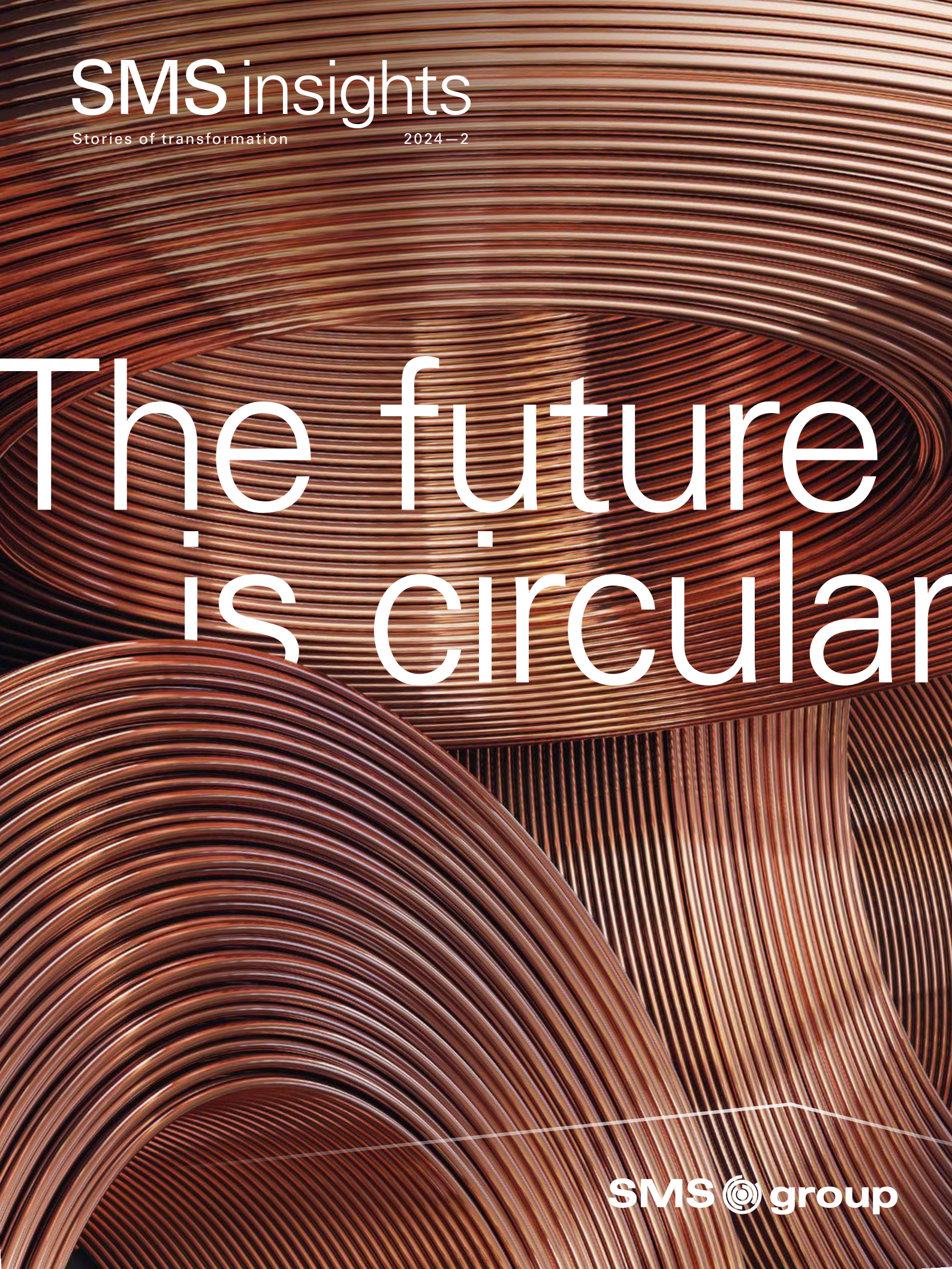
SMS insights
Stories of transformation
2024—2



The future is circular

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,

When it comes to the green transformation of the metals industry, the focus of public discourse is often on decarbonization and the related costs. However, increasing resource efficiency is an equally powerful tool for reducing emissions and requires far less investment. While the linear "take-make-dispose" model dominates many sectors, the metals industry is at the forefront of transitioning to a circular economy and a key enabler for true circularity. Nevertheless, significant challenges remain: why is a mere 22 percent of electronic waste recycled globally? Each year, around 70 billion US dollars' worth of metals are lost. To address this issue, we need the backing of politicians and stakeholders to establish efficient collection systems for valuable materials and to promote product designs that facilitate recycling. Moreover, we require bold investors in the metals industry who are willing to explore the "urban mine" for its hidden treasures.

We stand ready to guide and support our customers in seizing these opportunities. We strive to push metal recycling rates to their technological limits while venturing into new realms of metal recovery – from electronic waste to photovoltaic systems and batteries. Our circular economy strategy extends beyond recycling and recovery: it emphasizes reduction, with our engineers committed to minimizing resource consumption and maximizing plant efficiency. Repair and reuse are integral to our operations, as we extend the lifespan of equipment through refurbishing and repurposing. As markets evolve, we provide redesign solutions, ranging from quick tuning to comprehensive plant overhauls.

We invite you to embark on this circular economy journey with us – both through this magazine and in real-world partnerships.

Thomas Hansmann
CTO SMS group

FOCUS

Circular economy

22 Battery recycling: Solutions for a growing market

Photo: Mercedes-Benz Group

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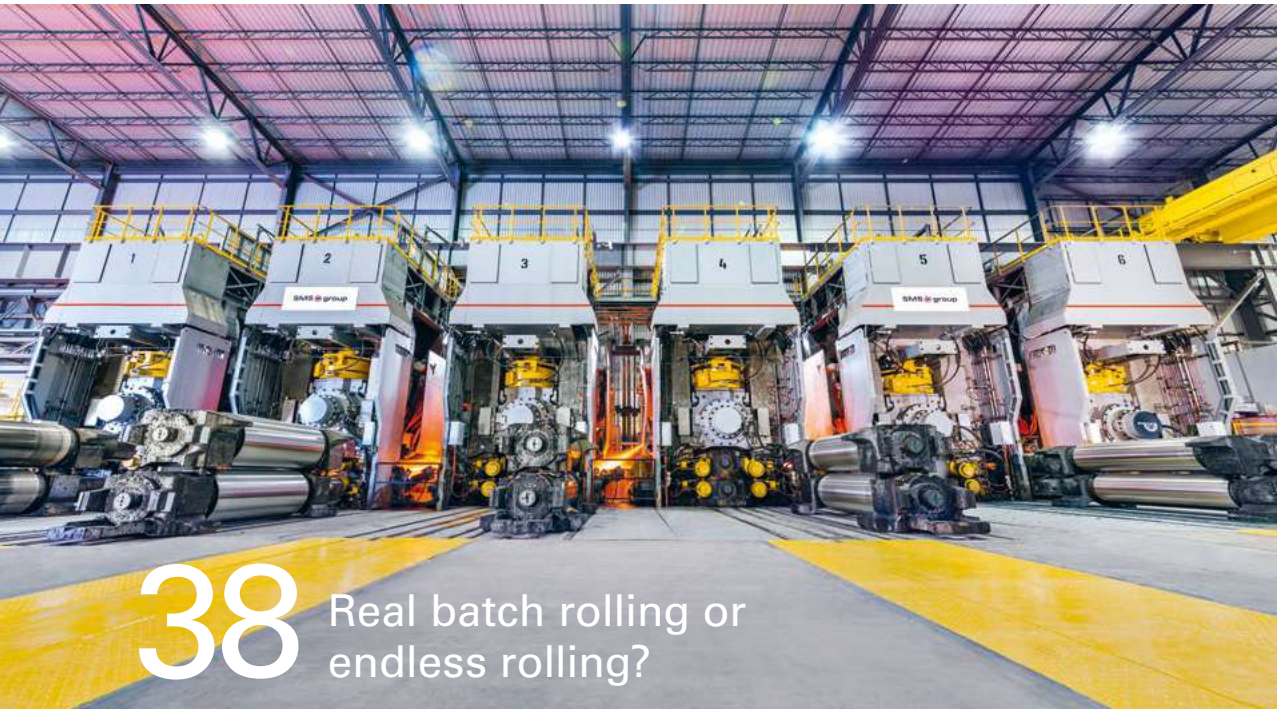

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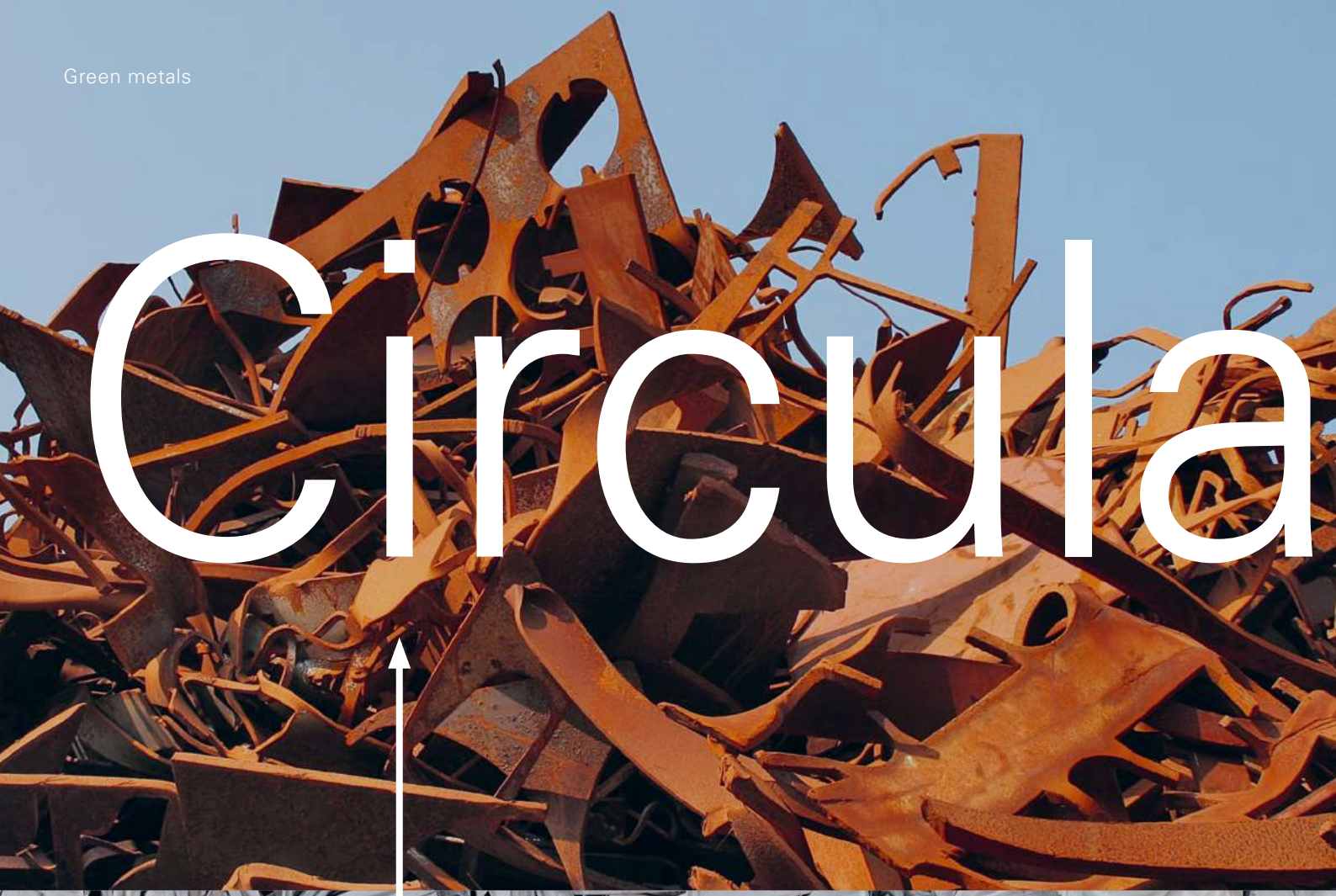
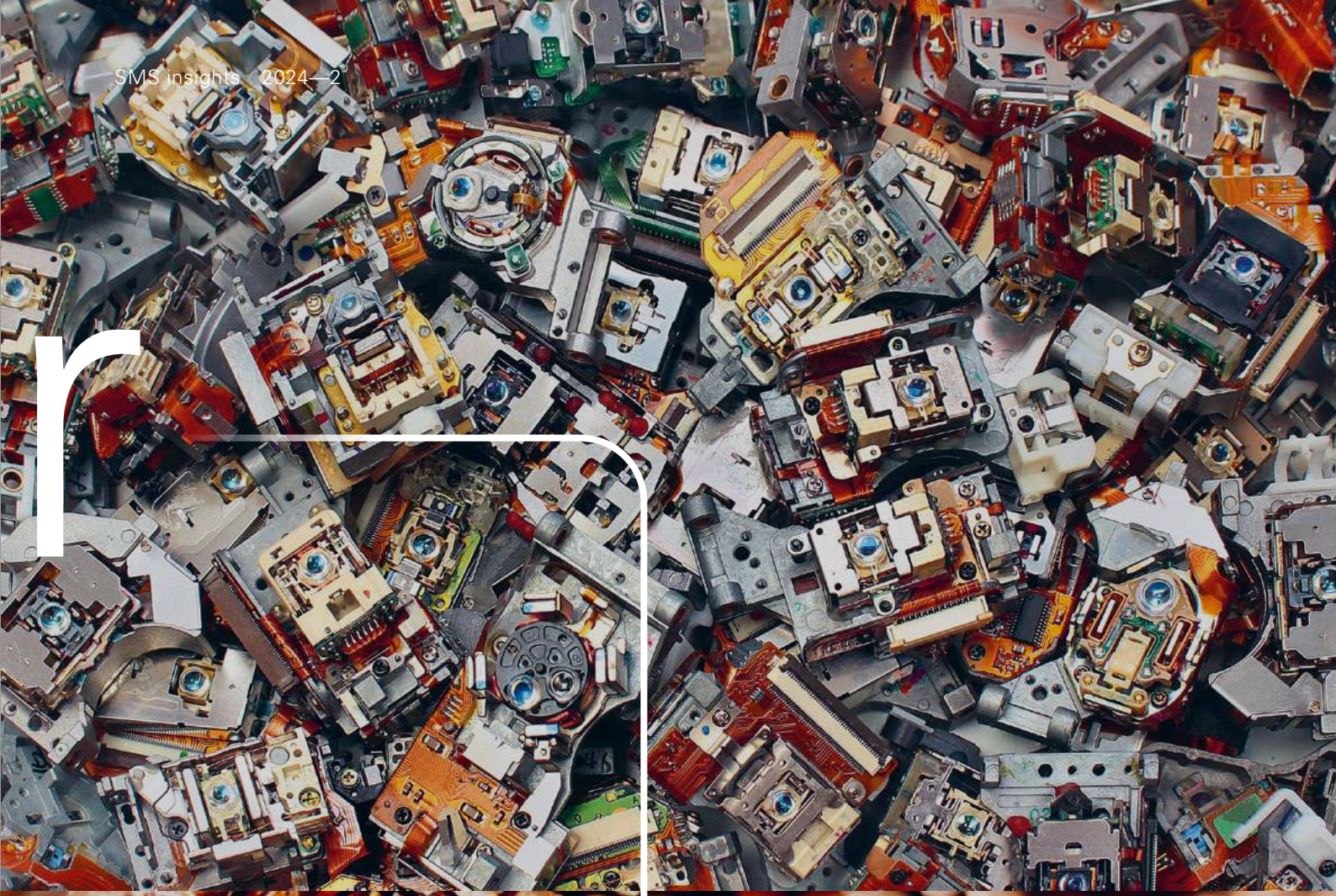


eco

Photos: iStock/Lya_Cattel (Rusty metal), iStock/adaherkus (Industrial waste), iStock/zakokor (Compacted aluminum)



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SMS group plays a pivotal role in integrating the principles of the circular economy within the metals industry. Join us as we examine how circular economy practices are embedded in metals production, discuss limits and constraints, and present solutions to push the boundaries of resource efficiency within the circular economy.

Turning metals green requires more than just replacing fossil fuels with sustainable energy; it calls for a focused commitment to resource efficiency and a shift from a linear economic model to a circular one. When produced with maximum efficiency, metals play a crucial role in enabling a circular economy due to their durability and inherent recyclability. However, circularity extends beyond recycling – it encompasses a wide range of stakeholders, including those involved in repair, reuse, refurbishment, repurposing, and remanufacturing.

From arrow to loop

The circular economy seeks to transform the traditional linear model of "take, make, use, dispose" into a more sustainable, circular system. In this model, goods are produced and consumed in ways that minimize resource use by extending product lifecycles and repurposing waste as a resource while reducing unavoidable losses. Recycling is one central pillar of this approach, as it directly boosts resource efficiency and helps secure the supply of raw materials from intermediate and end-of-life products. However, other measures focus on the demand side. These "inner loops" of the circular economy include increasing the utilization of products through reuse, repair, refurbishment, and remanufacturing. Each of these efforts contributes to prolonging product lifespans of equipment, process units, and plants and deferring the need for new raw materials. Furthermore, product design plays a key role in mitigating material losses and preventing quality degradation.

The endless cycle

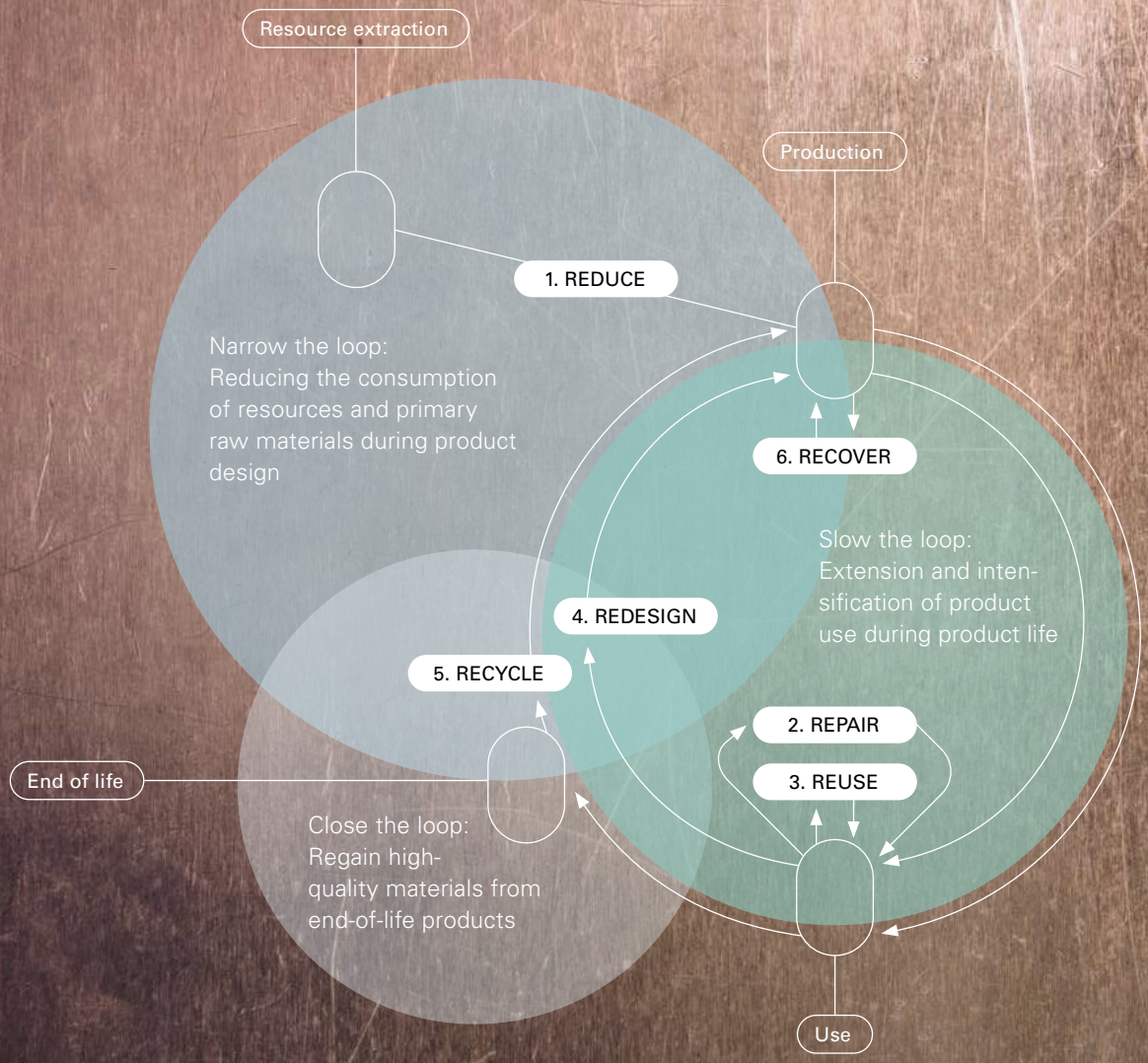
Metals are a fundamental building block of modern civilization and society, alongside cement, plastics, and ammonia. Metals are ubiquitous, found in industrial products as well as in consumer goods. Many new developments in communications, electrification, digitalization, and the transition to green energy sources and decarbonization all rely heavily on the use of metals. What sets metals apart is their exceptional recyclability, as losses from the cycle and quality degradation of materials can be managed. Therefore, metals are ideal candidates for a circular economy. Unlike fossil raw materials, they are not permanently lost if managed well; excessive down-cycling or material quality issues can be mitigated if recycling occurs in state-of-the-art processes. However, their reactivity with oxygen and propensity to dissolve other elements can limit recyclability.

