making.

From a technological perspective, hydrogen-based iron production is the most direct path to CO_2 reduction. But is it also the most economical?

Industrialized countries are trying to maintain primary steelmaking as a strategic sector under their regional control, while decarbonizing the enormous energy it consumes. Promising concepts to alleviate the resulting renewable energy shortage in the global north for this purpose is to establish efficient supply chains from the global south through either ammonia as an efficient hydrogen carrier molecule, or to relocate iron production and import hot briquetted iron (HBI).

Postulate 1: Big money talks (and steel doesn't have it)

The transition towards green steel requires massive investment in new infrastructure. Green electricity generation, hydrogen production, and storage system investments often exceed the market capitalization of steelmakers, as upstream energy-related investments have an order of magnitude that is greater than that of the steel plant itself.

For example, the following investment volumes for plant technology, infrastructure, and additional costs would be required for a green steel plant with a capacity of 2.5 million t/year and corresponding green energy supply:

Total energy supply investment*	**>10 billion**
Renewable electricity production	5 billion
Hydrogen production	4 billion
Energy storage	>1 billion
Total greenfield DRI steel plant	**3.0 billion**
Direct reduction plant	1 billion
Steelmaking	0.5 billion
Downstream plants	0.5 billion
Balance of plant	1 billion

When it comes to future energy supply chain investments, it is clear that energy companies and green investment funds will be in the driver's seat, and not steel producers. The former have much better credit ratings, giving them access to capital and at much lower interest rates than for steelmakers. This difference in financial leveraging power is only further increased when interest rates remain high. The resulting high treasury bond yields make lenders even more wary of non-investment-grade bonds from steelmakers. Additionally, the energy sector offers much more stable returns and free cash flow due to the nature of their business model and generally present bigger market capitalization, allowing them easier access to equity for large investments on top of higher borrowing capacity at better rates.

In short, decarbonization projects at this scale require the financial resources of players outside the steel industry. It is therefore up to the energy sector and possibly also governments to set the tone on whichever national and global green energy strategy is the most beneficial to them, while steelmakers will most likely have to play the hand they are dealt.

Postulate 2: Money always chooses more money

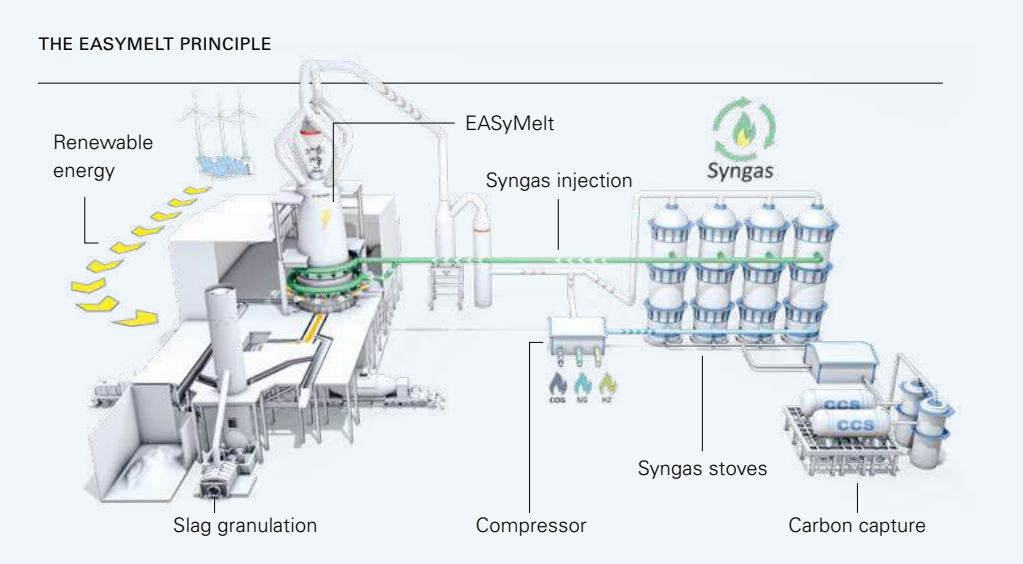
Steel can be decarbonized via multiple routes. If it is to be produced "CO_2 lean," the coal feedstock in its production process must be replaced with non-fossil-based alternatives. Pioneering projects use green hydrogen for this purpose. However, the steel plants are often located in regions with an uncompetitive hydrogen infrastructure in terms of availability and costs. That goes, in particular, for heavily industrialized countries such as Germany, Japan, Korea, and many regions of China.

Given their capital-backed decision-making power, investors will always choose the option that generates the highest risk-adjusted return. Energy generation will be relocated to regions with abundant resources of renewable energies mainly in the global south, although some of these countries are characterized by high risk profiles. Steelmakers do not have the financial firepower or profit margins to bear such risks compared to the energy sector.

Consequently, steelmakers face an uphill battle to secure capital willing to be allocated to remote, high-risk regions for the production of hot briquetted iron (HBI), for instance, which companies rely on to decarbonize steel production via the direct reduction route.

An alternative could be ammonia, as it would not only provide the steel industry with a reductant, but it also has a large existing market for fertilizer and chemicals, as well as a growing market for co-firing in power plants in the Asia Pacific region. The offtake market is diversified and much bigger, consistently offering producers the flexibility to sell to the highest bidder, whereas HBI production is a much narrower and much more rigid value chain. Ammonia production has an inherently lower risk profile and has at least the same or better profitability. Capital will thus most likely be drawn to ammonia

* Rough estimations including plant technology, infrastructure, and additional costs in USD.



The Paul Wurth EASyMelt is a resource-flexible, crisis-resilient, and cost-efficient alternative to direct reduction shaft furnaces.

as its higher risk-adjusted return acts as gravity for investment.

In summary, our analysis indicates that the responsibility for global and regional decarbonization strategies will likely extend beyond the steel sector itself. This is due to the significant financial and infrastructural resources needed, which are better handled by players with larger budgets, such as those in the energy sector. Additionally, these entities seek to maximize returns while minimizing investment. Among the options, ammonia presents more opportunities for utilization, has existing infrastructure, and involves lower risk compared to alternatives like HBI.

EASyMelt is the steel industry's wild card

At present, the outlook for the steel industry is that it will serve as one of several players in a larger strategic plan, exploited by energy giants to their own benefit. However, novel technologies such as the Paul Wurth EASyMelt, which allow the efficient direct use of ammonia in the process, thereby avoiding energy losses from hydrogen separation out of imported ammonia, can represent a wild card in the steel industry, allowing it to have its part of the cake and eat it, too.

The Paul Wurth EASyMelt requires a much smaller initial investment compared to other decarbonization options, shifting capital risks to the energy sector, while being able to efficiently utilize ammonia in the green steel value chain. This efficient usage inevitably results in cost savings, i.e., a slice of the pie that can be shared among steelmakers and energy suppliers. As a result, ammonia is not only the financially preferred investment for the energy sector but can also be the more profitable energy source for steelmaking.

Total brownfield EASyMelt steel plant retrofit	0.5 billion
Blast furnace retrofit	0.5 billion
Rolling mill	existing

By using ammonia, steelmakers can both source a green reductant at a global seaborne price, and also allow the flexibility to easily adapt the energy form the plant consumes (coal, natural gas, local hydrogen, local electricity, or ammonia) in varying proportions. All of which could be sourced from multiple possible suppliers. This is a valuable and unique economic advantage of the Paul Wurth EASyMelt, which a conventional DRI-based green steel plant simply does not have. The steel production supply chain/OPEX is thus derisked and energy purchasing negotiating power is restored to the steelmaker.

Lower operating risk on the renewable energy producer and consumer side translates to either lower costs of borrowed capital or higher risk-adjusted return of equity. Therefore, capital from all sides win, as capital always tends to and should do. ●

