

ISSUE 11 | MAY 2022

METALS MAGAZINE

INNOVATION AND TECHNOLOGY FOR THE METALS INDUSTRY

A BREATH OF FRESH AIR FOR SOUTHERN ITALY

**A POWERFUL COMBINATION: DATA ANALYTICS
AND PHYSICS-BASED MODELING**

**VISITING THE SHEFFIELD COMPANY
LOCATION OF PRIMETALS TECHNOLOGIES**



PRIMETALS
TECHNOLOGIES



RAIN FROM A CLEAR SKY: THE LEGEND OF TARANTO

Although many legends tell the story of the founding of Taranto in southern Italy, none speak to us more than the legend of Phalanthus of Tarentum (Taranto). Tasked with founding the city for Spartan soldiers, Phalanthus consulted the Oracle of Delphi to learn where he should establish a new colony. The Oracle prophesied that Phalanthus should discover a settlement where rain falls from a clear sky. After several failures, Phalanthus was on the brink of despair, unable to understand the Oracle's vision. As his wife comforted him, she laid his head in her lap and began to weep. As her teardrops fell onto the brow of Phalanthus, the oracle's riddle became apparent. Phalanthus' wife was named Aethra, meaning crisp, pure air or the clear, serene sky. As Aethra's tears fell, Phalanthus set his sights on the nearby harbor of Taranto in Puglia and founded Taras. At Primetals Technologies, we are proud of our decades-long relationship with Taranto and of our contribution to the crisp, pure air above the city and in the larger region of Puglia.

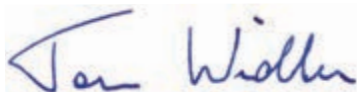
EDITOR'S COLUMN

DEAR READER,

I have long been fascinated with how certain artists were able to transform their craft and to redefine their particular style. Take Van Gogh or Picasso: when they first began to put paint onto canvas, the works they produced looked nothing like the masterpieces they would later be known and admired for. Picasso did not start out drawing those characteristic cubic or uniquely shaped forms, and Van Gogh did not embrace the "impasto" technique from the outset. It was only after they redefined their artistic vision and changed their approach that they were able to reach a level of originality that has remained singular ever since.

While the times we live in are not without challenges, they also provide immense opportunity to those who are willing to make the necessary adjustments. The steel industry is already in a process of deep transformation, as producers do what they can to safeguard their businesses for the long term. Depending on where in the world they are located, they will establish different recipes for success. But one thing is clear: the question won't be whether to "go digital" or to "go green." It will be the considered combination of the correct market-oriented strategy, the right green-production technologies, and next-level digital solutions that will enable true progress. Personally, I feel that it is easy to be preoccupied with the uncertainties of our times. It is harder to take calculated risks and to redefine what you stand for. The latter is also so much more rewarding.

Yours sincerely,



Dr. Tom Widter
Editor-in-Chief of Metals Magazine
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DR. TOM WIDTER
EDITOR-IN-CHIEF, METALS MAGAZINE



52

A BREATH OF FRESH AIR

03 Editor's Column

04 Table of Contents

06 Message from the CEO

08 Recent Project and Company News

SPOTLIGHT

18 Masterful Strategists

Interview with thyssenkrupp, who has crafted a multi-decade strategy to serve the electric-car market

26 Funding a Zero-Carbon Future for Steel

Financial Expert Claire Coustar discusses how metals producers can fund their transition to greener steel.

32 A Vision for Humankind

How to best deal with the aftermath of Covid? Professor Thomas Stephenson provides guidance.

36 Skating to Where the Puck Will Be

Metals Magazine visits the Primetals Technologies company location in Sheffield, U.K.

TECHNOLOGY

46 The Future of Pelletizing

What does it take to build a modern pelletizing plant? Primetals Technologies, thanks to its expertise with the full production chain, provides unparalleled solutions.

52 A Breath of Fresh Air

With the goal of improving air quality in southern Italy, Acciaierie d'Italia has chosen to implement a total of seven MEROS off-gas cleaning systems in Taranto.

60 Environmentally Fueled Innovation

The world's first By-Product Leaching plant, designed to treat the residual dust from off-gas cleaning systems like MEROS, went into operation in 2020.

66 The Green Pulse of Ironmaking

The Sequence Impulse Process was developed to take blast-furnace ironmaking one step closer to carbon neutrality and shifts the coal-coke ratio toward coal.

72 Get Smart: Smart Strip Threading

This innovative solution increases yield in cold-rolling mills, accelerates and smooths mill operation, and reduces the need for manual labor.



MEROS off-gas cleaning illustrates the commitment of Primetals Technologies to innovate for nature—and to support steel producers seeking to make their operations even more environmentally compatible.

74 **Beyond Data Analytics**

Data Scientists at Primetals Technologies uniquely combine machine learning and physics-based models.

80 **From Automation to Digitalization**

Steel producers are asking Primetals Technologies to support them in building digitalization strategies.

INSPIRATION

84 **Women in Steel**

The metals industry may still be a male-dominated sector, but this is changing—and fast.

88 **Great Pioneers That Inspire Us**

At Primetals Technologies, we look up to people like Edward Jenner, the "father of immunology."

92 **What if ...?**

In this innovative interview format, we ask Andreas Viehböck, Head of Casting and ESP, to be imaginative.

96 **Metals Magazine Online**

We proudly present our new on-demand platform that provides up-to-date information for steel producers.

100 **The Rich History of British Steel**

Kelham Island Museum showcases the rich history of metals production and manufacturing in Sheffield, U.K.

104 **How Will We Live?**

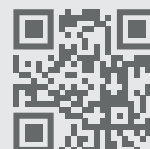
Contributing editor James Gray looks into his crystal ball and envisages the future of telemedicine.

110 **The Pioneer's Guide to Boosting Creativity**

Sometimes in life, we must take risks and venture outside our comfort zone to boost our creativity.

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MESSAGE FROM THE CEO

DEAR CUSTOMER,

Over the last few years, it has become increasingly clear that the single greatest vector for ensuring long-term success in the steel industry is to embrace the transition to "green" production methods. This means more than just optimizing plants for efficiency. Emissions have become an extremely relevant topic, and in order to move toward sustainable steel production, not only carbon emissions must be considered but also other substances typically found in the off-gas of a plant's production units—especially in the upstream area.

At Primetals Technologies, it is our ambition to pioneer the future of metals. Therefore, we are prioritizing the development of new green production solutions. Our multinational R&D teams are currently working on what I am sure will become the world's "best available technologies" for the decades ahead. We have many exciting products in our pipeline, and I look forward to sharing more information on these innovations with you.

One "best available technology" that is already on the market is the MEROS off-gas cleaning system, which has been ordered by steel producers around the world 15 times and counting. When this solution was first installed at voestalpine's sinter plant in Linz, Austria, everyone was shocked with how effective it was. After flipping the switch, all visible smoke coming from the sinter plant's stack suddenly disappeared. All that was left for the engineers to watch was the clear blue sky.

As Primetals Technologies operates worldwide, I am responsible for thousands of employees and numerous projects in many countries. I pay close attention to global developments, some of which have been very troubling. They reminded me of a quote by Japanese poet Kenji Miyazawa, who, when he was badly ill, wrote to his friend: 青ぞらと すきとほった風ばかりです—which translates as "I only see a beautiful blue sky and clear winds." I do wish for us all that we will soon get there.

Yours sincerely,



Satoru Iijima

CEO of Primetals Technologies
and Chairman of the Board



“ The single greatest vector for ensuring long-term success in the steel industry is to embrace the transition to green production methods.”

Satoru Iijima

CEO of Primetals Technologies and Chairman of the Board



— WITH —

PRIMETALS TECHNOLOGIES

Primetals Technologies supports steel producers everywhere in the world with innovative solutions. Find out how—in our project and company news.



- | | |
|----------------------------------|-------------------------------|
| 1. Sault Ste. Marie, Canada | 9. Dilovasi, Turkey |
| 2. Latrobe, Pennsylvania, U.S.A. | 10. Newcastle, South Africa |
| 3. London, U.K. | 11. Dolvi, India |
| 4. Genk, Belgium | 12. Dung Quat, Vietnam |
| 5. Freital, Germany | 13. Ho Chi Minh City, Vietnam |
| 6. Duisburg, Germany | 14. Fuding City, China |
| 7. Taranto, Italy | 15. Anshan, China |
| 8. Dąbrowa Górnicza, Poland | 16. Sydney, Australia |

Geographic locations of the project news topics discussed in this section



JSW's new casters have a total annual capacity of 4.5 million tons.

JSW'S TWO NEW CONTINUOUS SLAB CASTERS NOW FULLY OPERATIONAL AT DOLVI PLANT

The two new slab casters at the Dolvi plant take JSW closer to its target of producing 40 million tons per year.

INDIA: Indian steel producer JSW has started up a pair of 2-strand continuous slab casters at its Dolvi plant in the state of Maharashtra. The new casters have a combined annual capacity of 4.5 million tons, which is upgradeable to as much as 6 million. They are designed as bow casters featuring a straight Smart Mold, with a current metallurgical length of 34.5 meters and the option to extend the length to 36.9 meters. The cast slabs will be 220 to 260 millimeters thick and 900 to 1,650 millimeters wide. Casting speeds are expected to reach almost 2 meters per minute and could hit 2.1 meters after a future upgrade. Several advanced solutions uniquely available from Primetals Technologies ensure optimal caster performance—including the Mold Expert breakout-detection system, the LevCon mold-level control system, the DynaFlex mold oscillator, and the inline quality-control system Quality Expert. The combination of DynaGap Soft Reduction and the Dynacs 3D cooling model will enable JSW to cast pipe-grade and micro-alloyed steels. Primetals Technologies provided extensive operator training for the new equipment.

ATI is transforming its specialty-rolled-products business to serve customers in highly demanding market segments such as the aerospace and defense industries.

ALGOMA'S DOWNCOILER NOW POWERED BY NEW HIGH-QUALITY DRIVES

1. CANADA: Algoma Steel has issued Primetals Technologies with the final acceptance certificate for a modernization project executed at the company's Sault Ste. Marie plant. Algoma is one of only a few plate steel producers in Canada and serves customers in both Canada and the mid-western U.S.A. with competitively priced hot-rolled steel coil. The project aimed to replace the master drives at the hot-strip mill's downcoiler section. The new state-of-the-art drives were specified to use synchronous motors operating at 690 volts, which was unusual for Canada and necessitated the involvement of the country's standards association. Obtaining the association's approval took time, and Covid-19 put an additional burden on the project. But despite these challenges, the implementation of the new drives was completed ahead of schedule.



State-of-the-art drives for the direct strip production complex at Algoma Steel.



The new electric arc furnace supplied by Primetals Technologies began operation at U.S.-based steel producer ATI in Latrobe, Pennsylvania.

ATI TARGETS AEROSPACE AND DEFENSE INDUSTRIES WITH EAF-BASED STEELS

2. U.S.A.: Specialty-materials producer ATI has brought a new electric arc furnace into operation at the company's Latrobe, Pennsylvania, site. Primetals Technologies specifically engineered the furnace for foundry applications such as the melting and refining of high-end steels. It uses alternating current and is optimally equipped to handle small batches, varying charge sizes, and discontinuous production—all made possible by the fact that the furnace will not fracture if any leftover steel solidifies on its bottom in between batches. Increased efficiency and state-of-the-art controls contribute to a significant reduction in carbon emissions. ATI is transforming its specialty-rolled-products business to serve customers in highly demanding market segments such as the aerospace and defense industries. The implementation of the new furnace represents one crucial step toward this goal.



Well-sorted scrap is of great relevance to high-end producers relying on electric steelmaking.

PRIMETALS TECHNOLOGIES TO PARTNER WITH SICON ON THE DIGITALIZATION OF SCRAP YARDS

3. UNITED KINGDOM: Primetals Technologies and SICON have signed an agreement to develop holistic solutions for the comprehensive digitalization of scrap yards. The dual integration of innovations from Primetals Technologies and SICON, from optical scrap identification and the automation of production processes and logistics to the processing, analysis, and sorting of scrap, allow for "smart" scrap yards that automatically process input materials to create high-quality end products. Primetals Technologies and SICON have previously worked with steel producers to automate and digitalize processes related to scrap handling and are now developing holistic solutions to take scrap-yard digitalization one decisive step further. The technologies cover every step from the delivery of scrap to the feeding of the melting units. To save steel producers time and effort, interfaces between different modules are standardized, making it easier to define a producer's current demands, implement the modules required, and add further ones later if desired.



Second AOD converter to be implemented in existing plant at Aperam Genk

PRIMETALS TECHNOLOGIES TO SUPPLY NEW AOD LINE AND TO UPGRADE EXISTING AOD LINE AT APERAM GENK, BELGIUM

4. BELGIUM: Aperam Genk in Belgium has ordered a new argon oxygen decarburization (AOD) production line and an upgrade to the existing AOD production line from Primetals Technologies. The project aims to increase operational safety, improve operating costs, and reduce environmental impact by using a dedusting system with components for heat recovery. To meet these goals, Primetals Technologies will extend the existing material-handling system and provide Level 1 and Level 2 automation. The new Level 2 automation systems, installed on both AOD lines at Aperam Genk, will feature advanced process models that enable cost-efficient dynamic process control at the highest level of accuracy. They will also include condition-monitoring solutions capable of enabling predictive maintenance. Primetals Technologies will be responsible for the engineering and the supply of mechanical equipment—including transfer cars, electrical equipment, a new ladle-transfer crane, and primary and secondary dedusting systems. The new AOD will also be equipped with the Vaicon drive damper to reduce vibration loads and extend the lifetime of the equipment. The installation of the new AOD line will be scheduled to minimize downtime at the existing plant.

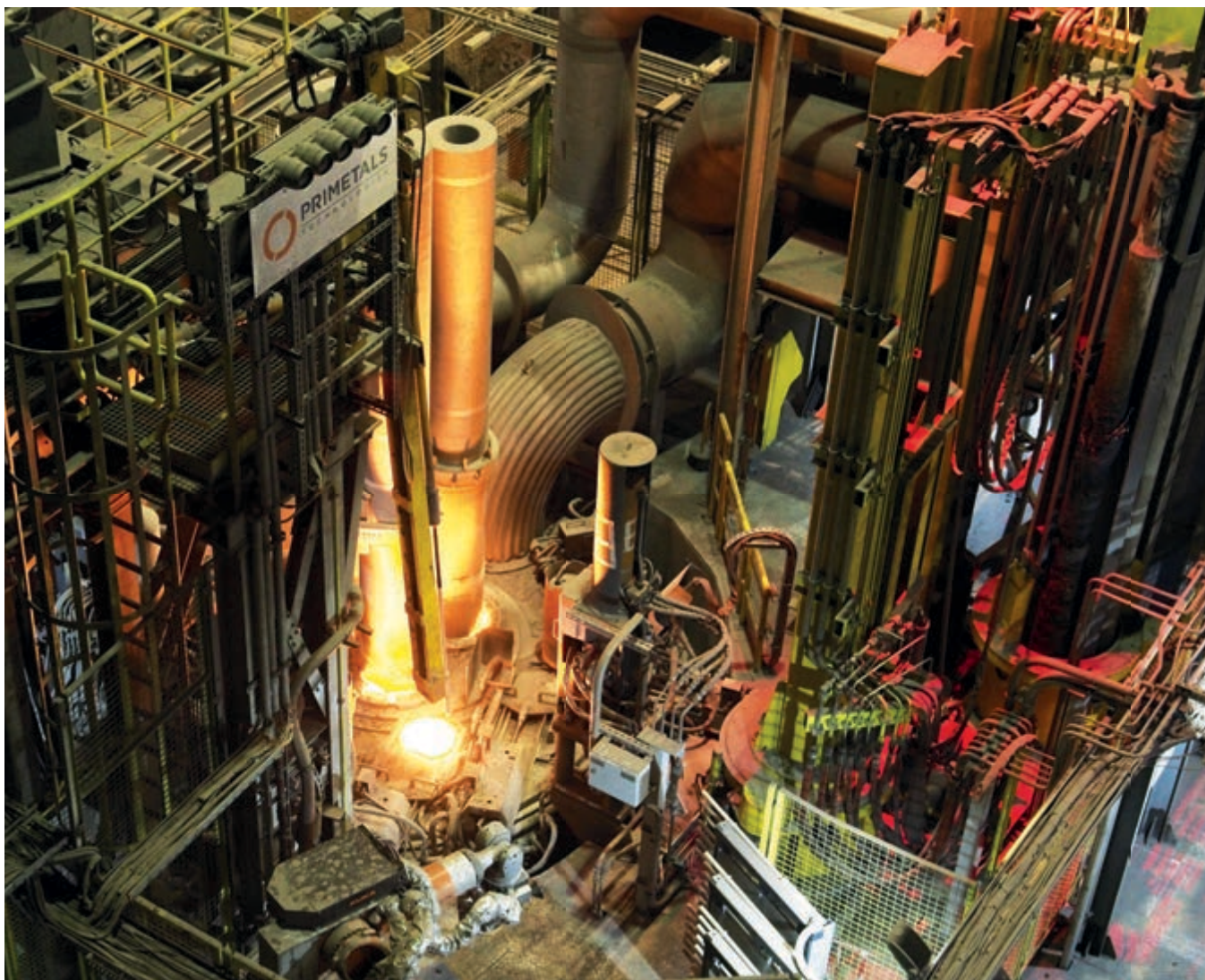
FAC GRANTED BY BGH EDELSTAHL FOR AOD CONVERTER IN FREITAL

5. GERMANY: The German steel producer BGH Edelstahl granted Primetals Technologies a final acceptance certificate for a new argon oxygen decarburization (AOD) converter, expanding the company's electric steelmaking facility in Freital, Saxony. Primetals Technologies supplied the 50-ton AOD converter, the alloying and material-handling system, the doghouse and primary gas-cooling system, auxiliary and ancillary equipment, as well as electrics and automation. The new converter supplements and reduces the workload of the existing vacuum oxygen decarburization plant and makes production more flexible, reducing the consumption of raw materials, refractory materials, and electrical energy requirements. The AOD converter also increases productivity with shorter treatment times while simultaneously improving the quality of the final product. The capacity of the extended steel mill corresponds to an output of about 120,000 tons of stainless steel and specialty steels per year.



New argon oxygen decarburization (AOD) converter from Primetals Technologies at BGH Edelstahlwerke in Freital, Germany

New Level 2 automation will feature new process models that enable cost-efficient dynamic process control at the highest level of accuracy and include condition-monitoring solutions.



One of two ladle-treatment stands with copper-clad lids and LiquiRob from Primetals Technologies

HKM RECEIVES TWO NEW LADLE-TREATMENT STANDS FEATURING LIQUIROB FOR DUISBURG PLANT

6. GERMANY: German steel producer Hüttenwerke Krupp Mannesmann (HKM) is one of Germany's largest steel producers. The company operates an integrated steel plant in Duisburg-Huckingen with an annual production capacity of 5.6 million tons of slabs and round bars, and a portfolio of over 1,800 different steel grades. HKM has granted Primetals Technologies the final acceptance certificate for two new 285-ton ladle-treatment stands featuring the LiquiRob robotic system for the BOF steelmaking plant. LiquiRob is replacing semi-automatic sampling solutions operated by personnel and can perform tasks from connecting or disconnecting equipment to and from the ladle to measuring temperature and hydrogen content. The application of this and other fully automated systems improves the safety and efficiency of the steelmaking process and primes the plant for further digitalization initiatives. Beyond reducing operational expenditures, the two new treatment stands will also increase the optional use of pig iron or scrap, optimize the use of lime, and reduce the amount of slag. All of these benefits will help to ensure high-end production.

A new gas-cleaning plant will increase dry dust recycling capabilities while reducing energy consumption in Dąbrowa Górnicza.

ACCIAIERIE D'ITALIA CONTRACTS THREE NEW FLUE-GAS TREATMENT SYSTEMS FOR TARANTO

7. ITALY: Acciaierie d'Italia has contracted Primetals Technologies and YARA Environmental Technologies to provide new flue-gas treatment systems for the three 160-megawatt boilers at power plant No. 2 in Taranto, Italy. YARA Environmental Technologies will supply a new economizer and their selective catalytic reduction and DeNO_x solution for the denitrification of flue gases, while Primetals Technologies will handle the flue-gas desulfurization and fine-dust separation. Power plant No. 2 is a conventional thermo-electric power plant built in the early 1970s; it will become significantly more environmentally friendly after the modifications. The new equipment will help Acciaierie d'Italia to save energy and optimize its carbon footprint. Primetals Technologies is already in the process of implementing seven MEROS off-gas cleaning systems for Acciaierie d'Italia in Taranto (see pgs. 52–59). The new flue-gas treatment plant is one more facet in the collaboration between Acciaierie d'Italia and Primetals Technologies on green production.



A 6.5-meter Tri-Ax cyclone, installed on a European producer's blast furnace

ARCELORMITTAL POLAND ORDERS GAS-CLEANING PLANT FOR BLAST FURNACE

8. POLAND: ArcelorMittal Poland ordered a gas-cleaning plant, including Primetals Technologies' patented Tri-Ax cyclone dust catcher and separator as well as a wet-gas scrubber, for its blast furnace No. 2 in Dąbrowa Górnicza. The new equipment will improve the site's environmental performance by increasing dry-dust-recycling capacities and reducing wet-waste processing requirements, energy consumption, and maintenance costs, thereby making the plant more cost-effective to run. Operating six production plants in the south of Poland, ArcelorMittal is the top steel producer in the country. As part of an ArcelorMittal R&D project and co-funded by the European Regional Development Fund, Mostostal Zabrze Realizacje Przemysłowe will lead construction on the pilot turnkey installation, as Primetals Technologies heads implementation and supplies key components.



ÇOLAKOĞLU ISSUES FINAL ACCEPTANCE CERTIFICATE FOR PART ONE OF SLAB CASTER MODERNIZATION

9. TURKEY: Turkish steel producer Çolakoğlu Metalurji issued the final acceptance certificate to Primetals Technologies for the first part of the modernization of the 2-strand slab caster at Çolakoğlu's Dilovası plant near Istanbul. The order includes Level 1 and Level 2 automation systems, the Mold Expert mold-monitoring solution, and the segment controller. The modernization of existing systems will improve product quality, enable the production of additional steel grades, increase casting speed, and boost production capacity. Due to travel restrictions related to Covid-19, Primetals Technologies relied on remote-collaboration tools in addition to on-site presence during implementation.

NEW BLAST FURNACE STAVES AT NEWCASTLE WORKS FOR ARCELORMITTAL SOUTH AFRICA

10. SOUTH AFRICA: Primetals Technologies will supply new cast-iron staves for the blast furnace at ArcelorMittal South Africa's steelworks in Newcastle, KwaZulu Natal. The new staves incorporate vital features like their well-proven fixing system and other patented and established anti-bending solutions. These innovations eliminate premature stove failure by preventing corner deformation caused by thermal effects. The design will result in reliable, predictable production for the entire life of the blast furnace.