The advantages of recycling are obvious. First, metal recycling helps conserve raw materials, especially rare and precious metals. Second, recycling improves supply security, which is crucial for countries with limited resources and during periods of supply chain disruptions. Finally, recycling metals significantly reduces carbon emissions compared to primary production, with reductions ranging from 70% for steel to about 95% for aluminum. Depending on the metal and/or compound, these percentages are contingent upon the complexity of the end-of-life products from which they are recovered and may therefore vary. These savings are the result of reduced raw material extraction, transportation, and the energy-intensive processes needed for primary metal production. Finally, certain wastes can also be converted to energy.

Reality check

A modern, integrated steel plant exemplifies circular economy principles with waste streams of less than 2%. Internal steel scrap is recycled back into steelmaking. By-products are either sold or further processed in the non-ferrous metals industry. Blast furnace and steel slag are primarily repurposed for cement production and road construction. Dust, sludge, and mill scale are recycled in the sinter plant, recovering iron and producing zinc for the non-ferrous metals industry. Coke oven gas and other combustibles are cleaned and used as fuel or sold for chemical production. CO_2 can be captured for enhanced oil recovery, algae cultivation, or →

Contribution of SMS group to the circular economy



Source: Deutsches Institut für Normung e.V., Photo: iStock/Dmitr1ch (Metal surface)

1. REDUCE
Reducing the use of resources or utilities is integral to our everyday work with the goal of maximizing efficiency and providing customers with a competitive advantage. This implies that the footprint of our equipment remains as small as possible without compromising functionality.

2. REPAIR
Reconditioning used equipment to its original state is a core competency of our service domain. Our global service workshops specialize in repairing components and restoring them to full functionality. In some cases, a repair can even increase the performance of a component.

3. REUSE
Reusing or repurposing equipment after its first lifecycle is crucial. This can apply to entire plants (e.g., relocating to a new site) or individual components. A notable example is the reuse of refurbished copper molds.

4. REDESIGN
To meet changing market demands, we offer revamps and modernizations, ranging from quick-win tuning packages to comprehensive plant overhauls. These can involve upgrading and adding new equipment, modernizing automation systems, or implementing digital tools.

5. RECYCLE
Over 4,000 types of metal-bearing materials are available for recycling, including complex materials such as electronic waste, batteries, slags, or minerals. SMS strives to make recycling as efficient as possible and to extend the range of materials that can be recovered.

6. RECOVER
In a circular economy, even wastes should be viewed as resources. Treatment costs and the potential value created determine the economic viability of this approach. A classic example of recovery is blast furnace slag, used as a by-product in the cement industry.

7.8

kilograms of e-waste are generated per capita

80

percent of e-waste is not recycled

90

percent of metals from the automotive industry are recycled

chemical production. Acid and alkali wastes are neutralized, reused, or safely disposed of, and refractory waste is partially recycled into new products or used in road construction.

Steel, with an annual production of almost two billion tons, is by far the most widely produced metal. The World Steel Association reported that 865 million tons of scrap were available in 2019. This includes three different types of scrap: home scrap (internal scrap from steelmaking, 165 million tons), prompt scrap from steel processing (225 million tons), and end-of-life scrap (445 million tons) from vehicles, buildings, infrastructure, machines, appliances, or cans. The amount of collected steel that is lost from the recycling cycle is probably small in comparison with the total production.

Remelting scrap aluminum to produce alloys of suitable quality saves approximately 95% of the energy required for primary aluminum production. As the second most produced metal in the world by volume, aluminum accounts for about 106 million tons annually, with around 35% (37 million tons) derived from recycled material. Global recycling rates for aluminum are high, with end-of-life scrap representing about 60% (22 million tons) of the total scrap volume.

Copper ranks third in terms of production volume. A total of around 26 million tons of refined copper were produced globally in 2021, with around 20% based on recycling. The benefits of secondary copper production are huge, as recycling saves up to 85% of the energy, resulting in a reduction of approximately 2.1 tons of CO_2 per ton of copper.

Bulk metals like steel, aluminum, and copper have been recycled for centuries, supported by a very well-developed system of scrap collectors, scrap-processing companies, and plants utilizing scrap in almost all parts of the world. However, when recycling complex functional material combinations originating from end-of-life products, the situation is more challenging. Electronic waste or WEEE (waste of electronic and electrical equipment) is the post-consumption waste from consumer and business devices such as mobile phones, computers, screens, and household appliances. In 2022, the world generated 62 million tons of e-waste, an average of 7.8 kg per capita.

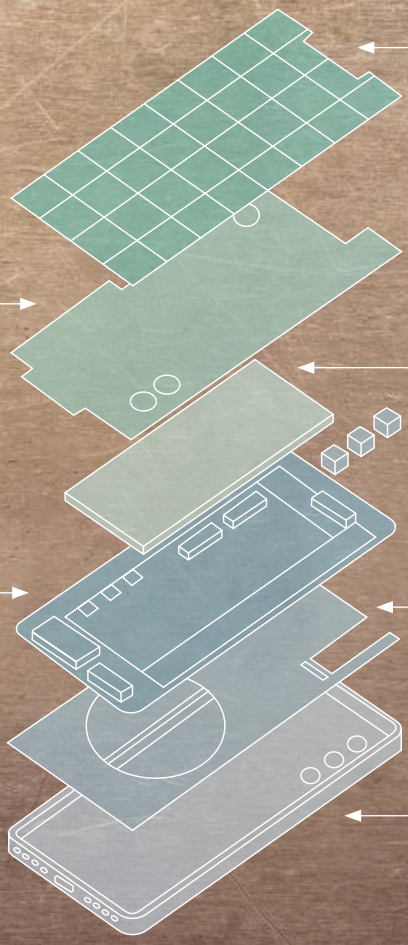
The complexity of recycling WEEE stems from the diverse and functional combination of metals and other materials, such as plastics, ceramics, and organic compounds. More than 60% of WEEE consists of various metals, including ferrous metals, aluminum, copper, PGM (platinum group metals), magnesium, silver, antimony, and rare earth elements, to name just a few. Although WEEE contains only small quantities of these metals, recycling can be highly profitable due to the high market prices for certain rare technology metals. Batteries are another complex product where functional materials are combined to provide electricity. Annual growth rates of 15% and more are projected from e-mobility, consumer goods, pedelecs, and stationary energy storage systems. After initial physical separation steps, batteries are typically recycled using pyro- and hydrometallurgical processes, depending on the battery type or product mixture.

Slags are valuable by-products of high-temperature processing, largely due to their mineral content. Metal industries generate around 800 million tons of slag annually as by-products, most of that from iron and steelmaking. The copper, nickel, lead, zinc, tin, and ferroalloy industries also produce over 40 million tons of slag globally, sometimes still rich in valuable metals. Recovery of these metals in dedicated furnaces cleans the slags to produce oxide premium building materials and other products. This process eliminates dumping costs, saves space, and substitutes geological building materials from primary sources. However, due to increasingly tighter legislation imposed on the final quality of these materials, undesired elements must be removed.

As we have seen, metals, alloys, and compounds in consumer products are often combined in complex functional ways that complicate recovery. SMS plays a crucial role within the circular economy by providing the technology to efficiently recover metal, alloys, and other substances from complex end-of-life materials. Our contribution to the circular economy is to develop technology that remelts scrap and secondary materials

Metals in a smartphone

Smartphones consist of around 60 different materials and form thus an important element of the "urban mine."



TOUCHSCREEN
A thin layer of indium tin oxide allows the screen to function as a touchscreen.

DISPLAY
The display contains aluminum, gallium, indium, and tin, but also rare earth metals.

BATTERY
The majority of smartphones use lithium-ion batteries.

PRINTED CIRCUIT BOARD
Contains copper, silver, tin, tantalum, palladium, gallium, and many more metals.

SHIELDING
Mainly made from aluminum.

CASING
The casing is mainly made up of plastics, glass, and ceramics, along with nickel and aluminum.

Source: acatech – National Academy of Science and Engineering; Photo: iStock/Dmitr1ch (Metal surface)

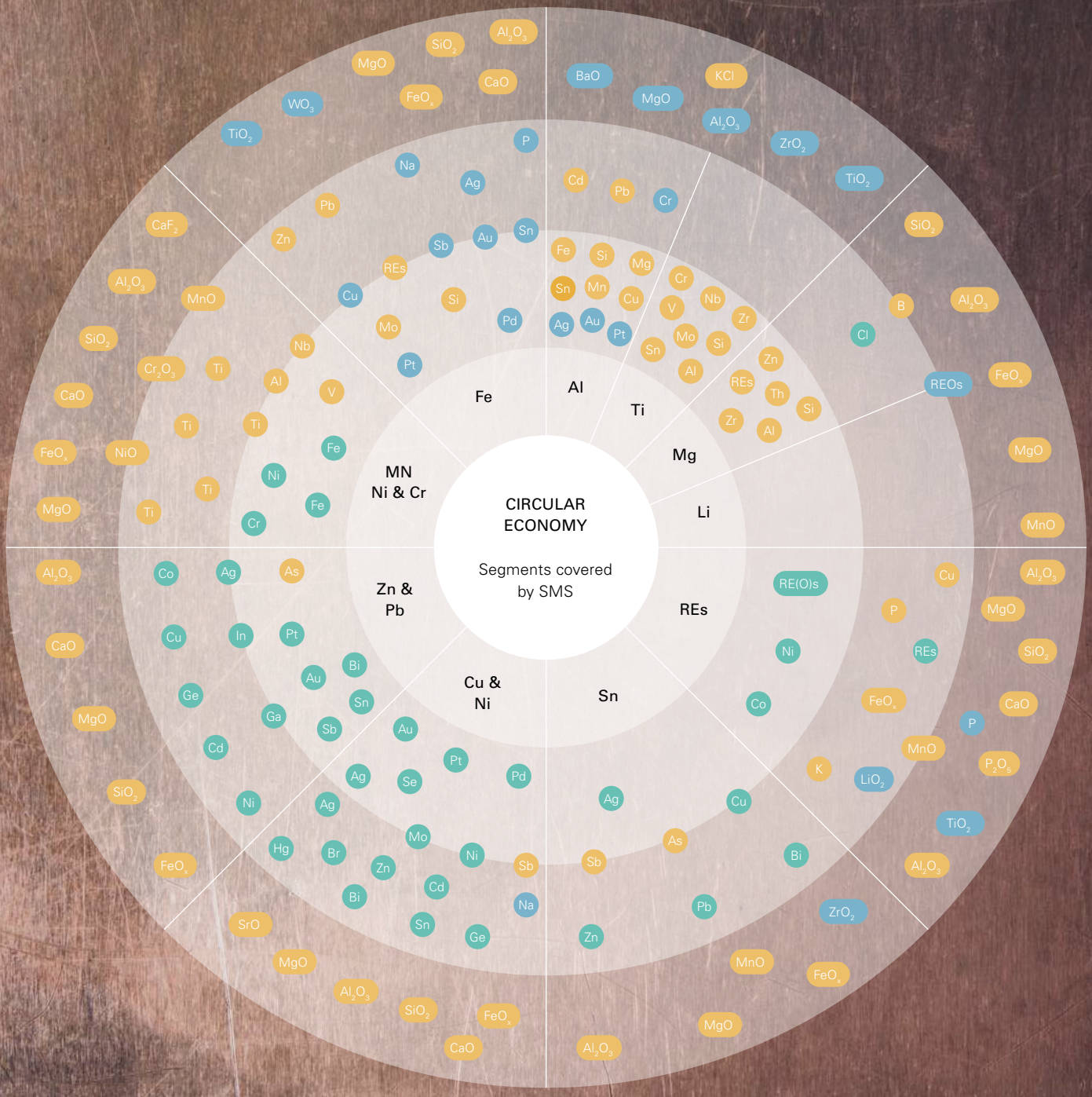
to produce high-quality metal products suitable for consumer products.

The challenges of a circular economy

All metal scraps and end-of-life goods originate as alloys mixed with many different metals in the form of alloying elements, or tramp tramp elements, or are linked to functional combinations. Steel recycling can only partially handle copper, tin, and antimony in the input streams since these elements are difficult to remove due to their chemical properties. It is, therefore, challenging for a circular economy to minimize contamination in the supply chain that is caused by either poor design or poor separation. Because of these challenges, the only solution is to dilute the impurities with virgin iron units from HBI or DRI into concentrations that meet alloy requirements. Similarly, due to aluminum's high reactivity, dilution with primary pure aluminum is the only path to create alloys with the required specification. In contrast, when recycling more noble non-ferrous metals such as gold, platinum, palladium, silver, and other valuable metals such as copper, nickel, →

Metal wheel

- Mainly to benign lower-value building material products and dissipative loss
- Forms compounds which report mainly to dust, slime, or speiss (mainly hydrometallurgy)
- Dissolves mainly in carrier metal if metallic (mainly pyrometallurgy)
- Carrier metals processing infrastructure of the circular economy
- Mainly recovered element
- Recovered in alloy or compound or lost if in incorrect stream, scrap, or module
- Mainly lost element: not always compatible with carrier metal or product



Source: Inspired by Handbook of Recycling 2nd Edition, Elsevier, 2024 Photo: iStock/Dmitri1dh (Metal surface)

zinc, or lead, a wide range of metals can be separated and recovered with high purity due to their chemical refining properties. However, with the increasing complexity of the composition of starting materials, the recycling and recovery of individual metals is becoming more demanding. Recycling and recovering pure components from residue materials requires complex multistep processes, in other words, flow sheets.

The growing complexity of end-of-life products requires shifting from a material-centric to a product-centric approach. This implies that all materials in a product have to be processed at the same time. In the first step, they must be separated as thoroughly as possible by physical means before their chemical separation through process metallurgy can begin.

The wheel of metal recycling

However, it is not only the metallurgical challenges that limit recycling rates. To effectively use the material goods of modern life – such as buildings, cars, electrical appliances, and mobile phones – as "urban mines," a comprehensive infrastructure for collecting, pre-processing, and distributing the scrap is essential. While primary extraction through mining, although often at low grade, benefits from a large ore volume available at a fixed location with a well-defined mineralogy, urban mines are dispersed over millions of units in private households and industries. Therefore, their "mineralogy" or composition is not well defined. One of the main challenges is accumulating these millions of discarded products to achieve economically viable recovery while managing the complex composition of these materials. The key challenge of metallurgy is to develop robust processes that can process diverse input feeds cost-effectively with a product-centric approach.

The complexity of metal-bearing end-of-life materials makes recycling challenging. Items such as mobile phones can contain over 70 different elements and compounds, intricately and functionally mixed and combined, making it impossible to achieve 100% recovery of all materials and elements. Losses are inevitable, as dictated by thermodynamics.

The metal wheel for end-of-life products effectively visualizes the challenges of dealing with complex metal-bearing end-of-life materials. It elucidates the interconnectedness of metals in nature and recycling and the resulting effects on the entire metal production and circular economy when these connections are disrupted. The circular economy of metal production and recovery is categorized into metal product sectors, each representing a specific base metal industry. The inner ring of the wheel depicts base metals, while the outer rings show the metals associated with each base metal and chemical processing compatibility, either as recoverable by-products or as non-usable components. That basically means they remain in residues, which cannot be processed economically due to their complexity, and slags. Metals and compounds that can be extracted from intermediate or by-products in the base metal industry are marked in green in the wheel, indicating chemical refining compatibility. Metals shown in yellow can be recovered but are also prone to losses due to incomplete chemical compatibility. Metals marked in blue are lost as residues, especially when they appear in a segment with an incompatible carrier metal (e.g., for reasons of product functionality).

Achieving an efficient circular economy requires a metallurgical infrastructure that fully integrates all segments of the metal wheel. This approach helps maximize resource efficiency by enabling the production of a maximum number of valuable alloys, materials, and compounds. Additionally, energy recovery becomes crucial when end-of-life material mixtures become too complex. We must understand and minimize entropy creation within our systems, and, in turn, minimize exergy dissipation in our solutions. In simple terms, this means designing processes that create as little waste and energy loss as possible to ensure minimal exergy dissipation.

Our mission

SMS group aims to cover all segments with innovative and high-performance equipment and flow sheet solutions that achieve optimal recycling rates and energy recovery. Given the complexity of end-of-life materials, a combination of suitable physical separation followed by pyro- and hydrometallurgical processes is required. This approach allows for high elemental recovery rates, efficient energy recovery, and the design of economically and ecologically viable process routes, all within the rapidly evolving circular economy of modern society.

SMS group's ambition is to be the technological leader for metallurgical process equipment and process flow sheets that push recycling rates and energy recovery to their thermodynamic and technological limits. In this role, we are a key enabler, supporting our customers in navigating the opportunities and challenges of the circular economy by developing cost-effective and sustainable solutions. ●

“We owe it to the next generations to improve the world.”

Interview with Markus Reuter

Markus Reuter is one of the world’s leading metallurgists in the recycling field and a circular economy thought leader. In our interview, he talks about inconvenient truths, circular economy enablers, and why the world needs more metallurgists.

Markus, you have dedicated almost your entire professional life to metallurgy, recycling, and the circular economy. You've worked in universities and research institutes, and now at SMS, focusing on product design. What is so interesting about this topic?

Markus Reuter—There is something fascinating about taking what many consider post-consumer goods or simply scrap and recovering metals and other materials in their pure form from such complex functional material combinations. Recycling is a complex undertaking and is often more difficult than recycling your morning cup of coffee into its ingredients: pure water, sugar, milk, and coffee to create an aromatic new cup. Our Metal Wheel shows this complex puzzle of extractive metallurgy succinctly (see page 12).

In metals, considerable expertise has to be harmonized to bring them back to the functional purity required to produce new high-tech products. This includes the simulation and twinning of processes within the circular economy paradigm, the design and optimization of metallurgical vessels, automation and digital systems, the construction and commissioning of plants, also applying AI-based surrogate functions, and then linking this back to the design of consumer goods. So, it never gets boring, is stimulating, and immensely creative. Embedding this in the circular economy is a significant, highly relevant, positive, and noble objective that serves our society!

I am recording our conversation with my smartphone. If I purchase a new device in a few years, can we recycle the old one?