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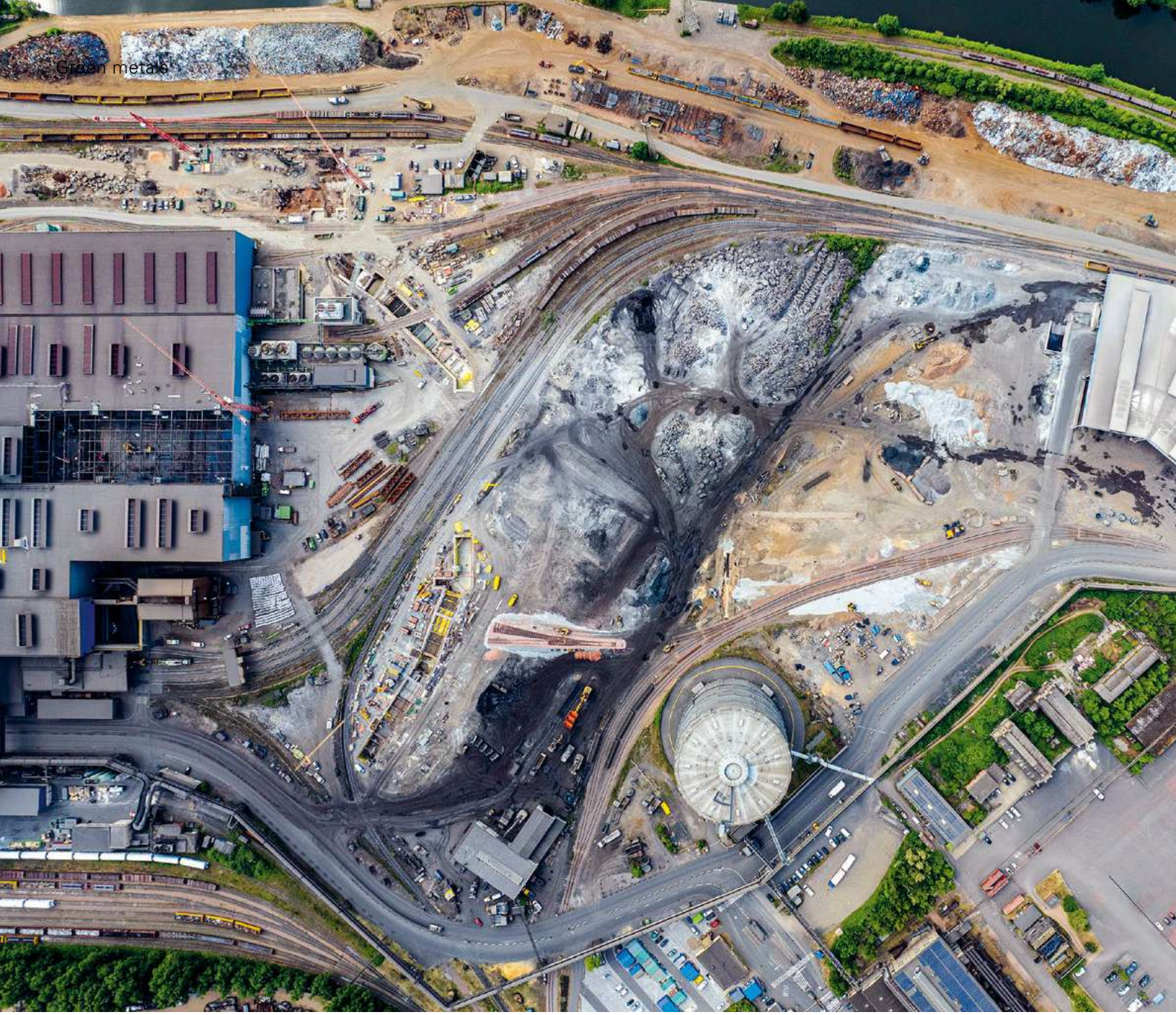


(©: Stahl-Holding-Saar)

Saarstahl: A pivotal step towards green steel

In October 2024, SHS (Stahl-Holding-Saar) awarded SMS a contract to supply a super-scale electric steelmaking plant for its Saarstahl site in Völklingen, Germany. The new electric arc furnace is part of SHS's Power4Steel strategy to decarbonize the steel industry in the Saarland region. We took the opportunity to speak with key project stakeholders from both Saarstahl and SMS.

Dr. Michael Bott
is Director Decarbonization
at SHS.

Andrea Lanari
is Vice-President Metallurgy
of SMS group.

Maria Kmiecik
is Senior Sales Manager
Metallurgy of SMS group.

"The new electric arc furnaces play a key role."

—Dr. Michael Bott

Mr. Bott, could you provide an overview of SHS' climate strategy and how the Power4Steel project aligns with your goals?

Michael Bott—Dillinger and Saarstahl are clearly committed to meeting the goals of the Paris Climate Agreement. The "Power4Steel" decarbonization project envisages a significant reduction in greenhouse gas emissions by 2045 at the latest, with the aim of achieving carbon-neutral production.

Our objective is to supply our customers with green steel from 2028/29 onwards. The plan in phase 1 is to put a direct reduced iron (DRI) plant at our Dillingen site and two electric arc furnaces (EAFs) for our production facilities in Dillingen and Völklingen into operation. The commissioning of these facilities will allow one of the two blast furnaces in Dillingen to be shut down by 2030. The long-term goal is to fully switch the remaining blast furnace operation to carbon-neutral production by 2045 at the latest. Initially, we intend to use natural gas for DRI production, which will be successively replaced by hydrogen.

The new electric arc furnaces play a key role in our plan to become carbon neutral by 2045. The increased use of scrap and DRI lowers CO_2 emissions significantly and paves the way to a sustainable future, taking a pivotal step toward "green steel."

Mr. Bott In what ways does the automation and digitalization of the EAF contribute to operational efficiency and safety, and how does this align with SHS's objectives for innovation?

The comprehensive automation and digitalization of the new electric arc furnace is setting new standards in terms of efficiency and safety. The entire melting process is optimized by employing intelligent control systems, high-precision sensors, and AI-assisted analytics. This reduces energy consumption, improves the utilization of resources, and ensures consistently high steel quality. At the same time, automated processes cut production times and minimize material losses.

Occupational safety also benefits considerably: Digital monitoring systems detect potential risks early on, while machines are increasingly handling critical tasks. This results in fewer manual interventions and enhances employee safety. Predictive AI-assisted maintenance contributes significantly to occupational safety by reducing unplanned outages, avoiding dangerous maintenance work, and creating a safer working environment. AI detects wear or malfunctions at an early stage, so that preventive measures can be taken. →

The result is safer, more efficient, and more sustainable steel production. From a long-term perspective, the aim is to reduce CO_2 emissions by up to 4.9 million tons per year and achieve corresponding annual cost savings. These innovations strengthen the competitiveness of SHS and consistently advance its transformation toward eco-friendly steel production.

Mr. Bott, you will be pioneering green steel production in Europe, what support do you expect from policymakers to ensure the success of this transition?

We are pioneers in green steel production in Europe. In order for this transformation to succeed, we need stable political framework conditions and long-term planning security. Companies like ours, which are proactively committed to decarbonization pathways, depend on a reliable regulatory environment. The crucial factor here is that politics maintains its course and continues to consistently support this transformation.

First and foremost, it is vital that energy prices become internationally competitive again. What's more, sufficient green power must be available to drive transformative change in the steel industry. Our industry also needs protection from unfair competition – an effective Carbon Border Adjustment Mechanism (CBAM) with targeted safeguards will play a central role in this. These measures must ensure that market distortions are avoided and that steel companies that have already invested in decarbonization are not put at a disadvantage.

We also need pragmatic solutions to secure hydrogen supplies that allow rapid use for industrial applications. At the same time, it must be possible for natural gas to continue to be utilized as a bridge technology during the transition phase. Natural gas is already available today and offers considerable potential for CO_2 reduction.

Political actors must be able to recognize these realities with a pragmatic approach and respond flexibly to new developments. It is only through joint, resolute action that we can decarbonize our production processes while remaining competitive at the same time.

SHS – STAHL-HOLDING-SAAR

In 2010, SHS – Stahl-Holding-Saar was established as an operational management holding company that has since taken up activities for Saarland's steel industry and notably its two most prominent companies: Dillinger and Saarstahl. In this way, the two companies are able to cooperate more closely through existing partnerships and to enhance their presence within their markets. As part of the Power4Steel initiative, SHS is focused to achieve carbon neutrality by 2045.

"The flexibility in raw materials allows resilient production."

—Andrea Lanari

Mr. Lanari, the new Saarstahl EAF boasts a transformer capacity of 300 MVA, making it one of the most powerful in the world. How does this installation support the industry's shift towards sustainability?

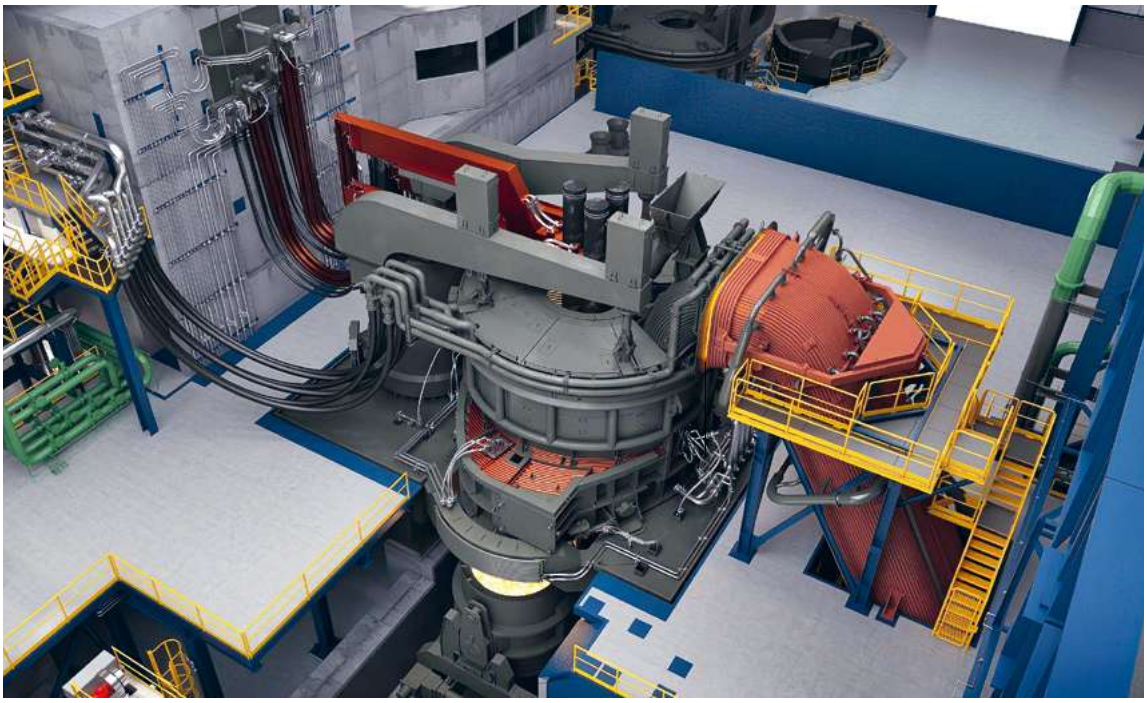
Andrea Lanari—This powerful electric arc furnace demonstrates our commitment to pioneering advancements in steelmaking technology. The EAF's capacity to process up to 100% scrap or a mix of cold direct reduced iron (CDRI) and scrap shows our dedication to resource efficiency and recycling. This flexibility allows for the optimization of raw material inputs based on availability, cost, and environmental considerations, thereby enhancing the adaptability of the steelmaking process.