HOA PHAT EXPANDS DUNG QUAT, VIETNAM, STEEL PLANT WITH FULL-FLEDGED PRODUCTION LINE

12. VIETNAM: Hoa Phat is expanding its plant in Dung Quat, Vietnam, with two slab casters, a hot-rolling mill, Level 1 and Level 2 automation systems, and comprehensive digitalization solutions. The project aims to increase production capacity by 5.6 million tons per year to meet the region's growing demand for steel. Through-Process Optimization, Primetals Technologies' fully integrated quality-control system, the digital assistant Asset Life Expert, and new scheduling solutions ensure a high level of equipment availability, reliability, and efficiency throughout the plant. With an annual capacity of eight million tons, Hoa Phat is the largest steel producer in Southeast Asia.

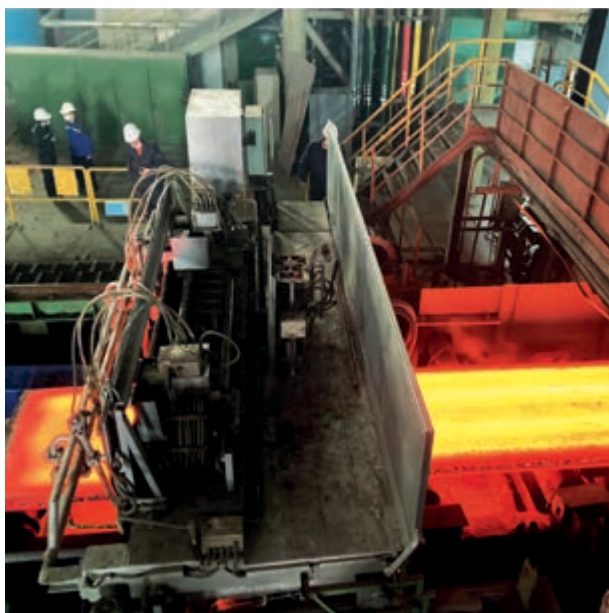
MARUICHI SUN STEEL'S HYPER UC-MILL FROM PRIMETALS TECHNOLOGIES PRODUCES ITS FIRST COIL IN VIETNAM

13. VIETNAM: Maruichi Sun Steel produced its first coil using its new Hyper UC-Mill supplied by Primetals Technologies in Ho Chi Minh City. Primetals Technologies' first-ever Hyper UC-Mill's in Vietnam answers the growing demand in the region for thinner, cold-rolled materials produced at lower investment sizes and maintenance costs. The Hyper UC-Mill uses a small-diameter work-roll drive with MH Spindle capable of withstanding high loads, developed to reduce rolling loads and maintain high-level shape control. Primetals Technologies' innovations ensure optimal strip-shape controllability even when rolling high-tensile steels. With its new Hyper UC-Mill, Maruichi Sun Steel has further strengthened its position as a producer of lightweight steel products in a growing market.



HENAN YAXIN'S FIRST ARVEDI ESP PLANT AND EAF QUANTUM FURNACE COMMENCE OPERATION IN FUJIAN

14. CHINA: Chinese steel producer Henan Yaxin began operating its new, eco-friendly minimill for flat products at its Fujian Dingsheng plant in Fuding City, China. The mill's groundbreaking design represents the first-ever combination of Arvedi Endless Strip Production (ESP) technology and the energy-efficient EAF Quantum furnace. Minimized energy requirements lead to a reduction in CO₂ emissions and operating costs, and point the way to a greener future of steel production. Compared to plants based on the integrated production route, Henan Yaxin's mill saves about 85 percent of carbon emissions. Primetals Technologies supplied the entire mechanical and electrical equipment for both the new EAF Quantum and the Arvedi ESP line.



ANGANG STARTS UP TWO MODERNIZED SLAB CASTERS

15. CHINA: Two continuous slab casters modernized by Primetals Technologies began operation at Chinese steel producer Angang Iron & Steel at its steelworks No. 2 in Anshan. Primetals Technologies implemented DynaGap Soft Reduction—a fully automatic roll-gap control system to minimize centerline segregation for improved internal strand quality—and advanced automation solutions designed to increase caster availability. The straight cassette-type Smart Mold is equipped with the Mold Expert breakout detection system, DynaWidth for automatic width adjustment, and the DynaFlex mold oscillator. Despite a challenging travel situation, the startup of both modernized casters was executed ahead of schedule.

Primetals Technologies' Hydrogen-Based Fine-Ore Reduction (HYFOR) technology is currently being piloted with Austrian steel producer voestalpine.

MHI ADVANCES HYDROGEN-BASED IRONMAKING

16. AUSTRALIA: Mitsubishi Heavy Industries (MHI) Australia and Primetals Technologies have joined Australia's Heavy Industry Low-Carbon Transition Cooperative Research Centre (HILT CRC). The non-profit center aims to develop technologies to decarbonize Australia's heavy industrial sector, including iron and steel production, by utilizing the country's natural and renewable energy resources and seizing new opportunities presented by certified low-carbon products. Over the next ten years, Primetals Technologies and MHI Australia will offer their decades of experience in iron and steel production alongside financial support to this effort. HILT CRC focuses on research and development of hydrogen-based direct reduction of iron ore, including Primetals Technologies' Hydrogen-Based Fine-Ore Reduction (HYFOR) technology currently being piloted with Austrian steel producer voestalpine. MHI is partnering with the government of New South Wales to propose a comprehensive development plan for the western Sydney region. MHI is also working with Hydrogen Utility (H2U) to support the Front-End Engineering and Design study for H2U's Eyre Peninsula Gateway project in southern Australia, a new development that will produce green hydrogen and ammonia. This partnership will contribute to MHI Group's aim to realize a carbon-neutral future—one of the most critical challenges of today—by helping to establish a robust hydrogen-solutions ecosystem in Australia and around the world.





CHRIS LINDNER

Head of Upstream Operations,
thyssenkrupp Steel

ANDY ROHE

Head of Downstream Operations,
thyssenkrupp Steel

DR. HARALD ESPENHAHN

Head of Quality, Technology,
and Environment Management,
thyssenkrupp Steel

MASTERFUL STRATEGISTS

THYSSENKRUPP STEEL HAS CRAFTED A MULTI-DECADE STRATEGY DESIGNED TO SUPPORT THE TRANSITION TOWARD E-MOBILITY.

As a central part of thyssenkrupp Steel's ambitious "Strategy 20-30," Primetals Technologies was tasked with projects that amount to a 9-figure order. It includes the revamp of a casting and rolling section, the modernization of a second caster, and the implementation of a new double reversing cold mill. What is thyssenkrupp Steel's plan?

“Our core ambition is to become a market leader for steel grades used for the manufacture of electric cars. The trend toward e-mobility could not be more evident.”

Dr. Harald Espenhahn

Head of Quality, Technology,
and Environment Management,
thyssenkrupp Steel

Is Europe—or, more precisely, Germany—a good place for steel producers these days?

Dr. Harald Espenhahn: Germany is Europe’s geographical heart. More than 40 percent of our customers are located within a 500-kilometer radius, and thanks to Germany’s central position within Europe, customers from other countries usually aren’t far away, either. Germany has an excellent logistics infrastructure, so you don’t have to have a coastal connection to ship your products quickly, easily, and economically. In fact, I think that thyssenkrupp Steel has the best inbound-outbound logistics setup of any European steel producer. Which of course is of great benefit to our customers in the automotive industry and beyond.

Does that mean that your logistics operate as if you were located by the sea?

Chris Lindner: You could certainly say that our logistics are as good as—if not better than—they might be for any direct coastal location. Our port in Duisburg is uniquely capable, giving us an enormous advantage.

Andy Rohe: Plus, all the major industries that are driving economic and technological development are in

the vicinity. We are based in an area that facilitates progress.

You are currently making strategic investments in your plants in Duisburg and Bochum with substantial involvement from Primetals Technologies. What are your business targets?

Espenhahn: Our core ambition is to become a market leader for steel grades used for the manufacture of electric cars. We started planning for this development in the summer of 2019, with the aim of anticipating what was to come. Today, the trend toward e-mobility could not be more evident—for instance, the European Union only recently presented its “Fit for 55” program.

And what are the technological changes you will be making to your plants?

Lindner: In essence, we are de-coupling casting and hot rolling so that the slabs we produce can be rolled using different mills, depending on circumstances and steel grade. You could say that it is our aim to have the slabs of the right quality ready for rolling at the right mill at the right time. »



“The investments we are making are tailored toward implementing the technologies we need to shift our product mix to a changed market.”

Andy Rohe

Head of Downstream Operations,
thyssenkrupp Steel

Espenhahn: Our previous production route was designed in the 1990s and was using a longer production chain that ultimately made interruptions more likely. Back then, the goal was to have a fast and energy-efficient production; we had a specific customer group in mind. But times have changed. Today, advanced high-strength and silicon steel grades have taken center stage. The planned de-coupling will facilitate our move toward these steel grades.

Will this de-coupling add to the complexity of your plant logistics?

Rohe: Actually, the new setup will be optimal in this regard. The two separate units, casting and hot rolling, will be right next to each other. With the planned modifications, the old continuous caster will be lowered in capacity, but the revamped second caster will compensate for that. We will be prioritizing the option to roll directly after casting but we won't be limited to this approach. We can flexibly choose the best process chain for every product we make. Certain grades—for example silicon steel grades—must be kept above a certain temperature during production. They would become brittle otherwise.

Does this mean that quality will be prioritized over capacity?

Espenhahn: Financing investments through capacity expansions, as was often the case in the past, will not be a solution of the future. So the answer to this ques-

tion is probably yes. The demands of our customers are constantly increasing. Therefore, quality will be the decisive criterion for success more than ever. This is another reason why we will reconfigure and modernize our plants with the help of Primetals Technologies, for example to produce silicon steel grades of the highest quality.

How did you develop your strategy that ultimately led to making the recent investments?

Rohe: We tried to establish what focus areas our customers would have in the future. We asked ourselves what they would require and how we could best support them with just the right products. Then, we worked our way backward to what we'd need to target to fulfill that demand: What kind of plants would we need? What would they look like? What would they have to be capable of? The investments we are now making are tailored toward implementing exactly the technologies we need to shift our product mix to a changed market.

And e-mobility was one of the trends you wanted to prepare for?

Rohe: Yes, e-mobility was one of the vectors that we considered to hold great potential—for us and our customers. Generally, when we came up with “Strategy 20–30,” we made a point of setting ourselves realistic targets based on actual demand as far as we could predict. Often, strategies are just bullet points on a



“Our products are a basis for our customers’ products. Any measure we take to add value to our products should add value to theirs.”

Chris Lindner

Head of Upstream Operations,
thyssenkrupp Steel

PowerPoint presentation with a pretty name on top. We wanted to go much deeper. Also, we wanted our strategy to be dependable and sustainable, so that it could really guide us through the planned 10-year period. We do not believe in changing our targets every other year.

What impact will a carbon border adjustment mechanism have on the European steel industry?

Rohe: We are critical of the current plans to introduce a Carbon Border Adjustment Mechanism. An inclusion of steel in the CBAM should only be implemented after an appropriate test phase and evaluation, but not from 2030. Steel is systemically relevant and by far the most internationally traded commodity and is not suitable for experimentation. Associated with such a step is the renunciation of the additional cuts in the free allocation of the European Emissions Trading Scheme planned from the middle of this decade by the CBAM.

Lindner: And regardless of this issue, we want to further improve our position in the domestic markets. We are partnering very closely with our customers in their product development. Our products are a basis for their products, and any measure we take to add value to our products should translate into added value for theirs. We work very hard to achieve this win-win situation.

Espenhahn: Also, I can’t image the German automotive industry relying exclusively on imports. It’s a great asset to have your partners nearby. Sharing the

»

A MULTI-DECADE RELATIONSHIP

The relationship between thyssenkrupp and Primetals Technologies is long and rich in history. The first documented transaction between Krupp, one of the predecessor companies of today’s thyssenkrupp, and Siemens, which would later co-found Primetals Technologies, dates back as far as 1851. On December 4 that year, 16 bars of cast steel changed hands for 27 talers—the German currency at the time. Many other deals and projects were to follow. In 1863, Siemens started the development of a new “regenerative” furnace design for customer Krupp. Only one year later, initial trial runs were conducted, and in 1869, the furnace went into full operation. The technology was a huge success not only for Krupp but for the steel industry at large. As a result, the new furnace was presented at the Exposition Universelle in Paris in 1889 as the world’s most advanced furnace technology for steel production. Since then, the relationship between thyssenkrupp and Primetals Technologies—if largely through its predecessor companies—has continued to grow. Today, the two partners look to an equally exciting future.



same language also makes things easier when you are involved in joint development. I think we are very well positioned for the future. In addition, we are of course observing the global steel markets and see, for example, a changed steel strategy in China that is more oriented towards meeting national demand, with less focus on exports. Nevertheless, we need effective European carbon leakage protection.

You have committed to producing carbon-neutral “green steel” from 2045 ...

Rohe: Yes, and we are really serious about that. There will be no “greenwashing” at thyssenkrupp Steel. Our plans are designed to ensure factual change. We will gradually replace our conventional blast furnaces with direct reduction plants that can operate on the basis of green hydrogen and thus in a climate-neutral manner. The first plant is scheduled to go into operation in 2025. By 2030, a second one, so that by then we will already be able to take six million tons of CO₂ out of the system and produce three million tons of CO₂-reduced steel. We want to be completely climate neutral by 2045 at the latest. Our plans are technologically mature. We are ready to go.

Is “Industry 4.0”—an Angela Merkel creation—still relevant to you?

Rohe: These days, “Industry 4.0” is largely a marketing buzzword. Our ambition was and is to determine how to implement what lies behind the term so that our customers profit from the measures we are taking. The aim is not to have this kind of futuristic manager’s pul-

pit you see in magazines, where every aspect of every process is displayed on monitors. Rather, we think it makes sense to have comprehensive data on the complete production chain, from the blast furnace to the end-product. This enables us to get even better at a couple of things: data-backed analysis, process control, product quality, order fulfillment, and of course accommodating specific customer requests.

The steel industry is not always portrayed favorably in the European press. Would you agree that our industry deserves a better reputation?

Espenhahn: I have three children, and because their dad works in the metals industry, they know what it takes to produce steel. But their peers don’t have the faintest idea. For most people, it is extremely hard to grasp the complexity of the processes we are dealing with, or the sheer size of the equipment involved. Everyone takes it for granted that, for example, their car doors look and function as they do. But hardly anyone appreciates how they are made. Young people have other interests. The steel industry to them represents a sector where you’d have to get your hands dirty if you chose to work in it. I feel there is a certain reluctance among our youngsters to do just that. At the moment, we are not regarded a “hip” industry. But consider our transformation to climate neutrality: this biggest change in our history has the potential to fundamentally change the image of the steel industry.

Lindner: We all know the saying, “you don’t miss it until it’s gone.” With industry, once it’s gone, it is

“At thyssenkrupp Steel, we are trying to prove that, in spite of a challenging environment, the industrial sector is still essential.”

Dr. Harald Espenhahn

Head of Quality, Technology,
and Environment Management,
thyssenkrupp Steel

usually gone forever. As a society, I don't think that we should choose that option.

Espenhahn: Industry creates value, and this is something we need—not only in Germany, but equally in Europe. At thyssenkrupp Steel, we are trying to prove that, in spite of a challenging environment, the industrial sector is still essential. We believe that steel production will have a firm place in Germany in the coming decades, and this is why we are making strategic investments in the country.

Do you think that the rise of e-mobility will change the perception of the steel industry?

Espenhahn: What's clear is that this transition will prove a major challenge for Germany. But we can't miss the boat for the associated re-orientation. One out of five people in this country are directly or indirectly employed by the automotive industry, if you include all the suppliers. If this industry were to move elsewhere, it would have massive consequences not only for Germany but for all of Europe.

What inspires you, working in the steel industry?

Espenhahn: Our great people—and our technologies, which are highly complex and present us with new challenges every day. Personally, I am an absolute fan of the Ruhr district [region of Germany in which thyssenkrupp Steel is located], including the local soccer clubs, especially “Rot-Weiss Essen”—Essen being the town I am from. Soccer, much like steel, to me is an integral aspect of this region.

Rohe: After all these years, I still find it exciting to work here. Of course, I also have my roots in the Ruhr district. Thanks to the company, I have been able to see many other parts of the world, and my travels have become a major influence on my decision-making today. It is a fascinating task to orchestrate the many processes that happen inside a steel plant; all the things you must watch out for to get good results. We are dealing with extremely high-level technologies, even though sometimes they may not be fully visible. Also, we are partnering very closely with our customers, which I really appreciate and enjoy. We have a very direct and effective way of communicating. And we do have a great team: When dealing with difficult decisions, we will sometimes get into heated arguments about what direction to take. But afterward, we always find common ground and move forward together. It is a great working environment because it gives you a sense of purpose.

Lindner: I was introduced to the steel industry by my father, who got me summer jobs at the company, for instance, working at the converter. I always found it fascinating that there was no direct way of controlling the converter—any control was only ever intermediate. Apart from that, each day brings something new and unexpected. After 33 years of working in steel production, I still learn a lot. And even though I have worked in different plants, the mentality has always been the same. Our people are very hands-on, direct, passionate, and very resourceful. They never cease to amaze me. ●

THYSSENKRUPP TAKES A GREAT LEAP FORWARD

thyssenkrupp Steel has chosen Primetals Technologies as its partner for turning an inspired vision into reality: the two companies will be executing three major projects together, which will enable thyssenkrupp to produce silicon, advanced high-strength, and dual phase steel grades for the automotive industry.

At the **Duisburg-Bruckhausen** site, the existing continuous casting and hot rolling plant will be modified so that the caster and the mill are decoupled. As a result, slabs can either be rolled directly after casting—or moved to an intermediate storage area, from where they are then taken to the ideal mill for the respective steel grade. Thanks to this upgrade and the advanced

process-automation solutions that come with it, thyssenkrupp's customers can expect products of even higher and more consistent quality, faster order turnaround times, and an optimized product mix.

The caster at thyssenkrupp's **Duisburg-Bruckhausen** plant will be completely rebuilt to support the production of strip of the highest metallurgical properties. This comprehensive modernization will also make a massive contribution to thyssenkrupp's future overall capacity.

In **Bochum**, a double reversing cold mill will be added to the existing cold mill. This measure will help to make the production of electrical and multi-phase steels a reality.



FIG. 1: thyssenkrupp Steel is located in the Ruhr district—an area of Germany well-known for its industrial prowess. The image underlines the importance of the river Rhein for thyssenkrupp Steel's logistics infrastructure. The port in Duisburg is a world-class hub, enabling the company to ship its products quickly and easily.

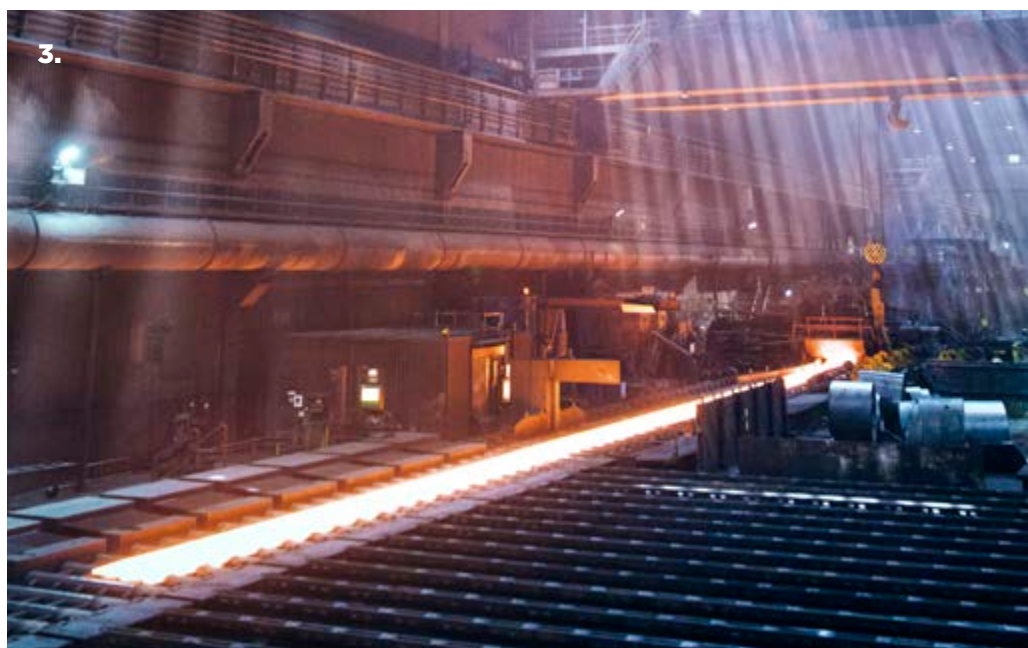


FIG. 2: As part of thyssenkrupp Steel's "Strategy 20-30," two continuous casting machines will be rebuilt. In one case, the caster will be revamped and decoupled from the hot-rolling mill; in the other case, the caster will be modernized from the ground up to improve the surface quality of the strip ultimately produced.

FIG. 3: Hot rolling will continue to play a major role in thyssenkrupp Steel's future production strategy. This is in spite of the planned decoupling of the continuous caster from the hot-rolling section at the Duisburg-Bruckhausen plant. Certain steel grades—such as silicon steels—necessitate almost immediate rolling after casting.



Learn more about the projects thyssenkrupp Steel is currently executing with Primetals Technologies.

meta.is/thyssenprojects

FUNDING A ZERO-CARBON FUTURE FOR STEEL



Decarbonizing the steel industry will cost more than 1.4 trillion dollars. The emerging sustainable-finance market has a key role to play in funding the transition.

As the European Union pushes forward with an ambitious roadmap for a sustainable, “no net emissions” future, Claire Coustar, Head of ESG, FIC, Deutsche Bank, explores how the steel industry can ensure it has the funding needed to support—and even drive—this green transition.

The world is stepping up its efforts on a momentous project—the fight to limit the damage from climate change. Pre-eminent among the battle objectives is the call to reduce CO₂ emissions for energy-intensive industries in order to meet climate targets. Nowhere is this more apparent than in the steel sector, which, according to the World Steel Association, accounts for nearly 9 percent of all direct fossil-fuel emissions globally.