Every smartphone is a complex functional mix of metals, materials, plastics, and glass, to name the most important ingredients. Physically and chemically separating these components again to ultimately retrieve the metals is an extremely complex task due to their intimately connected functionality.

In 2017, a colleague and I collaborated on a study with the smartphone manufacturer Fairphone. We found that only 30% to 40% of the materials could be recovered, even with a modular design. Our second study in 2019 showed that, with suitable design modifications, the recovery rate can be increased to the 50% to 60% range. This highlights how far we are from achieving true circularity. But within the constraints of functionality, we can push recycling to the limits physics constrains us to. That's why we must be honest about the "inconvenient truths" of the circular economy.

What are these "inconvenient truths"?

Marketing or politics are all too happy to use the circular economy as a buzzword and, let's be honest, gloss over the underlying physics. As metallurgists, we must first consider the physics within the constraints of the reactors, mills, etc. The ever-present second law of thermodynamics dictates that continuous reuse, reprocessing, renewal, and loss-less recycling are unachievable – we also measure our process efficiencies via exergy. While losses and residues can be minimized, they cannot be eliminated; residues are always created. The apparent closure of one loop might come at the expense of another; closing a material loop often relies on opening an energy loop elsewhere. Therefore, we must always consider raw materials and energy together, and exergy is the best measure for this. There are no simple answers here – at some point, the amount of exergetic effort outweighs the value of the metal content that can be extracted.

Although products can be manufactured entirely from recycled materials, losses will occur during the recovery of those materials. Consequently, the finished product can never be fully recycled due to these unrecoverable losses. Ignoring this principle would hinder impactful innovation – actual resource efficiency can only be determined if losses are taken into account.

Bearing this in mind, our ambition is to always push recycling and metal recovery rates from complex resources, scrap, and end-of-life goods to their thermodynamic, technological, and economic limits. This is a prerequisite for being a technological leader and provider of metallurgical process equipment for recycling and processing. Having said that, metallurgy is just one part of the wheel that makes the circular economy go round.

Who else needs to contribute?

The circular economy needs a mindset change along the entire supply chain. Consider, for example, product design. Although one can never recycle 100% of any given product, we can maximize the recovery of metals, alloys, and materials if we integrate product design with metallurgy knowledge and calculate in detail in advance what can be recycled later. By default, we must then be clear that not everything can be converted back into high-quality materials. In many cases, complex mixtures of plastics in products are used as an energy source or as a →

Markus Reuter

…is currently ranked #8 by ScholarGPS globally among scholars in the field of recycling. He has been working for SMS group since 2020 and has been active in the copper and non-ferrous metals industry for almost 45 years, both as an academic and in industry. Graduated from University of Stellenbosch, South Africa, he has been a professor at TU Delft in the Netherlands, the University of Melbourne in Australia, Changsha University in China, Curtin University in Perth, Australia since 2018, and TU Bergakademie Freiberg, Germany since 2015. Among other accomplishments, he was the lead author of the United Nations Environment Programme (UNEP) report on "Metal Recycling: Opportunities, Limits, Infrastructure." His award-winning "Handbook of Recycling" published in 2014 and the 2nd Edition in 2024 by Elsevier, is also highly recommended reading.

chemical to enhance extraction. If a product is smartly modularized, the raw materials can be distributed so that each module can be directly recycled with suitable technology and appropriate disassembly. This would make recycling many valuable metals easier while maximizing energy efficiency. However, due to functional complexity, there will always be losses.

In addition, policy also has to play a significant part. Why not introduce a label to provide consumers with information about the recyclability of a product based on good supply chain digital twinning? We have developed simulation models that digitally twin the entire value chain, allowing products' actual recyclability to be calculated and improved. This enhances transparency for consumers and helps them make fact-based decisions. With the detailed know-how of SMS, we can generate meaningful data to optimize the supply chain's environmental performance.

Unfortunately, policymakers sometimes have ideas that ignore the realities of process physics. An interesting example is lead. The EU discussed the idea of banning lead. Yes, lead is toxic. However, it is also a metallurgical fact that lead – like copper – is crucial as a metal collector in multi-metal metallurgical recycling, as shown in the metal wheel. Therefore, base metals are essential enablers of the circular economy, as they help recover valuable metals such as gold, silver, bismuth, and antimony. Therefore, the circular economy paradigm is not well-served by banning lead. We must be keenly aware that smelters are an integral part of the critical metallurgical infrastructure, securing the supply of raw materials.

What is the role of SMS in the circular economy?

Metals processing technology and digitalization are key enablers of the circular economy and are strategically positioned in various areas within it. Process know-how and detailed flow-sheet understanding are, therefore, essential foundations to maximizing recycling rates. They are the DNA of plant design, plant automation, digital systems, project implementation, and so forth – the core competencies of SMS.

Digital twins offer a perfect platform for communicating with internal and external stakeholders based on the results of simulations with different parameters. That's why we are intensifying our work to understand every detail of recycling and implement this know-how in digital twins. While digital twinning is the foundation for cost definitions and thus for informed joint decision-making with our customers, it is also a precise tool for accurate carbon footprint predictions and planning for complete plants.

> "Study metallurgy and help save the world!"
>
> — Markus Reuter

How optimistic is your view for the upcoming generations?

Youth needs a torch to carry, and SMS has the depth to light that torch of creative energy. We owe it to the next generations to improve the world. We can help pass on that torch, and the older generation can infuse creative energy to keep the flame burning with vigor. Right now, we are seeing progress in so many promising areas. One of the most exciting projects is the world's largest plant for electronic scrap recycling that we are supplying to Aurubis in the US. This plant will significantly increase the recycling capacity for this kind of material. In addition, we are expanding our plant portfolio for recycling materials such as catalysts, slags, batteries, and metal-bearing scraps and minerals.

As a concluding remark, the circular economy of metals and end-of-life products requires one thing above all: metallurgists. We need creative, in-depth knowledge and understanding in the field of metallurgy embedded in circular economy thinking to increase the efficiency and effectiveness of recycling and process metallurgy. That is why I teach process and system simulation at Bergakademie Freiberg (Germany) and the exergy of systems at Curtin University in Australia. I always tell my students: "Study metallurgy and help save the world!" Come and help develop new processing solutions within the circular economy paradigm. This worthwhile career has enriched my life for over 45 years in so many ways! ●

Contact
markusandreas.reuter@sms-group.com

E-waste: A treasure to be recovered

When electronic devices reach their end-of-life, they become an important resource in the "urban mine." Our technology enables the effective recovery of valuable metals from e-waste.

Photo: iStock/aquatarkus (Industrial waste)

Electronic waste is an important resource for valuable metals.

Only a few miles south of Augusta in the US state of Georgia, one of the most advanced endeavors in the circular economy is taking shape: the multi-metal recycling plant for Aurubis. The plant, which is being supplied by SMS, will be able to recycle up to 180,000 t of recycling materials every year, following the conclusion of the two building phases. The Aurubis plant will be the first recycling facility for these kinds of materials in the US and is primarily designed to recover metals from electronic waste.

Huge economic potential

The digital transformation has changed and continues to alter the way we live, work, learn, socialize, and do business. Electronic devices play a central role as they interconnect people, applications, and machines. This trend extends beyond computers and mobile phones to include smart appliances, e-bikes, e-scooters, health monitors, sensors, smart furniture, wearable tech, toys, tools, and devices like LEDs and solar panels, to name but a few.

Electronic waste is the downside of this development as all of these products come to the end of their useful life when they are replaced by rapid innovations. This results in fast-growing amounts of waste electronic and electrical equipment, or WEEE for short. In 2022, the world generated 62 million tons of e-waste, an average of 7.8 kg per capita. The composition varies by type of equipment, but e-waste consists primarily of metals and alloys (50% to 60%), plastics →

(25%), as well as composite materials, glass, and concrete. Among the metals, steel is the most used, followed by aluminum and copper, although WEEE also contains notable amounts of zinc, lead, tin, cobalt, antimony, gold, silver, and palladium, as well as platinum group metals. Much more impressive than the mere quantities are the associated values. The Global E-waste Monitor estimates that e-waste contains 19 billion US dollars' worth of copper, 15 billion in gold, 14 billion in nickel, 8 billion in palladium, and 1.4 billion in tin every year. So, recycling electronic devices should be a no-brainer to transform the inevitable waste created by society using appropriate technology.

However, only a small part of these metals is recovered. The main reason is the low collection rate. Only 22% of this WEEE mass was documented as formally collected and recycled in an environmentally sound manner. The large majority is collected outside formal e-waste management systems, shipped to countries with no developed e-waste management infrastructure, or simply used as landfill. This can have a severe impact on the environment and people's health as WEEE contains harmful materials.

E-waste recycling technology

When properly collected, the recycling of WEEE remains a complex metallurgical challenge. The complexity arises from the diverse and functional combination of metals and other materials, making recycling and recovery more challenging compared to conventional metal scraps. High recycling rates can only be achieved with a profound understanding of the metallurgical processes in combination with extensive experience in plant engineering. Ideally, digital twins and simulations are used to determine the best process route and the design of the various plants (see interview on page 14).

Over recent decades, we have developed numerous processes to offer tailored solutions for recycling WEEE, more specifically circuit boards that contain valuable elements. SMS provides pyro- and hydrometallurgical solutions, as well as combinations of both, designed to effectively address the challenges of recycling complex metal-containing waste. Our WEEE recycling solutions range from standalone technologies that produce copper-rich alloys consisting mainly of valuable metals such as copper, cobalt, nickel, gold, silver, platinum, and palladium as an intermediate product, to complex plants producing all relevant metals as well as slag and energy. The larger plant concepts can be complemented with rectangular copper anode refining furnaces, which also allow the recycling of various copper scraps.

The current design offers an annual capacity of 3,000 to 120,000 t of WEEE concentrates. The BlueSmelter and the TBRC are key units for smelting the WEEE scrap. Compared with each other, the BlueSmelter can handle lower-grade WEEE concentrates with higher organic contents, while the TBRC can handle bulky material or higher viscous slags. To establish the most effective recycling processes, SMS offers various technology options and customer-specific process combinations.

The BlueSmelter for WEEE smelting is designed to process a wide range of secondary raw materials containing copper and precious metals, with a focus on low qualities and high organic content but with significant monetary value. The improved bath smelter furnace enables maintenance-free blowing of the media via the patented injectors, which provides better turbulence for rapid reactions in the vessel.

The Aurubis project

The key component of the new multi-metal recycling plant for Aurubis is a top-blown rotary converter (TBRC), used to recover copper, nickel, tin, zinc, precious metals, and platinum group metals from complex recycling materials. This technology also has its origins in the steel industry. Our scope of delivery includes sampling and off-gas cleaning facilities. Aurubis and SMS group have also signed a cooperation agreement, establishing a long-term collaborative partnership. ●

More infomation on e-waste:

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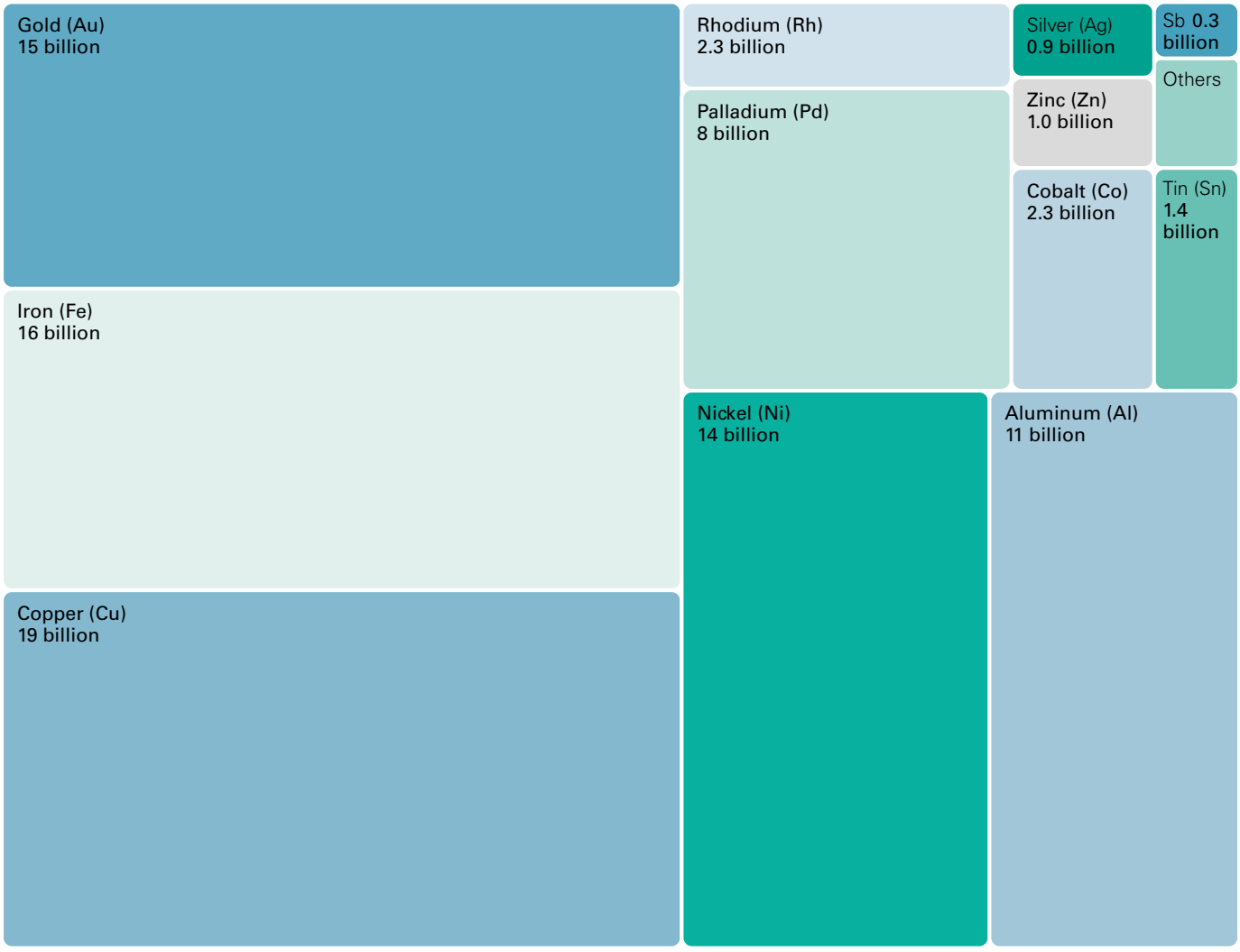
ECONOMIC VALUES OF METALS FROM E-WASTE
IN USD BILLION IN 2022



Source: The Global E-waste Monitor 2024

Transforming copper scrap into premium products

Copper plays an essential role in our modern world. With an anticipated copper supply gap and the need to preserve precious natural resources, it is crucial to transform copper scrap into high-quality copper. Our recycling solutions support high recovery rates while maintaining a minimal carbon footprint.

Tilting refining furnace with anode casting wheel

Copper possesses a number of properties that contribute to its high value and versatility, mainly heat conductivity, electrical conductivity, formability, and toughness. Without copper, there would be no use of renewable energies such as solar power. Cars could not run without copper. The weight of the copper components installed in a typical passenger car today consists of approximately 9 kg to 23 kg, which is equivalent to a half mile of copper cabling. Copper and copper alloys are utilized in electric and hybrid vehicles in even greater quantities: up to 91 kg of copper and copper alloys can be found in fully electric vehicles. The ever-growing power requirements and increasingly small dimensions of computers and smartphones would be equally inconceivable without copper's fast signal transmission capability. It is also ideal for semiconductor chips that need ultra-thin, ultra-compact wiring.

Parallel to these developments, copper has become scarcer on the global market. Experts even see a gap emerging between copper supply and demand in the years ahead. This results in a growing call for high-quality copper from recycled material.

Great demand for high-quality copper recycling

Worldwide, around 10 million t of copper scrap is recycled every year. Due to the high value and extensive range of applications of copper, copper scrap recycling is part of the circular economy.

The advantages of secondary copper production are considerable. Recycling saves up to 85% of the energy required for primary production, which results in a reduction of approximately 2.1 t of CO_2 per t of copper. Consequently, recycling copper scrap significantly conserves natural resources while lowering carbon emissions. It reduces energy consumption and minimizes environmental impact compared to mining new copper. It also provides economic benefits, cuts waste, and ensures a stable supply of high-quality copper for industrial use.

85

PERCENT OF ENERGY
is saved when recycling copper compared to primary production.

318

USD BILLION
was the global copper market size in 2023.

Copper scrap is categorized into various grades based on the purity and form. Common qualities include bare bright copper (Millberry), #1 copper to #3 copper, and insulated copper wire. Consequently, there are several options for recycling processes within both primary plants and secondary plants that treat only scrap material.

The quality of available copper scrap plays an essential role in determining the most efficient secondary copper processing route. The process involves collection, sorting, cleaning, shredding or baling, melting, refining, casting, and manufacturing. The smelting and refining of copper scrap is challenging due to the inherent impurities, the heterogeneity of scrap materials, and the tendency of copper to oxidize during processing. Additionally, these processes are energy-intensive, must comply with strict environmental regulations, and are influenced by fluctuating market prices. These factors collectively complicate the efficient and profitable recycling of copper scrap.

Melting, refining, and casting in one unit

For copper scrap recycling, SMS group has developed a new generation of tilting refining furnaces, enabling the production of anode copper, fire-refined, high-conductivity (FRHC) copper, or even copper granules for copper foil manufacturing.

Tilting refining furnaces (TRF) and elliptical tilting refining furnaces (ETRF) perform the task of melting, refining, and casting copper scrap in one flexible unit. By combining the tilting refining furnace with a casting wheel, high-quality anodes are produced. The type of furnace employed depends on the desired production capacity. The TRF is designed for large capacities of up to 500 t, whereas the ETRF handles capacities up to 100 t. The copper scrap is charged in the form of bales or loose scrap via the charging doors. Depending on the desired product and quality, different grades of copper scrap (grades 1 to 3, e.g., birch or cliff) can be used. The units can also be offered "H_2-ready," enabling CO_2-reduced copper production.

Additional equipment such as top blown rotary converters (TBRC) or basic rotary refiners (BRR) can be added for recycling slag, lower-grade copper scrap, and e-waste. The flexibility of the TRF/ETRF process ensures that the copper quality is adequate for the partial replacement of cathodes for a fire-refined semi-product.

Maximize profits: BlueControl process control system

Maximum recycling rates are attained by combining plant technology and automation. The BlueControl calculation engine is designed to optimize metallurgical processes, aiming to achieve the highest copper content with the lowest impurities in the copper anode. It employs two core applications: simulation and optimization. The simulation controls the copper scrap refining process, calculating the mass and impurities concentration of anode copper at the end of the refining steps. The calculation happens in seconds and evaluates more than 100 potential operation points, choosing the best fit – both at the batch start and during operation. AI support also ensures the system's self-learning capability. It dynamically adjusts parameters such as air blowing, oxidation, reduction, and purification rates, to meet the desired copper purity and composition.

The optimization algorithm embedded in BlueControl maximizes copper yield and minimizes impurities by finding the optimal combination of fluxes based on input parameters such as copper scrap weight, composition, feed temperature, and gas rates. This enhances production efficiency, yield, quality, and throughput, and reduces production costs. Our comprehensive metallurgical expertise coupled with innovative furnace design and our new BlueControl process control system are what make the difference. A first prediction for a large-scale TRF with a capacity of 350 t shows an annual saving potential of more than 10 million euros – only by software optimization. ●

MODERN COPPER SCRAP RECYCLING UNIT IN THE US

Our latest reference project for a copper scrap recycling plant is the secondary copper smelter for Ames Copper Group, a joint venture of Prime Materials Recovery Inc. and the Cunext Group, located in North Carolina. The new facility is designed for an annual capacity of 50,000 t of anodes. It is the first copper recycling plant based on pure copper scrap in the USA. The entire system consists of a TRF, which handles the melting, multistage oxidation and reduction stages, one anode casting wheel, and a gas cleaning system. SMS has received orders for TRF also from Malaysia, Japan, and Spain.