By utilizing up to 100% scrap, the EAF maximizes the recycling of steel, reducing the need for virgin raw materials and significantly decreasing the carbon footprint. The ability to incorporate a high percentage of CDRI/HBI further supports sustainability by enabling the use of low-carbon feedstocks.

Moreover, this flexibility in raw material processing allows for a more responsive and resilient production system, capable of adjusting to market fluctuations and supply chain dynamics. This adaptability not only ensures consistent output and quality but also contributes to the overarching goal of achieving carbon neutrality.

How does the EAF design with features like Condoor and X-Pact automation represent a technological advancement and what benefits do these features provide?

With these solutions, we aim to maximize yield and optimize energy efficiency in electric steelmaking. The Condoor system optimizes slag management, reducing power-off time and enhancing energy savings, which directly contributes to lowering the environmental impact. Meanwhile, the X-Pact automation suite, with features like X-Pact Sense and X-Pact Autotap, ensures precise control over the steelmaking process, facilitating predictive maintenance and minimizing downtimes. These advancements not only improve productivity but also ensure a safer working environment.



3D model of the new 185-ton electric arc furnace for Saarstahl

"Managing noise emissions is crucial for the local community."

—Maria Kmiecik

Ms. Kmiecik, considering the plant's location on a brownfield site in a densely populated area , how have SMS group and SHS addressed the challenge of noise emissions to ensure minimal impact on the surrounding community?

Maria Kmiecik—In urban settings like Völklingen, managing noise emissions is crucial to maintaining a peaceful coexistence with the local community. SHS, in close collaboration with SMS group, has undertaken a comprehensive analysis of noise emissions. This initiative involved working closely with a consulting company to meticulously identify and assess the primary sources of noise within the plant. Through this partnership, SMS group and SHS have developed and implemented effective noise-reduction strategies. These efforts not only comply with regulatory standards but also demonstrate a proactive commitment to sustainability and community well-being.

How does the collaboration with SHS work during the project so far?

Up to now, SMS group and SHS worked closely to identify key areas where technological advancements could drive efficiency and sustainability. Our close collaboration ensured that the proposed solutions were not only technically feasible but also economically viable, providing SHS with a clear pathway to achieving their carbon-neutrality goals.

Now that the project proceeds to execution, we will enforce our partnership even more, since – as mentioned – the location in Völklingen is challenging, and the project will take place in a brownfield environment and thus during ongoing operations. On behalf of the entire project team, I can say that we are all set to turn this project into a success and we are looking forward to working closely with SHS. ●

MAIN TECHNICAL DATA

- 1 x 185 t EDGE AC EAF
- Upper shell diameter: 9.4 m (one of the largest installations in the world)
- Transformer capacity: 300 MVA
- Capacity: 1.9 million t/year
- Input materials and mixes: Flexible mix from 100% scrap up to 80% CDRI/HBI and 20% scrap, with future provision for hot metal charging

1

2

Success stories

Every project is unique. For us, each one is an opportunity to create something exceptional for our customers by applying everything we know and excel at. We are proud to showcase some of our recent projects here. For a complete overview, please visit **www.sms-group.com/success-stories**


3

4

1 POSCO, 2 TOSYALI SULB, 3 EL MARAKBY, 4 THYSSENKRUPP STEEL EUROPE

5 SSAB, 6 JSOL, 7 TATA STEEL, 8 FUJIAN KEBAO, 9 FUTURE FORGEWORKS, 10 ROGESA

Orders and start-ups

Record-breaking blast furnace

Tata Steel's blast furnace H surpasses all expectations.

Tata Steel has achieved a significant milestone with its H blast furnace in Jamshedpur, becoming the first in India to surpass 50 million t of hot metal production without the need for any mid-term repairs. Commissioned in 2008, the Paul Wurth blast furnace has consistently exceeded its designed capacity by 20% annually, underscoring its exceptional reliability and performance.

The project originated in 2005 when Tata Steel awarded the construction contract to a consortium comprising SMS group companies and Larsen and Toubro. With an inner volume of 3,814 m³ and a production capacity of 2.5 million t/year, it was the largest furnace built in India at the time. The project was completed in just 25 months, overcoming logistical challenges in a restricted area.

The H blast furnace incorporates advanced technological solutions emphasizing energy efficiency and environmental sustainability. Key features include a Paul Wurth bell-less top charging system, INBA slag granulation plants, an annular gap scrubber gas cleaning plant, a top gas recovery turbine, and a pulverized coal injection plant. These innovations enhance energy efficiency and operational safety.

The Paul Wurth blast furnace has received national and international acclaim for its performance, achieving the highest tuyere coal injection levels in India for nine consecutive years and earning recognition for energy-saving innovations. It has set industry benchmarks in hot metal quality and process safety.

SMS and Tata Steel's joint commitment to sustainability is reflected in the innovative design and operation of Tata Steel's H blast furnace. By integrating advanced energy-saving technologies and efficient resource management, Tata Steel and SMS continue to lead the way in reducing the environmental impact of steel production. This achievement not only highlights the two companies' dedication to sustainable practices but also serves as an inspiration for the entire industry to pursue cleaner and more efficient steelmaking processes. As we celebrate this historic achievement, both companies remain focused on driving sustainable practices and pioneering innovations in steelmaking.

CUSTOMER
Tata Steel, India

SUPPLY
Blast furnace

STATUS
In operation

HIGHLIGHT
50 million t of hot metal production without mid-term repairs since 2008

Start-up of new cokemaking complex

POSCO celebrates the start-up of two new coke oven batteries.

POSCO and SMS group celebrated the inauguration of a new cokemaking complex, comprising two Paul Wurth coke oven batteries with 48 ovens each, measuring 7.6 m in height and 20 m in length. The top-charged batteries are designed for an annual production of 1.5 million t of coke. The complex includes a coke oven gas treatment and by-products plant, handling a gas flow of 100,000 Nm^3/hour. Driven by POSCO's objective to significantly reduce emissions and to meet the highest standards in productivity and quality, the new complex is equipped with the Paul Wurth SOPRECO system (single oven pressure control) and a low-emission combustion system.

CUSTOMER
POSCO, South Korea

SUPPLY
New cokemaking complex

STATUS
Start-up in February and June 2024

HIGHLIGHT
Highest standards in terms of coke productivity and quality, emission control, low energy consumption, user-friendliness, and plant safety.

Blast furnace modernization for enhanced efficiency

ROGESA upgrades its blast furnace with Paul Wurth technology.

ROGESA Roheisengesellschaft Saar GmbH has commissioned SMS group to modernize blast furnace number 4, enhancing its durability and monitoring capabilities. The project involves renewing the furnace lining using Paul Wurth technology to improve thermal insulation and corrosion resistance. Multi thermocouple sensor probes will be installed for precise wear monitoring. Completion is expected in 2025 and includes a 55-day shutdown. Dr. Jürgen Hochhaus, operations manager at ROGESA: "The expert solutions, particularly the hearth lining and multi thermocouple sensor probes, ensure the durability and safety of our operations."

CUSTOMER
ROGESA Roheisengesellschaft Saar, Germany

SUPPLY
Modernization of blast furnace

STATUS
New order, start-up in 2025

HIGHLIGHT
Thermocouple sensors will determine lining wear and increase operational efficiency.

Major expansion of steelmaking facility

JSW Steel partners with SMS for the Dolvi works expansion.

JSW Steel has commissioned SMS group to supply a 350 t BOF converter, a twin ladle furnace, and gas cleaning plant for a major expansion of its steelmaking plant at the Dolvi works. This strategic expansion will increase JSW's capacity by 3.7 million t/year. The new converter, one of India's largest, features an advanced oxygen lance system that enhances production efficiency. Comprehensive automation solutions will ensure consistent quality and reliability. Together with the new blast furnace and the CSP Nexus plant, this project will enable JSW to produce the highest-quality materials.

CUSTOMER
JSW Steel, India

SUPPLY
New BOF converter, twin ladle furnace, and primary gas cleaning plant

STATUS
New order, start-up in 2026

HIGHLIGHT
Expansion of steelmaking capacity by 3.7 million t/year.

DRI plant in Libya

Tosyalı Sulb has awarded Midrex and SMS group the order to supply a DRI (direct reduced iron) complex in the Benghazi region in Libya. Tosyalı Sulb will utilize MIDREX technology similar to the two DRI plants owned and operated by Tosyalı Algerie in Bethioua (Oran), Algeria, supplied by Midrex with Paul Wurth as a consortium partner.

With MIDREX Flex, the plants can operate initially with natural gas and transition to using hydrogen, as it becomes available, making them leading contributors to green steel production. The Libyan plant will supply cold DRI to meet the needs of the nearby region. When this investment is completed, Tosyalı Sulb will be one of the world's key suppliers of DRI.

Tosyalı Sulb Steel Industries was formed by Tosyalı and Libya United Steel Company for Iron and Steel Industry (SULB) to lead the development of the iron and steel sector in Libya. Fuat Tosyalı, Chairman of Tosyalı Holding, said, "At Tosyalı, we place environmental sustainability at the core of our operations and work tirelessly to develop innovative solutions that reduce carbon emissions. As Tosyalı Sulb, we are committed to leading the way in green steel production while building a sustainable future."