The European Union has traditionally been at the front line. As the bloc follows a path toward net zero emissions by 2050—the primary goal of the European Green Deal, whose latest proposals were announced in July 2021—the process of “greening” the steel industry has gained more urgency. And other major steel producing economies are proceeding along similar lines: both Japan and Korea have announced net-zero targets and even China is now on a zero-carbon deadline. But with the industry still feeling the effects of faltering

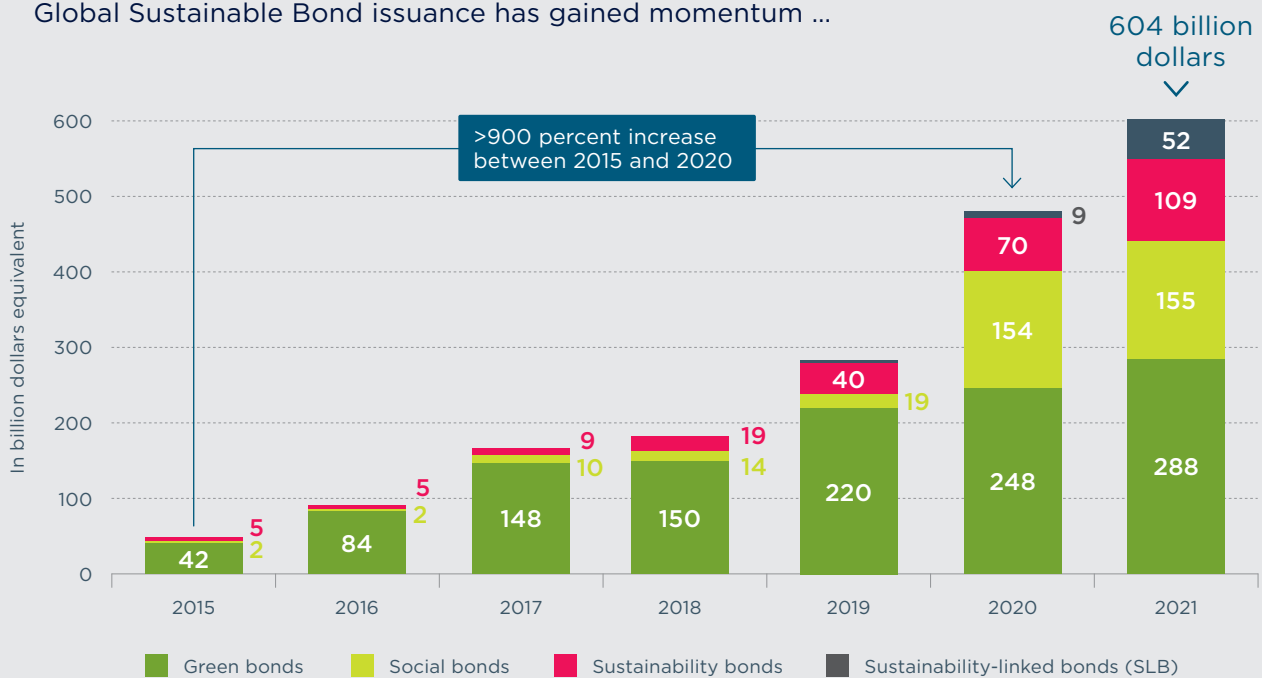
demand and disrupted supply chains, how can it secure the significant funding needed to make this vision a reality? The emerging sustainable-finance market has a key role to play.

GREENING THE INDUSTRY

A concerted, global effort to decarbonize the economy is underway—one that aims to shift the energy mix away from fossil fuels in moving toward a renewable future. As part of this journey, several ambitious targets have been laid out by governments and corporations alike. The biggest of these is the Paris Agreement, a legally binding international treaty on climate change. Adopted by 196 parties, the agreement aims to limit global warming to well below 2 °C—preferably to 1.5 °C—compared to pre-industrial levels.

To ensure sustainability efforts stay on track, Europe has laid out a comprehensive roadmap to prepare »

Global Sustainable Bond issuance has gained momentum ...



Source: Bloomberg, Deutsche Bank

the continent for a net-zero future. In December 2019, the European Commission announced the “European Green Deal”—the bloc’s most ambitious attempt to date to counter climate change and environmental degradation. In line with the Paris Agreement, the initiative targets zero net emissions of greenhouse gases by 2050 and is underpinned by a series of interconnected goals covering almost every element of the economy, including energy, construction, agriculture, and transport.

Meeting the aims of the Green Deal involves a massive funding injection for every part of the economy, in every industry and across every sector. At least 1 trillion euros in funding is needed for the coming decade and while a large share of this will come from the E.U. budget and national governments, a contribution worth 279 billion euros is required from the private sector. Looking only at the steel sector (but taking a global view) the IEA has projected a cumulative need for investment of around 1.4 trillion dollars until 2050.

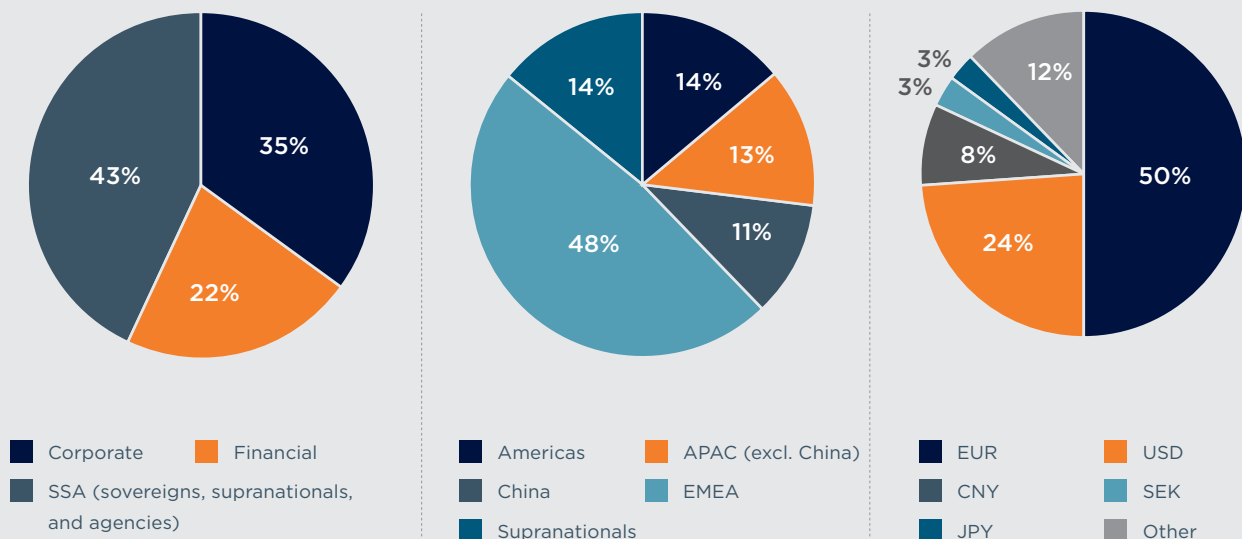
This presents a huge challenge for banks, and also a huge opportunity. Capital will need to be allocated, and banks—those best positioned to support sustainability—can be there to provide it. But how exactly will the funding be achieved?

INTEGRATING ESG INTO FINANCE

The shift toward sustainable financing—with tools linked to “ESG” criteria: environment, social, and governance—has already begun. It is best illustrated by the recent, exponential growth of the green-bond market. Ten years ago, it had yet to develop, yet fast-forward to today and total market capitalization recently surpassed 1 trillion dollars. In the past decade, the market for both green bonds and green financial instruments in general has expanded significantly. For example, social bonds have seen a significant surge, especially since the onset of Covid-19, while the market for sustainability-linked instruments (which tie the cost of the financing to performance on ESG metrics) has also grown substantially.

In part, this growth is down to the increasing awareness among corporates of the urgent need to tackle climate change, but it is also being driven by governmental and regulatory policies. For instance, in June 2020 the European Union published its Taxonomy Regulation—a classification system for green investments that, it is hoped, will be instrumental to the E.U. scaling up sustainable investment and implementing the European Green Deal. Under the taxonomy, activities are considered to be “green” if they substantially support one (or more) of six objectives: climate change mitigation;

... with a healthy split across sectors and a focus on EMEA and euros



climate change adaptation; sustainable use and protection of water and marine resources; circular economy; pollution prevention and control; and biodiversity. By providing a common language, issuers will be able to more easily demonstrate how their efforts align with the Paris Agreement and goals of the European Green Deal, while investors should more easily avoid the reputational risks of associating with activities that undermine environmental objectives.

CHALLENGES FOR THE STEEL INDUSTRY

Among the largest contributors to carbon emissions is the steel industry. And even Europe, with all its modern

assets and infrastructure, has much remedial work to do. Recent statistics from industry group Eurofer show only around 40 percent of the 160 million tons of crude steel produced in the E.U. comes from electric furnaces—both arc and induction. The rest involves traditional blast furnaces—a good indication as to why carbon emissions run so high in this industry.

Indeed, after the power-generation sector, iron and steel is the largest industrial producer of CO₂ emissions in Europe—with the industry currently generating 221 megatons of greenhouse-gas emissions annually, representing 5.7 percent of total E.U. emissions. Reducing CO₂ levels for this energy-intensive industry will, therefore, be central to meeting the E.U.'s climate objectives.

Working toward this goal, over the past year major mining and steel companies have put a significant focus on climate-change disclosure—with many corporates having now adopted the major voluntary reporting guidelines, including the Global Reporting Initiative and the Financial Stability Board's Task Force on Climate-related Financial Disclosures (TCFD).

At the same time, individual companies are stepping up to the plate. In September 2020, ArcelorMittal, the world's largest steelmaker, became the first to »

Many companies are announcing their own net-zero goals, but these efforts will be costly.

pledge net-zero emissions by 2050, with plans to combine small amounts of hydrogen with coal in a blast furnace, as well as substituting wood biomass for coal in processes. Unfortunately, these efforts will prove costly. The company estimates that decarbonizing its facilities in Europe alone—in line with the E.U.'s Green Deal—will require between 15 billion and 40 billion euros and won't be profitable before the 2030s. And the price is estimated to be just as eye-watering for others in the industry, with a July 2021 Deutsche Bank Research paper, titled "Can Mining & Steel sustain in a low carbon world?," reporting that the capex bill for European carbon steel over the next 10 years could reach 20 billion dollars for the already capital-constrained sector.

European steel has been struggling in recent years, hit by the trio of stagnating demand, international-trade distortions, and the impact of Covid-19 on supply chains. At the same time, the industry is expected to turn its attention to a complete rethink of its existing processes to facilitate substantial reductions in emissions—something it has to do quickly and at great expense. As explained in the European Commission's report "Towards Competitive and Clean European Steel," these headwinds, combined with the cost and urgency of upgrades "make for an exceptionally challenging business environment and illustrate many of the challenges that E.U. industry at large faces." So how exactly can the struggling industry meet these capex demands? One potential route is through the sustainable-financing market.

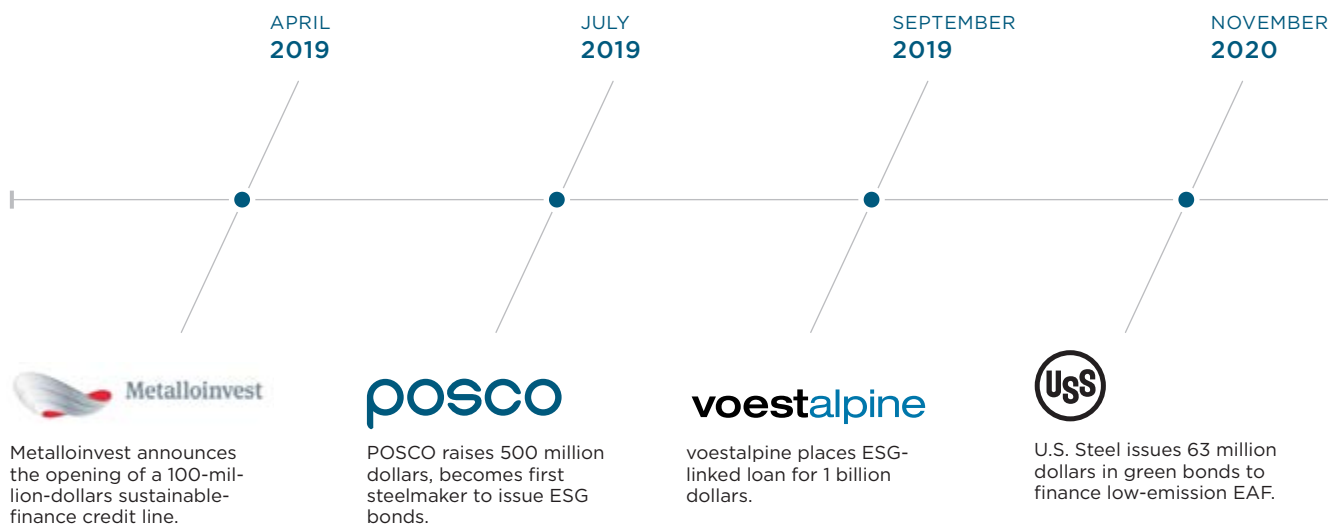
INTEGRATING ESG INTO STEEL

As noted, financial products that meet ESG criteria have enjoyed increasing demand for several years—not least within the steel industry. Given the high levels of

emissions produced by its members, the prospect of reconciling the desire for returns with personal or institutional values is particularly resonant. Interest in the markets has been building rapidly in recent times. For example U.S. Steel launched its inaugural, 60-million-dollar green-bond issuance in December of 2020 to finance a new electric arc furnace. In early 2021, Hyundai Steel received 1.9 billion dollars in orders for its green bond issue. And Indian steel company JSW recently raised 1 billion dollars with sustainability-linked bonds (SLB), becoming the first company in the steel sector to issue an SLB in hard currency.

It's not just the bond market that is making an impact. In November 2020, Deutsche Bank and Primetals Technologies agreed the world's first hedging concept that links currency hedges to sustainability goals. The framework enables the supplier of plants, equipment, and services to hedge its currency risk with FX derivatives over a 4-year period, with the product offered on the basis of the company's wider ESG performance based on pre-agreed metrics. These metrics are in line with the new Sustainable Finance Framework published by Deutsche Bank in July 2020. This sets out the classification of ESG financing and other financial products, which is aligned on a best-effort basis to the E.U. Taxonomy Regulation.

The targets were developed in consultation with the external independent consultancy Environmental Resources Management, which will be monitoring Primetals Technologies' ambitious targets, with a remit to annually assess whether the targets have been met. Among the goals are the percentage of projects sold in total sales that lead to a reduction in greenhouse-gas emissions for the customer; the ratio of sales to expenditure on research and development for product



If the steel industry is serious about bringing together its own ambitions with those of the E.U.'s Green Deal and other emerging frameworks, then steel companies must begin to tap into this market.

solutions that lead to improved resource efficiency; and the promotion of a safe and healthy work environment for all Primetals Technologies employees. If the company fails to meet these agreed sustainability targets, it pays a predefined sum to a contractually defined non-government organization.

Going forward, it is clear that the industry needs to keep up-to-date of what is occurring in the sustainable finance space. This is a trend that is long-term—and if the steel industry is serious about bringing together its own ambitions with those of the E.U.'s Green Deal and other emerging frameworks, then companies must begin to tap into this expanding market. The capital expenditure needed to green steel might be substantial but, with the potential and desire now in place, there is a clear path forward for the industry. ●



A LIFE IN FINANCE

Claire Coustar is Managing Director, Global Head of ESG for Fixed Income & Currencies at Deutsche Bank. Claire joined in 2003, and during her tenure she has held various positions across structuring, sales, trading, and governance; including Head of Emerging Market Structuring and Co-Head of the CEEMEA Structured Credit Trading. Prior to Deutsche Bank, Claire held various positions in the New York and London offices of Merrill Lynch, including Commodity Derivative, European Securitization, and Latin America Structured Products groups. Claire holds a Bachelor of Science degree from Babson College with major in Finance, Economics, and International Business and a Non-Executive Director Diploma from the Financial Times. Claire represents Deutsche Bank in the Net Zero Banking Alliance, is a member of the Group Sustainability Council, and represents the Investment Bank on Deutsche Bank's Green Bond Forum. Claire sits on the Fixed Income and Currencies Executive Committee of Deutsche Bank and is Vice-Chair of the Board of Directors of Deutsche Bank Turkey.

NOVEMBER
2020

JANUARY
2021

APRIL
2021

AUGUST
2021

SEPTEMBER
2021



Primetals Technologies and Deutsche Bank create ESG-linked hedging concept for currency options.



Hyundai Steel receives 1.9 billion dollars in orders for green bonds.



ArcelorMittal

ArcelorMittal links 5.5-billion-dollars Revolving Credit Facility ESG goals.



POSCO raises 1.1 billion euros in convertible green bonds.



JSW raises 1 billion dollars in sustainability-linked bonds for decarbonization efforts.

A VISION FOR HUMANKIND

**INTERVIEW WITH PROF. THOMAS STEPHENSON,
DEPARTMENT HEAD OF PSYCHOTHERAPY SCIENCE
AT SIGMUND FREUD UNIVERSITY, LINZ, AUSTRIA**

Over a century ago, the theories of Austrian neurologist Sigmund Freud began to conquer the world. The unconscious, the Oedipus complex, the interpretation of dreams: today, Freud's ideas are an integral part of what Western cultures believe to be the fabric of the human condition. They have also made massive contributions to scientific disciplines such as psychology and sociology. Prof. Thomas Stephenson leads the psychotherapy science department of the Linz location of Sigmund Freud University. We sat down with him to discuss what makes us tick, what makes us innovate, and what we should make of the post Covid-19 situation.

Professor, you are leading the psychotherapy science department in Linz—is this a new academic field?

Professor Thomas Stephenson: The field itself, strictly speaking, is not new—because much research has been done in the wider academic realm. But Freud always wanted his ideas to live on in universities, and it was only with the founding of Sigmund Freud University in 2005 that this goal was truly met. Having said that, here in the psychotherapy science department, we are indeed facing the specific challenge of establishing a new research method. Not all aspects of the traditional scientific approach apply here; we are focusing on the subjective and the intersubjective experience of individuals, and are thus dealing with some very fluid subject matter.

Covid has affected the mental health of many. What are the signs indicating that one should seek advice?

Stephenson: I think that Covid is causing a lot of fragmentation and deterioration—in our societies in general but also in families, couples, and individuals. This is a global phenomenon. Prior to Covid, a limited number of people were showing troubling symptoms. Many others, who may have had a disposition, were able to suppress their problems and keep them underneath the surface. Now, what Covid has effectively done is lower the threshold for these issues to appear and cause problems. So if you notice that your emotions or your thoughts have changed—that you are feeling and thinking things that seem foreign to you—you may be suffering from the



“ I see us living in a world where each and every one of us is free to do what they are actually good at.”

stress inflicted upon us by the pandemic and its ramifications. There are usually three ways in which humans react to stress: fight, flight, or freeze. The “fight” reaction can lead to violence, the “flight” reaction to addictions including spending excessive amounts of time online, and “freeze” manifests in apathy and depression. None of these outcomes is very desirable.

How can companies best prepare their workforce for the time after Covid?

Stephenson: The obvious answer is that companies should hire an adequate number of psychotherapists [smiles]. But I do have a vision for the post-pandemic future, and it centers around a new mindset that puts

sustainability at the center of our activities. Today, we still live in a world that encourages competition, over-production, and the generation of artificial needs. We have become predators without instincts or boundaries, and we are rewarded for aggressive behavior. Consequently, our potential for destruction is enormous. I feel that change is due, and is coming—in part because of Covid. Our idea of work will undergo a deep transformation. For that to happen, the East and the West will have to unite, open up, and learn from one another, so as to let a new mindset emerge. Eventually, I see us living in a world where each and every one of us will be free to do the things we are actually good at. Life will feel much more meaningful under these new circumstances. »

“Digitalization has called into question our understanding of the human mind and of human consciousness.”



Is there an intersection between psychotherapy science and technology?

Stephenson: Yes, both areas have been impacted by digitalization—first of all because digitalization has revolutionized how we communicate. Even more importantly, it has called into question our understanding of the human mind, by virtue of new advances in artificial intelligence. Will AI ever reach a level of consciousness that compares to that of a human being? And if so, to what extent will this new consciousness be of a personal or interpersonal nature? I think that many disciplines are trying to answer this fascinating question.

Are there any other recent technological developments that have captured your imagination?

Stephenson: CRISPR gene editing comes to mind. It prompts many ethical questions. It makes you think about what it is that defines us as individuals. And it reminds us of the distance we still have to go to arrive at a holistic understanding of the human condition.

Is there any one innovator you particularly admire?

Stephenson: Prometheus. He was the forefather, the pioneer, of all innovation. When he saw a new path opening up before him, he simply had to take it—no

matter what. He lived and breathed total dedication.

"There is something that needs to be done for the good of all humankind, and I am the only one who can pull it off"—it was this belief that fueled his determination. Even though he is a mythical figure, I find him utterly inspiring.

Is innovation necessarily disruptive, or is incremental refinement just as good?

Stephenson: I think that both principles are valid and have their place. Personally, I tend to lean more toward promoting disruptive innovation—it is just more fascinating to me. But there is one aspect to incremental progress that I appreciate quite a bit: If a researcher provides the scientific community with a comprehensive, "big picture"-type overview of the current state of affairs in their field, this can be an excellent basis for future contributions. We all need these kinds of contextual frameworks—even if we then choose to act more disruptively ourselves. In the field of psychotherapy science, we encounter both principles: when individuals learn to re-tell their personal story—to re-frame their lives—, they may do so taking small steps or giant leaps.

What's the best method for nurturing creativity?

Stephenson: The answer is simple. It is love.



What's the next big thing in the humanities, and in psychotherapy science in particular?

Stephenson: My inner prophet tells me that three things will be of the essence: affectedness, mindfulness, and humility—all subjects on which I would like to see people write books. Due to Covid, we are now all in the same boat: We are all concerned, all stuck in the mud. Collectively, we'll have to come to our senses. And then we must all be humble and appreciate that, in a world of great diversity, there can be no moral high ground. There is no universal right or wrong, and yet we must find common ground to move on after the pandemic.

And if we should struggle to achieve this unity in diversity, we might turn to psychotherapists for help ...

Stephenson: That's exactly right.

You are based in Linz, which is often called the "City of Steel." Do you find the designation appropriate?