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Battery recycling: Solutions for a growing market

On October 21, Mercedes-Benz opened its first factory for battery recycling – supplied by our joint venture Primobius. Recycling batteries is a fast-growing market that we serve effectively with our metallurgical and technological expertise.

Illumination of battery recycling plant during opening

In future scenarios, batteries play a crucial role with regard to energy storage, the electrification of transport, and the operation of portable electronic devices. With expected annual growth rates of 15% and more, there is a growing need for efficient recycling solutions for end-of-life batteries. Battery recycling allows valuable raw materials, such as lithium, cobalt, and nickel, to be recovered from – and then used to produce – new battery cells.

A vast array of battery types

In recent decades, hundreds of different battery types have been launched on the market. The main types can be broadly categorized into the following groups:

— Lead-acid batteries are commonly used in automotive applications.
— Nickel-based batteries come in two main varieties: nickel-cadmium (NiCd), which are known for their durability and ability to perform well in extreme temperatures, and nickel-metal hydride (NiMH), which have a higher capacity and less environmental impact.
— Lithium-based batteries are used for various applications. Lithium-ion (Li-ion) batteries are prevalent in consumer electronics, electric vehicles, and renewable energy storage. Lithium iron phosphate ($LiFePO_4$) batteries are noted for their safety and long life, while lithium polymer (LiPo) batteries offer high energy density and flexible form factors.
— Alkaline batteries are commonly found in household items, for example remote controls and flashlights, and are typically non-rechargeable.

Photos: Mercedes-Benz Group

Sorting of materials after shredding

— Flow batteries are suitable for large-scale energy storage systems, with types including vanadium redox flow and zinc-bromine flow.

Although each type of battery has its own specific applications, advantages, and limitations, they all have one thing in common. Batteries are highly complex products, which are characterized by a diverse and functional combination of metals and other materials that have to be "unmixed" during metallurgical processing in a cost-effective way. As a result, this calls for sophisticated recycling processes, starting with mechanical separation and followed by the most suitable, economically viable combination of pyro- and/or hydrometallurgical processes.

Pyrometallurgical solutions

SMS offers solutions for recycling all of the battery types described. Choosing the best recycling process for batteries and accumulators depends greatly on the amount and on the chemical and physical properties of the input material, as well as the location. The pyrometallurgical process route is best combined with hydrometallurgical steps, separating the individual metals from a multiple metals regulus to produce high-quality battery precursor material.

Pyrometallurgical technology such as the BlueSmelter, TBRC (top blown rotating converter), electric smelters, and the Kivcet furnace are typical melt production techniques. SMS group is also developing a solution that combines pyro- and hydrometallurgical steps for recycling complex metal-bearing materials, including lithium-ion batteries. The advantage of this new process route is that it offers more flexibility when processing rapidly changing battery chemistries.

Hydrometallurgical solutions from Primobius

To address the growing demand for recycling lithium-ion batteries, Primobius was founded – a joint venture between SMS group and Neometals Ltd., an Australian process technology developer. Primobius has developed a sustainable two-stage recycling process to recover cobalt, nickel, lithium, copper, iron, aluminum, and manganese and turn them into marketable products that can be reused in the battery supply chain, utilizing a combination of efficient mechanical and hydrometallurgical processes with recovery rates of up to 90%.

In the shredding and beneficiation stage (stage 1), spent batteries are shredded and the plastic and metal components are removed from the so-called "black mass." The hydrometallurgical approach (stage 2) represents an extremely safe and efficient method of extracting materials from the black mass at ordinary temperatures with recirculating liquid solvents. In this process, Primobius complies with international battery regulations and places great importance on health and safety.
Michel Siemon, CEO of Primobius: "Primobius stands for much more than just technology. We provide process know-how and an ecosystem of partners along the value chain and offer unique and flexible business models and opportunities for engagement with our partners."

These advanced recycling solutions close the valuable materials loop and provide battery manufacturers in the automotive industry and other sectors with a way to decarbonize the supply chain and reduce dependence on critical and foreign-mined raw materials. Additionally, the consistent reduction and avoidance of CO_2 emissions in all process stages have a positive impact on the carbon footprint of the lifecycle of the battery module as well as the electric vehicle in which it is used.

Mercedes-Benz relies on Primobius technology

The opening ceremony for the first Primobius battery recycling plant at Mercedes-Benz in Kuppenheim, Germany was held on October 21, 2024. German Chancellor Olaf Scholz opened the plant.

Primobius was responsible for the engineering, equipment supply, and installation of the complete two-stage integrated recycling plant, which will process 2,500 t of batteries annually. The facility will continue to receive technological and R&D support from Primobius. ●

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Powering the circular economy:

Scrap management is the foundation of high-quality steel production.

Electric arc furnaces

As the steel industry continues to prioritize circularity, electric arc furnaces stand out as a key technology driving the transition towards a more sustainable and resource-efficient future.

Electric arc furnaces (EAF) use scrap metal directly as their primary raw material, thereby offering significant carbon footprint savings – up to 90% compared to traditional integrated steelmaking methods. This route is the fastest way to produce near-zero emission steel, as long as green electricity is used. Nevertheless, there is great potential for optimizing electric steelmaking in terms of product quality and efficiency.

Scrap management and product quality

When recycling steel scrap in an EAF, tramp elements such as copper, tin, and lead cannot be eliminated by the melting process, compromising 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 when it comes to meeting stringent quality standards and thus enabling premium-grade steel production.

The X-Pact Metallic Optimizer enhances efficiency by optimizing the use of scrap and metal materials, ensuring an effective mix, higher quality, and better resource utilization. It selects the lowest-cost charging mix for the target steel grade, verifying and updating tramp element assumptions in real time. This iterative process results in consistent, high-quality output with reduced energy consumption.

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

Maximizing yield and energy efficiency

Maximizing yield and optimizing energy efficiency are crucial for ensuring cost-effectiveness and environmental sustainability in electric steelmaking. Our automatic slag door concept, Condoor, paved the way to the first concept of unmanned operation years ago. As a slag valve control system, Condoor manages the slag volume and atmosphere in the EAF. By precisely controlling these parameters, it reduces material losses, improves overall yield, optimizes energy consumption, and reduces electrode usage. Condoor can also be retrofitted in existing facilities, making it the perfect solution for modernization projects. Its design allows it to work with all types of solid and liquid raw material charges, as proven by multiple installations.

A key factor for increasing yield is controlling the slag chemistry inside the EAF. This involves balancing the need to cover the electric arc with slag and recovering iron oxides from the slag back into the steel. This is where Condoor excels, especially when combined with the process control suite developed by SMS.

In view of the huge demand for electricity in the production of electric steel, every EAF has great potential for optimizing energy utilization and reducing energy consumption. A modern digital energy management system like the Viridis Energy & Sustainability Suite is therefore a must. The Viridis Suite consists of different applications that are tightly integrated, with each application solving specific challenges. This way, the digital solution can improve energy and resource flows in real time. Customers also benefit from functionalities that allow inte- →

Photo: Getty Images/Monty Rakusen (Gripping arm)

grating data and transactions for energy contracts. Among other features, the Viridis Suite increases energy efficiency through anomaly detection, and it tracks, reports, and verifies emissions.

For further digital optimization, EAFXpert utilizes data analytics and machine learning to monitor and optimize furnace performance, providing real-time insights and predictive maintenance to minimize downtime and maximize productivity.

Ensuring the electrodes deliver the required melt power regardless of the charge material is the job of the X-Pact SynReg. Fully configurable and incorporating an extensive historical database, X-Pact SynReg delivers consistent, optimal performance: fast electrode control, first-touch logic, and arc prediction are some of the functions embedded in the system, leading to better energy efficiency, reduced electrode wear, and lower operational costs.

A further solution that enables high-power melting in weak grid production sites is X-Pact AURA. Based on IGBT (insulated gate bipolar transistor) technology, it offers a modular design with state-of-the-art power electronics, ensuring maximum efficiency, power density, current stability, dynamic response, and reliability, as well as minimal impact on the electricity network. Moving away from monolithic equipment like heavy-duty transformers and reactors, AURA introduces the concept of modularity, where the required power is reached by a number of parallel cabinets installed in a dedicated room.

X-Pact AURA powers DC furnaces using fast-switching electronics, enhancing heat transfer and reducing energy requirements through strong vertical stirring of the liquid bath, which avoids stratification inside the shell.

Shaping the future: Innovating for more

Despite all these developments, there is still substantial potential for further innovations, particularly in reducing the carbon footprint to unprecedented levels. One of the most promising innovations is the hydrogen burner, which uses hydrogen instead of fossil fuels, producing water vapor instead of carbon dioxide. In this way, we not only reduce the carbon footprint of the melting process but also boost its efficiency. Following successful laboratory tests conducted as part of an EU-funded project, the hydrogen burner is now being tested in an industrial EAF in Italy and will soon be tested in Spain, to be followed by the more widespread adoption of this innovative technology across the steel industry.

Another groundbreaking solution is Allcharge, a versatile charging system designed to optimize the use of various metal materials, including scrap and DRI. Allcharge ensures the most efficient and effective input mix to achieve consistent quality and yield. By optimizing the charge, Allcharge helps to reduce energy consumption and minimize waste, further contributing to sustainability goals. Compared to other solutions, SMS Allcharge operates without preheating the scrap, limiting dioxins, VOC, and CO emissions. Additionally, the flat bath operation, which is enabled by sidewall charging, results in reduced NOx emissions and less impact on the power grid. ●

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RECENT EAF REFERENCES SUPPORTING THE GREEN TRANSFORMATION

	Saarstahl (SHS)	SSAB	Stegra (former H2GS)
TYPE	185 t AC EAF	190 t AC EAF	180 t DC EAF
SHELL DIAMETER	9.3 m	9.3 m	7.8 m
TRANSFORMER RATING	300 MVA	280 MVA	13 * 14.5 MVA

“Process modeling and AI-supported twinning are key enablers.”

In this interview, our experts Nikolaus Borowski and Ali Akouch discuss the role of digitalization in the metals industry, how SMS group employs process modeling and a predictive control engine to simulate and optimize metallurgical processes, and why digital twins play a crucial role in promoting the circular economy and decarbonization.

Ali Akouch and Nikolaus Borowski discussing the simulation results of BlueControl for a copper reduction process.

What is the connection between digitalization and the circular economy?

Nikolaus Borowski—Process modeling and digital process twinning are key enablers of the circular economy and relevant for all metals-producing plants. For the recycling of non-ferrous metals, the design of plants for multi-metal recycling is particularly complex due to the large number of elements that must be handled. We aim to recover not only base metals like copper or nickel but also additional metals like tin, zinc, lead, as well as platinum group metals, or PGMs. With process simulations, we couple the metallurgical processing of primary and secondary resources with the product design of our metallurgical equipment.

Ali Akouch—The main objective is to minimize the dissipation of materials and maintain material quality. However, we also strive to minimize energy →

losses to ensure minimal exergy dissipation. Digital twins facilitate the integration of the thermodynamic and physical foundations that enable us to evaluate different energy mixes.

NB—Digital process twins provide the basis for assessing the most effective metallurgical process with the most efficient equipment. By simulating different scenarios, they help predict outcomes and optimize process parameters. In the first step, we compare different process routes to define the optimum process for a given input material. Then, our simulations allow us to go into much more detail and design the process in such a way that we maximize output and minimize waste by creating valuable by-products.

What are the elements of this simulation?

NB—Digital process twins are virtual replicas of physical and metallurgical processes. This involves gathering detailed process knowledge and industrial data in a mathematical structure consistent with the physics of the respective process. The foundation is the knowledge of all our metallurgists, process experts, mechanical engineers, researchers, automation specialists, and digital experts, as well as feedback from an array of successful projects. To address the enormous variety of elements and guarantee high recovery rates, we use flexible and intelligent software tools.

What are the benefits of process twinning?

AA—Digital twins serve as a foundation platform for communication with customers, but also other stakeholders, enabling transparency based on simulation results. They provide detailed data for developing optimized processes, defining operating costs, and new product lines, obtaining detailed environmental impact data, and setting parameters for the plant and furnace design. Additionally, the process data define the technological solution and, therefore, the costs for the supplies and services for the main process equipment. These cost definitions are the basis for informed joint decision-making.

Can you name a reference project in which you have successfully worked with a digital twin?

NB—Together with KGHM in Poland, we created a detailed digital process twin of their plant including over 100 calculation units/reactors, linked by close to 600 flows, containing over 40 elements and a significant number of compounds that can arise when processing both concentrates and secondary materials as well as e-waste. Detailed modeling of the various reactors of the Legnica plant was simulated using Gibbs free energy minimization and included various non-idealities in multi-compartments/units (up to five) for some reactors to capture as many of the industrial realities as possible. Various optimization aspects were investigated on this basis. Above all, this permits a physics-based approach to footprinting and, in turn, the allocation of the footprint of a multi-material recycling plant based on exergy. This is a major new milestone in the use of a simulation tool to derive the right conclusions for future investments in plant-optimization projects.

> "BlueControl is the first AI-supported, accurate process control system."
>
> —Nikolaus Borowski

So far we have talked about the use of digital twins during the design phase. What about process control in the operating phase?

AA—We have developed BlueControl, an advanced real-time predictive process control system. BlueControl is the first AI-supported, accurate process control system and a game changer in the non-ferrous metals industry. It is a real-time calculation engine for designing, analyzing, controlling, and optimizing metallurgical processes "on the fly." It is based on a rigorous simulation, which together with real-time data creates datasets that are integrated by deep-learning applications within level 2 and 3 process control architectures. We have integrated thermodynamic information in the deep-learning results to ensure predictions are

always consistent with the fundamental laws of physics.

BlueControl has a wide variety of applications. For example, it can be used to determine the best feed mix to lower the carbon footprint at maximum production, or to optimize the final product quality while using the most economical feed input materials and reducing tap-to-tap times. Other applications include the prediction of operating points to extend the furnace life or the optimization of the gas cleaning process.

Can you give an example of BlueControl in action?

AA—BlueControl uses two core applications: simulation and optimization. Simulation is the heart of BlueControl and functions as a controlling procedure. Take the copper scrap refining process in a tilting refining furnace (TRF): it calculates the anode copper mass and impurities' concentration at the end of the refining oxidation and reduction stages. The model calculations produce multiple results, including the dynamic liquid copper weight and its composition, dynamic slag weight and its composition, dynamic off-gas composition, and the solid weight. Using the HMI, the operator can visualize and analyze the results of the simulated refining process.

BlueControl is embedded in a modular optimization algorithm to optimize copper refining efficiency. Based on the copper scrap weight and its composition, feed temperature, oxidation gas rate, and reduction gas rate, the optimization algorithm finds the optimum flux combination to maximize the amount of copper and minimize the impurities at the end of the refining process (purest copper anode). This improves production efficiency, yield, quality, and throughput, and reduces production – and we are talking about many millions of euros per year.

What is the current status of BlueControl? What are the future plans for this technology?

AA—A first prototype of BlueControl has already been successfully tested at a customer. We are excited about developing this technology further to deliver next-generation metallurgical plants with enhanced efficiency and effectiveness. We still have various applications in the pipeline for the non-ferrous metals sector. However, the potential applications extend beyond non-ferrous metals to the iron and steel industry, submerged arc furnaces, and open bath furnaces used in ferroalloy production and iron making. Our intention is to offer BlueControl as a performance-based service model. ●

Nikolaus Borowski is General Manager Non-ferrous Metals and Alloys at SMS group

Ali Akouch is Data Scientist at SMS group

Read the paper from Markus Reuter for a deep dive on the topic:

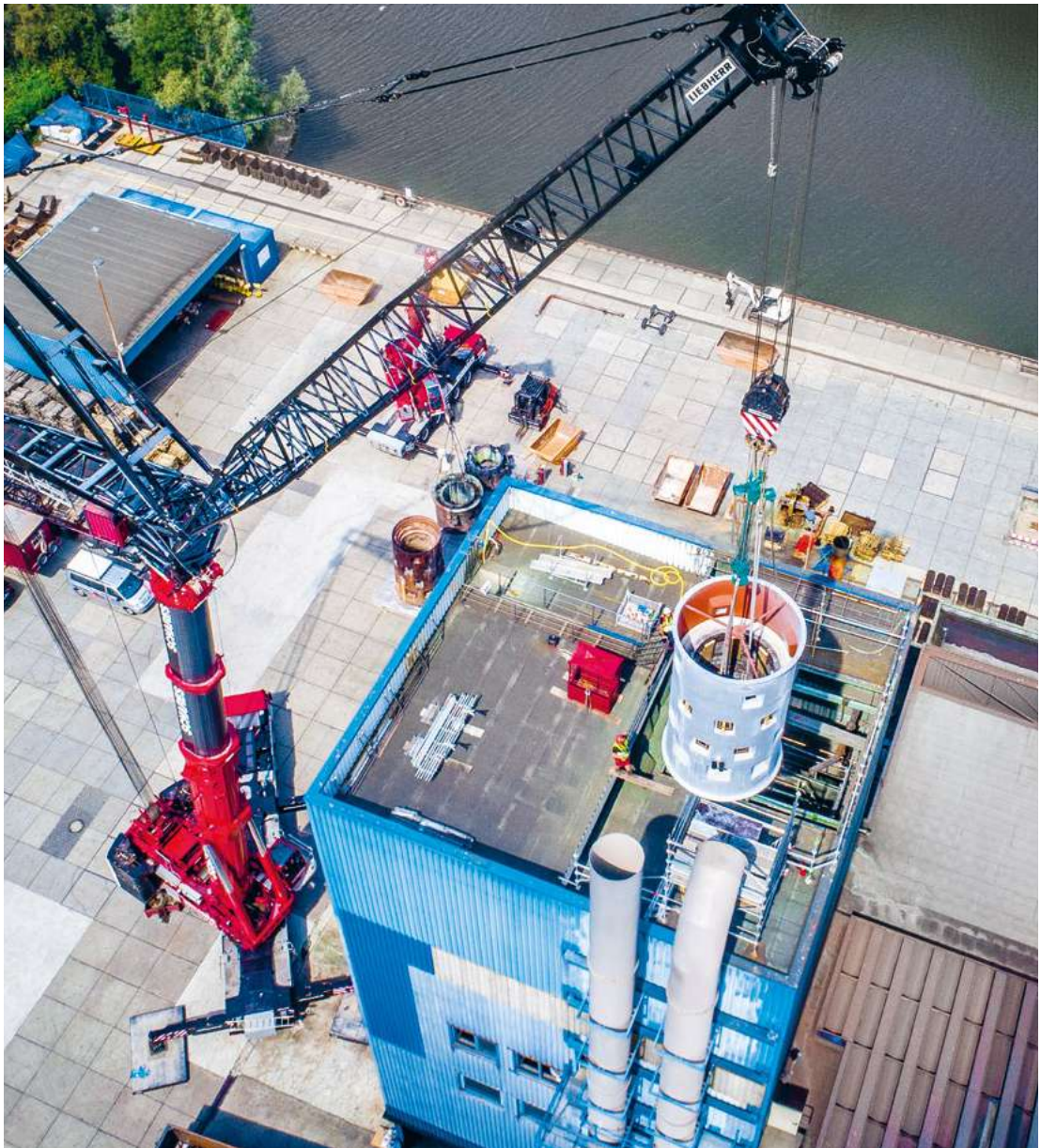
BENEFITS OF BLUECONTROL

- Real-time process control
- Determine the best feed mix to lower the carbon-footprint at maximum production
- Optimize final product quality while using the most economical feed materials
- Optimize tap-to-tap times
- Fuel and flux savings
- Extend the furnace lifetime
- Predicted operating points
- Optimized gas cleaning
- Easy operation

From repair to modernization

The circular economy concept goes beyond recycling. With a focus on repair, reuse, and redesign, we extend the lifecycle of plants and equipment.