Ahmed Gadalla, Chairman of Libya United Steel Company for Iron and Steel Industry (SULB), said, "Tosyalı Sulb's first project will greatly expand the DRI export capability of Libya and position the nation as a significant contributor to green steelmaking and decarbonization. This investment is a strategic contribution to Libya's economic development and industrial infrastructure."

K.C. Woody, President and CEO of Midrex, added, "Midrex is proud of our market leadership in the production of green iron and looks forward to conducting another project with Tosyalı."

Thomas Hansmann, Chief Technology Officer of SMS group, said, "Being part of this new project is a privilege for SMS group. It acknowledges the strong collaboration between our teams. This marks our third project with Tosyalı, highlighting our long-standing partnership. As we continue to turn metals green, we remain committed to advancing sustainable practices in the industry."

Tosyalı Sulb orders DRI plant ready for hydrogen operation.

CUSTOMER
Tosyalı Sulb, Libya

SUPPLY
DRI plant

STATUS
New order

HIGHLIGHT
Third DRI plant supplied to Tosyalı by Midrex and SMS group in the region

Advancing aluminum recycling with digital solutions

Speira sets new standards in aluminum recycling with the Metallics Optimizer.

CUSTOMER
Speira, Germany

SUPPLY
Digital solution for aluminum scrap flows

STATUS
New order

HIGHLIGHT
Energy and charging material savings

Speira's Recycling Services (SRS) and SMS group have formed a strategic partnership to set new operational standards by implementing state-of-the-art digital technologies for scrap handling. This collaboration focuses on implementing SMS group's Metallics Optimizer, a self-learning charge-mix optimization solution aimed at enhancing operational efficiency, reducing costs, and optimizing the scrap mix. The Metallics Optimizer integrates seamlessly with existing melting and holding furnaces for aluminum and magnesium production at Speira's sites in Töging am Inn, Grevenbroich, and Deizisau in Germany.

The Metallics Optimizer will address Speira-specific use cases, focusing on business processes and enabling step-by-step charging and heat sequencing. It considers factors such as scrap availability, process costs, and purchasing costs, enhancing alloy recipes to improve cost competitiveness. By optimizing scrap usage, the solution reduces energy consumption and raw material losses during melting.

The integration with the existing IT infrastructure allows for enriched charge-mix calculations and additional planning functions. The solution is fully customizable to meet the requirements of Speira's European plants, supporting in-house circular materials reuse, post-consumer recycling, and compliance with environmental regulations. Its web-based nature facilitates remote operation and integrative exchanges among all Speira locations. A long-term software and maintenance contract ensures continued operation and technological updates.

"With SMS group, we have the right partner for our business in the sensitive aluminum recycling industry. They convinced us with a digital solution that seamlessly integrates third-party equipment and automation in a brownfield environment with specific challenges and additionally is fully customized to meet the needs of our business processes," says Marco Gehlen, Head of Operations & Technology at SRS.

Complete hot strip mill automation upgrade

PTKS celebrates restart of hot strip mill no. 1.

CUSTOMER
PT Krakatau Steel, Indonesia

SUPPLY
Modernization of hot strip mill automation

STATUS
Modernization completed

HIGHLIGHT
New automation systems for high-quality products with a wide range of properties and dimensions

SMS group has completed the automation system upgrade of hot strip mill no. 1 at PT Krakatau Steel (Persero) (PTKS) in Cilegon, Indonesia. This achievement underlines PTKS's return to the Indonesian market as a producer of hot rolled coils following a lengthy production stoppage.

The project was initiated as a recovery plan for the drive and automation cabinets in the finishing mill. Rather than merely replacing the damaged automation parts in the finishing mill, PTKS opted for a comprehensive upgrade to next-generation automation technology throughout the entire hot strip mill. For the drive system, however, the existing DC drives used for other sections, such as the slab sizing press, roughing mill, downcoiler, and other units, were retained. SMS ensured the seamless integration of the new automation system and existing DC drive technology.

At the core of this upgrade is SMS group's X-Pact process automation control technology, comprising a range of advanced solutions that provide enhanced control, improved diagnostic capabilities, and consistent performance. SMS level 1 and level 2 automation systems are incorporated within the powerful X-Pact ProBAS platform based on the X-Pact Embedded controllers. The innovative software architecture provides extensive connectivity and open interfaces.

The scope of supply comprised technological process models such as the X-Pact Pass Schedule Calculation (PSC) model for the roughing and finishing stands, and the X-Pact Cooling Section Control model for strip cooling, designed to ensure fully automatic cooling. The X-Pact Profile, Contour, and Flatness Control process model guarantees a stable rolling process that reliably adheres to strip thickness and flatness tolerances.

"SMS group acted like a partner in every sense. We are delighted that SMS could achieve our milestone of starting up the plant within 2024. It was a huge challenge of putting a new automation system on the existing machinery," said Utomo Nugroho, Director of Infrastructure and Operation at PTKS.

Completion of VOD plant

Baosteel Desheng expands into stainless steel production.

Baosteel Desheng Stainless Steel has issued the final acceptance for the vacuum oxygen decarburization (VOD) plant in Fuzhou, China. The VOD system supplied by SMS is engineered to meet the demanding specifications required for high-purity steel production. With a capacity of 120 t per heat, the VOD unit effectively removes carbon and other impurities, thus enhancing the quality of the steel produced. The new VOD system enables Baosteel Desheng to produce steel with lower impurity levels, catering to the growing demand for high-quality materials in various industries, including automotive, aerospace, and construction.

CUSTOMER
Baosteel Desheng Stainless Steel, China

SUPPLY
New VOD plant

STATUS
Final acceptance issued in 2025

HIGHLIGHT
Production of 417,000 t of vacuum-treated steels per year

Five-strand combi caster to expand product range

Kardemir partners with SMS for plant expansion.

Kardemir has placed an order for a five-strand Concast continuous combi caster to enhance production at its Karabük plant in Türkiye. Scheduled for service by the end of 2025, this facility will boost Kardemir's production capacity by 1.2 million t/year. The plant is designed to manufacture three square billet sizes, one bloom size, and one beam blank section size. The caster features advanced SMS technologies such as the CONDRIVE oscillation drive and CONSTIR electromagnetic stirrers, ensuring high quality and operational efficiency. The scope of supply includes advanced level 1 and level 2 automation systems for controlling and optimizing production processes.

CUSTOMER
Kardemir Karabük Demir Çelik, Türkiye

SUPPLY
Five-strand combi caster

STATUS
New order, start-up end of 2025

HIGHLIGHT
Increased flexibility and efficiency, allowing the manufacture of billets, beam blanks, and blooms

Modernization of hot strip mill

Colakoğlu Metalurji enters the market for wear-resistant grades.

Colakoğlu Metalurji has placed an order for the modernization of the laminar cooling section and the downcoiler in its hot strip mill. With this order, Colakoğlu aims to enter the market for wear-resistant steel grades. To increase the cooling rate required for the production of these grades, SMS will replace the first cooling banks in the laminar cooling with super-reinforced cooling technology, which provides a specific water application rate up to three times higher. In addition, SMS is supplying the X-Pact Microstructure Property Model, which offers specialized functions for monitoring and simulating mechanical properties.

CUSTOMER
Colakoğlu Metalurji, Türkiye

SUPPLY
Modernization of laminar cooling and downcoiler

STATUS
New order, start-up in 2026

HIGHLIGHT
Pre-assembly of equipment before modernization to reduce plant downtime

Upgrade of seamless tube mill

BENTELER installs advanced CARTA neo automation technology.

BENTELER Steel/Tube, a leading manufacturer of seamless and welded tubes, has placed an order to upgrade its seamless tube mill in Paderborn, Germany, with the advanced CARTA neo SRM Technology System. The new system includes the latest crop end control and wall thickness control functions, developed to improve the yield, wall thickness performance, and operational efficiency of seamless tube mills. CARTA neo SRM replaces the existing CARTA system. SMS group will provide continued support with a 36-month system service package, including remote maintenance, troubleshooting, updates, and customizations.

CUSTOMER
BENTELER Steel/Tube, Germany

SUPPLY
CARTA neo SRM for seamless tube plant

STATUS
New order, start-up in 2025

HIGHLIGHT
Fourth generation of the CARTA SRM provided by SMS for this mill

Two state-of-the-art food-grade tinplate lines

Fujian Kebao enters high-end packaging market.

Fujian Kebao Metal Products, a subsidiary of Fujian Sanbao Group, has commissioned SMS group to supply two tinplate continuous annealing lines. The project aims to produce high-end, food-grade tinplate for domestic and international markets. The scope of supply includes an advanced Drever annealing furnace to ensure efficient and reliable thermal processing. A double cold reduction mill and a twin-stand skin pass mill are installed inline to enhance strip quality parameters, which are crucial for the manufacture of high-end tinplate. The total production capacity of the lines is 800,000 t/year.

CUSTOMER
Fujian Kebao Metal Products, China

SUPPLY
Two continuous annealing lines for tinplate

STATUS
New order, start-up in mid-2026

HIGHLIGHT
Production of high-end, food-grade tinplate

Casting and rolling line for copper rod

Conticon orders CONTIROD plant.