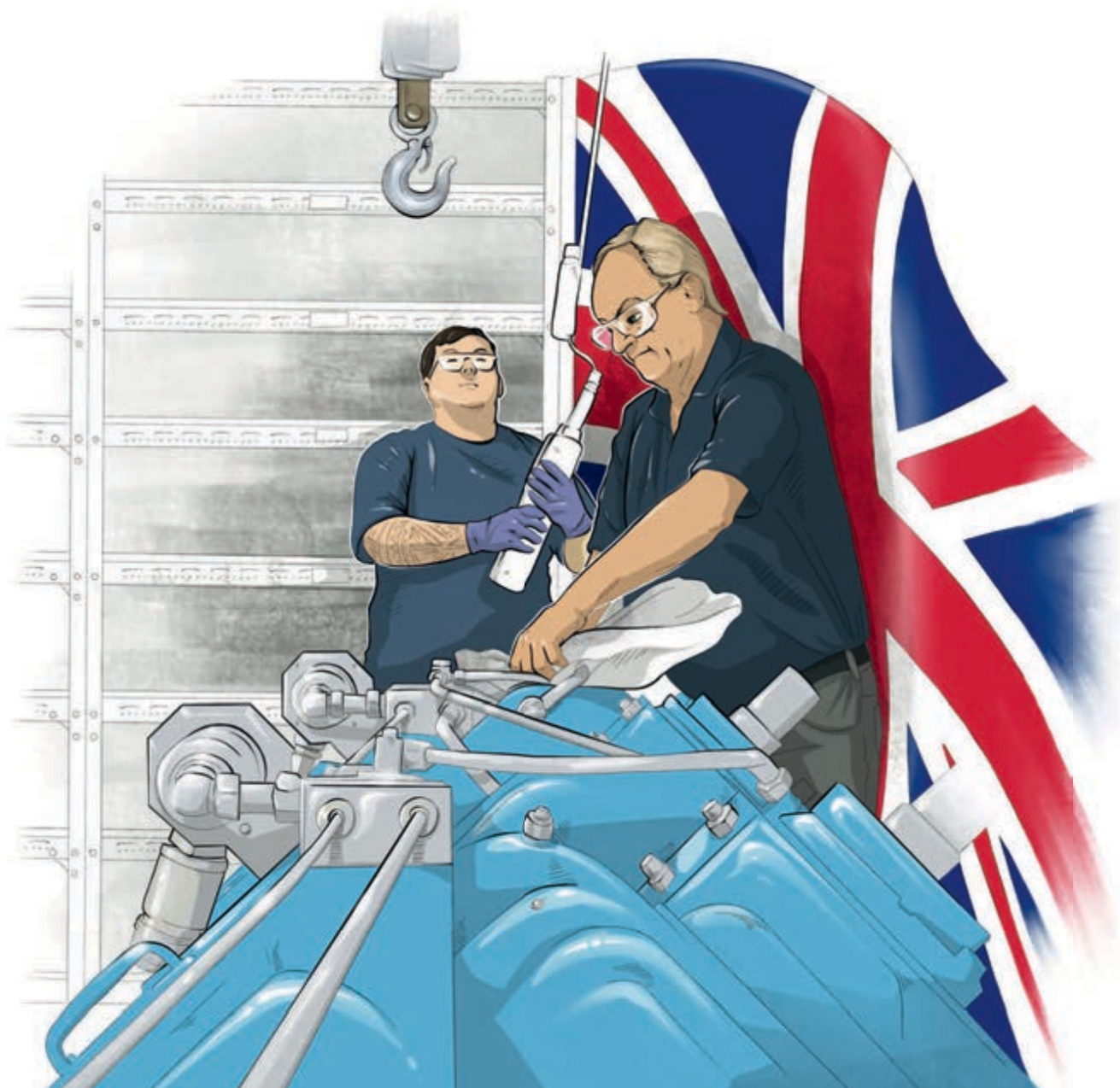
Stephenson: A few decades ago, Linz was almost universally thought to be a dirty place. Today, this could not be further from the truth. Linz has become one of the cleanest cities I know. Socially and culturally, it also has a lot to offer. I am glad to be here and to make my contribution to the educational landscape in Linz. ●

SIGMUND FREUD UNIVERSITY

Founded in 2005, Sigmund Freud University quickly grew beyond its base in Vienna, Austria, and currently extends to locations in Linz, Berlin, Paris, Ljubljana, and Milan. The university's first program was psychotherapy science, but it eventually added psychology, medicine (including dentistry), and law to its disciplines. Sports science will be the likely next step as the respective accreditation process is already underway. While Sigmund Freud University in total has over 5000 students and employs more than 1100 staff, the Linz location is still expanding and presently focuses on psychotherapy and psychology. Professor Thomas Stephenson has been associated with Sigmund Freud University since 2009 and has been leading the psychotherapy department in Linz since 2019.

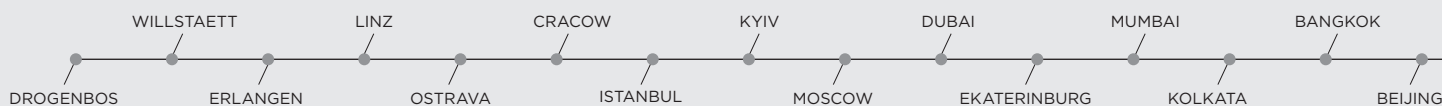
To learn more, visit www.sfu.ac.at/en

SKATING TO WHERE **THE PUCK WILL BE**



The workshop staff at the Sheffield company location recondition various parts used in the rolling of flat and long products.

SHEFFIELD IS THE FEATURED COMPANY LOCATION IN THIS EDITION OF METALS MAGAZINE



Sheffield has been one of the cornerstones of British steel production for centuries. Rather appropriately, it is also home to the largest company location of Primetals Technologies in the U.K. About 175 engineers, project managers, sales experts, and services specialists cater to a global customer base—with solutions and support designed to point the way to the future of metals production. Metals Magazine's Dr. Tom Widter reports from the "Steel Capital" of northern England that was famously built on seven hills.

"You simply have to! There is just no other way to get it right," insists Paul Sherman. I first met Sherman four years ago when he was manager of the Christchurch location of Primetals Technologies in the south of England. These days, he runs the company's Metallurgical Services division for the U.K. from Sheffield in South Yorkshire. Then, as now, his charisma and energy are incredibly infectious. But what is Sherman talking about so passionately? What is the insight he wants to share with me?

On Paul's whiteboard is written a famous quote by ice hockey legend Wayne Gretzky: "I skate to where the puck is going to be, not where it has been." This is Sherman's philosophy for making business decisions in a nutshell. A pioneer at heart, Sherman knows that the metals industry requires business leaders to make smart, forward-looking decisions. You can't rely on what worked yesterday; you need to focus on what's to come. As I explore the Sheffield location of Primetals Technologies, I learn that this mantra holds true pretty much throughout. This place is all about anticipating what the world of metals will look like in the coming decades—in terms of technologies, innovations, and services. As far as staff count goes, it is the largest of the Primetals Technologies company locations in Great Britain, with some 175 employees. Within the wider company network, it plays a central role. Clearly, it is well worth a visit—even in times of Covid. Which of

course begs the question how my journey went. "Did you get here okay?" Sherman asks.

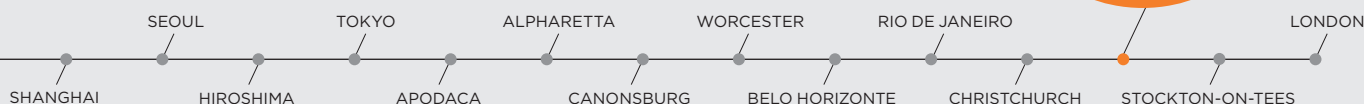
TRAVEL IN TIMES OF COVID

The journey from Linz, Austria, to Sheffield has been neither easy nor straightforward. In the days leading up to my departure, I find that Coronavirus-related travel guidance is changing continually, meaning that I have to hastily book a "Day 2" Covid test—to be taken on the second day after my arrival—just hours before take-off. It is a requirement for obtaining the paperwork I need to enter the U.K. Add to that my printed vaccination certificates and a confirmation that this qualifies as a business trip—there's a whole lot of prep work. When my plane finally lands at Manchester airport, I could not be happier or more relieved.

As I drive to the Sheffield company location for the first time, it strikes me that the steel industry has been a fixture in the region for generations. In these turbulent times, it is good to encounter moments of stability. Long before Primetals Technologies was formed in 2015, what is now the Sheffield location began life in 1837 as the Davy company—started by two brothers who were skillful and versatile engineers. After a few transformations and name changes, Davy was eventually bought by Linz-based VAI in 1999 and became part of Siemens six years later. Today, the location continues to play a central role in the U.K. operations »

SHEFFIELD

The company location in Sheffield is the U.K.'s largest and serves metals producers all around the world.



of Primetals Technologies, with a reach far beyond the British market.

Having survived the ordeal of air travel, I find the drive from Manchester to Sheffield to be pure pleasure. It leads me through the Peak District—an area of stunning natural beauty that became the first of the national parks of England and Wales back in 1951. As I pass by grazing sheep, charming old buildings, and the odd pub, I begin to appreciate the special atmosphere so unique to the region. Sheffield was built on the eastern foot of the Pennine Hills, and I can clearly see the benefits as I approach the city. Even today, some sixty percent of the greater Sheffield area is green space, with over 250 parks, woodlands, and gardens—if you enjoy nature, this is a great place to live.

My destination is a modern-looking building in the “Sheffield Business Park.” Its three floors house the offices for engineers, sales staff, and services specialists. Right next to it, you’ll find a workshop and an innovation center, which is pioneering 3D printing, video animation, and other technologies. This much I already know from earlier briefings. Curious to find out more, I park the car and ring the doorbell, which has been installed on account of Covid. Esther Edwards, marketing manager extraordi-

naire, has already been expecting me and lets me in. Most of the staff are now back at the office, she explains, especially those who work in Services. For a while, everyone was asked to work from home as much as possible. Talking to Edwards, I soon understand that, during my visit, there will be slightly more emphasis on the services side of things, as it is the most well-staffed at the time.

“Have you noticed that Boeing is one of our immediate neighbors?” Edwards asks. “It is their only manufacturing site outside of Seattle.” She explains that Sheffield is an advanced-manufacturing hub for numerous companies, including McLaren Automotive and Rolls Royce. “The University of Sheffield is partnering with many of the local businesses—with programs designed to teach students the skills they require to become the city’s future workforce, and with dedicated company-specific projects.”

EXTRATERRESTRIAL DESIGN

One employee who came to Primetals Technologies directly from university is Rhodri Evans. Together with his colleague Peter Kilham, Evans is on a mission to bring 3D printing to the metals industry. Some of Evans’ many creations are spread out on a large table. They look otherworldly, almost alien—as if they have come from a distant future and traveled through time.

TOURING THE WORKSHOP AT THE SHEFFIELD LOCATION



Quality-control team leader Kyle Bowskill demonstrates a coordinate measuring machine used to inspect incoming parts. It is accurate down to 0.029 millimeters.



Harry Grindle, apprentice mechanical engineer, and Kevin Roe, mechanical fitter, closely examine a stripper nozzle. Grindle makes sure their findings are well recorded.



The workshop handles over 2,500 parts per month. As a result, the logistics can become a bit tricky. But the services staff is highly organized and keeps workspaces very tidy.

"This is the design for a swing arm," Evans says as he picks up something that is eerily similar to tree branches, only they have grown together in a way you would not expect: the structure of the piece resembles that of a network of asymmetrical rods of varying thicknesses that somehow chose to form a strange union.

Evans tells me that there are several principles in which additive manufacturing is different from the traditional subtractive approach. Had Evans constructed the arm the "old" way, he probably would have cast it in steel or aluminum. Once out of the mold, the arm would have been machined. Evans would have drilled some holes, cut away unnecessary parts, and softened the edges. Each manufacturing step would have introduced additional labor, with significant build-up of waste from everything that had to be subtracted after casting.

But additive manufacturing has revolutionized the process: "Roughly speaking, we create our designs in the computer based on analyses of the distribution of stress inside that particular part," Evans explains. "So what you, Tom, just referred to as 'tree branches' is effectively the physical representation of the strain we expect this part will have to handle." In other words, the arm was built to its precise purpose and designed

to deal with the real-world stress it will be experiencing, with minimal labor and no wasted material.

"Were these all made from plastic?" I ask Evans. "Actually, it is a mix of nylon and carbon fiber," he answers. "There are different types of nylon, and we can embed fiber-glass inlays if required." Another technique that Evans may apply in future uses plastic with metal particles—aluminum, stainless steel, or titanium—as the base material; this approach would then let him create aerospace-grade products. "We use one kind of material per layer, and each layer is 0.1 to 0.8 millimeters thick, depending on which printer and which settings we use." The team currently has two printers at its disposal. The smaller of the two can comfortably fit on a desk, while the larger one is about two meters in height and could easily accommodate a small person.

MANUFACTURING, RE-IMAGINED

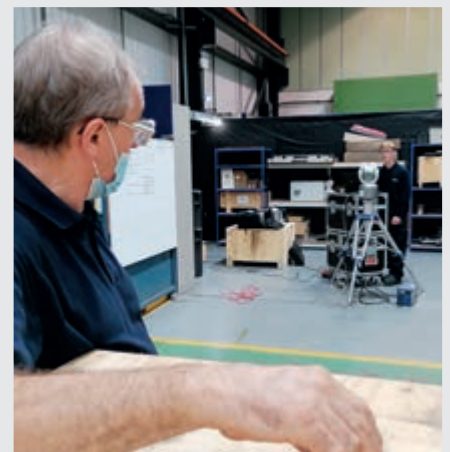
Evans says that, for now, he has mostly been focusing on the production of prototypes of spare parts. "Eventually, additive manufacturing will allow for in-depth system optimization—meaning that we'll be able to redesign parts to become the 'right tool for the job' and to be much less heavy and bulky." 3D printing, he goes on to say, not only results in lighter parts but also allows for »



This guide assembly consists of 127 single parts and takes a while to service. The team expects that some of the parts will come from the 3D printer in future.



The U.K.'s Services boss, Paul Sherman, proudly shows off one of the larger units reconditioned at the workshop. It is a laying head that took months to repair.



This laser-tracking meter is employed at customer sites to check whether a plant's documentation is correct. It is accurate to within 0.1 millimeter over a 15-meter radius.

the inclusion of built-in pneumatics and sensors—in places they could not have been added before.

3D printing, it seems to me, will soon change everything about how parts and products are designed and manufactured. Evans agrees. “There is only one thing that 3D printing can’t do: it cannot defy gravity,” he says. It turns out that if you were to manufacture a windowed wall, you would have to manually put in the top end of the window frame so that the printer could then use it as a new foundation and continue producing the wall. It can’t print on air. In spite of this shortcoming, by the end of his demonstration, Evans has me convinced that the additive manufacturing revolution will be all-pervading. “I feel like once 3D printing takes off, it will create a whole new distribution channel for spare parts ... a true next-level thing,” I tell Evans, who nods enthusiastically.

Right on cue, Services chief Paul Sherman enters through the lab’s rear door. “Have I missed anything?”

he asks, and I can’t even begin to fill him in. Of course, Sherman himself was responsible for installing the lab equipment, and he knew exactly what he was doing and what he was aiming for. We walk to Sherman’s office, where he tells me that the services sector has grown quite a bit over the years and will likely continue on this trajectory, with all the positive implications for the Sheffield location you would expect. The metallurgical services provided by Sherman’s team range from maintenance work to the provision of spares and the reconditioning of production equipment. With a smile, Sherman then invites me on a tour of the workshop.

SPARE PARTS LARGE AND SMALL

Said workshop is split into two organizational halves: the left side is largely dedicated to servicing long-rolling production equipment, while the right side takes care of everything flat. For now, the “long products” section is the busier one, but that is expected to change over the next few years. Sherman introduces



WHAT MAKES ME PROUD TO BE BRITISH ...

Employees of Primetals Technologies share many passions, such as pioneering new solutions for their customers. But every location also has unique qualities. In this section, we catch a glimpse of what makes the U.K.’s north so special.



“I am proud of both my Indian heritage and to be a British citizen. I value the three pillars of our inclusive society: justice, fairness, and safety.”

Sandip Samanta
Head of Technology



“I feel that we are a friendly nation, especially in the north, where I live.”

Heather Woods
HR Business Partner

me to Kyle Bowskill, the workshop's quality-control team leader. Modesty is one of the hallmarks of the British—and especially of the English—mentality, and while Bowskill is almost too humble to instruct me on the correct spelling of his name, he is obviously proud to discuss his team's achievements. "On average, we inspect some 2,500 parts per month on the long-rolling side alone," he says.

It often amounts to highly detail-oriented investigative work, Bowskill explains. Parts can fail because of wear and tear, operator error, or incorrect design. His team's job is to determine what has happened, and why. In some cases, the inspection involves the use of sophisticated coordinate measuring machines, for results accurate down to 0.029 millimeters. After each inspection, a comprehensive report is generated that includes a "lessons learned" section, which ensures continual improvement and informs the customer about any issues they may need to look into.

Depending on the extent of the damage, parts are either reconditioned or replaced. Reconditioning can get quite tricky. Bowskill shows me one of the more complex pieces of equipment sent to the workshop. "This guide assembly is made out of 127 individual parts," he says. "It takes a while to disassemble, examine, fix, and put back together again." How many replacement parts does he have in his inventory, I ask him. "We do buy in a fair number of spares," he replies. "Also, in future, I expect us to use 3D printing technology to manufacture certain parts just as we need them."

Bowskill and Sherman then show me one of the largest parts being serviced at the workshop. "This is a laying head," Sherman says, pointing at the sizeable apparatus, which is higher than Sherman is tall, and of considerable width and depth. "We've just finished reconditioning this for a French producer. It was a multi-month project and involved a complete strip-down, a full inspection, the replacement of broken parts, and of course the »



“ I like our countryside and how quickly you can get there from the towns. I am also fond of our many accents. We are a very diverse nation on many levels.”

Barry Clay
Sales Manager



“ In spite of parts of the U.K.'s population complaining, I believe that we are actually a very well looked-after country.”

Stuart John Leflay
Senior Expert



“ We have a huge history of engineering in Britain, and Sheffield can be seen as the nation's steel capital. Plus, I am quite fond of our fish and chips.”

Joanne Loveday
Senior Design Engineer



CHALLENGE YOUR MIND TO FIND NEW SOLUTIONS

Rhodri Evans is Senior Design Engineer at Primetals Technologies. He is pioneering the use of additive manufacturing in Sheffield.

In your view, is creativity something you are born with, or something you can learn?

Rhodri Evans: I think it is acquired through life experience. Training can only get you so far, and it's the life lessons that make the difference. You also have to have the desire to find new solutions.

Are there any "tricks" you use to promote creativity and inventiveness?

Evans: I like mind challenges and puzzles such as the Rubik's Cube. I use the cube to give my mind a little warmup into "problem solving mode" by first doing a puzzle before I proceed to work on a technical issue.

Is there any new technological area you are particularly fascinated by?

Evans: Advanced manufacturing, because it means solving old problems in new ways. For example, advanced casting techniques that rely on 3D-printed sand molds enable the casting of complex forms that were not feasible before.

Is there any inventor, scientist, or entrepreneur that you admire?

Evans: I have two. British inventor and engineer Isambard Kingdom Brunel, who crafted various famous British pieces of infrastructure such as the Great Western Railway. The other is Elon Musk, because I find his approach toward problem solving refreshing. I appreciate the way he pushes new technologies forward.

reassembly." It sounds like a daunting undertaking, and in my mind's eye I see myself struggling to put all the pieces back together again; when I'm finally done, I end up with three extra screws that should have been used somewhere in the process! I shudder at the thought. Thank goodness my professional Sheffield colleagues are as fearless as they are experienced.

"GREENING" METALS PRODUCTION

Of course, my tour of the Sheffield location would not be complete without meeting Steve Brown, the CEO, and Sandip Samanta, Head of Technology. Brown has just returned from COP26, the climate conference, and tells me that the steel industry will be making a very meaningful contribution to carbon neutrality. But it will take time. "We know we must 'go green', but the task is not to be underestimated," Brown says. "A key challenge for the metals industry will be the amount of hydrogen required, and the electricity needed to generate it. We estimate that we need about 50 kilograms of hydrogen to produce one ton of steel. The world currently produces 1.9 billion tons of steel, so just imagine how much hydrogen we will need!" Whether in spite of or because of these numbers, Brown says he feels that we can hardly do enough for the planet. Everyone must contribute to create a worthwhile environment for future generations.

Brown's chief technologist echoes the sentiment. "Whenever I work with customers, I target win-win situations," Sandip Samanta says, "because they are the most sustainable for all involved. In that sense, I am very commercially-oriented in my role." He has a simple but effective mantra: "I care deeply about making people's lives better—both professionally and in my personal life." In what ways is he doing his bit for the planet? "I always think about energy consumption and the reduction of waste. Also, I am a father of two, and I inspire my children to be environmentally conscious and to act as responsible citizens."

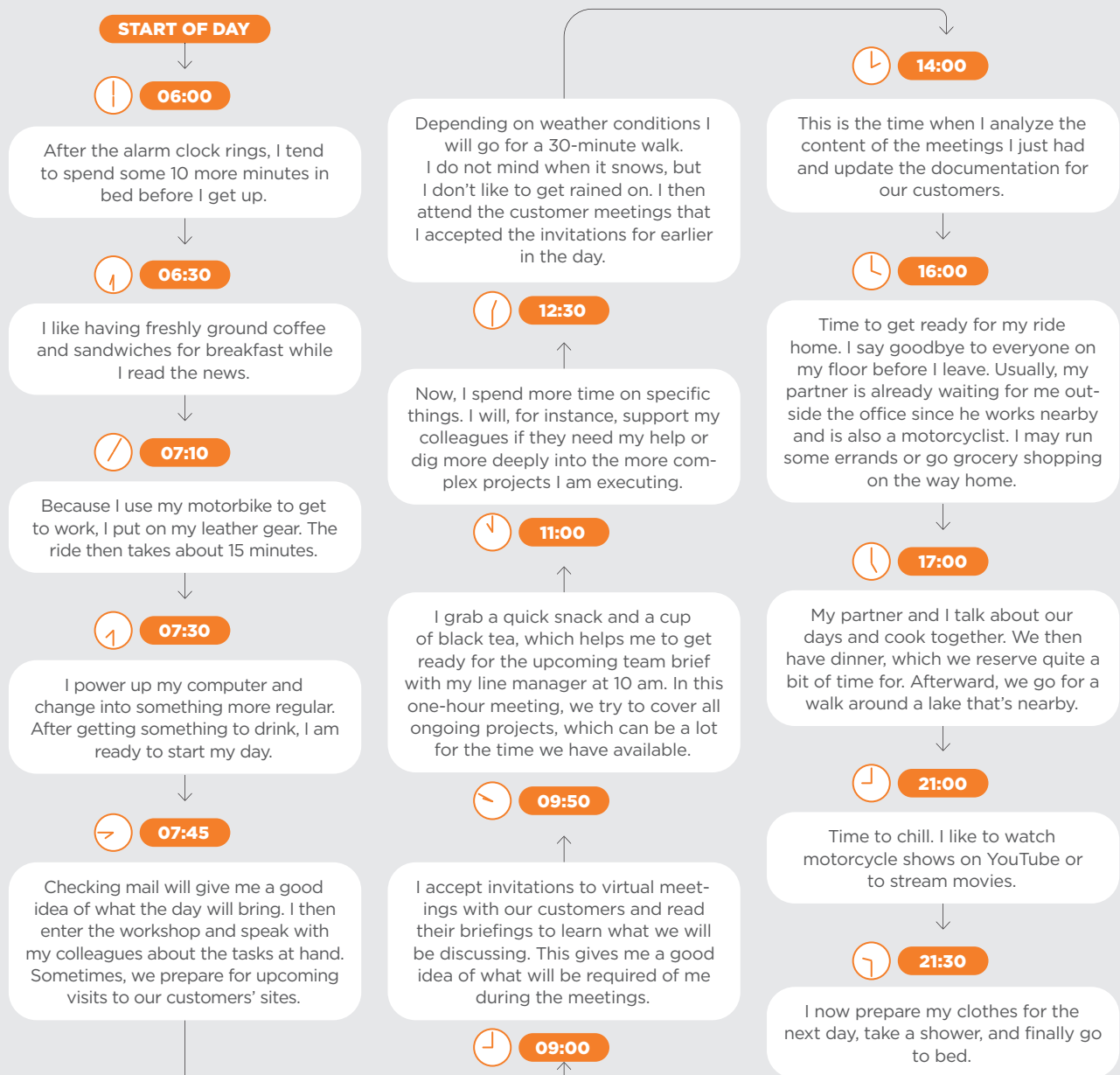
Before I make my way home, I stop by Froggatt Edge, a place of impeccable natural beauty in the Peak District's "Dark Park" area. It is the middle of November, but even with the sunlight fading on a cloudy day I can sense the site's subtle poetic romance. A short path takes me to a viewpoint from where I can see the many hills and valleys the area is so well-known for. Most of the trees have long shed their leaves, their branches exposed. I think of the "network of branches" that Rhodri Evans makes with his 3D printers, and for a moment, I am reminded of how so many technical innovations have already been inspired by natural phenomena. I begin to imagine a world where nature and technology exist in perfect harmony, where that which is man-made blends seamlessly into that which has always existed, and always will. And as I walk back from Froggatt Edge to my rental car, it occurs to me that we will eventually enter that perfect world—provided we all get our skates on.