Modernizations are full of logistical challenges, such as replacing a copper shaft furnace at Deutsche Giessdraht.



Repair of caster segments in our workshop in East Palestine, Ohio, USA

Our concept of the circular economy entails more than recycling end-of-life goods or the recovery of waste materials. We also concentrate on the "inner loops" in the value chain, including better utilization rates for products by reusing, repairing, refurbishing, or remanufacturing them. These measures all contribute to extending the lifetime and/or utilization of plants and equipment, thereby delaying the demand for new products. With more than 2,000 specialists for electrical and automation systems, digitalization, and technical service, we can effectively cover this part of the circular economy. Our experts pool their expertise not only to supply new equipment to customers but also to deliver tangible benefits during plant operation.

Repair: Back to original state

Reprocessing used equipment and components and restoring them to their original state is handled by more than 50 SMS group workshops all around the world. A typical area is the repair of molds, oscillators, and segments for continuous casters. For hot rolling mills, our repair and service portfolio includes the overhaul of work and backup roll chocks, drive spindles, gearboxes, downcoiler mandrels and reels, and HGC (hydraulic gap control) cylinders.

In bar and wire rod mills, the rolling cassettes in a PSM (precision sizing mill) are subjected to enormous mechanical and thermal stresses during the rolling process. To ensure that the cassette can withstand all these loads, we offer regular maintenance and repair for the installed components. SMS also offers a circular system in which customers bring worn cassettes to a workshop and in return take a repaired cassette with them. This outsourcing concept ensures that all components are always adjusted and installed according to OEM specifications.

Coatings are another field of expertise of our service workshops. By applying a wear-resistant coating to molds, rolls, shafts, and chocks, we can increase the campaign length by up to 600%, while the product quality remains constant over a longer period of time. Broken or impaired equipment and components can often be repaired by coating them.

Repairing equipment is a reliable way of increasing the utilization rate of components. However, how can a customer work out the best interval for repairs – not too early, but not too late? Our Genius CM Condition Monitoring is a predictive tool that is based on equipment and process data. It can derive maintenance tasks that need to be carried out before the plant's productivity is negatively affected. Most importantly, predictive maintenance helps to avoid damage to the equipment and thus eliminates the need to fully replace a component.

Reuse: More than one lifecycle

The concept of reusing equipment after its first lifecycle can be applied to components as well as to entire plants. A good example of the reuse of components is the circular system for molds in continuous casters for long products. Our clients benefit from a circular process that includes delivering new mold tubes, picking up used tubes, and refurbishing used copper tubes – all against the background that SMS group "owns the copper."

It all starts with a one-time contract that defines the basic commercial conditions. This is followed by manufacturing in our Concast workshop in Switzerland. At the same time, a level of stock is established to ensure that requested tubes can always be delivered on time. Once the tubes are used, SMS group picks them up, checks them, and decides whether they can be refurbished or if they need to be remelted. In both scenarios, the copper is fed back into the circular process.

This procedure helps the environment by minimizing transport, reusing the copper, and achieving overall resource savings. Our customers benefit from easy and fast processes from one source →

that come with attractive pricing. Only the conversion costs are invoiced, there is generally less cash out, and the risk of copper price and exchange fluctuations is eliminated. Furthermore, a delivery contract can be concluded for faster supplies, including emergency stock.

The example from Handan Iron & Steel shows that metallurgical plants are living systems, where reuse and redesign are often closely connected. The heavy plate mill was built in 2006 by a local supplier. Just seven years later, Handan commissioned us to redesign the mill. Among other things, the order included upgrading the finishing stand with more powerful components, such as new hydraulic adjustment and work roll bending systems, to increase product quality. The existing hot plate leveler was moved in front of the plate cooling system and reused as a pre-leveler. After another seven years of successful operation, Handan decided to relocate the plant from the center of the city to a suburb due to environmental reasons. It was our job to bring the level 1 and level 2 X-Pact automation systems up to the latest state of the art and to integrate an additional roughing mill stand into our systems. The general commissioning was successfully completed in a record time of six weeks, until the first plate was produced. The total delivery time was only ten months, something that had never been achieved before, especially against the backdrop of global supply chain difficulties.

Redesign: Improve competitiveness

For all our plants, we offer a multitude of solutions to substantially improve our customers' competitiveness at moderate investment costs. These technologies, components, automation solutions, and services are specially designed to retrofit existing plants with low or medium investment. Each of these "performance modules" helps customers improve the performance of their plants in one or several areas and hence achieve a competitive edge in a tough market environment. This means the modules will not only increase plant productivity and product quality but also reduce operating costs and allow new, high-margin products to be introduced. An example for copper recycling plants is the "tuning package" for tilting refining furnaces. With only minor equipment and automation modifications, plant capacity can be increased by over 20%.

Extensive modernizations are often very complex and require a great deal of experience. A successful revamp is not only about implementing new technology in an existing infrastructure but also keeping downtimes to a minimum. That's why modernizations start with a thorough analysis of the as-is situation and the goals of the project. Shutdowns are the most critical part of revamp projects. To avoid unpleasant surprises, we leave nothing to chance. Preparatory work is done during routine maintenance downtimes and regular shutdowns. Preassembly of equipment and testing of the automation also minimize risks and guarantee that production can start as soon as possible.

A recent example of a successful revamp is the capacity increase of the pickling line/tandem cold mill at ArcelorMittal Vega in Brazil. By adding another mill stand, the capacity of the 20-year-old PL-TCM was increased by 640,000 to 2.15 million t/year. The modernization also enabled ArcelorMittal Vega to extend its product mix and offer ultra-high-strength steel strip for the automotive industry.

To meet these targets, the existing four-stand cold rolling mill was expanded to include a fifth stand on the mill's entry side. Before the shutdown, the new mill stand was assembled and pre-commissioned in an assembly pit next to the mill, with regular operations remaining uninterrupted. In parallel, the foundation for the new mill stand was prepared underneath the entry of the tandem mill. At the beginning of the shutdown, the mill's entry equipment was disassembled, and the ceiling of the cellar was cut out to provide access to the new foundation. Lastly, the new "mill stand no. 0" with a total weight of 360 t was shifted into its final position. ●

Machining of Concast copper tubes

Coating solutions for refurbishments, repairs, and wear protection

Coating solutions significantly boost the durability and performance of equipment by offering exceptional wear and corrosion protection.

Quality control of a coated furnace roll in a SMS group workshop in Brazil

In recent years, we have dedicated ourselves to designing and building coating technology that offers reliable and sustainable solutions for refurbishments, repairs, and wear protection. With 150 years of experience in the metals industry, our engineers have a fundamental understanding of all related processes and technical requirements for associated components. This expertise extends to the development and design of bespoke coating solutions and proprietary coating equipment, combined in our lineup of TecGuard coatings. Each TecGuard solution is customized to meet the needs of different industrial processes, ensuring optimal →

performance and longevity. SMS coatings thus seamlessly combine sustainability and cost-effectiveness. We continually invest in research and development to stay ahead of technological advancements and industry trends, ensuring that our solutions are always at the cutting edge.

Sustainability and global challenges

"Repairing parts instead of manufacturing new ones significantly reduces material waste and energy consumption. That's why our coatings are inherently sustainable," says Markus Mirz, Product Manager Coating at SMS group. "Additionally, we offer coatings that comply with environmental and local regulations, such as REACH in the European Union or OSHA in the US. These alternatives often provide a better service life compared to traditional coating processes, such as hard chroming, which involves toxic chemicals and is heavily regulated."

The sustainability of our coating solutions is further highlighted by their ability to significantly extend the service life of components. TecGuard-PRC coatings can triple or quadruple the service life of rolls in strip processing lines compared to hardened or chromed rolls, reducing machine downtimes. These rolls can be re-coated and repaired multiple times, lowering the demand for new materials and resources. This not only conserves raw materials, but also reduces the environmental impact associated with manufacturing new components. This helps our clients to achieve their environmental goals and regulatory compliance, all while maintaining high performance and reliability.

Markus Mirz gives an example: "One of our customers, a major steel manufacturer in South America, faced frequent downtimes due to wear on their deflector rolls in the pickling line scale breaker unit, heavily affecting the strip quality. After applying one of the TecGuard-PRC coatings, the customer reported an increase in service life of six months, reducing machine downtime by at least four shifts every year. This may seem insignificant, but small improvements across the whole pickling line add up."

Another application is the repair of heavy machine parts such as rolling mill chocks or gearbox housings. The manufacturing process of such parts often requires casting and melting many tons of material, consuming significant energy and water. TecGuard-REP and BoreGuard coatings restore the bore geometry of worn-out chocks, ensuring perfect and smooth rolling for years. This process not only saves energy but also significantly reduces the carbon footprint of manufacturing. By opting for repair over replacement, companies can contribute to a circular economy, where resources are used more efficiently and waste is minimized.

Customer benefits

Customers benefit greatly from our coatings through reduced total cost of ownership, improved part service lives, as well as better machine performance and overall equipment effectiveness. Extended service intervals increase machine availability, and the enhanced capability to withstand harsh operating conditions keeps the final product quality high for longer periods. CAPEX is transformed into OPEX, as machine parts last longer and investment intervals are extended. Our reliable coatings for wear protection reduce unexpected machine downtimes, making maintenance shutdowns more predictable and enhancing operational efficiency. This predictability is crucial for ensuring continuous production and

Coating of continuous casting copper mold in US workshop

Rolling mill chock after coating and repair

meeting delivery deadlines, which are often critical in the competitive industrial landscape.

TecGuard coatings balance sustainability and cost-effectiveness, making them attractive for businesses aiming to consider both economic and ecological KPIs. Current supply chain crises underscore the importance of repair solutions and short lead times. While procuring new parts can take months or years, repair coatings and procedures are often completed in weeks. This agility in the supply chain is vital for maintaining operational continuity in today's volatile market conditions.

Close to customers

To keep to the tight schedules of planned machine shutdowns, we offer coating solutions and repairs in seven global service workshops, located in the US, South America, Europe, Asia Pacific, and China. In all major markets, these workshops offer a variety of coating processes, including high-velocity oxygen fuel spraying, atmospheric plasma spraying, and arc wire spraying, complemented by welding and electroplating facilities in certain markets. This global network of service workshops ensures that customers receive timely and efficient support, minimizing downtimes and enhancing productivity. By being strategically located near major industrial hubs, SMS group can provide rapid response times and localized expertise. Our ability to deliver solutions tailored to individual customer needs further underscores our commitment to providing exceptional service and support.

Future prospects

To ensure the continuous development and improvement of our coating technology, we established the Coating Competence Center, which aims to streamline all coating-related activities, securing the delivery of customized solutions that enhance plant availability and performance. The center connects knowledge gained from process technology, OEM equipment experts, material experts, and coating experts. The Coating Competence Center acts as a hub for research and development, driving innovations that meet the evolving needs of the industry.

Innovations like the UniGuard coating, which significantly reduces wear on copper plates in continuous casting machines, highlight the growing role of coatings in reducing carbon footprints. By collaborating closely with clients, we develop solutions that reduce process costs and enhance the quality of final products, paving the way for future advancements in coating technologies that are beneficial in terms of both the environment and financial performance. This collaborative approach ensures that we remain at the cutting edge of coating technology, delivering solutions that are both innovative and practical. By staying attuned to market needs and regulatory changes, we proactively create solutions that address emerging challenges and opportunities in the industry. ●

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More information on our coating services:

Technology

Technology and innovation are fundamental cornerstones of SMS. Our new solutions ensure sustainable, competitive advantages and therefore, future revenue and growth.

Real batch rolling or endless rolling? A comparison

CSP Nexus has expanded the capabilities of CSP technology. A key feature is real batch rolling, in which roughing and finishing are decoupled and run independently of each other, as well as the option of endless rolling if this is an beneficial option. What are the possibilities and the limits of these rolling modes?

With more than 30 reference plants worldwide, CSP (Compact Strip Production) is the leading thin-slab casting and rolling technology. With the typical configuration comprising a caster, tunnel furnace, finishing mill, cooling section, and downcoiler, a CSP plant is able to produce 1.5 million t of hot strip per strand every year. It is characterized by comparatively low investment costs, a wide range of products, and high yield. Even ultrathin final thicknesses of less than one millimeter can be produced on CSP plants using the batch rolling or semi-endless rolling mode. With batch rolling, the slabs are cut into the corresponding coil size at the caster by the pendulum shear. In the case of semi-endless rolling, a so-called jumbo slab is cut by the pendulum shear and subsequently divided into several coils by the high-speed shear upstream of the coiler.

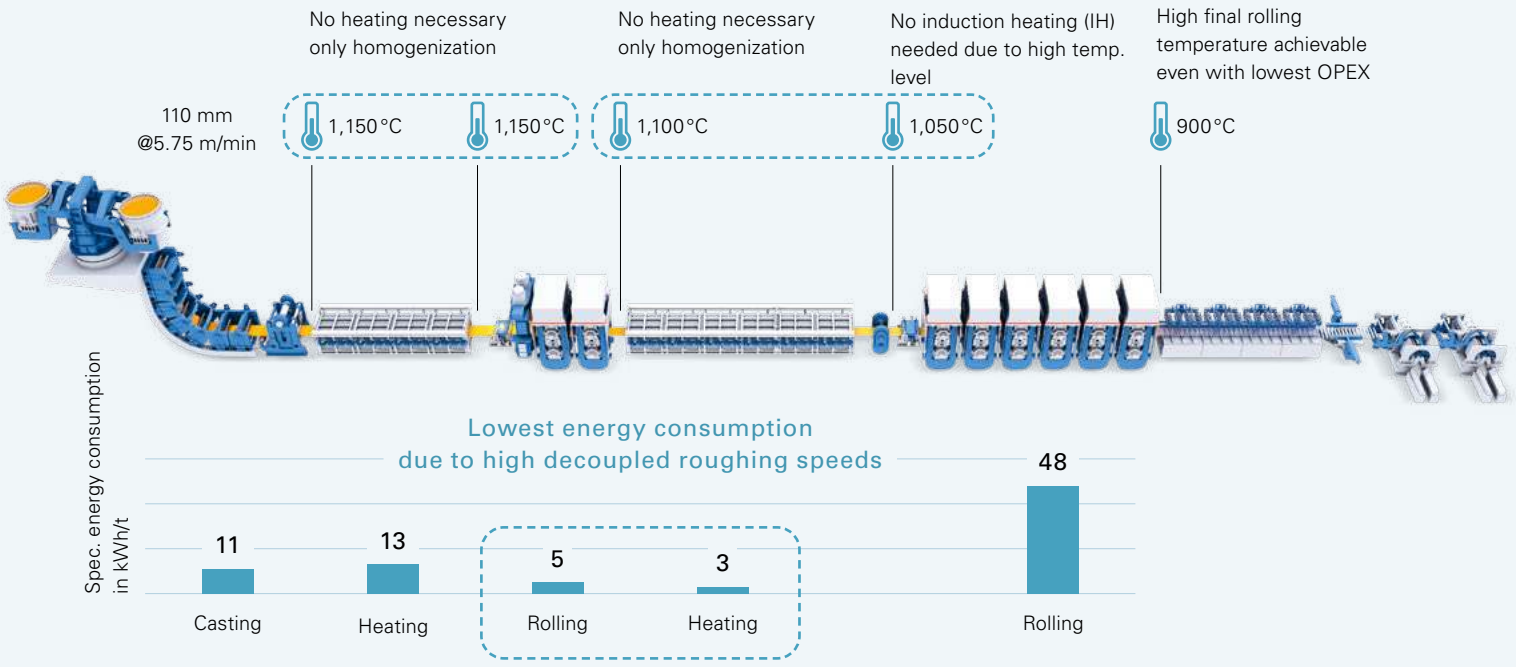
While CSP technology features the batch and semi-endless rolling modes, CSP Nexus significantly expands the possibilities and offers real batch and endless rolling. The significant increase in the slab thickness up to 160 mm, in order to expand the product range in terms of grades and thicknesses, requires the use of a roughing mill. By decoupling the roughing and finishing processes, real batch rolling is possible, which is comparable with the rolling process in a conventional hot strip mill.

In the field of thin, high-strength, and wide products (such as AHSS automotive steels), other casting-rolling concepts need energy-intensive endless rolling, where the caster is coupled to the roughing and finishing mill, in order to produce the desired final thicknesses. This is where CSP Nexus offers the cutting-edge advantage of being able to produce a large share of the product portfolio by using the real batch rolling mode. The need for an energy-intensive endless rolling technique can thus be limited to special applications such as ultrathin strip (<1.0 mm).

OVERVIEW OF ROLLING MODES

BATCH ROLLING	The pendulum shear downstream of the caster produces the desired coil size. The rolling mill is decoupled from the caster.
SEMI-ENDLESS ROLLING	The caster produces a jumbo slab. The high-speed shear upstream of the coilers cuts the strip to the desired coil size. The rolling mill is decoupled from the caster.
ENDLESS ROLLING	The high-speed shear upstream of the coilers produces the desired coil size. The caster, the roughing mill, and the finishing mill are force-coupled with each other.
REAL BATCH ROLLING	The pendulum shear downstream of the caster produces the desired coil size. The caster, the roughing mill, and the finishing mill are decoupled from one another.

HIGHEST ENERGY EFFICIENCY DUE TO “REAL BATCH” ROLLING



∑ 80 kWh/t
for 2.0 mm low-carbon grade in energy-efficient “real batch” mode with CSP Nexus

vs.

∑ 130* kWh/t
on a 100 % endless plant
for 2.0 mm low-carbon grade in energy-demanding endless mode

–

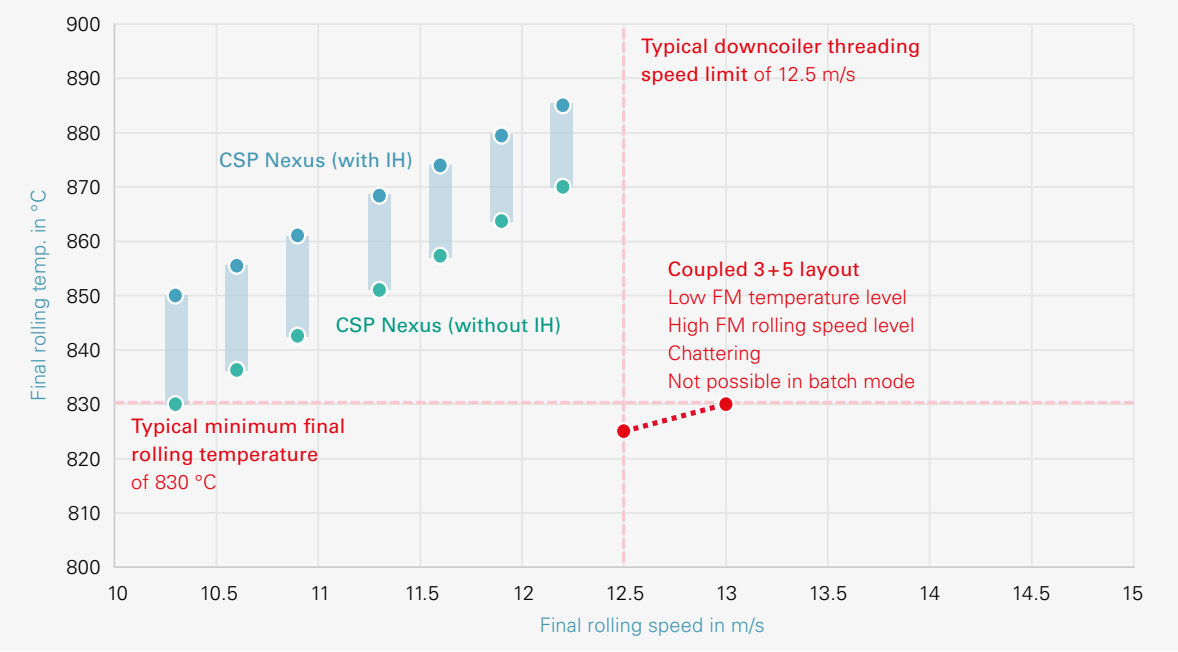
∑ 160* kWh/t
on a coupled batch/endless plant
for 2.0 mm low-carbon grade in energy-demanding endless mode
*Not achieving 900 °C final rolling temperature

Real batch rolling with CSP Nexus

In developing CSP Nexus, SMS group has gone a crucial step further than conventional CSP technology. With CSP Nexus, maximum sustainability meets maximum flexibility and productivity. CSP Nexus includes possibilities that so far only a conventional hot strip mill could offer. The essential difference is that CSP Nexus combines the decoupling of roughing and finishing phases with the benefit of customary temperature homogeneity and the efficiency of CSP technology. The transfer bar area is equipped with a heated roller table to ensure temperature homogeneity. This decoupling has several advantages compared to the batch rolling of other casting-rolling concepts, where the roughing and finishing mills are directly interlinked and thus necessarily have to work in a force-coupled manner.