Conticon has ordered a new CONTIROD® line to expand the production of high-quality copper rod at its plant in Celaya-Villagrán, Mexico. The capacity of the combined casting and rolling CONTIROD® plant will be 320,000 t/year. The new line offers sustainability benefits, including reductions of 55% for electrical energy consumption and 30% for natural gas. These efficiencies are achieved through advanced design and process integration and optimized thermal energy utilization. The SMS group technology package also features process control systems that ensure precise operation, further contributing to energy savings.

CONTIROD® is a registered trademark of Aurubis Belgium.

CUSTOMER
Conticon (joint venture between Grupo Condumex and Xignux), Mexico

SUPPLY
CONTIROD CR3700 plant

STATUS
New order, start-up end of 2026

HIGHLIGHT
Energy-efficient production of electrolytic tough pitch (ETP) copper rod

Looking for more news? You can find all new orders and start-ups on our website: **www.sms-group.com/success-stories**

New cold rolling complex

SSAB chooses SMS for new cold rolling complex in Luleå, Sweden.

CUSTOMER
SSAB, Sweden

SUPPLY
Cold strip complex with tandem cold mill and strip processing lines

STATUS
Early services agreement

HIGHLIGHT
Production of third-generation advanced high-strength steels for the automotive sector, with a focus on sustainable production

SSAB, a global leader in steel manufacturing, has awarded SMS group an early services agreement for the delivery of the cold rolling complex at its steel production facility in Luleå, Sweden. This project marks a significant step towards sustainable steel production, underscoring SSAB's commitment to green technologies and processes. With an annual production capacity of approximately 1.3 million t, the equipment will enable SSAB to meet the growing demand for third-generation advanced high-strength steels (AHSS), particularly serving the automotive sector. The project encompasses sophisticated technology, including a pickling line / tandem cold mill with CVC technology, a continuous galvanizing line, a continuous annealing and galvanizing line, and a recoiling and inspection line, all being key components in achieving the final quality of SSAB's specialty products.

Fully electrically heated Drever furnaces will utilize a combination of induction and electrical radiant tubes, thus ensuring a minimal carbon footprint. For optimal surface quality, Duma-Bandzink air knives will precisely control the coating thickness. Amova robotics applications and logistics systems will optimize material flows and streamline logistics processes within the new cold rolling complex. Comprehensive automation and digitalization solutions will assure production efficiency, process stability, and product quality. Also included in the scope are major auxiliary plants like an acid regeneration plant, roll shop, coil logistics, and water treatment plants.

The cold rolling complex will be capable of processing strip widths up to 1,900 mm and thicknesses ranging from 0.3 to 2.5 mm, ensuring versatility in product offerings.

"This project underscores the trusted partnership between SSAB and SMS group. Together, we set new standards for sustainable steel production and technological innovations," says Olaf Stalfort, CSO Region Europe at SMS group.

High-capacity mill for thin hot strip

SMS group has successfully supplied a high-capacity hot strip mill to Jindal Steel Odisha. The mill, built for a capacity of 5 million t/year, boasts the latest generation of rolling technologies specially designed for the efficient and sustainable production of thin final gauges.

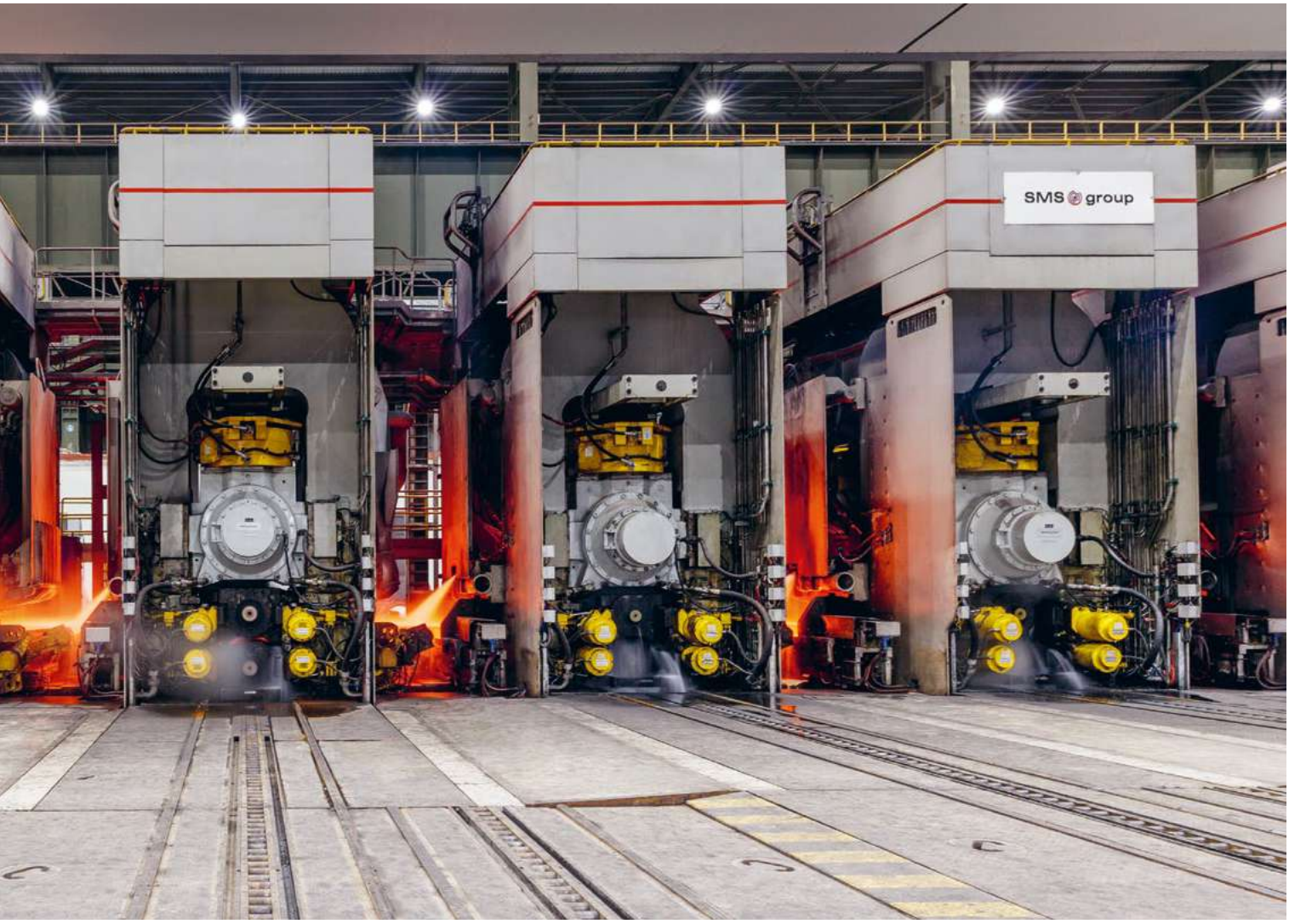
This is the first hot strip mill (HSM) at Jindal Steel Odisha Limited's (JSOL) Angul site in Odisha, India, and it marks yet another chapter in the long partnership between Jindal Steel and SMS. Having collaborated on a number of projects in the past, Jindal Steel entrusted SMS with the construction of this 1,780 mm HSM with cutting-edge technology for thin hot strip production.

The hot strip mill is packed with a range of highly advanced equipment. It includes a primary descaler, a two-high roughing stand with attached edger, a four-high roughing stand with attached edger, a transfer bar cooling system, HIBOX heat preservation hoods, a mandrel-less coilbox, edge heating equipment, a drum shear, a secondary descaler, a seven-stand finishing mill, a laminar cooling system, and three downcoilers. Not only that, the mill features an Amova coil handling system, strapping machines, a marking machine, and an inspection line.

Groundbreaking technology for challenging products

The mill can handle a wide range of steel grades, including high-strength low-alloy (HSLA), pipe grades, and silicon steels. Over 20% of the materials are tough grades, and the mill can reliably roll very thin strips thanks to its innovative, integrated rolling technologies. →

The finishing stands are equipped with latest technologies for superior product quality.



Some of the standout technological features include:

— Transfer bar cooling: For optimal temperature regulation in the roughing mill, SMS installed the newly developed transfer bar cooling system. It prevents uncontrolled air cooling during oscillation and has a favorable influence on temperature profiles, with positive effects on the rolling process in the finishing mill. By equalizing the temperature, product homogeneity is improved.
— HIBOX heat preservation hoods: JSOL's HSM is equipped with the latest generation of HIBOX heat panels. This simplifies the inspection and maintenance of the components and increases the service life by a factor of four compared to conventional preservation hoods. The use of HIBOX heat panels ensures more stable rolling behavior in the finishing train, and JSOL is able to shift the product mix toward smaller final thicknesses and/or higher-strength steel grades. The HIBOX system offers robust savings in terms of energy, carbon footprint, and OPEX.
— Mandrel-less coilbox: Arranged between the second roughing stand and the finishing mill, the coilbox shapes the transfer bar into coils, thereby equalizing the temperature over the whole transfer bar length. Coiling the transfer bar prevents the inner windings from cooling. Material and heat are accumulated, which has a positive effect on the material to be rolled and on the production process. The improved transfer bar temperature allows the product range to be expanded to include thinner gauges.
— Edge heater: Located upstream of the finishing mill descaler, the edge heater utilizes inductive heating. Its primary role is to enhance strip edge quality by maintaining optimal pre-rolling temperatures. This ensures flawless production results, even for advanced grades.
— Finishing mill: The seven-stand, four-high finishing mill is equipped with hydraulic adjustment systems, hydraulic loopers, the latest generation of CVC plus (continuously variable crown), with combined work roll shifting and bending systems. The scope of delivery also included the X-Pact Profile, Contour, and Flatness Control model (PCFC), which is capable of handling all requirements expected of highly sophisticated products with an exceptionally wide range of properties and dimensions. The PCFC calculates the optimal set points for the actuators in the CVC plus and bending system. As a result, it ensures the stability of the rolling process, superior product quality with regard to strip geometry, and rolling schedule flexibility.