A DAY IN THE LIFE OF MARTYNA TULWIN

As part of the series “Visiting the Company Locations of Primetals Technologies,” we sit down with one employee of the respective location—with the aim of illustrating what a regular work day is like for them.



MARTYNA TULWIN
Process Engineer



EXPERIENCING THE LOCATION

AND THE GREATER SHEFFIELD AREA



THE BUILDING ...

... that houses the Sheffield company location of Primetals Technologies can be found in "Sheffield Business Park" in the city's east end. Sheffield is a very green city—it is therefore no surprise that the Business Park area is surrounded by fields, which some employees use to go for a walk or a run in their lunch break. Right next to the building is the site's workshop.



THE BIKE ...

... belongs to process engineer Martyna Tulwin. Originally from Poland, Tulwin developed a strong affection for the U.K., the larger Sheffield region, and its country roads in particular. After she finished high school, Tulwin's father, a Polish university professor, recommended that she enter the field of metallurgy, which she did. Having completed her studies in Poland, Tulwin was immediately hired by Primetals Technologies in Sheffield.



THE 3D PRINTER ...

... shown in this picture is actually the smaller of the two printers currently installed at the Sheffield location. Engineers use them to prototype various new types of spare parts or to test out fresh ideas. The expectation is that additive manufacturing will eventually become a game changer in the metals industry.



THE CONVERTER ...

... that welcomes you to Sheffield's Kelham Island steel museum was the last of its kind to be in operation in the U.K. It was used to produce Bessemer steel until 1974 and was moved to the island in '78.



THE VIEW ...

... at beauty spot Froggatt Edge is particularly spectacular on sunny summer days. At the time of Metals Magazine's visit in November 2021, the hills and valleys were shrouded in the English fog and rain.

STEERING THE SHIP WITH A CALM HAND

Steve Brown is CEO of Primetals Technologies U.K. and based at the Sheffield location. He joined predecessor company Davy McKee in 1986, straight from secondary school, and completed his studies while working as an electrical engineer. One of his many strengths is paying close attention to policy decisions and macroeconomic trends in order to determine the best-possible course of action for all the company locations he is responsible for.



How would you describe the wider agenda of the Sheffield company location?

Steve Brown: We already have a strong setup thanks to our project, products, and spares business. But we will continue to develop and nurture new competences, for instance, in the field of e-services, where we will be providing additive manufacturing as well as augmented and virtual reality based services. The Sheffield location is partnering very closely with the other U.K. entities and with our international colleagues—especially those from Austria, Japan, and the U.S. The anglo-saxon connection helps us to be successful in the large American market.

What's the economic outlook for the metals business, globally and for the U.K.?

Brown: On a global level, the market situation is very good right now. The number of projects is growing daily and we are taking advantage of this. We are conscious that this situation will not last forever, but it could continue for another 12 months before inflation and an increase in interest rates squeeze the availability of cheap finance for big business. The U.K. metals industry, however, is at a crossroads. It requires significant capital investment to recover some of the ground lost to international competition. Also, it needs to set itself on the "green steel" path. The U.K. government has indicated a strong inclination toward carbon capture as a solution for the industry and will support businesses that are prepared to invest in this technology.

Has Brexit impacted the British metals industry more than Covid?

Brown: Overall, Brexit exacerbated wider issues in the world economy that we were already experiencing in the U.K.—such as supply shortages. The additional

paperwork required for imports and exports as well as E.U. regulations cause additional delays. Still, I do believe that the economy will recover in the longer term and that the impact will be much smaller than originally feared. Covid, on the other hand, is something we'll have to live with, but its effects should not be too significant on the metals sector. There are even some positive developments that have emerged from Covid: the ability to quickly and easily connect with our customers online, more flexible ways of working, and better work-life balance, to name a few.

You just attended the climate conference COP26. How much greener can metals production become?

Brown: In the short-to-medium term, we will have to employ new green technologies in the traditional integrated production route, addressing the blast furnace and basic oxygen furnace. But the blast furnace will always need a minimum coke charge to operate, so CO₂ will remain a by-product. "Net-zero-carbon steel" via carbon capture and storage or utilization is an alternative, and we are already seeing ambitious cooperations starting to take root at the U.K.'s east coast cluster. The majority of steel producers will, however, have difficulty finding carbon-storage locations. Primetals Technologies and LanzaTech are currently developing a carbon-utilization solution, and the hydrogen route is the obvious long-term option for our industry.

What aspect of our lives will be impacted the most by new environmental technologies?

Brown: Automobiles and aviation. In the next 5 to 10 years, car makers will completely switch to electric vehicles. New aeronautical designs and next-generation engines will improve the fuel performance of planes. ●



THE FUTURE OF **PELLETIZING**

A PASSION FOR PELLETTIZING AND CONSIDERATION OF THE ENTIRE PROCESS CHAIN FROM START TO FINISH ARE FUNDAMENTAL FOR INNOVATIVE PELLETTIZING-PLANT SOLUTIONS.

Raw-material testing, mathematical simulation, 3D planning, and process automation are key elements Primetals Technologies brings with its passion for innovation to the iron and steel industry. The first step in the steel production chain is the "smart" pelletizing plant of the future.



Primetals Technologies' unique approach to developing and implementing pelletizing plants gives steel producers an edge. It all starts with the ore.

FIG. 1: Pellet production is about understanding the entire process chain from beginning to end.

Primetals Technologies has long anticipated the transformation of the metallurgical industry toward a lower carbon footprint in iron and steelmaking. This change stimulates innovative technologies, particularly at the front end of the iron and steelmaking process, starting with iron ore. A strong trend toward direct reduction and electric steelmaking imposes progressively stringent quality requirements on raw materials. On the one hand, increased efforts in iron-ore beneficiation to enhance the iron level in raw materials lead to the ever-decreasing grain size of iron ores. On the other hand, dominating shaft technologies such as the MIDREX direct-reduction process require a complementary agglomeration step to transform the iron ore concentrate into a well-structured input material. Pelletizing is a fundamental resource for direct reduction

and electric steelmaking, meeting the challenging demands of a changing industry.

COMPREHENSIVE COMPETENCIES

Understanding all process technologies of the production chain from iron ore to liquid steel, Primetals Technologies is the only supplier in the metallurgical plant building business with a comprehensive portfolio containing these technologies. The technological and metallurgical know-how of the specialists and experts at Primetals Technologies is the fundamental basis for designing and implementing the most efficient conversion route while also considering energy and environmental aspects. These unique cross-process competencies allow Primetals Technologies to tackle the challenge of the steel industry's global transforma- »



FIG. 2: Circular Pelletizing Technology is designed for smaller production capacities, and the optimized arrangement of the circular furnace ensures an ultra-small footprint.

tion, starting at the front end of the production chain: the agglomeration of iron ore.

FROM LINEAR TO CIRCULAR

Primetals Technologies' unique approach to developing and implementing a traveling-grate pelletizing plant gives steel producers an edge. This approach applies to straight grate as well as circular grate pelletizing technology. The inhouse development of Circular Pelletizing Technology came from a desire for smaller production capacities between 0.8 and 2 million tons of pellets per year. The traveling-grate indurating furnace in a circular mechanical arrangement ensures an ultra-small footprint and minimal investment costs.

Whether straight grate or Circular Pelletizing Technology, plant design starts with the raw material. Profound knowledge of iron-ore characteristics, including variances in chemistry and regional factors, is key to creating the ideal pelletizing plant for high-quality pellets. Since 2015, Primetals Technologies' innovative laboratory in Austria has been operating a state-of-the-art pellet test facility, known as the "pellet pot," to provide valuable insights into the induration process, allowing exact adjustment of the temperature profile to reach the required compression strength and other quality parameters for the individual iron-ore type. Modern off-gas measurements also indicate at what temperature level sulfur burnout starts, and reveal the level of SO_x and other emissions.

The empirical data gained from the raw-material tests are fed into Primetals Technologies' sophisticated process-simulation tool. An underlying mathematical heat and mass balance was developed based on kinetic modeling of pressures, velocities, and temperatures in a three-dimensional grid of cells. The simulation model is adjusted and fine-tuned toward the characteristics of the producers' raw material and bed geometries. It provides the unique possibility to simulate the operation of both new and existing pelletizing plants. The model can simulate conditions for both blast furnace and direct-reduction-grade-pellet qualities. By inserting the operational parameters of existing pelletizing plants, the model can predict future process-related requirements to increase plant capacity, adjust to a change in raw materials, or change end-product characteristics. The need for costly and time-consuming on-site analysis campaigns is a thing of the past.

EMISSIONS AND ENGINEERING

By understanding the DNA of the raw materials and their behavior in the induration process, mass balances and flow sheets are generated to determine the size of the equipment and peripheral plants. While the pelletizing plant design is focused on the defined performance parameters, maximum operational flexibility for future process changes can be implemented in the plant concept. In particular, off-gas cleaning is of vital importance. As a first priority, current emission levels must be met as a minimum requirement. But knowing the trend



FIG. 3: An up-close look at the pelletizing pot grate testing facility. The ability to test and simulate pelletizing conditions ensures optimally configured, tailor-made pelletizing plants.

toward increasingly challenging environmental regulations in virtually all regions of the world, future reduction of gaseous emissions must be possible. The MEROS off-gas cleaning system—an inhouse development of Primetals Technologies (see pgs. 52–59)—has proven its compatibility in many industrial applications. The modular concept of the dry-dedusting bag-filter system covers a wide range of emission levels, and it can be adjusted to various operational settings such as SO_x, NO_x, and dust emissions.

At the start of a new project, the pelletizing plant "grows" rapidly in 3D, like a virtual construction site

during the engineering phase. The induration machine is built step by step with continuously increasing details of the individual areas such as duct sizes and hood design starting from the size of the grate area. With modern IT applications, engineers can simultaneously work on different plant locations from other workstations at Primetals Technologies' locations worldwide. The 3D model can be viewed and discussed with the client. At the same time, any conflicts between structural steel, equipment, or pipe routing are quickly resolved since all engineers simultaneously work with the same model. The model is then expanded toward detail engineering in project execution.

AUTOMATED FEATURES

While ensuring that customers receive the most up-to-date pelletizing plant, Primetals Technologies' passion for innovation makes them true pioneers, looking toward the future of iron and steel production. Known for advanced Level 2 automation solutions, specialists at Primetals Technologies have raised the bar for simulation technologies and automated process control. Simultaneous tracking, predictive modeling, and operational changes throughout the production process ensure that capacities and quality remain consistently at the highest level. By creating this "closed-loop" form of analysis and action, automation systems make controlled changes based on data previously collected from qualified operator input. Future upgrades and implementation of new models as well as fine-tun-



Known for advanced Level 2 automation solutions, specialists at Primetals Technologies have raised the bar for simulation technologies and process control.

PELLETIZING PLANT DESIGN: CUSTOMER-ORIENTED EFFICIENCY

Primetals Technologies' commitment has always been to provide its customers with integrated solutions that meet their individual needs. The design of an efficient and reliable pelletizing plant depends on the efficient interaction of all aspects of plant construction.



1. RAW-MATERIAL ANALYSIS

At home in Austria, Primetals Technologies' state-of-the-art pellet pot test laboratory analyzes the induration process to determine the parameters necessary to produce the highest-quality pellets. It assesses ore quality, simulates the production conditions, and measures emissions.



2. UNIQUE PLANT DESIGN

Combined with laboratory test results or actual production data of existing operations, a sophisticated process simulation tool—an in-house development of Primetals Technologies—enables a unique made-to-order pellet-plant design and determines appropriate measures for an efficient plant upgrade.



3. 3D ENGINEERING

While 3D engineering is industry standard, Primetals Technologies uses advanced 3D modeling, augmented reality tools, and interactive models. Visualization of the plant at an early stage of the project helps to optimize the arrangement of equipment and facilitates engineering activities.



4. EMISSIONS

MEROS is an integral part of the pelletizing-plant concept as a modular off-gas cleaning system. The dry-bag-filter dedusting arrangement can be expanded toward advanced DeSO_x and DeNO_x solutions and provides the flexibility to meet current and future emission limits.



5. AUTOMATION

The "smart plant" of the future operates efficiently, effectively, and automatically. Level 2 automation based on process models predicts and anticipates changes to production, continually analyzing data based on predictive models, and making adjustments quickly and efficiently.

Primetals Technologies is committed to providing long-lasting solutions and innovations for sustainable metallurgy.

ing of the control system is standard practice at Primetals Technologies.

PIONEERS IN ALL THINGS

As pioneers in all things, experts at Primetals Technologies find solutions that approach challenges from all sides. Primetals Technologies looks at the origin and characteristics of raw materials, available resources, and other essential factors of the steel-production chain to ensure that the design and implementation of plants remain faithful to a commitment to providing long-lasting solutions and modern innovations. Specialists have been creating reliable automated systems and flexible environmental solutions and keep a finger on the pulse of global developments. The increased use of direct reduction and focus on reducing carbon emissions across the globe have already begun to impact the iron and steel industry as more and more producers look to electric steelmaking and technologies that "future-proof" their business.

Recognizing the challenges of producing high-quality end products amidst increasing regulations, Primetals Technologies' experts have the tools and technologies ready to drive pelletizing toward the future of green metallurgy and offer flexible solutions for iron and steel producers today. There is a need for a unique and individual approach to pelletizing. The entire production chain from raw material to liquid steel must be considered to provide the best-possible solution. By focusing energy toward the needs of steel producers, a passion for pelletizing is ignited. With this passion, the agglomeration specialists at Primetals Technologies stand ready to take on the challenges facing steel producers around the world who look for innovative solutions to realize the pelletizing plant of the future. ●

Christoph Aichinger, Head of Agglomeration

Bernhard Hiebl, Senior Expert, Agglomeration Technology

Adam Merki, Lead Editor

(All with Primetals Technologies Austria)



A PASSION FOR PELLETIZING CUSTOMERS FIRST

Head of Agglomeration at Primetals Technologies, Christoph Aichinger's passion fuels his commitment to tackling customers' challenges.

What do customers think of Primetals Technologies' approach to pelletizing plants?

Christoph Aichinger: Our customers are often positively surprised about the detailed approach of our specialist team. They value our close analysis of their raw materials and our technological expertise with the induration process. They actively engage in an open dialog with us while we jointly develop a tailor-made solution to fit their needs. When they see "their" pelletizing plant for the first time in 3D and virtually "fly through" the individual plant areas, they are very impressed.

What is the key success factor in Primetals Technologies' pelletizing solutions?

Aichinger: It is our strong team. There is an incredible drive and passion for pelletizing in our group. The level of competence is exceptionally high in all disciplines, be it process technology, engineering, automation, or project management. Our team has a genuine passion for problem-solving and takes pride in exceeding customer expectations.

How do you see pelletizing as part of the future of the iron and steel industry?

Aichinger: With pelletizing's role in the reduction of CO₂ emissions, particularly in the direct-reduction route, I expect a high demand for pelletizing plants within at least the next two decades worldwide. I look forward to new exciting pelletizing projects.

A BREATH OF **FRESH AIR**

**WITH THE GOAL OF IMPROVING AIR QUALITY
IN SOUTHERN ITALY, ACCIAIERIE D'ITALIA
HAS CHOSEN MEROS GAS CLEANING.**

Acciaierie d'Italia has ordered no fewer than seven MEROS off-gas cleaning systems from Primetals Technologies for its Taranto, Italy, site. The first two MEROS plants have now become operational and are delivering exceptional results.

The first two of seven new MEROS plants at Acciaierie d'Italia's Taranto site are now in full operation.





Life has changed for Dr. Maria Fedele. Every morning, as she prepares her first espresso, she likes to open the kitchen window and to take a look around—and as the early sunshine fills the streets of Taranto and the first commuters get on their way to work, Fedele takes a moment to watch the clouds on the otherwise clear sky. In the past, the air in this part of Italy, the region of Puglia, was not always great. But today, things are dramatically better, and air quality has been transformed—in part thanks to environmental efforts in which Fedele played an important role.

Maria Fedele belongs to a small yet highly dedicated team of Primetals Technologies employees whose office is located directly on Acciaierie d'Italia's Taranto site. The team has been supporting the steel producer for several decades; since 1999, the two companies have realized a number of major projects together: a cold-briquetting plant, new basic oxygen furnaces, four slab caster revamps, two capacity upgrades for the sinter plants that included optimization of the cooler, and two new secondary dedusting systems. The latter is not the only environmental effort Acciaierie d'Italia has undertaken with Primetals Technologies thus far. Rather, the producer has recently doubled down on its ambition of making Italy's south a pristine place to live and work.

THE POWER OF MEROS

Air quality was top of mind for Acciaierie d'Italia when Dr. Alessandro Labile, the company's Head of Environment, Health, and Safety, approached Primetals Technologies regarding the proven MEROS off-gas cleaning solution. Acciaierie d'Italia was seeking a way to further tackle its dust and dioxin emissions at that time. After consulting with Primetals Technologies, the decision was made to invest in no fewer than seven MEROS plants, four of which would be installed at the producer's sinter plants, with the remaining three filtering the off-gas coming from power plant No. 2.

"Installing seven MEROS units represents the most important phase of our multi-year environmental plan," says Labile. The emissions generated by the site's sinter plants had been troubling him for a long time. The big blue stack right next to the sinter plants, whose job it was to "handle" their emissions, had become somewhat infamous in the region. But Labile would not rest until the matter was addressed and resolved.

Labile's goal was to ensure that two of the seven MEROS plants would commence operation by the end of 2021. The team of Primetals Technologies worked tirelessly to meet this target. Employees from both companies spent day and night on site for several months—even throughout the holiday season. Together, they succeeded in installing two fully operational units in record time. And as 2022 began, the blue stack had stopped emitting any visible smoke from sinter plant "E." This change was not just a cosmetic one. The two MEROS plants had started to do their job, and they did it extremely well.

Designed as a modular system, MEROS removes almost all harmful substances found in the off-gas of sinter plants and other production units.

Within the steel industry, MEROS is known as a "best available technology" for off-gas cleaning. This means that there simply is no better solution available at this time, no other gas-cleaning technology that could replace it—in terms of effectiveness, efficiency, and reliability, MEROS is without equal. It was developed in 2004 by Primetals Technologies' own Dr. Alexander Fleischanderl, with the first unit going into operation in 2007 at the plant of voestalpine in Linz, Austria. Since then, a total of 15 MEROS units have been ordered.

What is it that MEROS does so well? Designed as a modular system, it removes almost all harmful substances found in the off-gas of sinter plants and other steel-production units. This includes elements such as sulfur oxides, nitrogen oxides, dust with particle sizes as tiny as 2.5 nanometers, dioxins, furans, polyaromatic hydrocarbons, heavy metals like lead or mercury, acidic gases, and various other harmful organic compounds.

99 PERCENT EFFECTIVE

MEROS traps all of these elements—more than 99 percent of them—using a sophisticated additive injection and filtering system. The filters themselves are a special high-performance variety with a lifetime of up to ten years. Their durability is in part a consequence of the low pressure and frequency of the cleaning pulse applied by the system. Inside the MEROS plant, all off-gas is extensively recirculated, which contributes to the system's overall effectiveness. Because of the recirculation, the filters have to turn a particle concentration of around 10,000 milligrams per cubic meter into less than 5 milligrams—no small feat, but this is how MEROS obtained the label of being a "best available technology."

The desulfurization process relies on an additive, which is introduced into the off-gas at exactly the right dosage. This is all done automatically by the MEROS system once the correct parameters have been set. Produc- ➤

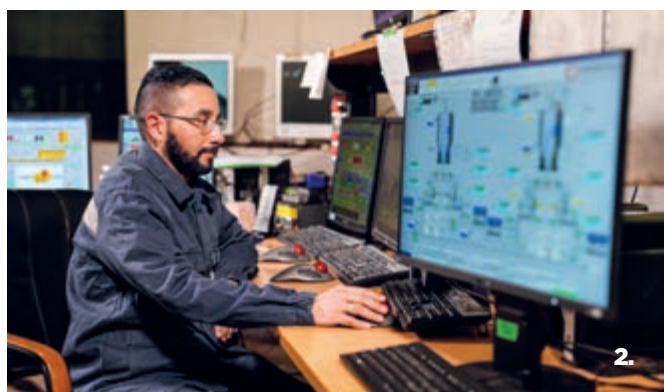


FIG. 1: An up-close look at one of the two MEROS plants at Acciaierie d'Italia's Taranto site that have already started cleaning sinter plant off-gas

FIG. 2: The sinter plant's control room handles not only all aspects of the sintering process but also the operational parameters of the two MEROS systems.

FIG. 3: The MEROS project team for Taranto (left to right): Dr. Alexander Fleischanderl, Angelo Cavallo, Dr. Maria Fedele, Marco Gratti, Dr. Vitantonio Paradiso

FIG. 4: The side view of the first two MEROS units unveils large induced-draft fans (left) and silo batteries for additives and extracted substances (right).

FIG. 5: Acciaierie d'Italia is the only steel producer in Europe with fully housed stockyards. These massive constructions are as high as 80 meters.