To achieve the energy-efficient production of certain steel grades, the roughing speed is substantially increased, thus minimizing the time spent in the roughing mill. This means that temperature losses are also reduced to a minimum and energy is saved. In particular, the greatest energy savings can be achieved with products that in coupled batch/endless plants can only be produced in endless rolling mode. In endless rolling mode, there is basically no flexibility regarding optimum speed selection, so that the temperature losses are high and need to be compensated by an induction heating system. Accordingly, CSP Nexus is using the option of endless rolling only where this is beneficial for the process.

Furthermore, the decoupled roughing and finish-rolling processes enable the optimum roughing mill speed to be selected independently of the process, so that the temperature of the transfer bar can be precisely set. This is particularly necessary for products that have to meet high demands in respect of thermomechanical rolling (e.g., API pipe grades). →



Final rolling speed and temperature for batch and endless rolling (strip thickness: 1.2 mm, steel grade: DD11)

Thin strip in combination with high final rolling temperatures

For certain products, a combination of thin final thicknesses, e.g., less than two millimeters, and high final rolling temperatures, e.g., above 880 °C, is required. Such products include, for example, ultra low-carbon steels, electrical steel, or high-strength low-alloy (HSLA) steels. Thanks to the possibility of considerably higher roughing speeds with a decoupled roughing mill, the temperature level in the area of the intermediate strip and in the first passes of the finishing mill can be increased substantially, resulting in:

— Far higher final rolling temperature with the same final strip thickness or
— Significantly thinner final strip thicknesses at the same final rolling temperature

The above diagram compares the final rolling speed and temperature for different concepts. It shows that with CSP Nexus, high final rolling temperatures can be achieved even when rolling thin strip at moderate rolling speeds.

In plants with coupled roughing and finishing mills, the lower temperature level in the intermediate strip must be equalized with high-power induction heating. This creates an additional area that, if coupled, must be passed through at low speed and with correspondingly high temperature losses. During batch rolling, plants with coupled roughing and finishing mills already reach their limits in terms of finishing rolling speed and temperature level at higher strip thicknesses. To avoid significant increase of chattering tendency and other quality issues, they have to switch to the energy-intensive endless rolling process much earlier.

Accordingly, the CSP Nexus predominantly employs endless rolling only where it makes sense from a process point of view. With the production of ultrathin strip (<1.0 mm) in particular, the rolling process benefits from the increased stability of endless rolling, which in turn justifies the greater amount of energy required.

In real batch rolling, in contrast to endless rolling, it is also far easier to make greater thickness, width, and grade changes from one strip to the next. Roll changes can also be performed at any time during a real batch rolling campaign, without having to interrupt the casting sequence. As a result, real batch rolling enables the design of a very flexible rolling campaign, while, at the same time, ensuring a high level of availability.

Highly efficient integrated process models

To increase the overall energy efficiency of the process, SMS incorporated the X-Pact Integrated Process Model (IPM) in the level 2 automation system. The process model coordinates the results of the existing individual level 2 models such as X-Pact Solid Control, X-Pact Pass Schedule Calculation (PSC), or X-Pact Cooling Section Control and considers the whole temperature evolution of all thin slabs from casting to coiling. It sets up the process prior to rolling in the most energy-efficient way while maintaining the target dimensions and properties. Depending on the actual production scheme, the furnace temperatures can be set as low as possible to achieve the desired final mechanical properties and dimensions. Furthermore, the rolling load in the mill stands as well as the increased speed level in the cooling section, including an energy-optimized water pump setting, are taken into account.

Moreover, the integrated process model enables higher productivity. The casting thickness can be optimized to attain maximum productivity, while, at the same time, ensuring that the desired final thickness and width after rolling can

be achieved. In addition to the extensive process controls and models, X-Pact Centerline Control is an integrated strip flow control system that ensures the stability of the rolling process. A closed-loop control circuit detects strip centerline deviations and calculates proper tilting set points for each mill stand. Various control strategies are used for the different rolling sequences (strip head end, main body, and strip tail end). SMS group's integrated strip guide package comprises mechanical side guards, control strategies for adjusting the roll gap, and camera-based measuring systems for real-time control of the strip position.

Since real batch rolling was created on the basis of the conventional rolling process, the many years of experience gained in this field can be brought to bear. The high flexibility and quality of the X-Pact Profile Contour and Flatness Control (PCFC) model, in particular, is a unique selling point. As plants that mainly operate in endless rolling mode have to focus on extending the rolling campaigns, their rolls are used with correspondingly wear-optimized roll barrel grinds, which means that continuously variable crown (CVC) technology cannot be applied. With the X-Pact PCFC model in combination with customized CVC grinds on the rolls in the finishing mill, the focus is on maximum quality and flexibility. Using special shifting strategies, such as "cyclic work roll shifting," these advantages can also be combined with a wear-optimized operating mode.

The result is an extremely reliable product that ensures high plant availability, on the one hand, and hot rolled strip of extraordinary product quality and close tolerances, on the other. Which is the reason why, over the last few years, SMS group has received a consistently growing number of inquiries and orders by customers who want to replace their work roll bending and shifting systems, delivered by other suppliers, with new short-stroke CVC systems including the PCFC model. ●

CSP NEXUS: TECHNICAL DATA FOR REFERENCE PLANTS

	SDI Sinton	Stegra (former H2GS)	JSW Dolvi
STRIP WIDTH	965–2,134 mm	900–1,950 mm	1,470–2,600 mm
STRIP THICKNESS	1.2–25.4 mm	1.0–20.0 mm	2.0–32.0 mm
1-STRAND CAPACITY	2.7 million t/year	2.5 million t/year	4.0 million t/year
MILL CONFIGURATION	2 + 6	2 + 6	3 + 6
HEATING CONCEPT	Natural gas	Electricity	Hybrid

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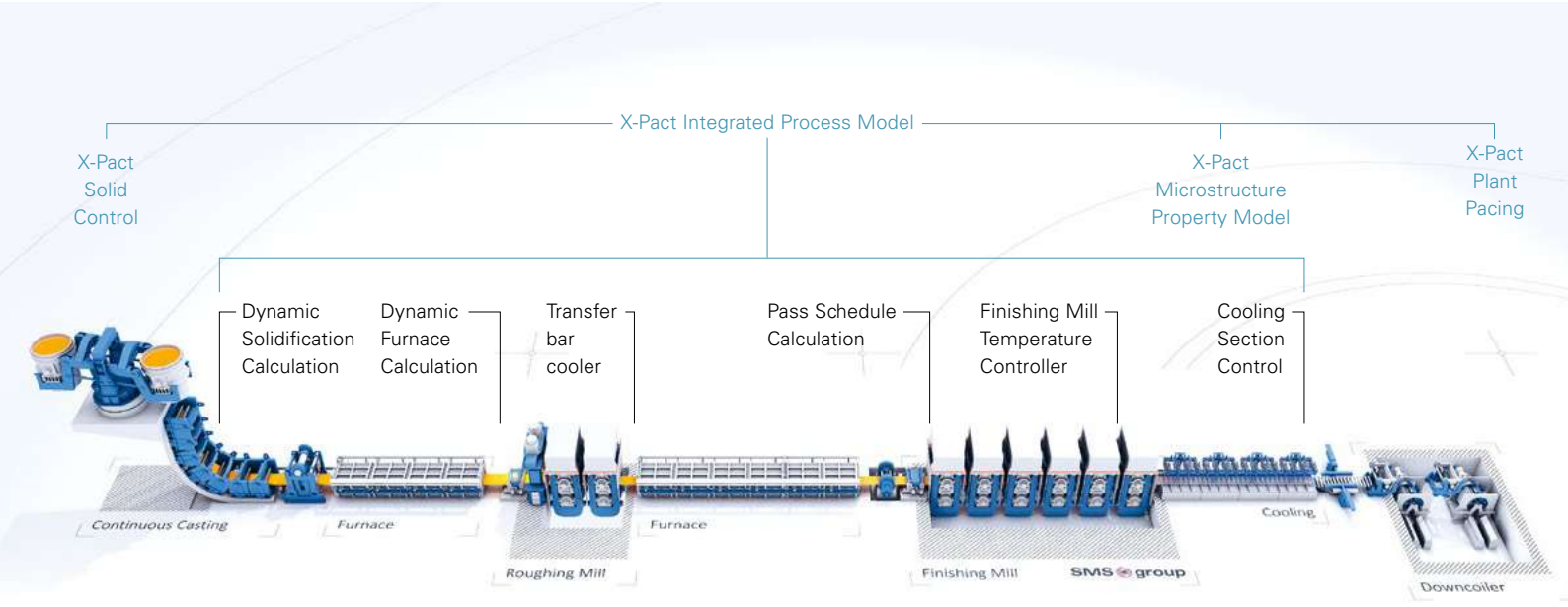


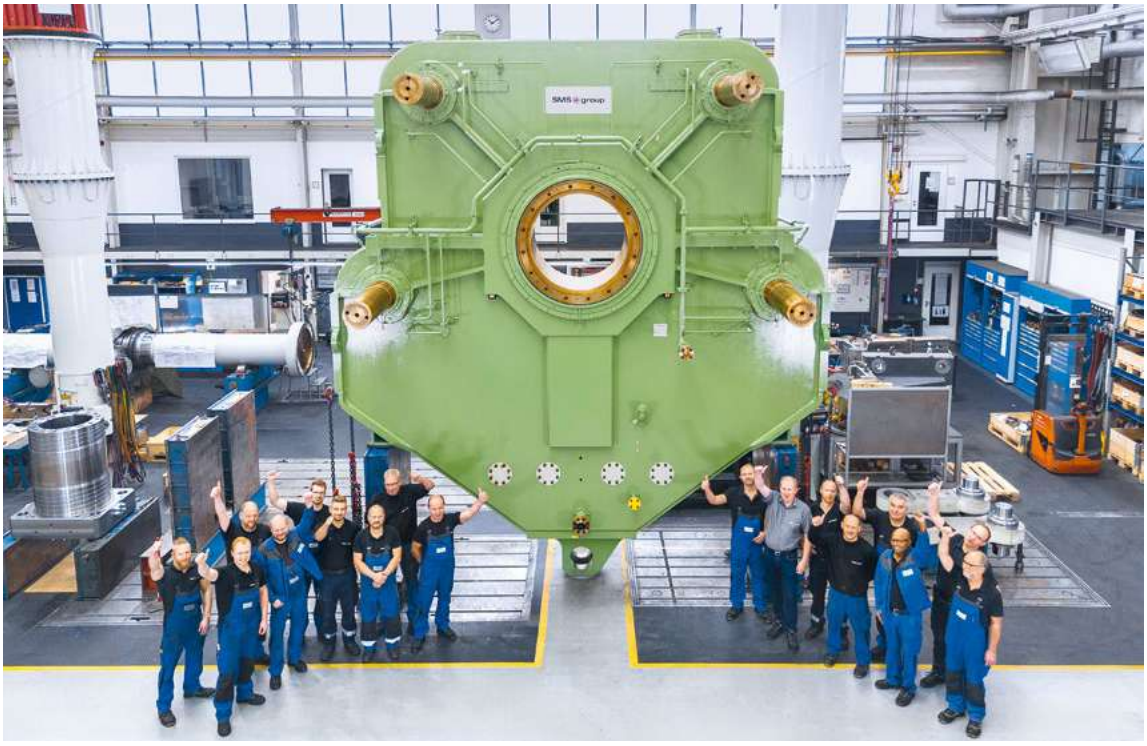
The X-Pact Integrated Process Model interacts on higher level for improved overall strategy.

Celebrating the 100th converter tilt drive from Hilchenbach

The tilt drive is an essential component in converter steelmaking, providing precise, safe, and efficient tilting control. Our Hilchenbach location celebrated the design, manufacture, and assembly of its 100th converter tilt drive—only 25 years after the first one.

In 1999, the first order for two tilt drives came from a customer in France. These huge pieces of equipment have since become a flagship product in our drives portfolio. Besides the advantages of having a sole supplier for process technology, design, and manufacturing, our customers quickly recognized the unparalleled reliability of our converter tilt drives.

The tilt drives have the main task of tilting BOF (basic oxygen furnace) and AOD (argon oxygen decarburization) converters into the charging, tapping, and sampling positions. Our tilt drives are especially renowned for their high quality and durability, with each drive designed and manufactured with the utmost precision and in compliance with the strictest



The Hilchenbach workshop team celebrates the 100th converter tilt drive.

quality standards. The continuous improvement of our design and manufacturing processes includes the implementation of novel design solutions. A unique feature is our in-house developed and patented hydraulic torque retaining system for AOD converters. This solution limits the dynamic loads from the AOD process to a minimum and, when retrofitted, even improves converters supplied by other manufacturers. By reducing the dynamic loads, the hydraulic torque retaining system not only increases the service life of gears and bearings, it also reduces the maintenance requirements of torque retainers. Together with our innovative gear solutions, our converter tilt drives can also help to make savings in the substructures.

We specialize in offering tailor-made solutions using our unique expertise in the design and manufacture of drive units. This includes gear manufacturing up to a diameter of 6 m and case-hardened gears up to a diameter of 4.5 m, with tilting moments up to 7,500 kNm and emergency torques up to 17,600 kNm. Our customers' specific requirements regarding the installation situation are addressed by offering single or multi-piece housings, variable drive configurations, and customized torque retainers. Further options include add-on modules such as oil-lubricating units or pneumatic emergency drives and selectable interfaces to the converter aimed at drastically reducing installation times.

The 100th converter tilt drive is an important milestone, but only an intermediate step in terms of innovation and new concepts. With our tilt drives for TBRC converters, we already have our sights set on new markets with innovative drive ideas. Service activities in the field of converter tilt drives are also constantly growing and have become an integral part of our daily business. ●

Converter tilt drive and furnace body

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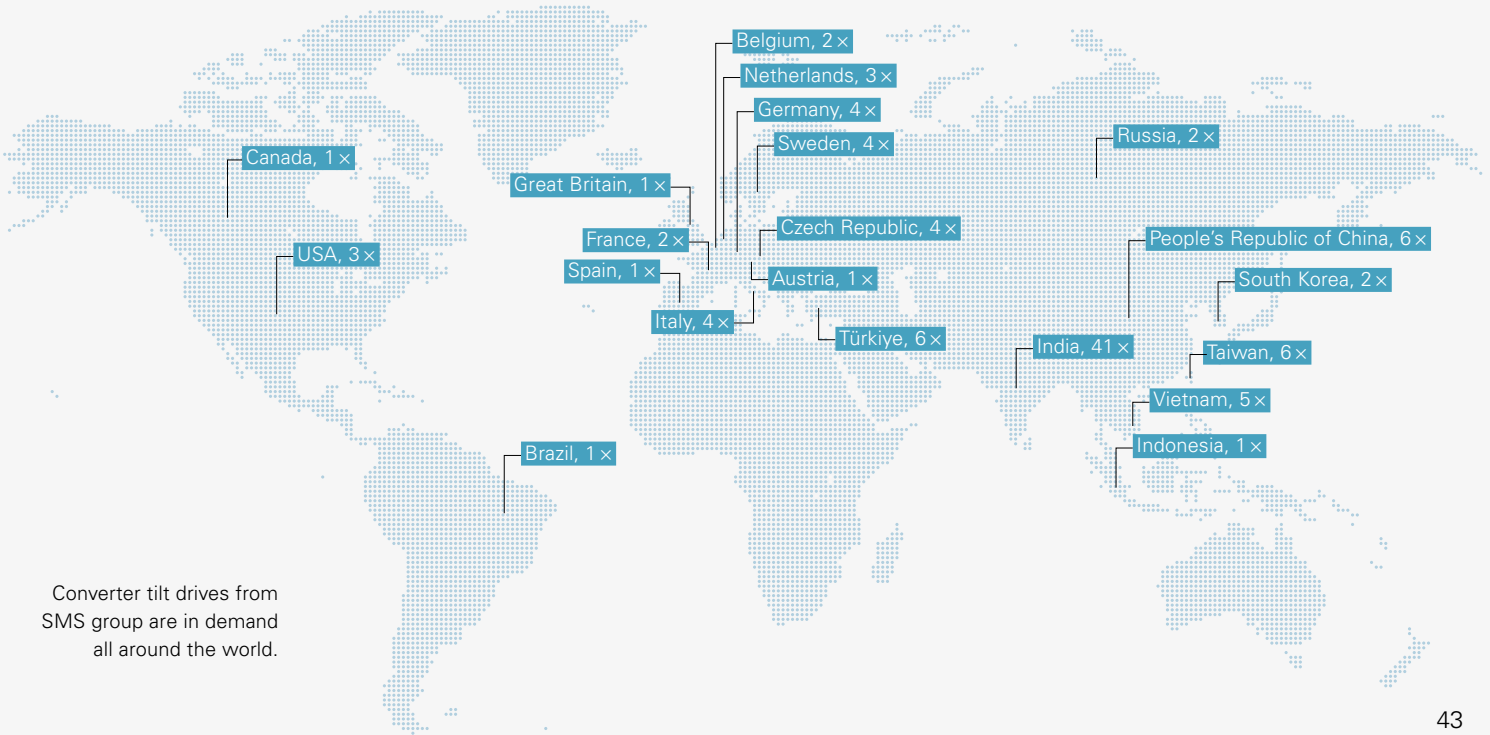

Converter tilt drives from SMS group are in demand all around the world.

1


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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 MERCEDES-BENZ, 2 STEEL DYNAMICS, 3 ALUMINUM DYNAMICS, 4 SALZGITTER FLACHSTAHL, 5 SHANDONG TISCO

5


6

7

8


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10

XINHAI STAINLESS, 6 ZHONGYOU BAOSHISHUN, 7 FERALPI, 8 SHOUGANG ZHIXIN QIAN'AN, 9 TUBACEX, 10 SAARSTAHL

Orders and start-ups

Start-up of four new strip processing lines

SDI operates four new strip processing lines.

Steel Dynamics (SDI) and SMS group have celebrated the successful start-up of four new production lines at two separate locations. The new continuous galvanizing lines and color coating lines in Sinton, Texas, and Heartland, Indiana in the US, mark another milestone in the long-standing and successful partnership between the two companies. With the commissioning of the four state-of-the-art lines in December 2023 and April 2024, SDI is now able to expand its production capacities for coated steel strips to meet growing demand.

Identical plants were installed in both locations: a new continuous galvanizing line (CGL) with an annual capacity of 278,000 t/year and a color coating line (CCL) that processes 240,000 t/year. The CGLs are designed to produce galvanized steel sheets, primarily for use in the construction industry and for white goods / home appliances. A key advantage of the new CGLs is its ability to produce Al-Si coated steel. In addition, the CGLs includes advanced technologies such as the Drever horizontal furnace and the Duma-Bandzink air-knife system to ensure efficient, high-quality production. With a maximum strip width of 1,830 mm, the CGL operates at a process speed of 198 m/min.