The new transfer bar cooling system (left) and HIBOX heat preservation hoods (right)

MAIN TECHNICAL DATA

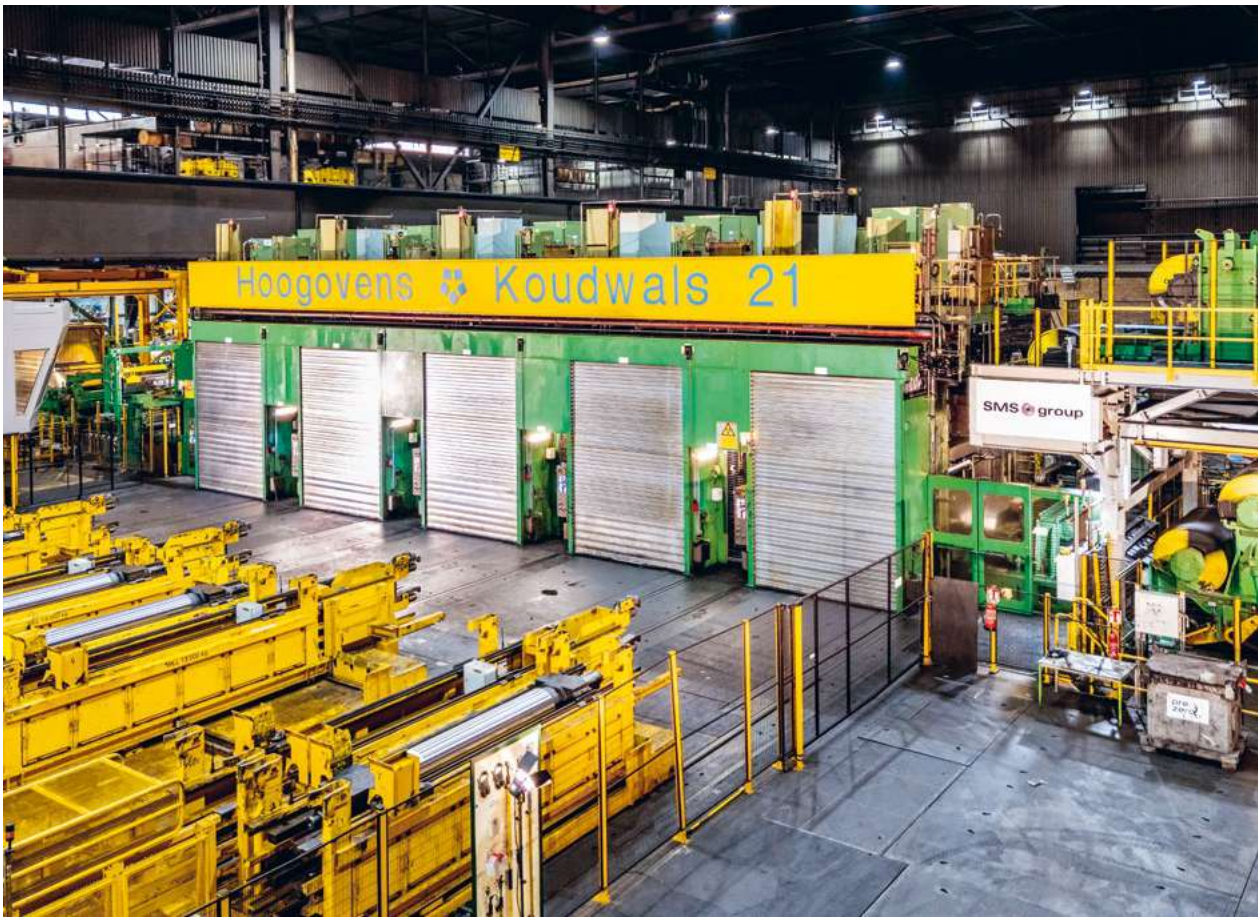
SLAB LENGTH
Max. 12 m

SLAB THICKNESS
180–260 mm

STRIP WIDTH
800–1,680 mm

STRIP THICKNESS
1.20–20.00 mm

CAPACITY
5.0 million t/year



Tandem mill upgraded with latest technology – now fully equipped for any rolling task

From batch operation to high-productivity continuous rolling in two shutdowns

The modernization of the tandem cold mill of Tata Steel Europe is a textbook example of how a plant can be adapted to growing market demands by integrating state-of-the art technology.

→

How can steel producers adapt their rolling mills to growing market demands without lengthy production interruptions? What technologies enable the production of wider strips, improved surface quality, a broader high-strength steel portfolio – and greater efficiency at the same time? We delivered answers to these questions through the successful modernization of Tata Steel Europe's tandem cold mill.

The tandem mill upgrade at Tata Steel Europe in IJmuiden (Netherlands) is an impressive example of how existing production facilities can be brought up to the latest technological standards with minimal downtime. Instead of erecting a new rolling mill, Tata Steel opted for the transformation of its existing mill, in operation since 1971 – achieving maximum gains in terms of efficiency, product quality, and competitiveness. The key to the successful outcome was precise planning and gradual implementation. Dividing the revamp project into three clearly defined phases allowed production to continue for the most part.

The goal of the comprehensive upgrade of the five-stand tandem cold mill was to convert batch operation into a high-productivity continuous process. As a result, annual capacity increased to 1.9 million t. Off-gauge lengths were also reduced, and strip surface quality enhanced significantly. Yet the real success lies in the way this transformation was achieved.

"Our customers expect a broader product mix, higher process stability, and more sustainable production processes – all at the same time. The switch to continuous rolling was crucial to meeting these requirements and minimizing downtime," says Ralf Schlote, Engineering Manager at SMS group.

Integration test: Digital commissioning with added value

A vital factor in the project's success was the early and detailed definition of the modernization concept, based on realistic, real-time 3D plant simulations and X-Pact Plug & Work integration testing of the automation systems. The plant and automation software were fully tested using a digital twin at SMS group's test facility in Mönchengladbach. The simulation covered the entire material flow – from the entry section through the continuous rolling mill to the coiling station and subsequent coil transport systems. Control systems were tested and optimized early in the process. This also allowed operating and maintenance crews to be trained by SMS group staff on the original control desks. As a result, the integration of the new systems was seamless, and the commissioning period significantly shorter.

Careful preparations for the upgrade were also made for the mechanical equip-

A key component of the continuous entry section is the X-Roll laser welder.

X-Pact process automation reduces off-gauge lengths by providing optimized rolling strategies.

ment. In the exit section, two new coil transfer cars and a tilting device, including the associated automation system, were installed to ensure continuous material flow during the revamp.

First shutdown: Laying the foundation for the upgrade

The goal of the first shutdown was to create a stable foundation for the next upgrade phases without extended production interruptions. In the exit section, a coil walking beam conveyor was removed to make room for the new exit equipment. In preparation for the second shutdown, the five mill stands were machined and the ancillary equipment was upgraded to a new automation level. These measures were essential to enable fully continuous operation in the future. In addition, new high-voltage transformers were installed to align the power supply with the increased capacity utilization in subsequent phases.

Ralf Schlote: "The first stage of the revamp was crucial to the success of the entire project. We established the structural and technological conditions necessary to implement the next steps in converting the tandem cold mill to continuous operation."

Transformation during ongoing production

In the next project phase, key technologies were implemented to enable continuous material guidance and a more efficient rolling process – all without interrupting production. The new entry end was installed and commissioned, including the X-Roll laser welder, which joins individual coils to form endless strips for continuous rolling. A new horizontal strip accumulator was also installed to provide a consistent and continuous feed of strip into the tandem mill.

To minimize downtime in the final phase of the revamp, extensive cabling was laid and new cable trays were installed.

At the exit end, the new carousel reel was also installed and commissioned. Additionally, the new rotary inspect offline inspection line was put into service, enabling quick and precise quality control of the rolled strips.

The final conversion

In the final phase, the transformation into a continuous mill was completed and the mill stands were comprehensively upgraded. The scope of work included:

— Installation of smaller work rolls and a CVC plus roll-shifting system for perfect strip flatness.
— Integration of a stepless wedge adjustment system for flexible passline control.
— Optimization of the work roll bending system for more precise strip thickness and flatness control.
— Installation of a high-precision X-Shape flatness measuring roll and control system to meet stringent flatness requirements.
— Implementation of a state-of-the-art multi-zone cooling system to guarantee target flatness in the final pass.
— Modernization of the drive train with new gear units and spindles to maintain the stable tensile forces required for high-strength steel production.
— Deployment of the X-Pact process automation package to reduce off-gauge lengths by providing optimized rolling strategies across level 1 and level 2 systems, and by applying settings in real time during strip transitions.

With the final integration of the carousel reel, a major innovation in the exit section became a reality. The new movable outboard bearing technology (traveling mandrel support bearing) ensures stable, tension-controlled winding of the strip, even with the highest-strength grades. In addition, the new continuous exit section was completed with automated coil transport systems.

"This project demonstrates that modernizing an existing facility is not only a cost-efficient alternative to building a new one, but can also deliver decisive technological advantages. Transforming a batch tandem mill into a continuous process is a complex challenge – but with the right planning and the right partners, it can become a model for success," says Ralf Schlote, Engineering Manager for the modernization.