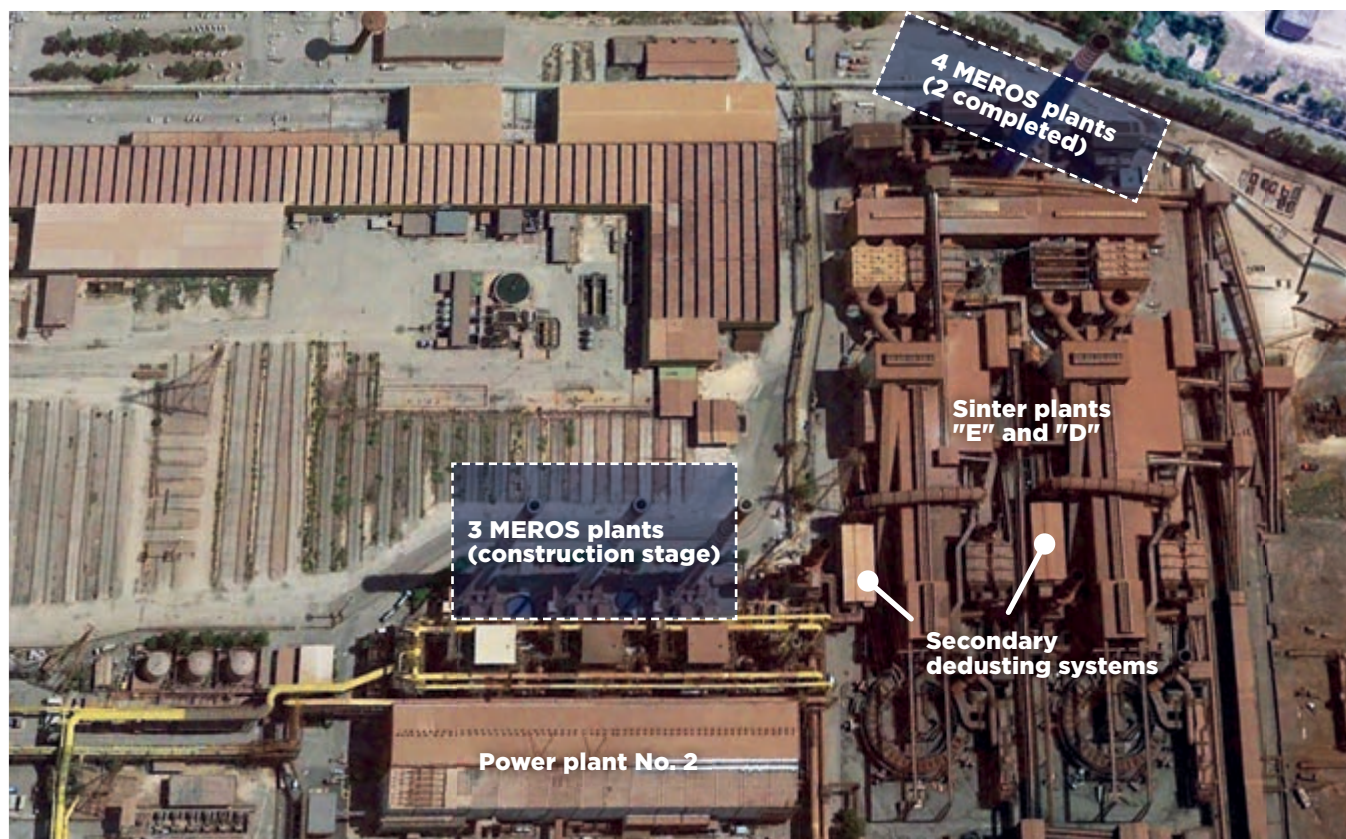


FIG. 6: Overview of the section of Acciaierie d'Italia's Taranto plant in which seven MEROS plants are being implemented. The secondary dedusting systems were installed in 2018, and the first two MEROS units (upper right of photo) commenced operation in late 2021.

ers can choose between using sodium bicarbonate or hydrated lime, depending on off-gas composition and on which of the two additives they can source more easily. Further options exist for the removal of organic compounds: here, producers have a choice between activated carbon or lignite. This flexibility ensures that MEROS can be operated in different regions and under varying market conditions in terms of raw materials.

EXCEEDING ALL TARGETS

For Acciaierie d'Italia, the relationship with MEROS has only just begun. The first two MEROS plants are already exceeding expectations: Dust emissions were reduced to less than 3 milligrams per cubic meter, far below the legal limit of 10 milligrams; dioxins are now at less than 0.01 nanograms per cubic meter, which is dramatically better than the 0.15 nanograms required by the Italian government. This means that sinter plant "E" and its emissions are fully taken care of. In the first half of 2023, sinter plant "D" will receive its own MEROS twins, in addition to three more units that will clean the off-gas from power plant No. 2 and feature specialized selective catalytic reduction technology from Primetals Technologies and partner company Yara to ensure optimal denitrification and waste-heat recovery. Operating seven MEROS plants simultaneously will not only have direct benefits for Acciaierie d'Italia but also indirect ones, as this setup

will make operation and maintenance of their gas-cleaning equipment more simple and straightforward. Spare-part management will also be effectively streamlined.

A GREENER FUTURE

Acciaierie d'Italia will continue on its path toward even more environmentally friendly steel production. The company has already demonstrated the extent of its commitment—not only by procuring seven MEROS plants and other environmental technologies from Primetals Technologies, but also through other initiatives. For instance, Acciaierie d'Italia built the first-ever fully housed raw-material stockyards in Europe. These are gigantic constructions (see Figure 5) that ensure that neither iron ore nor coal particles will be swept away by the wind. So far, two of the housings have been completed; the third is currently being finalized.

For Maria Fedele and the Primetals Technologies team in Taranto, the future will be a busy one. They will continue to support Acciaierie d'Italia in every way they can, sharing not only Acciaierie d'Italia's vision of even greener steel production but also its dedication to making the city of Taranto a poster child for environmental awareness. Together, the two companies will continue to do great things—for nature, for the region of Puglia, and for the air they all breathe in Taranto.

THE HISTORY AND FUTURE OF MEROS

With a great track record of “cleaning” up heavy industry, Maximized Emission Reduction of Sintering (MEROS) has made its mark on the twenty-first century and shows no signs of slowing down. MEROS demonstrates Primetals Technologies’ commitment to innovation, the environment, and sustainability.

Maximized Emission Reduction of Sintering, or MEROS, debuted in 2007. The brainchild of Dr. Alexander Fleischanderl, Head of Green Steel at Primetals Technologies, MEROS began as part of a new vision for the steel industry. Often considered a “dirty sector,” the steel industry was met with the motivations of Dr. Fleischanderl and other specialists looking to lessen steel producers’ contribution to air pollution while increasing energy efficiency and sustainability.

As one of the “dirtiest” parts of steel production, the sintering process accounts for a significant percentage of iron and steelmaking emissions. The high volumes of off-gas emitted usually contain large amounts of dust, sulfur dioxide (SO₂), nitrous oxides (NO_x), and toxic pollutants such as heavy metals—e.g., mercury (Hg), lead (Pb), cadmium (Cd)—and organic compounds. Flue gas treatment can employ wet and dry processes to remove these pollutants. While the wet process was traditionally implemented, several drawbacks, including operational costs and overall effectiveness, drove Fleischanderl and the team at Primetals Technologies into the direction of a dry dedusting system.

During early development, Primetals Technologies, then Siemens VAI, partnered with voestalpine in Linz, Austria, to produce the first-ever MEROS plant. What was once perhaps considered a far-fetched idea, the group of individuals who first saw MEROS at voestalpine in 2007 stood in awe of something they could not see. The pollutants that once made the sinter plant off-gas visible to the naked eye had been successfully removed.

From day one, MEROS exceeded design expectations regarding performance and is still the most modern and powerful system for cleaning off-gas from sinter plants. The core technology of MEROS has also led to further innovations such as MERIM, a dedicated dry gas-cleaning solution for ironmaking, and MERCON for BOFs. With a passion for the environment, experts at Primetals Technologies have also developed By-Product Leaching to treat



DR. ALEXANDER FLEISCHANDERL ...

... has pioneered many of Primetals Technologies’ unique solutions. He has a passion for anticipating trends and designing cutting-edge innovations.

the residual dust from dry dedusting systems, particularly MEROS. When used in combination, these innovations contribute to the circular economy by cleaning the off-gas from sinter plants and by recycling by-products from the residual dust for reuse in the sintering process (for more on By-Product Leaching, see pages 60–65).

Over the past fifteen years, MEROS expanded as one of the most widely adopted solutions for off-gas treatment worldwide. With its modular flexibility and innovative dry dedusting technology, MEROS continues to be one of the most inspiring technologies for sustainability and environmental solutions at Primetals Technologies. As such, the story of MEROS is far from over, with new chapters being written year after year.



ON A MISSION FOR TARANTO

INTERVIEW WITH DR. ALESSANDRO LABILE, HEAD OF ENVIRONMENT, HEALTH, AND SAFETY AT ACCIAIERIE D'ITALIA

What is the significance of Acciaierie d'Italia for the economy of Taranto and the region of Puglia?

Dr. Alessandro Labile: There is an important link between our company and this region. Many of our 8,000 employees in Taranto are second-generation. The local economy strongly depends on companies like Acciaierie d'Italia. Our Taranto site connects Italy's south with the north of the country, where we have further plants in Genoa and Novi Ligure. This setup enables us to produce high-end steels at the top of the value chain.

What are the main products of Acciaierie d'Italia?

Labile: We mainly produce plate tubes, pipes, and coiled strip for advanced applications such as automotive exposed.

You have just completed the implementation of two MEROS systems at one of your sinter plants in Taranto. Are you happy with their performance?

Labile: These two are the first of seven MEROS plants we will be installing in total. They were required to lower our emissions—especially in terms of dust, dioxins, and sulfur oxides. Governmental regulations require us to limit dust emissions to 10 milligrams per cubic meter—we have now reached a level of less than 3 milligrams. As far as dioxins go, the legal limit is set at 0.15 nanograms, and we are below 0.01. So yes, I am really happy with the performance. We will be installing two further MEROS plants at our sinter plants and three more units at power plant No. 2, where we will also add special DeNO_x technology in collaboration with Primetals Technologies and Yara.

“Our new MEROS plants are one of the most important steps we have taken to improve environmental performance at our Taranto site.”

Aside from performance, were there other factors that influenced your decision to choose MEROS?

Labile: We wanted a design that would prohibit any sinter plant operation without the off-gas cleaning being active. The solution had to be absolutely reliable and be able to work 24/7. When the two MEROS systems were installed, the downtime of the respective sinter plant was minimal—everything was back up and running well within four weeks. This was crucial for us.

I heard that both Acciaierie d'Italia and Primetals Technologies worked extra hard to speed up the implementation of the MEROS plants ...

Labile: That is correct. We started talks in early 2021 with the aim of compressing the schedule for project execution, because we had seen delays. We wanted to make up for lost time, and it worked out. Primetals Technologies has a dedicated team of employees based here on site at our plant, who were elemental in meeting our ambitious deadline. We needed the daily exchange to get the results we were aiming for. Today, I can say that the new MEROS plants represent one of the most important steps we have taken thus far to improve environmental performance.

What other measures have you taken to become even more environmentally compatible?

Labile: We have built two large-scale housings for our raw-material storage areas, and we are in the process of building a third one. These are massive buildings that ensure that the wind won't carry away any iron ore or coal particles. The project began in 2012, and getting

the required governmental authorizations turned out to be quite challenging. I did a lot of detail-oriented work with engineers and production managers to specify precisely what kind of construction we needed—for instance, the height of the buildings had to be exactly right, 80 meters. Otherwise, some of the machines we use to handle raw materials would have run into operational difficulties in certain scenarios. In addition to these projects, we are planning to reduce the use of coal, to shift the coal-coke ratio more toward coal and natural gas, to move into the direction of electric steel production, and to further decarbonize our steel.

How have you come to this role, and how do you define it?

I was born in Taranto, grew up here, and got my degree in environmental engineering at the University of Taranto. So I have my roots here and see my role in helping to improve my company.

Is there any one aspect to your role that you particularly enjoy?

Labile: I am very happy with my role because it allows me to continue learning about environmental technologies. I also like managing demanding tasks—for example, orchestrating the contributions of different parties and making sure that everyone meets their deadlines.

How would you describe Acciaierie d'Italia's relationship with Primetals Technologies?

Labile: Our relationship is very sincere and solutions-oriented. I think the results speak for themselves. ●



FIG. 1: The leaching plant, placed after the off-gas desulfurization plant, treats the residual dust with water in the leaching tank.

ENVIRONMENTALLY FUELED INNOVATION

IN EARLY 2020, PRIMETALS TECHNOLOGIES COMMISSIONED THE WORLD'S FIRST BY-PRODUCT LEACHING PLANT, DESIGNED TO TREAT THE RESIDUAL DUST FROM OFF-GAS-CLEANING SYSTEMS LIKE MEROS.

Primetals Technologies' new By-Product Leaching plant has now begun full operation. It was designed to treat the dust from off-gas cleaning systems such as the sinter-plant oriented MEROS system. By combining these two environmental solutions—MEROS and By-Product Leaching—Primetals Technologies has developed a method of recycling valuable materials for reuse in sinter and pelletizing plants. This innovative setup also reduces carbon emissions and the use of landfills without sacrificing efficiency.

ADAPTING TO CURRENT CHALLENGES

Countries worldwide have continued to develop and implement various measures and legislation to reduce disposable waste and encourage the reuse of waste material. Following such guidelines, multiple industries, such as the iron and steel industry, use desulfurization (DeSO_x) plants like MEROS (Maximized Emissions of Sintering) to improve waste gas emissions. These emission-reduction plants effectively remove harmful substances from the off-gas, capturing sulfur dioxide, dust, and 90 to 99 percent of the dioxins, furans, and heavy metals, which are separated and collected as residue. However, this innovation produces another type of waste in the form of residual dust, which contains high concentrations of heavy metals, harmful naturally occurring compounds, and other toxic substances. Manufacturers must then dispose of the dust from the desulfurization process.

One standard disposal method is sending the dust to a landfill site. However, according to environmental guidelines and based on the dust's chemical composition, the dust is classified as "toxic waste." The disposal to landfills is cost-intensive and limited to ever-shrinking hazardous-waste areas. Additionally, the dust must also meet specific requirements before being deposited in a landfill.

One such requirement is the stabilization and solidification of the dust using cement to render the dust »

BY-PRODUCT LEACHING

Introducing a By-Product Leaching plant in addition to gas-cleaning systems such as MEROS yields several benefits:

- By-Product Leaching takes care of large quantities of dust containing heavy metals, naturally occurring harmful components, and other toxins, concentrated to a fraction of the original residue.
- Designed for the comprehensive recovery and utilization of by-product from dry-dedusting systems
- Tailor-made design and compact layout based on a modular system
- Recovery of up to 90 percent of the by-product, which can then be reused and recycled
- Fulfills "Best Available Technology" requirements
- Adjustable to meet individual legal requirements
- By-Product Leaching plants make a substantial contribution to the circular economy.

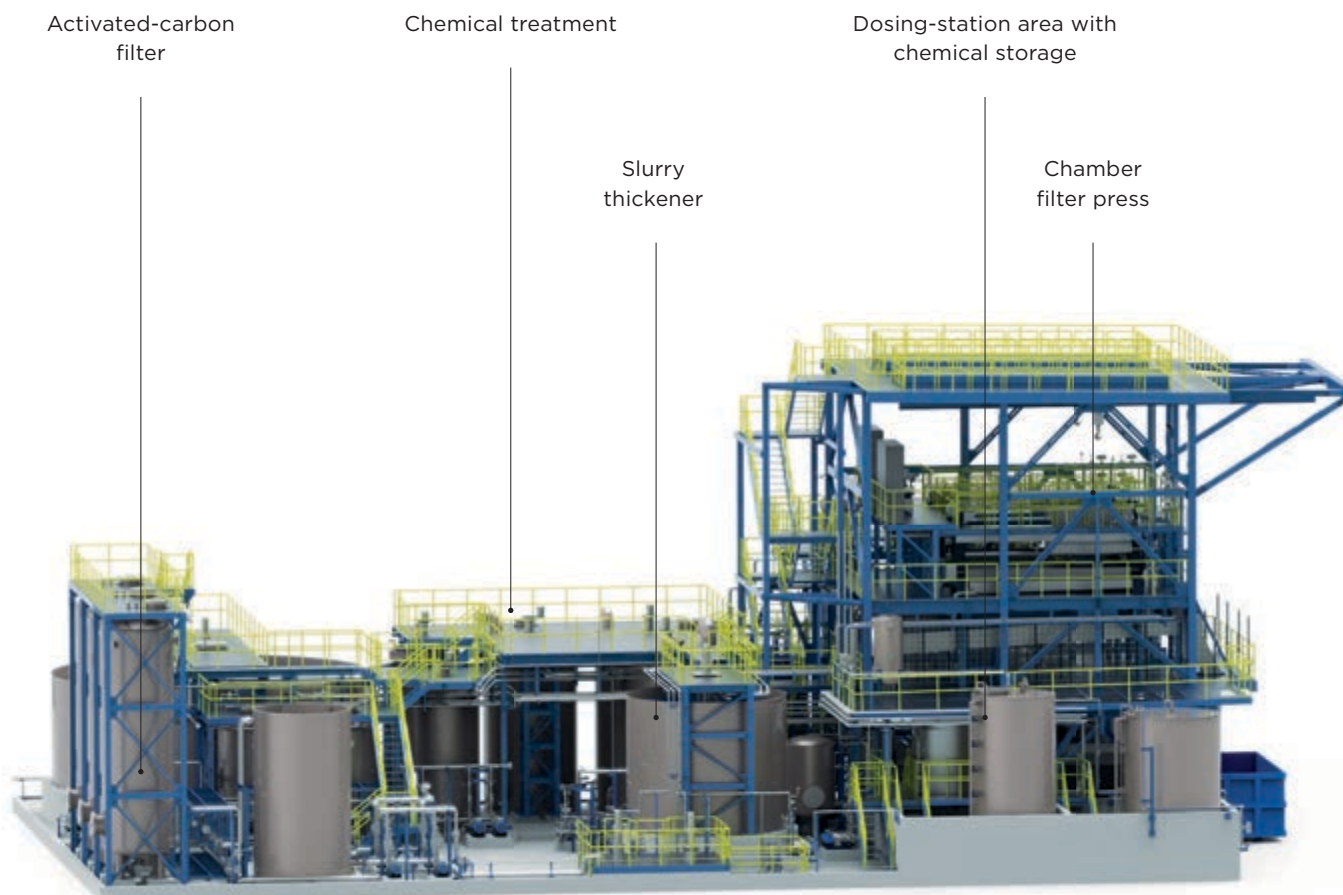


FIG. 2: Model showing the main components of the By-Product Leaching plant

immobile. Solidification ensures that rain or high air humidity cannot circulate harmful substances from the dust, polluting the surrounding soil and water. However, the soluble salts in the dust can also affect the long-term stability of the cement block and cause problems with the containment of heavy metals, making this an ineffective long-term solution.

Concrete solidification also requires a high concentration ratio between cement and dust, which reduces the ability to reuse the dust in the future. Using cement also means additional CO₂ emissions, producing between 200 to 550 kilograms for each ton of dust. Concrete solidification and the disposal to landfills is the applied method of iron manufacturing—until now.

FROM THEORY TO INNOVATION

Several scientific papers investigate the possibility of reusing the dust in sinter or pelletizing plants. These papers conclude that direct use of dust is problematic due to the high alkaline concentration. The dust from a dry desulfurization plant contains approximately 44 percent sulfate, 13 percent chloride, 24 percent sodium, and 11 percent potassium. The composition of the dust

from a dry desulfurization plant using sodium bicarbonate—i.e. MEROS—, depending on the desulfurization rate, is approximately 67 to 77 percent sodium sulfate, 3 to 8 percent sodium chloride, and 20 to 30 percent suspended solids.

The alkalis—sodium and potassium—have a particularly negative effect on blast furnace performance. These elements decrease the efficiency of the blast furnace's reduction process, locking the coke's incineration and building up scaffolds. Thus, the dust requires treatment based on its chemical composition before reuse in sinter or pelletizing plants. Additionally, the type of agent used in the desulfurization process determines how this residue, or dust, needs to be processed after being collected. When using sodium bicarbonate, which is the agent successfully used by the MEROS system, it is important to consider that the by-product after the MEROS plant cannot typically be recycled or reused in other applications, primarily due to its high salt and alkaline concentration.

By implementing a leaching plant after the desulfurization plant, the leaching process separates harmful »

materials, such as heavy metals and naturally occurring compounds, from the sinter dust. This innovation allows for more than 90 percent of the dust to be treated in an environmentally beneficial way, reutilizing up to 30 percent of materials previously deposited as residuals, recycling up to 70 percent of the dust, which is dissolved in water, used in the treatment process, and reducing deposits in landfills to just 10 percent of the residual dust (see Figure 3).

THE LEACHING PLANT STEP BY STEP

In the first step, the dust from a desulfurization plant is thoroughly mixed with water in the leaching tank (Figure 4). The resulting solution consists of suspended solids, including insoluble particles coming from the sinter dust—for example, activated carbon—and dissolved salts from the dust and desulfurization agent, as well as particles already in the water added during this step.

Once the mixing is complete, the solution is filtered. The main task of the filtering system is the separation

of particulate matter from leaching water. The filtered particulate will be washed, dried, and discharged back to the sinter or pelletizing plants. Depending on the desulfurization rate and the efficiency of the electrostatic precipitators, 20 to 30 percent of the undissolved materials from the dust, for example, iron oxide (Fe_2O_3) and activated carbon, can be reutilized. Following the filtration process, chemical treatment steps, like heavy metal removal, extract harmful substances from the solution. Due to the high concentration of toxic substances, approximately 10 percent of the dust is deposited to a specific landfill in the form of sludge, which results from the chemical cleaning process.

Finally, and in accordance with environmental regulations, the chemically treated water is filtered again with a sand filter and then polished with an activated-carbon filter before being discharged to a wastewater treatment plant or the sea, depending on local conditions and regional emission standards.



FIG. 5: A closer look at the technology at work in the By-Product Leaching plant

By implementing a sinter, MEROS, and By-Product Leaching plant configuration for the first time, Primetals Technologies' innovation reduces landfill deposits by 90 percent.

THE END RESULTS

Responding to a worldwide trend of waste-material handling, Primetals Technologies has developed a unique leaching plant that reduces waste material deposits in landfills to just 10 percent of the residual dust and decreases additional carbon emissions by moving away from the use of cement. Used in conjunction with MEROS, Primetals Technologies provides a tailor-made treatment system to recover raw materials, provide environmentally friendly wastewater disposal, and reduce harmful waste material to a small fraction.

The compact layout and modular system allow for a tailor-made design based on the needs of the customer. And by implementing a leaching plant after the desulfurization plant, customers will see a considerable reduction in operational expenditure (OPEX) in the long run, especially considering that disposal costs at landfills will increase as the space for such sites decreases year after year. Not only does the By-Product Leaching system satisfy the fulfillment of Best Available Techniques requirements, but it also decreases overall CO₂ emissions and reduces a steel plant's overall carbon footprint. ●

Dr. Martin Goetz, Project Manager, By-Product Leaching

Adam Merki, Lead Editor

(Both with Primetals Technologies Austria)



NEW SOLUTIONS FOR THE CIRCULAR ECONOMY

By-Product Leaching is a novelty in metals production. Dr. Martin Goetz was instrumental in the development of the technology.

How long did it take for you and the team to develop By-Product Leaching?

Dr. Martin Goetz: It took several years. Initially, the team at Primetals Technologies developed the concept; then, we collaborated with the University of Natural Resources and Life Sciences, Vienna, Austria, who helped us start up the first plant.

Could a By-Product Leaching plant be built anywhere, or only at seaside locations?