The color coating lines feature tailored solutions to produce coated cold-rolled and galvanized steel strip for various applications. Able to handle strip widths of up to 1,830 mm at 183 m/min, they allow SDI to meet diverse customer needs while adhering to stringent quality standards.

With its proven X-Pact basic and process automation packages, SMS group is taking an integrated and holistic approach to realizing the four processing lines, ensuring that all system components work together in perfect harmony. Alongside the main focus on process guidance for plant operation and control, the innovative, structured, and modularized level 1 and level 2 software architecture facilitates multidirectional connectivity.

A significant cornerstone of the project's success is the very fast start-up of the lines, made possible thanks to the virtual commissioning of the automation system during the X-Pact Plug & Work integration tests.

CUSTOMER
Steel Dynamics, Inc., USA

SUPPLY
Two continuous galvanizing lines and two color coating lines

STATUS
Successful start-up

HIGHLIGHT
Identical plant configurations for both sites

Energy management solution to optimize consumption

Siam Yamato Steel uses an AI model-based energy management solution.

Siam Yamato Steel (SYS) will implement the Viridis Performance energy management solution at its facilities in Rayong province, Thailand. This initiative aims to optimize energy consumption, enhance operational efficiency, and reduce environmental impact. SYS operates two mills for hot rolled structural steel with a combined capacity of 1.1 million t/year. Utilizing advanced AI models, Viridis Performance analyzes real-time data to optimize production processes and reduce energy consumption without affecting yield. Viridis Performance is able to provide monitoring of energy variables. Custom dashboards show real-time data against targets, enabling the plant operator to quickly address deviations by issuing specific instructions.

CUSTOMER
Siam Yamato Steel, Thailand

SUPPLY
Implementation of Viridis Suite

STATUS
New order, start-up in 2025

HIGHLIGHT
Greater energy efficiency, lower costs, and minimal carbon footprint

Future-proof strip processing

ArcelorMittal Vega operates a combined annealing and galvanizing line.

ArcelorMittal Vega has successfully commissioned its new combined annealing and hot-dip galvanizing line (CAL/CGL) in São Francisco do Sul, Brazil. With a capacity of 640,000 t/year, the new line boosts Vega's ability to produce high-strength steel for the automotive and household appliance industries. Each piece of equipment installed is capable of handling steel strip with a yield strength of at least 1,500 MPa. A Drever furnace ensures optimal heating and cooling for high-quality annealing. The line also includes a compact cleaning section for efficient pre-treatment of the strip and a horizontal roll coater for uniform coating applications.

CUSTOMER
ArcelorMittal Vega, Brazil

SUPPLY
Combined annealing and galvanizing line

STATUS
Start-up in September 2024

HIGHLIGHT
Annealing and galvanizing on a single line

Modernization of blast furnace completed

Salzgitter Flachstahl enhanced the efficiency of blast furnace A.

At Salzgitter Flachstahl, SMS group replaced the Bell Less Top (BLT) system, originally installed in 1977, in blast furnace A. The new Paul Wurth Parallel Hopper Bell Less Top offers enhanced efficiency and less maintenance thanks to improved access and dismantling aids. To improve operational efficiency, the modernization of the top charging system included the overhaul and integration of key components. Moreover, sound emissions have been substantially reduced with the installation of a new silencer. René Rockstroh, General Manager of the blast furnace department at Salzgitter, stated: "We are completely satisfied with the new solutions."

CUSTOMER
Salzgitter Flachstahl, Germany

SUPPLY
Modernization of blast furnace A

STATUS
Modernization completed

HIGHLIGHT
New Bell Less Top (BLT) for enhanced efficiency with less maintenance

Milestone for carbon-neutral steel industry

Saarstahl awarded us a contract to supply one of the world's strongest alternate current-electric arc furnaces (AC-EAF) and its auxiliaries to Völklingen, Germany. This will contribute to Saarstahl's goal to achieve carbon neutrality by 2045.

Jochen Burg, CEO of SMS group: "We are proud to play a key role in Europe's green steel transformation with this major project for Saarstahl and SHS (Stahl-Holding-Saar). With an installed power of 300 MVA, the new EAF is the biggest ever built by SMS group and will set a new milestone in a carbon-neutral future for the steel industry in Europe."

With a transformer capacity of 300 MVA, the new 185 t EAF will be one of the strongest in the world. It will process a flexible mix of up to 100% scrap or 80% cold direct reduced iron (CDRI) / hot briquetted iron (HBI) and 20% scrap.

Saarstahl accelerates decarbonization with one of the world's strongest electric arc furnaces.

Featuring 9.3 m shell-diameter – the largest EAF ever built by SMS group – it will have an annual capacity of 1.9 million t of liquid steel. This investment aligns with SHS's strategic plan to utilize a mix of 70–85% natural gas and 30–15% hydrogen as an energy source by 2030, significantly reducing carbon emissions.

The EAF will be equipped with Condoor, SMS group's enhanced slag door, ensuring significant advantages in terms of safety, productivity, energy savings, and environmental impact. Condoor enables automatic operation, reduces power-off time, ensures a clean slag door sill, saves energy, and lowers NO_x emissions with a sealed shell. Additionally, it optimizes slag residence time, improving flux and raw material use while reducing electrode, carbon, and lime consumption, thus lowering CO_2 footprint.

The EAF will feature SMS group's advanced X-Pact automation, including X-Pact Sense for leakage detection and X-Pact Auto Tapping for safe and automated tapping. Genius CM will be implemented for predictive maintenance, enhancing operational efficiency and safety.

CUSTOMER
Stahl-Holding-Saar (SHS), Germany

SUPPLY
Electric arc furnace

STATUS
New order, start-up in 2028

HIGHLIGHT
One of the strongest EAF worldwide

Comprehensive Steckel mill upgrade

Nucor Steel expands its Tuscaloosa Steckel mill into a tandem Steckel mill.

CUSTOMER
Nucor Steel, USA

SUPPLY
Modernization of Steckel mill

STATUS
New order

HIGHLIGHT
Conversion of existing Steckel mill into an ultramodern tandem Steckel mill

Nucor Steel, USA, has placed an order for the comprehensive modernization and expansion of its Steckel mill at its Tuscaloosa site, in Alabama. This conversion will enable Nucor Steel to significantly increase its production capacity and get ready to meet future challenges in the steel industry.

The centerpiece of the project is the conversion of the existing plant into a highly advanced tandem Steckel mill. To enhance the ability to produce thin, high-strength products, an additional high-performance mill stand will be installed downstream of the existing stand to create a tandem Steckel mill. Both mill stands will be equipped with CVC plus technology to ensure maximum strip quality.

The existing Steckel furnaces will be replaced with new furnaces in a closed-type design. These advanced furnaces are highly efficient at maintaining the right product temperature and protecting the roller tables against heat radiation.

SMS group will also handle the modernization of the electrical and automation systems, including the main drives, sensors, measuring equipment, and instrumentation, as well as the mill's basic and process automation.

Thanks to the modularized level 1 software architecture, the system responds very quickly to given requirements and guarantees fault-free performance. The stability of the rolling process and strip guidance is improved with the X-Pact Centerline Control system. The level 2 process automation includes the technological process models X-Pact Pass Schedule Calculation PSC, X-Pact Profile and Flatness Control PFC, and the higher-level material tracking system.

The existing mill stand will be retrofitted with a new twin drive that ensures the top and bottom work rolls can be operated independently. SMS group's Genius CM system continuously provides data that is used to monitor the status of the drive unit and to carry out condition-based equipment maintenance.

Outstanding technologies for electrical steel grades

Shougang Zhixin Qian'an has inaugurated its twelfth silicon steel line from SMS.

In February 2024, Shougang Zhixin Qian'an Electromagnetic Material produced the first coil on its new annealing and pickling line (APL). With this new line, Shougang intends to expand its production capacity for high-grade non-grain-oriented electrical steel strip with high silicon content at its existing production site in Hebei province by 650,000 t/year. The APL is part of an integrated production complex for sophisticated electrical steel grades and ranks as the largest facility of its kind globally. SMS group's scope of supply also included the X-Pact electrical and automation systems.

CUSTOMER
Shougang Zhixin Qian'an Electromagnetic Material, China

SUPPLY
New annealing and pickling line

STATUS
Start-up in February 2024

HIGHLIGHT
12th silicon steel line supplied by SMS group within the complex

Ring rolling machine upgrade

Taewoong upgrades its ring rolling machine.

Taewoong has contracted SMS to revamp and upgrade its ring rolling machine. The project includes dismantling the existing equipment as well as installation, supervising, and commissioning the new reinforcement equipment. The updated machine will be capable of producing rings up to 11 m in diameter and 2.75 m high, with a maximum weight of 95 t. These specifications are ideal for manufacturing components such as the tower flanges used in offshore wind turbine installations. The upgrade encompasses a suite of digital solutions that includes SMS Metrics and Smart Alarm.

CUSTOMER
Taewoong, South Korea

SUPPLY
Upgrade of ring rolling machine RAW630(800)/630(800)

STATUS
New order

HIGHLIGHT
Production of rings up to 11 m in diameter

Galvanizing line for automotive panels

Angang Guangzhou Automotive orders a hot dip galvanizing line.

Angang Guangzhou Automotive Steel and Ansteel Engineering Technology Corporation Limited have signed a contract for the supply of a new hot dip galvanizing line. The new line, which has a capacity of 400,000 t/year, is designed to produce exposed automotive panels that demand optimal surface quality. The all-radiant-tube Drever annealing furnace together with the Duma-Bandzink air-knife system are the technological centerpieces of the line. These systems ensure the right material properties within tight tolerances as well as the flawless surface condition that automotive end-users require for exposed qualities.

CUSTOMER
Angang Guangzhou Automotive Steel and Ansteel Engineering Technology, China

SUPPLY
New hot dip galvanizing line

STATUS
New order, start-up in November 2025

HIGHLIGHT
Full-line EP project in the highly competitive Chinese market

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

Breaking records

The two mill stands each in combination with a Steckel furnace form the centerpiece of the Steckel mill.

CUSTOMER
Shandong Tisco Xinhai Stainless, China

SUPPLY
Twin-stand Steckel Mill

STATUS
Final acceptance issued in June 2024

HIGHLIGHT
Global benchmark in rolling of stainless and acid resistant steel

In June 2024, Chinese steelmaker steelmaker Shandong Tisco Xinhai Stainless gave final acceptance for a new twin-stand Steckel mill. During commissioning, the Xinhai site team successfully rolled several coils in continuous operation mode with a width of 1,500 mm down to the final thickness of 2.0 mm.

SMS group supplied the entire mechanical equipment of the advanced twin-stand Steckel mill. The essential equipment includes a primary descaler, a four-high reversing roughing mill with attached edger and a drum shear upstream of the Steckel stands followed by the centerpieces of the hot rolling line, the two four-high stands with a Steckel furnace each in the entry and exit section.

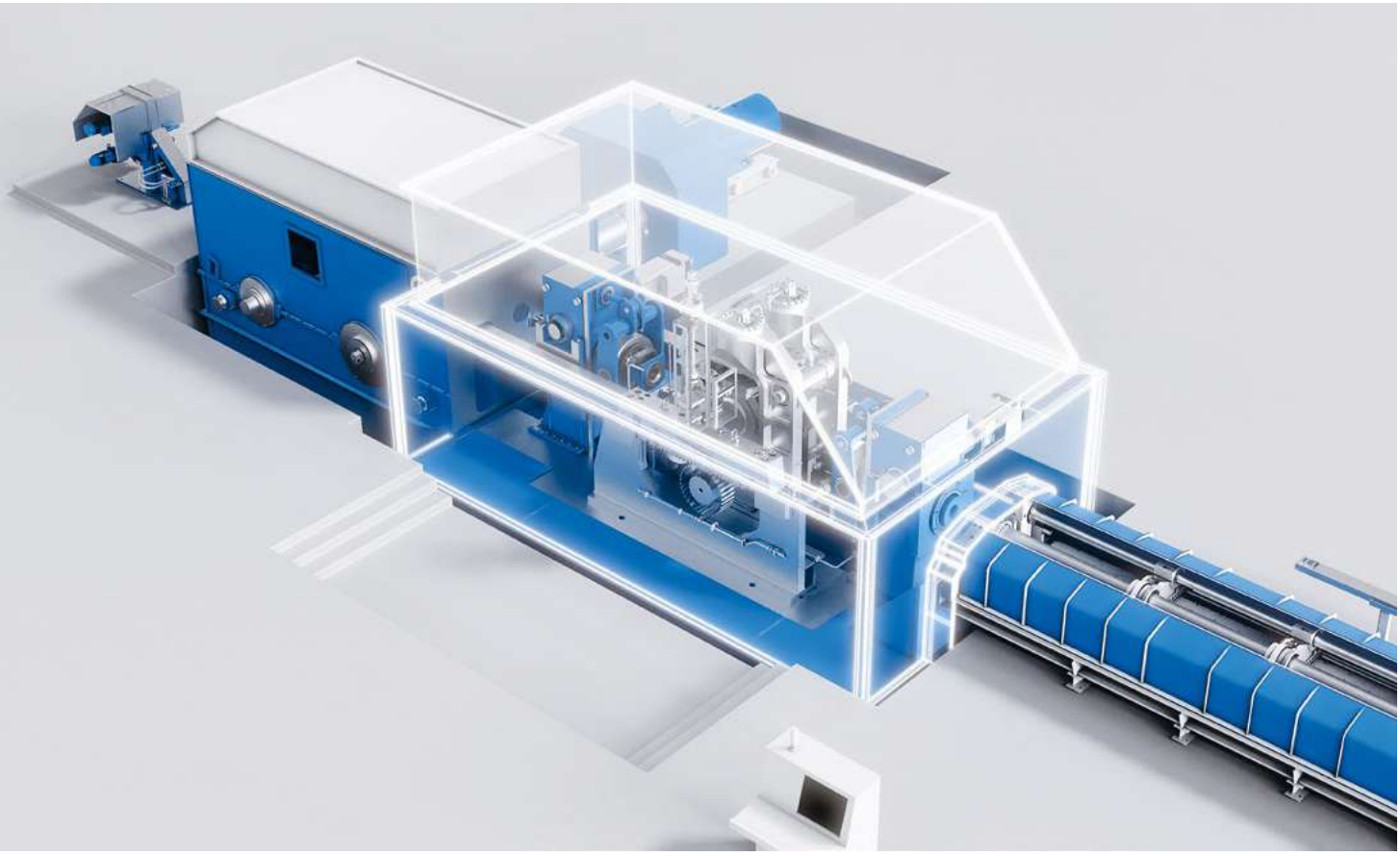
To ensure an efficient rolling process and a stable rolling temperature, the rolled stock is wound up in one of the Steckel furnaces after each pass. The Steckel furnaces are heated to ensure that the strip temperature is maintained at the required level during finish rolling. The Steckel looper enables strips to be rolled at higher speeds. In addition, they provide constant strip tension and thus an improved thickness tolerance.

The Steckel stands have proven CVC plus technology (Continuously Variable Crown) for roll shifting. In conjunction with the negative work roll bending, the profile and flatness are precisely adjusted and product tolerances are achieved.

SMS group also supplied the complete electrical and automation systems including the power supply and main drives, sensors, measuring devices, and instrumentation, as well as the basic and process automation for the plant. Before delivery, the X-Pact electrical and automation system was prepared and optimized for efficient commissioning by means of the X-Pact Plug & Work integration test. Due to the modularized level 1 software approach, the system can reply to requests much faster, to guarantee flawless production performance.

Stainless excellence

The culmination of our long-standing partnership with industry leader Tubacex is our latest project close to Abu Dhabi – a state-of-the-art facility with our KPW 290 L cold pilger mill as its centerpiece.



KPW 290 L

In the world of seamless stainless steel tube manufacturing, few names resonate as strongly as Tubacex. As a global leader, Tubacex has built a reputation for delivering high-value-added products and solutions across the energy and mobility sectors. They operate production facilities and service centers in 30 countries, serving a global clientele. Their unwavering commitment to quality, innovation, and sustainability has positioned Tubacex at the forefront of the industry, particularly in corrosion-resistant alloys (CRA) and advanced machining services. This progressive mindset is one of the many factors that sustain Tubacex's partnership with SMS group.

Innovation that lasts

The partnership between Tubacex and SMS group spans almost five decades and is rooted in a shared commitment to excellence and innovation. Through-

> "When we rely on SMS, things work out."
>
> —Javier Martínez-Conde, Senior Supply Chain & Operations Consultant, Tubacex

out this time, SMS group has provided Tubacex with state-of-the-art cold pilger technology that has played a crucial role in Tubacex's success across its global plants in Austria, Spain, the US, and India. Tubacex has repeatedly turned to SMS group, confident in the knowledge that "When we rely on SMS, things work out," says Javier Martínez-Conde, Senior Supply Chain & Operations Consultant at Tubacex. This trust is built on SMS group's track record of delivering bundled expertise, from digital and mechanical services to engineering support, ensuring that every project is completed on time and to the highest standards. The latest chapter in this partnership is perhaps one of the most significant: our delivery of a KPW 290 L cold pilger mill to Tubacex's new greenfield site near Abu Dhabi. This top-of-the-line facility is set to play a pivotal role in Tubacex's strategy to serve the growing market for corrosion-resistant OCTG (oil country tubular goods) solutions in the Middle East, a region that is critical to global energy production and export.

The Abu Dhabi project: A strategic move

The new 100-million-euro plant is a testament to Tubacex's strategic vision. As part of a major agreement with the Abu Dhabi National Oil Company (ADNOC), Tubacex has committed to supplying CRA OCTG solutions for gas extraction over the next decade. This investment, aligned with ADNOC's "Make it in the Emirates" program, underscores Tubacex's dedication to localizing production and ensuring a reliable supply chain for critical energy projects.

The KPW 290 L cold pilger mill: Cutting-edge technology

At the heart of the Abu Dhabi project is our KPW 290 L cold pilger mill – the second-largest cold pilger mill we have ever built and the result of decades of expertise in cold pilgering technology. It is designed to meet the exacting demands of the oil and gas industry, particularly in the production of stainless-steel tubes with the tightest outer diameter and wall thickness tolerances. One of the standout features of the KPW 290 L is its flexibility. The mill can produce a wide range of tube sizes, making it one of the most versatile cold pilger mills available. This flexibility is achieved through the innovative roll assembly, which allows quick and easy tool changes in just two hours, significantly reducing downtime and enhancing overall productivity. This was a critical factor in Tubacex's decision to invest in the KPW 290 L, as it enables the production of tubes with smaller outer diameters without the need for multiple mills. The KPW 290 L also has advanced data logging capabilities, providing continuous system analysis that benefits operators, maintenance workers, and production planners. This ensures that the mill operates at peak efficiency, contributing to Tubacex's goal of doubling its production capabilities in the CRA OCTG segment.

Looking ahead: A future of innovation and collaboration

The successful implementation of the KPW 290 L mill near Abu Dhabi is scheduled for the end of 2024, with the first production campaign expected in early 2025. As the project progresses, SMS group will continue to provide on-site support, leveraging its regional presence and in-depth understanding of local market dynamics to ensure a seamless start-up.

The Abu Dhabi project is more than just a milestone for Tubacex – it is a reaffirmation of the strength of its alliance with SMS group. Together, we are setting new standards in stainless steel manufacturing, driven by a shared vision of innovation, sustainability, and reliability. As Tubacex looks to the future, it does so with the confidence that comes from knowing that, with SMS group by its side, the possibilities are boundless.

See the Leading Partner Talk with Tubacex:

Positioning of the mill stands for the hot rolling mill.

Building a new leader in aluminum production

Construction of the new Aluminum Dynamics complex is making rapid progress. As the installation of key equipment on-site continues, we take a closer look at this project that highlights the excellent collaboration between Aluminum Dynamics and SMS group.

The Aluminum Dynamics LLC project represents a significant advancement for the aluminum industry with the implementation of cutting-edge technology and sustainable practices. This state-of-the-art flat rolling mill aims to set new standards with an annual production capacity of 650,000 t of aluminum sheet for cans, vehicles, and industrial applications.