Tata Steel facilities in IJmuiden, the Netherlands

See the video about the project:

New line for electrical steel strip

A new annealing and insulating line supports thyssenkrupp Steel Europe with the production of electrical steel sheet for energy-efficient electric motors.

New annealing and insulating line for the production of electrical steel sheet (©: thyssenkrupp Steel Europe)

The commissioning of the new annealing and insulating line in Bochum in January 2025 marked an important milestone for thyssenkrupp Steel Europe (tkSE). The electrical steel strip processing line, supplied by SMS group, enables tkSE to produce high-grade NGO (non-grain-oriented) electrical steel strip. This product is characterized by its special magnetic properties and low core losses, which are crucial for energy-efficient motors, generators, and applications in the electromobility sector.

The line is designed for a capacity of more than 200,000 t/year and processes electrical steel strip in widths of up to 1,350 mm and thicknesses of between 0.20 and 1.00 mm at a process speed of up to 150 m/min.

The strip treatment process comprises a precise heat treatment in which the cold-rolled strip is first cleaned and subsequently recrystallized. After that, a layer of varnish is applied to ensure optimal electrical insulation. As a result, tkSE will be able to meet the growing demand for high-performance electrical steel strip and strengthen its role as a pioneer in sustainable and energy-efficient processes and products for the future.

Technological advancements

SMS group supplied the complete strip processing line from a single source: Alongside the mechanical equipment, process engineering, and electrical and automation systems, the scope included Drever furnace technology, an Elotherm induction heating unit within the furnace, and the automated Amova coil transport system.

A key component of the line is the Drever furnace, equipped with a patented rapid heating system capable of reaching temperatures up to 1,100 °C. This system features a combination of natural gas-fired radiant tubes, Elotherm induction heating, and electrically heated zones to ensure precise control over the annealing process. The intelligent I-Furnace control system utilizes data-driven models to predict material properties, allowing for real-time adjustments that enhance material quality, improve the CO_2 balance, and reduce production costs.

Another essential element of electrical steel strip production is the advanced coating technology that is integrated in the line and used to apply a layer of insulating varnish. The technology comprises two horizontal coating systems (roll coaters), which were developed especially for electrically insulating coatings, and a flotation-type drying oven for the drying process. This setup ensures that the insulating varnish is applied to the strip surface in very thin, uniform layers of up to 0.5 µm without any flaws, and is dried in a contactless manner.

The automatic Amova coil transport system enhances operational efficiency through driverless technology, optimizing coil handling.

Efficient production and digital integration

SMS group's proven X-Pact automation packages, combined with advanced measuring instruments, power supply and drive solutions, ensure maximum efficiency and process stability in the line. Additionally, the Genius CM condition monitoring system continuously monitors the status of the installed equipment. The system is able to detect patterns in the process data and predict potential tolerance violations, which enables tkSE to optimize production processes and increase productivity.

Horizontal strip accumulator
(©: thyssenkrupp Steel Europe)

The line is equipped with SMS group's X-Pact Torque Drives, which deliver high torque efficiently, minimizing energy losses and maintenance requirements. Extensive tests in SMS group's test field have successfully confirmed the dynamic control behavior of the drives, demonstrating their capability to meet the requirements for continuous operation and precise tension control.

The electrolytic cleaning section, equipped with the innovative X-Pact High Current switched-mode power supply units, further enhances efficiency by significantly reducing energy consumption and maintenance costs while considerably increasing the line's availability.

The project was executed within tkSE's existing industrial environment, showcasing SMS group's expertise in managing complex installations. To ensure a seamless integration into the infrastructure, the entire plant was engineered using 3D modeling.

SMS group's X-Pact Plug & Work concept for conducting automation integration tests using the plant's digital twin enabled final optimizations to be made before the equipment was installed. This approach allowed the facility to be put into operation within a shorter time.

Strategic collaboration and sustainability

With this new production line, SMS group is supporting thyssenkrupp Steel Europe in achieving its strategic objectives while advancing the development of innovative materials crucial for a sustainable future. Dr. Harald Espenhahn from thyssenkrupp Steel Europe emphasized, "The successful commissioning of this state-of-the-art production line underlines the effective collaboration between our teams. This facility not only represents a huge step forward in our production capacities, but it also enables us to manufacture high-quality NGO steels that allow our customers to meet the changing demands of the market and to develop products with increased energy efficiency."

Simone Scheidgen from SMS group added, "The collaboration with thyssenkrupp Steel Europe has once again proved to be a positive experience of collaborative partnership. The synergy between our teams has resulted in a plant that meets our shared goals of technological progress and sustainability."

Photos: thyssenkrupp Steel Europe

The world's most powerful ring rolling machine

Compared to traditional forging, radial-axial ring rolling offers a range of benefits for the production of massive cylindrical components.

Ring rolling of a shell

As industries develop and demand larger, more complex components, the need for advanced forging technologies grows. This is particularly evident in the energy, heavy machinery, and offshore construction sectors. To produce the large pressure vessels used in nuclear reactors, for example, massive cylindrical components, often referred to as shells, are required. These shells can weigh up to 300 t, with outer diameters of 8 m and lengths of between 3 and 5 m.

The conventional process of manufacturing shells and other major components involves forging over a mandrel using large open-die forging presses with forces ranging from 70 to 150 MN. It begins with a blank, created from a solid starting block or a hollow ingot, depending on the metallurgical suitability. This blank, resembling a thick-walled pipe, is forged incrementally to the desired dimensions.

The process is time-consuming, as the workpiece must be rotated after each press stroke and may

require multiple intermediate reheats to maintain the necessary temperature for forging. These factors contribute to extended production times, often lasting several minutes or even hours, depending on the size and weight of the workpiece.

Advantages of ring rolling

Radial-axial ring rolling is a process in which a pre-forged workpiece, known as a ring blank, is rolled to its final dimensions using a specially designed machine. This approach offers a number of advantages over traditional mandrel forging. Radial-axial ring rolling eliminates the need for multiple forging cycles and intermediate reheating, significantly speeding up production. The precise controllability of the rolling machine ensures consistent geometries, reducing any additional machining requirements. By optimizing the forging process, material waste and energy consumption are minimized.

Until now, the application of radial-axial ring rolling was limited by the lack of machines capable of handling extremely large workpieces. SMS group's RAW 5000/1250-16000/5000 has addressed this gap.

One of the key benefits of this machine is the reproducibility of the process. Unlike free-form forging, which relies on the operator's skill, the ring rolling process is fully automated. Feedback from customers in China indicates that the production cycle for a large reactor casing with traditional methods can take up to two weeks. In contrast, using the ring rolling method, this time is reduced to less than two days. The actual rolling on the RAW machine takes only 10 to 15 minutes, while additional time is required for heating and blank preparation.

The RAW 5000/1250-16000/5000 is setting new benchmarks in the forging industry with its performance specifications:

— Radial rolling force: 50 MN
— Axial rolling force: 12.5 MN
— Maximum rollable ring outer diameter: 16 m
— Maximum rollable ring height: 5 m
— Total machine weight: approximately 6,600 t
— Overall machine length: 55 m
— Height above floor level: 16.6 m

Compared to the mandrel forging process, the RAW 5000/1250-16000/5000 enables faster production cycles, greater precision, and a higher output capacity.

Tackling engineering challenges

When designing and constructing a machine of this scale and capability, SMS had to address numerous technical hurdles, beginning with ensuring the structural stability of the machine under the immense forces it would endure during operation. To achieve this, the design was meticulously optimized to provide exceptional durability and reliability over its operational lifespan. Every structural element was engineered to withstand the extreme stresses of industrial-scale production.

SMS integrated state-of-the-art software and highly sensitive sensors to enable precise control over every aspect of the machine's operation. These systems ensure consistent quality for each component produced, regardless of size or complexity.

Increasing efficiency with radial-axial ring rolling for large-scale forging

The RAW 5000/1250-16000/5000 offers customers significant advantages that increase production efficiency and competitiveness. One of its primary benefits is the reduction in production times compared to traditional mandrel forging. The machine also delivers improved precision, ensuring dimensional accuracy for high-quality components. This precision minimizes the need for additional machining or corrections, saving both time and resources.

In addition, the RAW 5000/1250-16000/5000 provides cost efficiency through optimized processes that reduce material waste and energy consumption. Its advanced design ensures long-term reliability, minimizing maintenance costs and downtimes.

The machine can produce a wide range of large, complex components, including pressure vessel shells, wind turbine parts, and heavy machinery components. Despite the immense power of the machine, it operates with a highly sensitive system. For instance, rings with a wall thickness of approximately 60 mm have been manufactured on this machine. Capable of rolling forgings up to 16 m in diameter and 5 m in height, it meets the needs of diverse industries requiring large-scale, high-precision parts.

Comprehensive solutions for every ring rolling machines type

SMS offers comprehensive technical services for ring rolling machines to optimize their operation and maintenance. These services include spare parts for all machine components, remote service support, and also the opportunity for a long-term service agreement that ensures continuous care and maintenance. Additionally, SMS group provides digital tools to optimize plant production, which enhance the production process and maximize machine performance.

MISSION STATEMENT

SMS group is renowned worldwide for its future-oriented technologies and outstanding service for the metals industry. We apply our 150 years of experience and our digital know-how to provide the industry continuously with innovative products and processes that extend beyond our core business. We are the right partner for challenging projects and support our customers throughout the lifecycle of their equipment, enabling profitable and resource-efficient value chains. Paving the way for a carbon-neutral and sustainable metals industry is our stated goal.