Goetz: The current design does indeed depend on the ability to discharge the brine, which results from the leaching process and is chemically similar to seawater, to the sea. But this limitation will likely disappear. Together with our university partner, we are working on a new concept that would allow for inland operation. This is an important step for Primetals Technologies because about 50 percent of the world's sinter plants are not located by the sea.

Everyone is talking about green metals production. What contribution can By-Product Leaching make?

Goetz: By-Product Leaching is an important step toward realizing circular-economy principles in steel production. It reduces the amount of by-product sent to landfill by as much as 90 percent. We are also looking to further expand the scope of the solution to include mercury treatment in the future.



In a mature process such as blast furnace ironmaking, truly groundbreaking developments are rare.

THE GREEN PULSE OF IRONMAKING

THE NEWLY DEVELOPED SEQUENCE IMPULSE PROCESS (SIP) TAKES BLAST-FURNACE IRONMAKING ONE STEP CLOSER TO CARBON NEUTRALITY AND SHIFTS THE COAL-COKE RATIO TOWARD MORE COAL.

The Sequence Impulse Process enhances blast-furnace-based ironmaking and lowers the associated carbon footprint. The technology superimposes periodic bursts of oxygen on the steady flow of oxygen to the furnace, thereby optimizing the conversion behavior of coal and coke particles.



FIG. 1: Image showing a blast furnace with SIP installed. The proprietary SIP boxes can be seen in the upper part of the picture (silver/blue).

The global challenge faced by all steelmakers to eliminate greenhouse gas (GHG) emissions and to reduce raw material and energy consumption in pursuit of carbon neutrality is well documented. The route to achieving this is less clear and will be different for each producer. With around 7-10 percent of industrial GHG emissions attributed to the steel industry and 70 percent of the total global steel production reliant on thermal reduction via the integrated steelmaking route, replacement of carbon-based fuels will be necessary.

Improvements in the circular economy of steel to increase the availability of high-quality scrap and to support the transition to electric steelmaking as the primary production route are also underway. Hydrogen-powered ironmaking is seen as the natural successor to the blast furnace, with ferrous units being generated in the form of direct-reduced iron. Alternatively, compli-

mentary processes such as carbon capture and storage or utilization could lower the amount of CO₂ emitted to the atmosphere. The final picture will likely be a complex combination of these options for many steelmakers as this transformation evolves.

Whilst there appears to be a general acceptance of the global imperative and requirement by steel producers to change, the technologies and especially the infrastructure to do so are not yet fully realized. Availability and utilization of higher proportions of hydrogen, plentiful supplies of cheap “green” energy, high-quality scrap and mass capture and utilization of emissions remain frustratingly distant technical and economically viable options for producers. In each of the routes, there are substantial hurdles—both technologically and commercially—to facilitating a change at pace. This is in addition to what could be considered an overwhelming financial investment. »

THE IMPACT OF THE SEQUENCE IMPULSE PROCESS



FIG. 2: In regular BF operation, coal injection results in char deposits accumulating, which restricts penetration of the “dead-man” and limits the gas flow into the furnace center.



FIG. 3: With SIP implemented, the shock waves from the high pressure oxygen penetrate deep into the raceway, combusting the fine char and improving coke permeability.

It is probable that significant undertakings by governments, businesses, and consumers will be required on a global scale to provide both the legislative and commercial drivers to ensure the shift can happen to meet the ambitious, international goals set out. This will take lengthy and protracted negotiation, resulting in extended timescales, to realize the necessary outcomes. What can be concluded from these facts is that the movement to new steelmaking routes is coming, but not today or tomorrow and possibly not within the next decade.

A MAJOR TRANSITION

Clearly then, the challenge for blast furnace operators to accelerate this transition is immense—but they must continue to produce competitively in the interim. Even though the task seems daunting, it also presents opportunities where significant gains can be made. The blast furnace is the single greatest contributor to the production of GHGs in the process route. As carbon-trading markets continue to develop rapidly, operators are facing increasing cost pressure based on their existing footprint. Many have already declared their own ambitious plans but must act now. The reality remains that there is desperate need for effective technologies to support the roadmap toward carbon neutrality. Implementing technology that can have a significant impact in the blast furnace therefore represents a major stepping-stone for operators globally.

Whilst the fundamental characteristics of the blast furnace have changed little over the last 100 years or so,

designers and operators have implemented incremental developments for the main vessel and process equipment. This has continued to push productivity to ever higher levels; at the same time, it has been possible to reduce the cost of the hot metal produced. Lower fuel and energy requirements combined with optimization of raw-material quality have become paramount.

In the current environment, the costs for carbon emissions, growing awareness of climate targets, and sensitivity to climate-centered topics are increasingly influencing markets and consumers to the extent that every marginal gain allows steel producers to run their plants more competitively. What if that gain could be achieved whilst also complementing and making a significant contribution toward carbon neutral production?

A POWERFUL PULSE

In a mature process such as blast furnace ironmaking, technology step changes come rarely and are often decades apart. Sequence Impulse Process (or SIP for short), a new technology available from Primetals Technologies, is such a step change.

As the name suggests, SIP technology involves the pulsing of a medium into the blast furnace. That medium is oxygen. The overall equipment required consists of a pressure-reducing station with ring-distribution lines for nitrogen and oxygen, proprietary SIP boxes (the heart of the pulse generation), pulse lines from the SIP boxes to the tuyeres, and a bespoke plant-control system.

The costs for carbon emissions, growing awareness of climate targets, and sensitivity to climate-centered topics are increasingly influencing markets.

The pulse lines, coming from the SIP boxes, each lead to a dedicated lance, which is inserted into the blow-pipe next to the existing coal lance. For cooling, the lance is supplied with a continuous flow of oxygen, the so-called basic load. As it leaves the dedicated lance, the oxygen first meets the carbon stream emerging from the coal lance and is ignited. The pulsed oxygen initially ensures a mixing effect as well as a certain optimization of the conversion behavior of the injected coal.

Periodically, a pulse is generated by the SIP boxes (seen in Figure 1) and then superimposed on the basic oxygen-flow quantity at a pre-determined frequency. A proprietary valve opens and closes very quickly to ensure that a high-energy shock wave reaches the raceway zone of the blast furnace at supersonic speed (Figures 2 and 3). This wave front provides a massive increase in turbulence and thus has a positive effect on the conversion behavior of coal and coke particles—including the uncombusted char that builds up in the lower part of the furnace, forming the "dead-man."

The control of the system with regard to pulse frequency and the admission of individual tuyeres is freely selectable and depends on how the furnace is operated, which is why it will be matched to the respective furnace during initial setup. The expectation is that this initial setup will be adapted through the day-to-day life of the furnace as is the case with controlling the various other input parameters. »



A FUTURE-ORIENTED STEP IN THE RIGHT DIRECTION

Dr. Dirk Gotthelf, Head of thyssenkrupp Steel's Schwelgern blast-furnace plant, talks about his experience with the Sequence Impulse Process.

What motivated you to consider and then implement the Sequence Impulse Process?

Dr. Dirk Gotthelf: The availability of high-quality raw materials is now severely limited. Compromises between quality and cost have become absolutely necessary to ensure that the production process remains economical. This sometimes poses problems that are difficult to overcome with the conventional process-control strategy at the blast furnace. New approaches are inevitable. Helping the blast furnace right at its heart with regular "oxygen injections" is a fantastic idea.

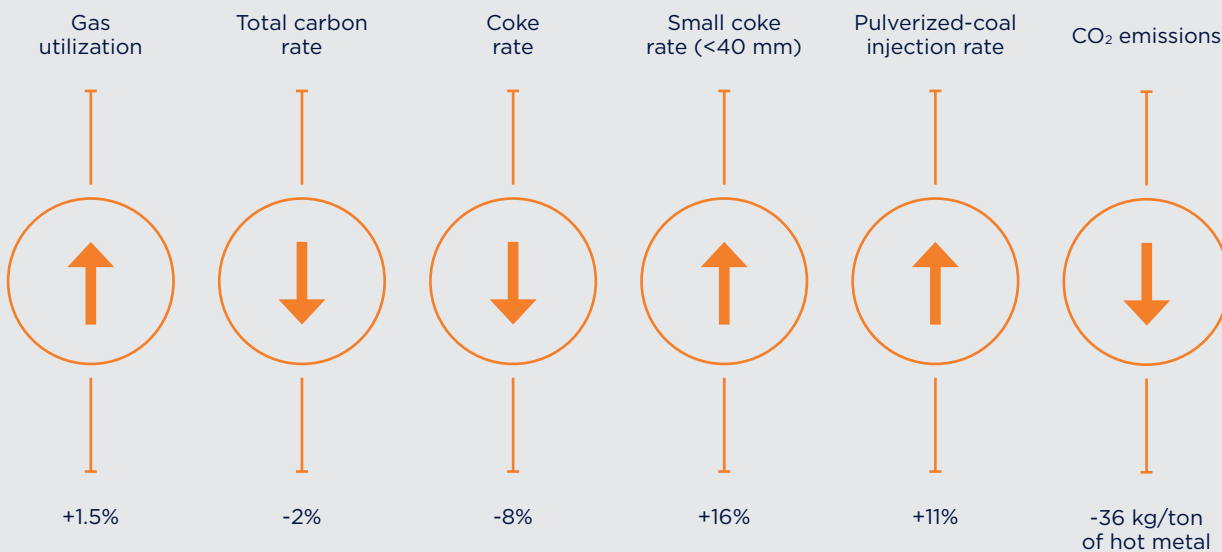
What are the biggest benefits you have seen with the Sequence Impulse Process solution?

Gotthelf: The task of every blast furnace operator is to produce pig iron at low cost and at high throughput. Due to the more stable furnace behavior and the cost savings on reducing agents, the SIP plant makes a significant contribution to reaching these goals.

Has the technology met or even surpassed your expectations?

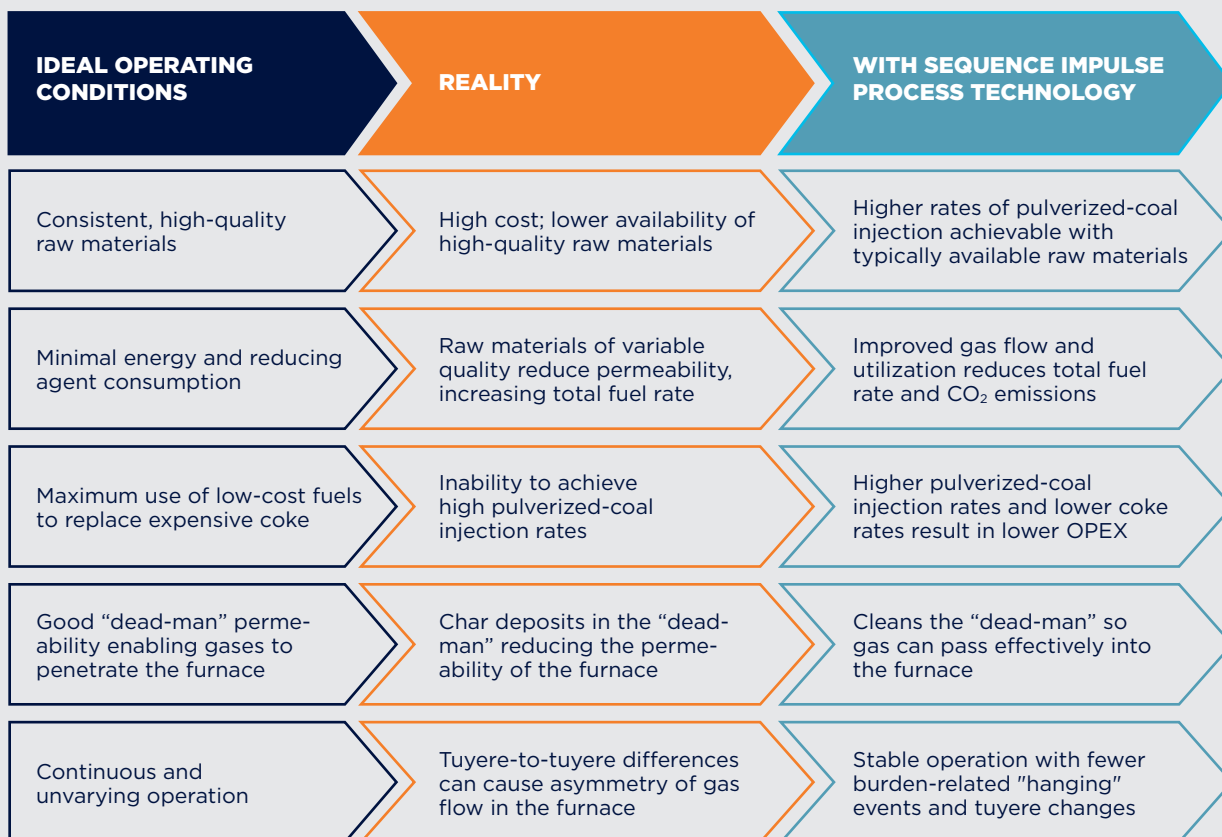
Gotthelf: Since the SIP technology was tested for the first time worldwide on a large blast furnace, I was curious to see what the results would be in terms of operation and cost benefits. The evaluation of the test phase showed great potential for production at lower costs, which for me as the responsible production manager means an important and future-oriented step in the right direction.

OPERATIONAL RESULTS WITH THE SEQUENCE IMPULSE PROCESS



All figures were obtained at thyssenkrupp Steel's Schwelgern plant in Duisburg; further improvements are expected once the system is fully optimized.

DESIGNED TO ADDRESS REAL-WORLD PROBLEMS



SIP offers blast-furnace operators a proven and effective tool in support of the journey to carbon neutrality.

Economically, the use of SIP technology at the blast furnace is expected to allow for more cheap injection coal to be used instead of the more expensive coke. In addition, the reduction of less thermally converted coal particles can be expected to improve throughput and drainage, which ultimately leads to increased production.

GREENER IRONMAKING

SIP was developed by thyssenkrupp AT.PRO tec and has seen success in foundry cupola furnace applications. Following significant research and development, the first full installation has been operational since December 2020 on blast furnace No. 1 at thyssenkrupp's Schwelgern steel plant in Duisburg, Germany. SIP delivered a significant shift in raw-material consumption. The improved gas utilization was demonstrated as expected and resulted in a lower overall fuel rate with the consequential reduction in CO₂ emissions.

As such, SIP offers blast furnace operators a proven and effective tool in support of the journey to carbon neutrality, bringing essential "green" credentials. Not only does the process enhance the overall OPEX, it also makes furnace operation smoother (see left).

The OPEX benefits lead to a short amortization time, typically within 12-18 months when considering the fuel rate only. This is dependent on production levels as well as internal utility and relative material costs. When also considering the added benefit of reducing the charges related to carbon emissions, the payback time shrinks further—to less than a year, depending upon the carbon levy applied. Primetals Technologies can provide an indicative payback figure to producers based on their specific operational conditions and associated material-utility and carbon costs. ●

Colin Morrison, Sales and Marketing Manager, Blast-Furnace Products
Martin Smith, Business-Development Director, Blast-Furnace Products
 (Both with Primetals Technologies U.K.)

BENEFITS OF THE SEQUENCE IMPULSE PROCESS

- Improved across-furnace gas distribution and drainage, enhancing production potential
- Improved gas flow into the furnace increases gas utilization, reducing both the total fuel rate and the total CO₂ emissions.
- SIP offers a rapid return on investment of under two years for most plants and less than one year for some.
- Substituting coke with higher rates of injected coal results in lower OPEX.
- Reduced carbon-related costs
- The oxygen previously injected via the stoves or oxy-coal injection is repurposed. The total oxygen requirement will be determined by the final pulverized-coal-injection demand.
- More stable furnace operation, compared to conventional coal injection operations. These effects are observed during pulsing:
 - Fewer burden-related "hanging" events
 - Fewer tuyere changes
 - Reduced heat loads, particularly in the lower stack of the furnace
 - Higher central-gas temperatures and lower wall-gas temperatures
- Improved furnace permeability and an increase in the small-coke proportion is possible without impacting productivity.



GET SMART **SMART STRIP THREADING**

**A NEW AND INNOVATIVE STRIP-THREADING SOLUTION THAT
INCREASES YIELD, ACCELERATES SMOOTH OPERATIONS,
AND IMPROVES REVERSING COLD MILLS**

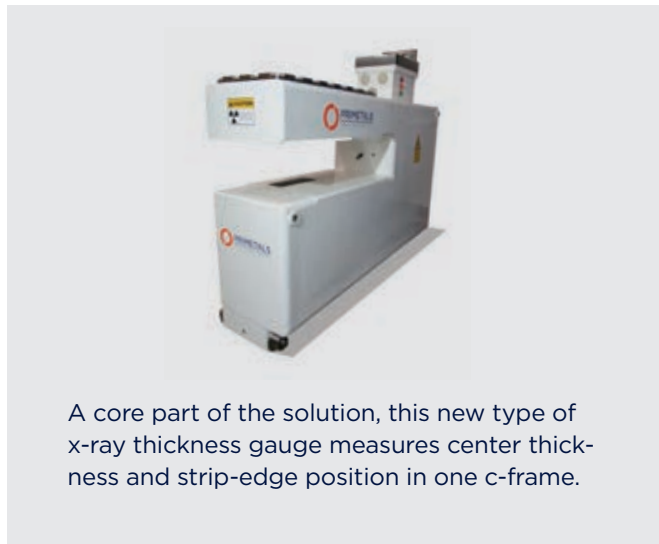
An up-close look at
Primetals Technolo-
gies' reversing cold
testing mill located
in Hiroshima, Japan

One common source of yield loss in cold-rolling mills is the strip's unrolled head and tail ends. As each coil is loaded into the pay-off reel, sent through the rolling stand, and coiled onto the reel, a substantial yield loss between 1.5-3 percent, or more, of overall production occurs. The process of loading coils and preparing the strip is also labor-intensive. It requires the involvement of skilled operators to send the strip through the mill and lock it into place. The process is commonplace in mill operation: depending on mill type, production capacities, and product mix, it can take place over 6,000 times a year. Reliance on this method creates a bottleneck in production, thus further increasing operational expenditures.

SMARTER THREADING

R&D specialists at Primetals Technologies have recently developed an efficient, stable, and consistent method to solve these issues at cold-rolling mills. The solution lowers the amount of scrap (yield loss) generated and makes the reduction process less labor-intensive. This new technology utilizes advanced x-ray sensor technology and a new control system for cold-rolling mills. While cold-rolling mills have relied on x-ray sensors to gauge centerline strip thickness, specialists have developed a new x-ray sensor to also detect any lateral movement of the strip. By measuring the movement of the strip, the sensor helps prevent various kinds of malfunctions even when threading at high speeds. Combined with the mill's automated control system, the real-time data provided by the sensor accounts for necessary adjustments on either side of the strip. Remarkably, this controlled steering works even at high reduction levels and speeds up to 30 meters per minute.

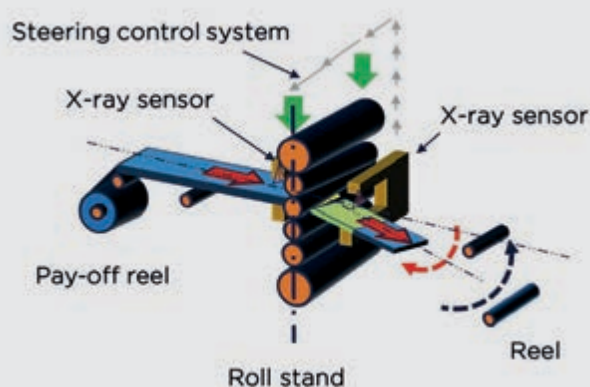
The solution's control system facilitates the automatic threading of the strip. After opening the mill stand and sending the strip head end through the roll-gap between the work rolls and centering, the roll-gap is adjusted to the target thickness for the respective pass. The rolling process can start immediately with-



A core part of the solution, this new type of x-ray thickness gauge measures center thickness and strip-edge position in one c-frame.

INTERPLAY OF TECHNOLOGIES

The x-ray sensor and the data it generates are combined with a steering control system to automatically thread and adjust the strip—and to ensure the production of high-quality cold-rolled steel. Smart Strip Threading also greatly improves consistency of production.



out any applied head tension onto the strip. The automated system means that no human interaction is required, and rolling can begin without stopping the mill. By eliminating the need to manually lock the strip into the reel or establish winding tension, this innovation accelerates production time and keeps operational expenditures low. This automated system ensures that more of the strip can be processed and transformed into a saleable product, meaning less scrap, and this technology can also be applied to the strip tail from the pay-off reel. The R&D team, drawing from Primetals Technologies' international locations, estimates a 0.6 percent or more increase in product yields, depending on steel grades and product dimensions.

INTEGRATED SOLUTIONS

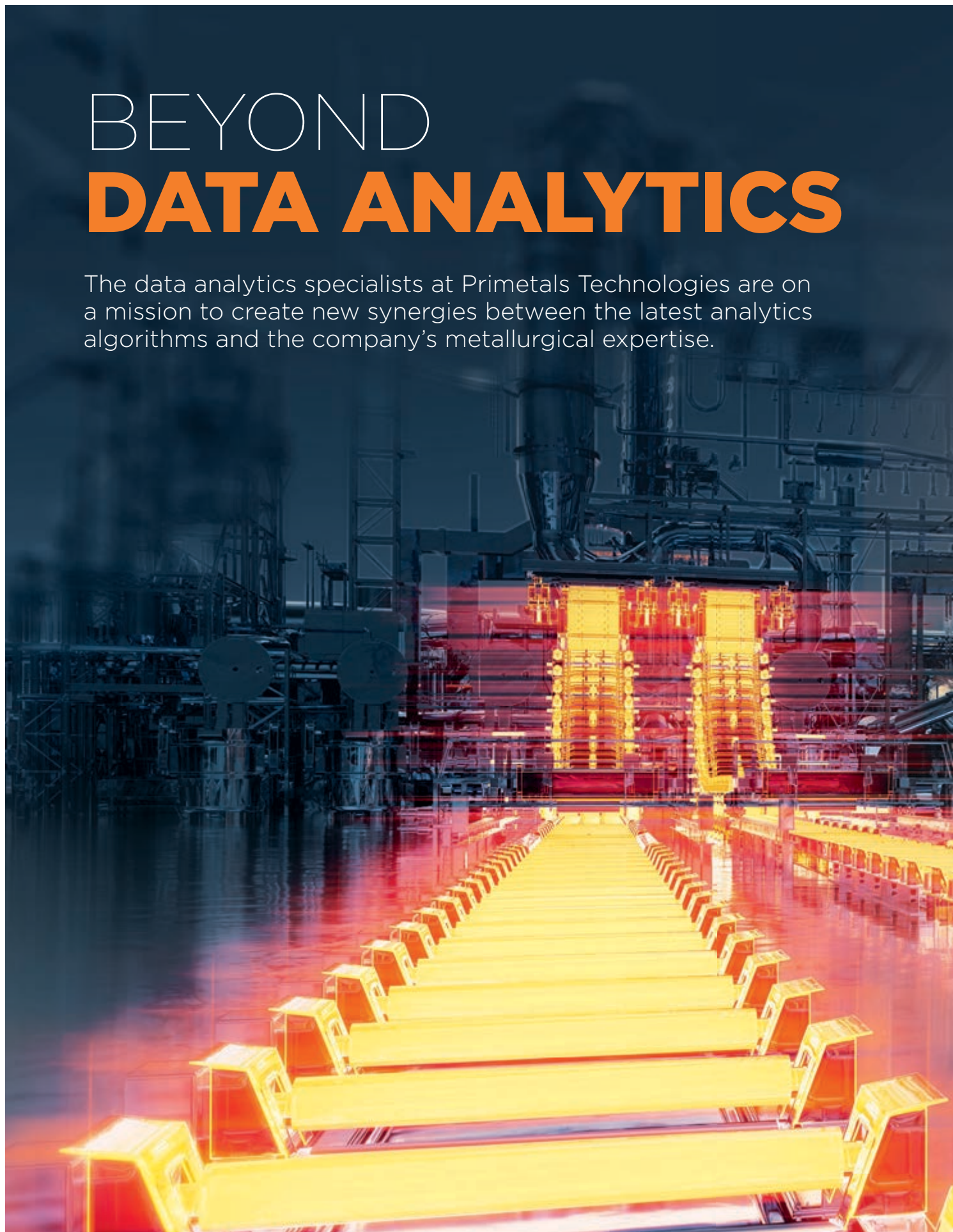
Dedicated specialists have tested the Smart Strip Threading technology at full-scale test facilities and are in the final stages of development at Primetals Technologies in Hiroshima, Japan. As a supplier of Smart Strip Threading technology and other unique rolling technologies, Primetals Technologies can readily upgrade existing cold-rolling mills and incorporate this technology as a standard feature of cold-rolling mills in the future. ●

Yoichi Matsui, Principal Key Expert Cold Rolling Mills,
Primetals Technologies Japan

Adam Merki, Lead Editor,
Primetals Technologies Austria

BEYOND **DATA ANALYTICS**

The data analytics specialists at Primetals Technologies are on a mission to create new synergies between the latest analytics algorithms and the company's metallurgical expertise.