Fast progress on-site

The project in the US state of Mississippi has made significant progress in recent months and is moving steadily forward, with the installation of core infrastructure and key equipment running on schedule. Each phase has been executed with precision, with all parties consistently demonstrating their commitment to excellence.

"The installation of the first mill stands was a very important milestone for this project and represents the commitment of our team to this project," says Alex Culberson, Hot Mill Manager at Aluminum Dynamics. "We're excited about how these advancements will establish our new project capabilities and contribute to the project's success."

Project milestones

Since the project launch in March 2023, several milestones have contributed to the overall progress of the project. In late 2023, teams from Aluminum Dynamics visited SMS group's facilities in Germany to inspect equipment for the hot and cold rolling mills prior to the delivery. This included the comprehensive review and functional testing of the preassembled hot and cold rolling mill stands, provided with hydraulic gap control and CVC system components as well as further actuators. The meetings underscored the close collaboration, which ensured that all technical specifications and quality standards were met or even exceeded. Further significant progress came in April 2024 with the delivery of essential equipment for the can coating line.

Integration tests for the automation systems, known as X-Pact Plug & Work, started in June 2024. Using a digital twin of the facility, SMS group simulated and refined the automation processes, ensuring all components work seamlessly together. This approach shortens the commissioning time and reduces start-up risks. Dave Durci, Senior Electrical Project Engineer at Aluminum Dynamics LLC, emphasizes: "I'm very impressed with the level of completeness that I find here. All the operator desks are set up and functional. And of course, there is a simulator that runs against the mill control systems. This gives us a unique opportunity to exercise the software and to identify problems that could cause difficulty once we're on the site."

In September 2024, alongside operator training, Aluminum Dynamics utilized the training services provided by SMS TECademy. By investing in personnel training, Aluminum Dynamics is preparing itself for a successful commissioning and for maintaining high operational standards.

A vision for innovation and sustainability

Aluminum Dynamics LLC is a joint venture of Steel Dynamics Inc. (SDI) and represents more than just a new facility. The flat rolling mill reflects a commitment to expanding in the aluminum sector while upholding high sustainability standards. With an expected production →

The equipment arrives near the site via barge.

Dave Durci, Senior Electrical Project Engineer at Aluminum Dynamics LLC

capacity of 650,000 t/year, the plant will meet the growing demand for beverage packaging, automotive materials, and industrial applications.

Partnering with SMS group was a strategic decision made by Aluminum Dynamics. This collaboration builds on a history of successful projects with Steel Dynamics, from the installation of a CSP plant in the 1990s to the recent supply of a new minimill flat steel complex in Sinton, Texas. Our scope for the current project includes a 1+4 hot rolling mill configuration comprising a roughing mill with attached edger, and a four-stand finishing mill, capable of producing aluminum strip with thicknesses ranging from 1.8 to 7 mm. Additionally, the facility will feature two tandem cold mills and a single-stand cold rolling mill, both equipped with the latest rolling technology for efficient and sustainable operation. Maximum environmental compatibility is ensured not least by the Multi Plate filter technology.

The can coating line (CCL) is designed for high-quality coatings that meet the most stringent food industry standards. The flotation dryer in the CCL uses jets of heated air to support the strip, providing a pristine coating surface. The line also features a regenerative thermal oxidizer that enhances efficiency by burning flue gases in an afterburner and feeding the energy back into the process, significantly reducing emissions as well as operational costs.

The project also includes two AMOVA high-bay storage systems, with intelligent, fully automated transport and storage solutions. Equipped with enhanced coil ventilation and warehouse management software, it optimizes the link between hot and cold mills, as well as the various process lines.

Integrated solutions

Proven X-Pact electrics and automation modules are key to the plant's efficiency. Covering the full process chain that includes power distribution and drive equipment, measuring systems as well as basic and process automation, the system and its newly developed software architecture is designed for dynamic and resource-efficient operation with minimal human intervention.

The automation system is further enhanced through the use of the plant's digital twin during the integration tests, ensuring that all systems are optimized for peak performance before they are physically assembled on-site. Additionally, the X-Pact Torque Drive and X-Pact Drive technologies contribute to the facility's energy efficiency, ensuring maximum process-oriented drive performance.

The future of aluminum production

The new facility is nearing completion and is expected to begin production in the middle of 2025, establishing Aluminum Dynamics as a leader in aluminum flat-rolled products in North America.

"Our collaboration with SMS has positioned us well to be able to perform to the highest industry standards," says Austin White, Cold Mills Manager at Aluminum Dynamics. "With these mills in place, we will be able to achieve our performance and sustainability goals."

The project exemplifies the future of aluminum production – a future characterized by innovation, environmental responsibility, and technological advancement. "Our joint efforts are creating a facility that will enhance aluminum production and set new benchmarks for sustainability and efficiency. This project demonstrates our dedication to delivering advanced technological solutions and supporting the industry's growth," adds Carsten Thiem, Site Manager from SMS group.

As the project approaches its final phases, all eyes are on Columbus, Mississippi, where the new facility is set to become a model of modern aluminum production, positioning Aluminum Dynamics as a new leader in the global aluminum market.

Learn more about the project:

Operator training in the test field in Mönchengladbach, Germany

Construction site at Aluminum Dynamics in Columbus, Mississippi, USA

Electrification: A key pathway to decarbonizing down-stream processes

The modernization of Feralpi's bar and wire rod mill is a textbook example of how electrification can reduce carbon emissions at a brownfield site.

New induction heating system at Feralpi Lonato

The steel industry is one of the most energy-intensive industries. Processes such as smelting, rolling, and reheating necessitate extremely high temperatures, while rolling, forging, and extrusion require substantial mechanical energy to shape steel into the desired form. However, electrification represents a promising path to decarbonizing the steel industry by enabling the replacement of fossil fuels with renewable energy sources.

The new billet welding machine joins multiple billets into a single semifinished product for continuous rolling.

Electrification and decarbonization

Electricity from renewable sources such as wind and solar power is a key energy source for decarbonizing the metals industry. Electrification allows steel plants to transition from fossil fuels to cleaner energy alternatives, significantly reducing their carbon footprint. Electric systems often achieve higher efficiency compared to fossil fuel-based systems, leading to reduced energy consumption. Replacing gas-powered processes, for example heating, with electric options is a strategic move in the ecological and energy transition.

At SMS group, we engineer solutions that meet sustainability standards and evolving production needs. We combine expertise in process optimization, mechanics, electrics and automation, digital solutions (especially for energy saving), and the corresponding equipment maintenance. As a lifecycle partner, SMS offers comprehensive packages and advises customers on efficient and sustainable measures. Intercepting changes in advance ensures that our technologies remain at the forefront of sustainability and production efficiency.

Rebar mill modernization at Feralpi Group

A good example of a strategic shift towards electrification is the modernization of Feralpi Group's rebar mill in Lonato, Italy. As part of this project, which started in September 2023, SMS dismantled the billet reheating furnace and replaced it with a new, electrically powered SMS Elotherm induction heating system. These heaters utilize electromagnetic induction to adjust the temperature, allowing for precise temperature control and reduced energy consumption compared to traditional gas-fired furnaces. The inductors operate only when billets pass through, avoiding unnecessary energy consumption during inactive periods.

With the upgrade, Feralpi has successfully realized a continuous and uninterrupted flow of billets from the continuous casting to the rolling area with minimal energy losses. The plant features a new transfer device that transports hot billets from the continuous casting facility to the rolling mill more efficiently, thus reducing unwanted heat losses. Additionally, a new billet welding machine joins multiple billets into a single semifinished product for continuous rolling, thereby increasing productivity and cutting waste.

A green rebar mill

As a result of this revamp, Feralpi was able to eliminate direct CO_2 emissions. By removing the gas-fired furnace, Feralpi has effectively eliminated fossil fuel usage in this specific process. The new billet welding machine has improved plant utilization rates and reduced waste, further enhancing the mill's environmental performance.

Feralpi's modernization project demonstrates that retrofitting brownfield plants with state-of-the-art technology can significantly reduce CO_2 emissions. By replacing traditional gas-fired furnaces with electrically powered induction heating systems, Feralpi has set a benchmark for other brownfield plant operators aiming to implement fossil-free solutions in steel manufacturing.

The role of electrification

Electrification is a crucial element in Feralpi's journey towards sustainable steel production. When integrated with renewable energy sources, electrification can significantly reduce a plant's CO_2 emissions. Even in regions that lack a renewable energy infrastructure, energy-efficient technologies from SMS group can reduce the consumption of primary fossil energy.

While electrification is not the sole solution, it serves as a foundational strategy. Combined with other innovations, energy efficiency solutions, and waste reduction measures, electrification can lead to improved sustainable production in both greenfield and brownfield steel plants.

Contact
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Performance in new dimensions

The new heavy plate mill allows TISCO to expand its product portfolio, particularly in the stainless steel segment.

TISCO's new 4.3 m heavy plate mill offers high production flexibility.

The new 4.3 m heavy plate mill for Taiyuan Iron & Steel (Group) Co. Ltd., China, (TISCO) boasts an annual capacity of 700,000 t, producing 300,000 t of stainless steel and 400,000 t of carbon steel. The new facility is designed to allow a production capacity expansion to 1.2 million t/year.

Integrated line for a wide product mix

The new heavy plate mill is one of the most powerful of its kind ever supplied by SMS group. It consists of a 4,300 mm four-high finishing stand, a vertical edger, a shearing line, a process line for extra-thick plates, a normalizing and tempering heat treatment line for carbon steels, as well as solutions for stainless steels and pickling, grinding, and packaging lines. Plates 1,550 to 4,200 mm wide and five to 120 mm thick are produced in a variety of material grades. The new mill also includes plant automation entirely supplied by SMS, including numerous technology packages with sophisticated process models from the automation solutions of the X-Pact family.

The new plant will be able to roll both extreme ingot dimensions and small-dimension slabs into plates. This enables flexible and dynamic production while maintaining the tightest geometrical tolerances. Other main benefits are:

— High flexibility: The new plant will be able to roll both extreme ingot dimensions and small-dimension slabs into plates. This enables flexible and dynamic production while maintaining the tightest geometrical tolerances.
— Near-net-shape plate: With heavy plates ranging from 1,550 mm to 4,200 mm in width and 6,000 mm to 38,000 mm in length, near-net-shape primary products for large components as well as for components with optimized weight and structure can be manufactured.
— Top quality every time: Thanks to the innovative rolling technologies, TISCO achieves outstanding performance not only in terms of surface quality but also in terms of thickness, profile, and flatness tolerances.
— Wide product portfolio: A standout feature of the mill is the wide range of materials. TISCO is able to serve, for example, the infrastructure sector, the chemical industry, shipbuilding, as well as offshore and onshore wind farms.

Plate mill stand with edger and rigid side guides

Mill stand equipped with new technologies

Boasting a rolling force of 109 MN and featuring work rolls with dimensions of 1,150 x 4,600 mm and backup rolls of 2,300 x 4,300 mm, the four-high stand is setting standards in forming. The maximum rolling speed is seven meters per second. One innovation is the co-axial CVC plus system with its large roll gap opening. TISCO is thus able to process rolling stock with an entry thickness of up to 960 mm. Moreover, the interaction of hydraulic roll adjustment, work roll bending, and sophisticated process models for temperature, profile, and flatness, as well as advanced control systems for thickness and mass-flow, stabilize the rolling process and enable high-quality production.

The mill stand is characterized by innovative technologies. For example, there is no reciprocal action between the balancing/bending forces of the work roll and the balancing force of the backup roll. In other words, the balancing cylinder of the backup roll can be equipped with the standard design for heavy plate mills of this size. The top balancing/bending cylinders of the work roll are fixed on top of the mill housings (via a hydraulic pipe connection, not a hose connection).

Another impressive characteristic of the vertical edger is its outstanding performance in achieving highly precise plate widths. For example, the rollers have a diameter of 1,000 mm and transmit a rolling force of 7,000 kN with a torque of 2x260 kNm. The mill stand is equipped with an automatic width control (AWC) system, which activates the combined mechanical/hydraulic roll adjustment system. Thanks to the supporting roller table equipped with a novel design drive, the edger is also capable of processing very short slabs.

A further special feature of the rolling mill is its easy serviceability. Here, SMS has put into practice its decades of vast experience gained from the operation and maintenance of its plants and feedback from its customers.

High-performance automation

The X-Pact automation system from SMS group controls the rolling process fully automatically and guarantees a high level of plant efficiency. Thanks to the holistic X-Pact Plug & Work integration tests at an early stage and the partnership between SMS and TISCO, the first plate was rolled just one and a half months after the I/O check. As a result, the originally scheduled commissioning time could be reduced by two weeks.

The level 1 automation system of the new heavy plate mill is packed with a wide range of X-Pact solutions. The X-Pact Vision control concept is just one of its highlights. The latest knowledge about ergonomics was taken into account to develop intuitive controls for the users and thus to optimize process management. All processes are visualized in real time in the centralized operator station X-Pact One Pulpit and monitored from there.

Highly developed technological process models are integrated into the level 2 process automation, including X-Pact PSC (Pass Schedule Calculation) and X-Pact PFC (Profile and Flatness Control).

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	€ 5,044 million
Sales	€ 3,431 million
Order backlog	€ 6,938 million
Employees	> 14,400

ce

MANAGING BOARD
(from left to right)

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

Integrated solutions

PROJECT EXCELLENCE
We provide solutions for greenfield and brownfield projects that integrate mechatronic production systems with advanced service concepts.

> Feasibility studies
> Project management
> Design and engineering
> Manufacturing
> Site management

Our customers' requirements are highly individual. From large, multi-billion-euro greenfield projects to solutions for optimizing systems and self-controlled plants based on artificial intelligence. No matter what our customers' needs are, we see ourselves as their long-term partner. Which is why we offer cyber-physical solutions to increase system performance over the entire lifecycle.

As a result, we have positioned ourselves as a provider of integrated, holistic solutions.

In order to offer our customers even better, customized solutions, we set up a new competence center called Solutions X this year. Solutions X combines the three previous competence centers Automation, Digital, and Service into one organization. This enables us to offer our customers a complete package that includes not only products, but also services and customized solutions. This strengthens our position in the market and creates benefits for our customers by addressing their needs with a holistic approach.

OPERATIONAL INTELLIGENCE

We supply smart, integrated services and optimization measures to help our customers focus on their core business while keeping their plants operating at the highest level of excellence.

> Process know-how
> Electrics
> Automation
> Digitalization
> Technical services
> Process optimization

#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

AMERICAS
HQ: Pittsburgh, USA
CEO: Doug Dunworth

32
locations

EUROPE
HQ: Luxembourg
CEO: Thomas Hansmann

47
locations

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

22
locations

CHINA
HQ: Shanghai, China
CEO: Peter Langner

9
locations

Company

Synhelion's DAWN industrial demonstration plant for the production of solar fuels

Demonstration plant for solar fuels

SMS group is supporting cleantech company Synhelion in establishing the world's first industrial solar fuel plant. In June 2024, Synhelion reached a significant milestone with the launch of the world's first industrial demonstration plant, DAWN, for the production of solar fuels. The innovative plant developed and built by Synhelion marks a crucial step in the defossilization of the transport sector and highlights the potential of solar fuels in cutting CO_2 emissions.

As a strategic investor and partner, SMS group supported Synhelion in the implementation of the energy storage system used in the DAWN plant. Our commitment here comprised not only financial resources but also expertise from SMS Concast, leveraging Paul Wurth technology. Synhelion's thermal energy storage system is crucial for ensuring the continuous production of synthesis gas by storing approximately two-thirds of the thermal energy generated during the day.

The collaboration between Synhelion and SMS group is a prime example of creating synergies that benefit both the scale-up company and our own product portfolio. Our expertise in the steel and metals industry enables us to efficiently support Synhelion with its innovative thermal energy storage system. This type of storage system is particularly suitable for high-temperature applications and provides a cost-effective alternative to energy storage in batteries.

After commissioning, the DAWN demonstration plant will produce several thousand liters of fuel per year. Synhelion plans to build its first commercial plant in Spain, starting in 2025. Within ten years, Synhelion intends to increase its production capacity to approximately one million tons of solar fuel per year. These developments underline the enormous market potential and the importance of Synhelion's solar fuels for a sustainable future.

Willlian Nunes, Paulo Pinheiro, and Marcellus Piedade will manage SMS group Brasil.

Brazil: Merger of Paul Wurth and SMS group

In Brazil, we are transitioning from the separate legal entities of SMS group Brasil and Paul Wurth Brasil to a unified identity under one corporate brand – SMS group. The full integration of Paul Wurth Brasil into SMS group will be effective January 2025. Paul Wurth will remain a strong product brand within SMS group. The renowned, high-quality products and services will be retained and integrated into the SMS group portfolio, ensuring continued excellence and unwavering commitment to our customers. From January 2025, SMS group Brasil will be managed by Paulo Pinheiro (CEO, CSO), Marcellus Piedade (COO, CTO), and Willian Nunes (CFO).

Technology days at SMS locations

After the opening of the SMS Campus in Mönchengladbach, several customer events were held there. Our Technology Days covered various topics, from closed-die forging to continuous casting. In Hilchenbach, experts from hot and cold rolling mills gathered for the "Technology Days Flat Rolling." In addition to presentations on new technologies, digitalization, and services, the focus of all events was also on the manufacturing capabilities of the SMS workshops.

SMS booth at ALUMINIUM trade fair

Trade shows around the world

In the second half of 2024, SMS group participated in important trade fairs and events in all key markets around the world. The 13th China International Steel Congress, hosted by the China Iron & Steel Association (CISA), kicked off on September 1, 2024, in Shanghai. Under the banner of "Synergy-Win-Win-Green-Sustainable", the five-day conference brought together key players in our industry to discuss ways to promote synergies, realize win-win solutions, and facilitate the sustainable development of the industry chain. Peter Langner, President and CEO of SMS group China, was invited to attend the event and shared our innovative technologies and experiences in the "Future Steel Technology" session on September 2.

From September 3 to 5, we took part in ABM Week in São Paulo, Brazil, Latin America's largest technical and scientific event for metallurgy, materials, and mining. Our presentations focused on decarbonization, the circular economy, and integrated lifecycle partnership. Special attention was given to ironmaking technologies and digital solutions aimed at reducing the CO_2 footprint.

Experts from all over the world met at the ALUMINIUM trade fair in Düsseldorf in October 2024. At our booth, we put the spotlight on our lifecycle partnership approach and our integrated solutions for automation, digitalization, and technical services. Our Leading Partner Talks provided a platform for inspiring discussions with customers, including Nordural and Aluminium Duffel, offered insights into major projects like Aluminium Dynamics, and gave us the opportunity to discuss new technology.

We will also be attending numerous events in 2025. For example, Expo Acero (Monterrey, Mexico, March 24–26), AISTech (Nashville, TN, USA, May 5–8), or E-waste World (Frankfurt, Germany, June 11–12) will be on the agenda in the first few months.

news

The story behind

The wedding

This photo was taken in our manufacturing workshop in Mönchengladbach and shows the first joining of a screw and nut specially designed for one of the largest spindle presses in the world. The coupling screw, which is made of quenched and tempered steel and has a weight of 82 t, a length of 8,600 mm, and a diameter of around 1,300 mm is suspended in the crane. This moment, when we test all the threads and perform ultraprecise checks to verify that the parts manufactured in our workshop fit together perfectly, is what we call "wedding."

The SPKA-type clutch-operated screw press has a hard-on-hard blow force of 365 MN, a gross energy of 27,000 kJ, and a machine weight of 2,900 t. The screw set is the heart of every screw press, converting the immense power and energy from the rotating flywheel into a translational force to produce huge closed-die forgings, mainly for the aerospace industry. After lengthy periods of use, the wear on the spindle set can be so severe that the original forces can no longer be transmitted. By replacing the screw and the nut, the press can continue to fulfill its original requirements. ●

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