At a glan

KEY FIGURES (2023)

Order intake	€ 3,620 million
Sales	€ 4,033 million
Order backlog	€ 6,336 million
Employees	> 13,500

ce

MANAGING BOARD
(from left to right)

Thomas Hansmann CTO
Fabíola Fernandez CFO
Jochen Burg Chair & CEO
Katja Windt CDO
Michael Rzepczyk COO

Integrated solutions

MANY SKILLS, ONE MISSION: WE ARE MAKING THE METAL INDUSTRY FIT FOR THE FUTURE

The metal industry is evolving at a rapid pace. All companies must constantly endeavor to improve their production processes, sustainability strategy, and technology integration concepts. This is one of the reasons why SMS group has also evolved over the past 150 years, starting out as a pure plant manufacturer and now a comprehensive service partner to the metal industry. Our mission goes way beyond plant manufacturing: We are committed to a **performance partnership** – a close, long-term cooperation with our customers aimed at optimizing their performance on a permanent basis.

Our customers have individual needs and face unique challenges. Our skills enable us to find the right solution for every situation and support our customers with our expertise as they make their way into a more efficient, digital, and sustainable future. With our global network of engineers, metallurgists, automation experts, and programmers, we combine in-depth metallurgical knowledge with state-of-the-art technology. Our holistic approach brings together plant engineering, automation, digital innovation, and a strong service network. This is how we minimize complexity for our customers and increase efficiency, enabling them to concentrate on their core business.

OUR AREAS OF EXPERTISE

Project management
Mastering complexity. We manage projects from the initial idea to the commissioning stage – efficiently, on time, and at the highest technological level.

Global production
Quality worldwide. With our global manufacturing network, we guarantee high quality, fast delivery times, and maximum reliability.

Energy supply and drive technology
Efficient energy management. A reliable energy supply, robust hardware, and powerful automation are the basis for resource-saving and stable production processes.

Process automation and visualization
Control concepts with vision. Our intelligent systems monitor and automate processes in real time, making metal production more efficient.

Data management
Data is the key. We transform complex data streams into usable insights with the aim of optimizing processes and taking a predictive approach to controlling production workflows.

Software solutions
Shaping the digital future. Our software combines AI, automation, and process data to make production processes smarter and more sustainable.

Spare parts management
Security of supply. We offer comprehensive spare parts management for high plant availability combined with low capital commitment.

Maintenance and modernization
Guaranteeing plant performance.
We provide maintenance, repair, and modernization services from a single source to minimize downtime and keep machines fit for the future.

Education and consulting
Knowledge leads to success. Our experts share their expertise through consulting services and training courses to help our customers to get the most out of their plants.

#turningmetalsgreen

Metals are indispensable for a large number of key industries. But in the fight against climate change, the metals industry must change. We are committed to creating a sustainable metals industry that approaches the neutrality frontier. That's what it means when we talk about #turningmetalsgreen. We are a key player in this historic transformation. We are focusing on the two key areas of decarbonization and the circular economy.

SELECTED PROJECTS AND TECHNOLOGIES

Aurubis, USA
The first multi-metal recycling plant in the US

Paul Wurth EASyMelt technology
Turning blast furnaces into low CO_2 operation

Hybar, USA
A minimill powered by the sun

Mercedes-Benz, Germany
Recycling plant for lithium-ion batteries

Saarstahl, Germany
Power4Steel. Towards carbon-neutral steelmaking

SSAB, Sweden
Transition from integrated to electric steelmaking

Stegra, Sweden
The world's first 100% hydrogen-based steel plant

thyssenkrupp Steel, Germany
Decarbonization of Europe's largest steel site

People and places

Founded in 1871, we have developed from a small family business into a global player with a significant influence on the development of the metals industries. Crucial to this success story was the early orientation towards global markets, the focus on technology, and the adherence to the values as a family-owned company.

HEADQUARTERS
Mönchengladbach, Germany
CEO: Jochen Burg

REGION AMERICAS
HQ: Pittsburgh, USA
CEO: Doug Dunworth

30
locations

REGION EUROPE
HQ: Mönchengladbach, Germany
CEO: Thomas Hansmann

44
locations

REGION APAC & MEA
HQ: Gurugram, India
CEO: Marco Asquini

22
locations

REGION CHINA
HQ: Shanghai, China
CEO: Peter Langner

9
locations

Company

From left to right:
Heinz-Erik Decker;
Johannes Frauendörfer
(Chairman), and
Georg Heinrich Weiss

Generational change in the Familie Weiss Foundation

The Familie Weiss Foundation, sole owner of SMS group, has now completed its generational changeover process. Heinrich Weiss, until now the sole director on the foundation's board, has handed over the reins to the next generation of the owning family. The foundation's new Board of Management is made up of Johannes Frauendörfer as chair, Georg Heinrich Weiss, and Heinz-Erik Decker.

Heinrich Weiss laid the cornerstone for the establishment of the Familie Weiss Foundation back in 2016, with all shareholders contributing their shares in order to keep SMS group in the long-term ownership of the family. The new Chairman of the Foundation's Board of Management, Johannes Frauendörfer, stressed: "Our focus is on continuity and stability. This generational change means that we are consistently embracing the values that have made our company strong. We will continue to rely on trusting partnerships with our customers in the future in order to consolidate SMS group's leading market position."

Heinrich Weiss also resigned from his positions on the Shareholders' Committee and Supervisory Board at the end of 2024. "It is with considerable gratitude that we look back on the outstanding work of my father Heinrich Weiss, who led the company with real vision and passion for a number of decades. His tireless commitment has shaped SMS as a leading company in the field of mechanical and plant engineering for the metal industry and played a key role in its international success," said Georg Heinrich Weiss.

The three members of the foundation's board, Johannes Frauendörfer, Georg Heinrich Weiss, and Heinz-Erik Decker, have now moved up to the Supervisory Boards, ensuring continuity and a seamless transition in the strategic direction of SMS group. Heinz-Erik Decker: "In close cooperation with the Managing Board, we will oversee the strategic direction of SMS while driving technological progress, promoting the sustainable transformation of the industry, and securing the long-term competitiveness of the company."

The generational changeover process in the Managing Board of SMS group was completed back in 2023 with the appointment of Jochen Burg as CEO and Fabíola Fernandez as CFO.

news

SMS acquires parts of Metso's metals business

SMS group has signed an agreement with Metso Corporation to acquire parts of their portfolio for sustainable metals production. Metso is a technology and services provider in the aggregates, minerals processing, and metals refining industries. The transaction includes technologies that SMS aims to develop further to the benefit of customers, supporting the green steel strategy as well as further strengthening the service portfolio, e.g., with sintering and traveling grate pelletizing as well as fluidized bed technologies. The transaction is expected to close in the first quarter of 2026, subject to customary regulatory approvals. The deal also includes ongoing business activities and the growing service business related to these technologies.

"We are very pleased to add these technologies to our product portfolio including the respective know-how carriers. With this acquisition we pursue our ambition to be a leading partner for the green transformation of the metals industry," says Thomas Hansmann, Chief Technology Officer of SMS group.

Approximately 180 employees, primarily based in Germany, India, and China, are planned to join the SMS group at the closing of the transaction.

A 3D model of the Norsk e-Fuel plant in Norway

Expansion of e-fuel projects

As part of our strategy to extend our business activities beyond steelmaking, SMS group is contributing to the decarbonization of the aviation industry by becoming the leading shareholder of Norsk e-Fuel, a project developer aiming to establish sustainable aviation fuels (SAF) at scale. Our joint efforts are focusing on establishing industrial-scale production of e-fuels from CO_2 and water. For a groundbreaking e-fuel facility in Mosjøen, Norway, SMS group is conducting a front-end engineering and design (FEED) study.

In January 2025, Boeing joined as a key offtaker of e-SAF, supporting Norsk e-Fuel's initiative and strategy. Additionally, Norsk e-Fuel has secured a key investment commitment from Prime Capital AG, bolstering its project pipeline with a new potential facility located in Ange, Sweden, with a minimum annual e-fuel capacity of 80.000 t.

In Finland, Norsk e-Fuel has acquired land in Rauma and Imatra, each planning to produce up to 100 million l of e-fuel annually too.

Upcoming events

CHINA INT. STEEL CONGRESS	Shanghai, China	August 6–10
ABM WEEK	São Paulo, Brazil	September 3–5
EMO	Hanover, Germany	September 22–26
ESTAD	Verona, Italy	October 6–9
IERC ASIA	Shanghai, China	November 10–13
COPPER	Phoenix, AZ, USA	November 16–20
FORMNEXT	Frankfurt, Germany	November 18–21

The story behind

The road trip

On December 4, 2024, the first massive mill stand for the hot and the cold rolling mills at Stegra left our Hilchenbach workshop, embarking on its journey by land and sea to northern Sweden. A total of 28 mill stands, each weighing between 80 and 146 t, were meticulously machined at our workshops in Hilchenbach and Mönchengladbach. Besides the mill stands, our workshops also produced gears, spindles, hydraulic gauge control cylinders, bending blocks, and numerous other components that are vital to the quality and performance of the rolling mills.

Sixteen of these mill stands will be integral to the CSP Nexus plant, enabling Stegra to manufacture a wide range of products, including high-strength steels and demanding automotive grades. More significantly, these stands will contribute to the world's first near-zero carbon CSP Nexus plant. This groundbreaking achievement is being made possible by relying exclusively on electricity for heating processes, utilizing a combination of resistance heating furnaces and inductive heating modules. ●

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SMS group

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