It is important to acknowledge that data-based models reach their full potential in steel production only when combined with first-principle physical models.

The use of data analytics is on the verge of becoming an essential factor in metals production. But what precisely is data analytics, or “analytics?” According to the Oxford Dictionary, analytics is the “systematic computational analysis of data or statistics” and has various diverse applications. We can already see data analytics work their magic in image and speech recognition on a day-to-day basis. Search engines, such as Google, are becoming increasingly capable of identifying content found in the pictures uploaded to webpages—which is an area expected to develop further in the next few years. Today’s smart devices, such as phones and voice assistants, rely on artificial intelligence and big data, both associated but not identical with data analytics, to identify commands and enable dictation functionality.

When applied to the world’s steel plants, data analytics will facilitate the next step in overall performance optimization—making the production process more intelligent, more adaptive, and more efficient. This increase in machine-applied intelligence will lead to even greater consistency in terms of product quality and help speed up product development—especially that of higher-quality steels. New applications will support operators in finding the root cause of any production issue they may be investigating and enable smaller production runs with minimal losses in productivity. Additionally, data analytics would also make it easier to adjust a plant’s production process to changes in the raw-material mix or if a producer wants to extend their product mix. As the technology matures, additional application areas will become apparent.

DATA IS THE FUEL

Of course, there is one crucial prerequisite to implementing data analytics-based solutions: data. The availability of large amounts of data is the fuel that powers the analytics engine. For example, Primetals Technologies has developed a “heat cloning” solution for electric arc furnaces. Still, historical production data, going back at least half a year, is required for this technology to realize its full potential. These solutions function similarly to artificial intelligence applications that need to be extensively “trained” with a vast number of real-world scenarios before they can effectively build simulations. Data analytics can only find meaningful correlations if their algorithms are let loose on a decently sized data lake. However, once these preconditions are met, data analytics technologies can unveil the hidden secrets of metals production, including correlations no one even dreamed existed, making the world of metals more predictable and transparent than ever before.

Which begs the question, what is the most powerful data analytics algorithm? In 1997, American mathematicians David Wolpert and William Macready stipulated that no single algorithm consistently outperforms others. In their view, circumstances determined which approach was best suited to deliver optimum results. They called this idea the “No Free Lunch” theorem and demonstrated its validity in various contexts. Their conclusion states, “If an algorithm performs well on a certain class of problems, then it necessarily pays for that with degraded performance on the set of all remaining problems.”



FIG. 1: New solutions employing data analytics are taking steel production to the next level.

BLACK-BOX MAGIC

While choosing the correct algorithm for the task at hand is a challenge in and of itself, the use of highly complex models can present additional problems. Their intricate inner workings are hard to explain without additional visualizations of their architecture and a detailed explanation of their features. Still, even with these aids in place, data analytics algorithms appear to many people as “black boxes”—they seem to be performing a certain kind of magic that remains largely opaque. The black box effect leads to common misunderstandings of what data analytics can and cannot do, leading to unrealistic expectations. Often, programmers have to remind their colleagues and managers that there is not much they can do without sufficient amounts of high-quality data. No matter how sophisticated an algorithm might be, it cannot turn a messy and incomplete dataset into a treasure chest, like an alchemist turning lead into gold.

It is also important to acknowledge that data-based models reach their full potential in steel production when combined with first-principle physical models. The latter have existed for several decades but have seen excellent refinement and complement algorithms grounded in data analytics and machine learning. This combination of physical and analytics-based models is considered most fruitful by R&D specialists at Primetals Technologies as they continue to fine-tune these complementary approaches in their new innovations. By developing more well-rounded applications using this approach, these data magicians take their solutions to a place beyond mere data analytics. ●

DISCOVER WHAT'S WHAT: OXFORD DEFINITIONS



Analytics:

“The systematic computational analysis of data or statistics.”



Artificial intelligence:

“The theory and development of computer systems able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages.”



Black box:

“Any complex piece of equipment, typically a unit in an electronic system, with contents that are mysterious to the user.” (In this context, “Black box” could also refer to a flight recorder.)



Big data:

“Vast data sets that may be analyzed computationally to reveal patterns, trends, and associations, especially relating to human behavior and interactions.”



Deep learning:

“A type of machine learning based on artificial neural networks in which multiple layers of processing are used to extract progressively higher-level features from data.”



Pattern recognition:

“The process by which a human or animal brain or a computer detects and identifies ordered structures in data, visual images, or other sensory stimuli.”

CASE STUDIES: GOING BEYOND ANALYTICS



SINTER-PERMEABILITY CONTROL

Dr. Petra Krahwinkler

How do you maximize sinter-plant productivity using a data-driven permeability control system? Sinter-permeability control can be implemented in any sinter plant and uses data analytics to ensure optimal sinter-plant performance. The control system relies on samples taken from the sinter feed before the top hopper and analyzes the raw material's permeability, density, and moisture values. This solution helps determine the correct amount of moisture to add to the raw-material mixer to maximize sinter permeability and reach full production capacity. A permeability control system allows operators to avoid excessive raw-mix moisture levels. Dr. Krahwinkler's Sinter-Permeability Control System goes beyond data analytics by applying a reliable statistical model based on profound knowledge and understanding of the metallurgical process and automation to integrate it easily into a closed-loop control system.



GRAIN-SIZE MONITOR

Anna Mayrhofer

Using acoustic monitoring and data analytics, the Grain-Size Monitor is a new way to detect an excessive proportion of fines in raw materials by listening to different materials transferred from conveyor belts. For example, this system can monitor raw input materials in iron and steelmaking, such as sinter and pellets. By replicating the functions of the human ear, the monitor mimics experienced operators but provides more information—and more readily than even the most experienced operator could provide. The Grain-Size Monitor can improve the quality of end products and add stability to the production process. It also makes up for blind spots in Level 2 systems in material handling, provides continuous basic information on raw materials, and directs operators to take samples. By applying enhanced analysis to the acoustic data, Anna Mayrhofer's monitor accounts for irregularities, providing a more detailed understanding of grain-size distribution, and can help understand additional quality parameters. This system also corresponds well with other automation systems to integrate into tailor-made solutions for unique applications.

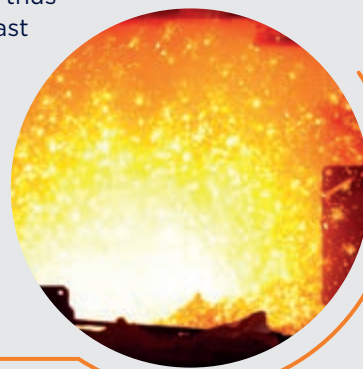




BLAST-FURNACE HOT-METAL TEMPERATURE FORECASTING

Dr. Christian Tauber

Hot-metal temperature forecasting ensures stable blast furnace operation, increased productivity, and consistent quality in the hot metal produced. Input data consists of charging data, pressure, temperature, top-gas analysis, hot metal, slag, and results from metallurgical models that the system then cleans and clusters to forecast hot-metal temperatures. The prediction results are integrated into the process-optimization system, thus creating a closed-loop scenario to control the blast furnace. Dr. Christian Tauber's system combines an intimate knowledge of the production process to determine relevant input data and create suitable predictive models by going beyond data analytics. This feature can be used with a closed-loop expert system for standard blast-furnace operations. This innovation is currently in operation at three different locations and continuously improving.



EAF HEAT CLONING

Manuel Sattler

This solution uses a reference heat to determine how operators can reliably recreate the target heat of an electric arc furnace (EAF). The system effectively produces a model for cloning the desired conditions using historical data of the prior operation as Level 1 and 2 inputs. Heat cloning helps steel producers adjust to new objectives, such as maximizing productivity, cost optimization, or reducing iron loss. By preserving the expertise of seasoned employees, heat cloning also optimizes operation using different input materials, including pig iron and hot-briquetted iron. It also adds a layer of transparency to furnace operation and is applicable in virtually any EAF. Manuel Sattler's heat-cloning solution goes beyond mere data analytics by combining algorithms and visualizations with a deep understanding of the melting process. EAF Heat Cloning builds on historical data and approaches real-world applications for enhanced productivity. Sattler and his colleagues are currently testing the system and expect to see it become standard in electric steelmaking.





FROM AUTOMATION **TO DIGITALIZATION**

DATA IS EMERGING AS A CRITICAL FACTOR IN THE ONGOING DIGITALIZATION OF A STEEL INDUSTRY KEEN TO EMBRACE A NEW WAVE OF INDUSTRY 4.0 STRATEGIES.



Digitalization solutions developed by Primetals Technologies are designed to analyze data, find patterns, provide insights, and automatically implement recommended actions.

In the steel industry, it is an undisputed truth that producers must embrace digitalization to prepare their businesses for increased competition and ever more stringent environmental regulations. Terms like data analytics, artificial intelligence (AI), or interconnected systems are more than just buzz words; they are critical concepts and the cornerstones of any steel plant's digitalization roadmap. Consequently, data—or, more specifically, data availability and utilization—has become the primary focus of Chief Technology Officers and Chief Digitalization Officers alike.

In Business-to-Consumer (B2C) scenarios, turning raw data into valuable insights to add value can be relatively straightforward. Historical data is collected and pooled in a so-called "data lake"—a storage repository capable of holding vast amounts of raw data in its native format—, allowing reports to be prepared using business-intelligence tools or generating insights using data analytics and AI to improve business performance.

There are countless predictive analytics tools on the market, available off-the-shelf from giants such as SAP and IBM, that can help companies identify trends and make predictions about future events using data mining, statistical algorithms, predictive modeling, and machine learning. The current data is overlaid with the patterns revealed by the historical data to predict what might happen next. The ability to accurately forecast future business outcomes such as product demand, resource requirements, or financial performance can hand a company a significant competitive edge.

FROM INSIGHTS TO ACTIONS

Yet, the steel industry is unique because there is no one-size-fits-all solution for moving plant operations comprehensively into the digital realm. So what is it that makes the steel industry so different? Contrary to commercially-oriented optimization processes in the B2C sector, where the data is highly accurate and there is a wealth of data sets with a small number »

5-STEP APPROACH TO INDUSTRY 4.0

By formulating a 5-step approach, at the center of which is a study designed to assess how far a producer has already implemented Industry 4.0 standards, Primetals Technologies works closely with steel producers to establish tailor-made digital transformation strategies. The study looks at the automation systems currently implemented at the plant and the strategic business targets—and it details the best approach for achieving those targets.

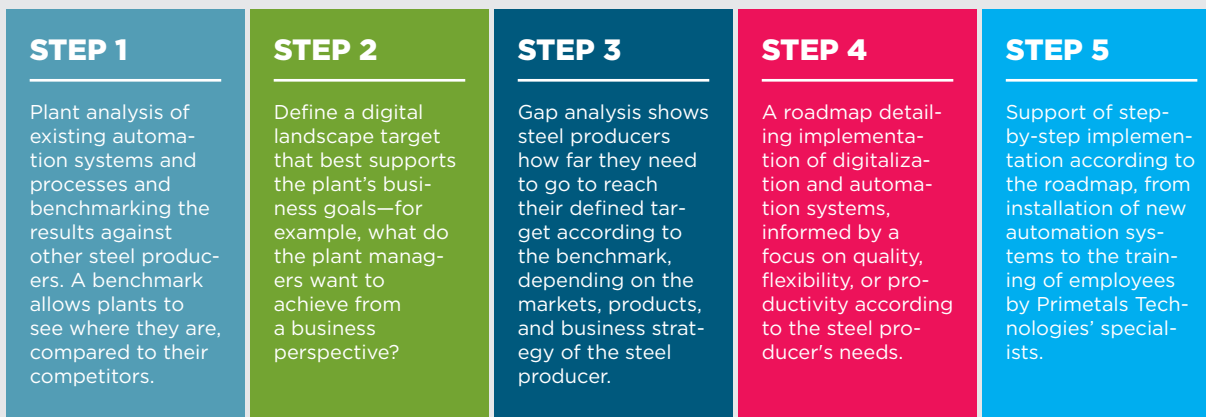


FIG. 2: The 5-step approach of Primetals Technologies assesses the current automation landscape of a steel producer to provide tailor-made solutions.

of data points, the number of data sets in steel production is lower. Still, each data set has a large number of data points. Thus, the number of data errors is also higher.

Compared with the use of predictive analysis in B2C, where tangible benefits include being able to identify new business opportunities, gain insights into competitors, reduce costs, and optimize products and performance, the significant advantage of leveraging raw historical data in steel production comes from turning the data into actionable information.

DIGITAL OPTIMIZATION

Digitalization solutions, such as those developed by Primetals Technologies, can analyze the data, determine patterns, and provide insights, as you would expect. But effective digitalization means automating the provision of actionable information and the generation of insights and taking the recommended action automatically, which results in a closed-loop scenario. Importantly, there is another prerequisite for a closed-loop implementation to work: the data required to derive the appropriate actions must be available. Here, plant automation is the solid foundation that can, on the one hand, provide this data and, on the other, execute the resulting actions.

Primetals Technologies' Through-Process Optimization (TPO) collects high-resolution data related to the process chain and to product quality, so that information about each coil, slab, billet, or bloom is available at every single stage of production.

As a result, TPO helps realize two crucial aspects of process and product optimization. For example, suppose a product shows deviations from the targeted quality parameters. In that case, TPO will indicate what measures need to be taken at subsequent processing steps to compensate for these deviations and still achieve the desired quality. Second, TPO can use the data it collects to optimize the production process for various targets such as costs, process stability, reduced need for alloying agents, and more.

FLEXIBILITY, QUALITY, PRODUCTIVITY

Expert systems, which Primetals Technologies has developed for several types of aggregates, are a good starting point for digitalization systems. They encompass a predefined knowledge base continuously being added to and enhanced. To illustrate the resulting benefit, imagine a plant's best operator. Now, imagine one who is not only thoroughly skilled based on experience but also never stops learning, never leaves the plant, and never resigns.

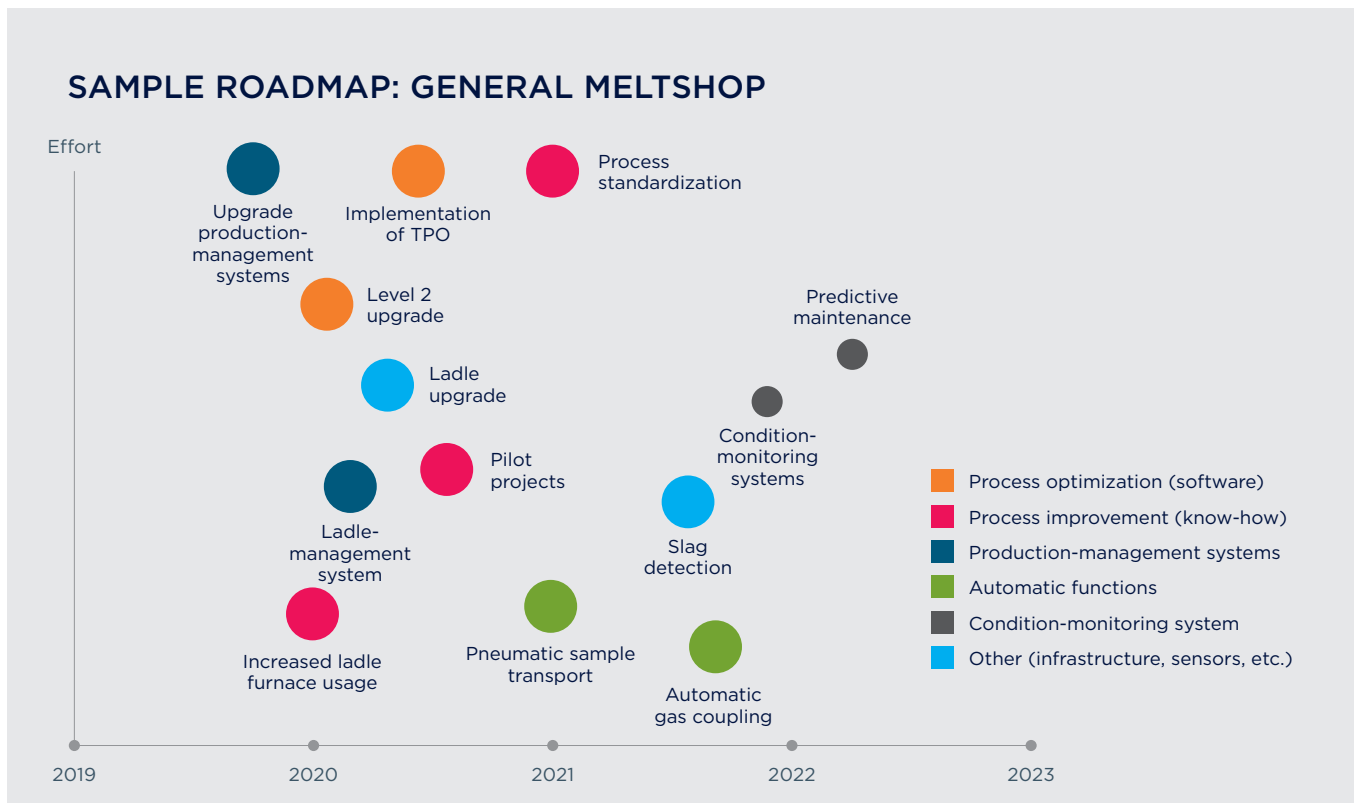


FIG. 3: This graphic shows the roadmap for a South American steel producer and defines effort required for each step (y-axis) over time (x-axis), and the size of the bubbles represents the business impact.

There is a broad range of options in terms of how digitalization in a plant can facilitate improvements. In the areas of quality, digitalization ensures all products are within the predefined range of quality parameters. In productivity, digitalization can increase output and reduce costs, and in regards to flexibility, digitalization can adapt to new products or different raw-material mixes. How digitalization fits into steel production depends on each steel plant's automation landscape and the business strategy defined by the producer. Digitalization is an ongoing process, and each steel producer can define their digitalization strategy and implementation roadmap.

PROVEN SOLUTIONS

Several insightful Industry 4.0 studies of all shapes and sizes have already been carried out with customers worldwide. For example, in one comparatively small study for a European steel producer interested in installing a Production-Management System (PMS), Primetals Technologies identified a shortfall in the existing automation system. Primetals Technologies discovered the plant's production units could not provide the data required for the PMS. Instead, the operator would have entered the data manually, which implies a high risk of error. Primetals Technologies recommended improvements to the existing automation

landscape so that the required data could be fed into the PMS. As a consequence, the production orders from the PMS could now be executed—all in a fully automated closed-loop scenario.

On a larger scale, another study for a South American steel producer with two different production facilities—one mini-mill and one integrated steel plant—with different automation landscapes led to an implementation roadmap and a cost-and-impact analysis. Now, several modifications and upgrade packages are being installed as part of an ongoing project: from dedicated sensor systems for certain plant sections to a full-fledged PMS.

Digitalization in the steel industry requires a unique approach and the development of bespoke automation solutions, such as those being pioneered by Primetals Technologies, where industry-specific expertise is combined with predictive analytics and automation competence to equip steel plants with the tools they need to implement their digitalization strategies and roadmaps to sustainable success. ●

Kurt Herzog, Head of Industry 4.0, Electrics & Automation, Primetals Technologies Austria

WOMEN IN STEEL

**LUCIA NARES**

Head of Product
Development for
Hot-Rolled Products,
Ternium Mexico

Who are the great women in the world of steel? In this series, we ask them to step into the limelight. The steel industry may long have been a bit more on the conservative side, but this is changing fast. These days, it is only right that Metals Magazine reflect the global trend toward an even more diverse and powerful workforce in steel production.

“When I started my career, many other students went into materials. I wanted to be different, and this ultimately led me to automation and then to metallurgy.”

Lucia Nares

Can you share with our readers a bit about your background?

Lucia Nares: My name has Libyan origins, but my entire family is from Mexico. I studied mechanical engineering at the University of Monterrey and began working at Ternium in January of 2012. Most of my work here has been in the hot-rolling area. When I started my career, at first I only knew that I wanted to be an engineer. I noticed that many students went in the same direction, which would have been materials. I wanted to be different, and this ultimately led me to automation and then to metallurgy.

One of the projects Ternium has executed with Primetals Technologies involves a new hot-rolling mill. Is this investment enabling new possibilities in R&D?

Nares: The mill is a total game changer. We will be able to significantly extend the range of products we can manufacture. I feel we really needed a hot-rolling mill at this stage, and I'm very excited about the new possibilities it provides us with.

What role do automotive steels play in your larger R&D strategy?

Nares: It matters greatly to us. Automotive steels are at the center of the steel industry's R&D work, and we always aim to develop lighter and harder materials for many car parts, for example wheels, structural components, and those relevant for increasing safety in the car.

Is it true that steel grades for the exterior of cars—automotive exposed—are the hardest to produce, and if so, why?

Nares: If cold-rolled material is used, I would say that it's indeed relatively hard to make. But for producers of hot-rolled steel, it's not quite so complex. With the new hot-rolling mill, we'll be able to tackle the most challenging steels, as we've already got two galvanizing lines and a PLTCM. The new hot-rolling mill will allow us to establish a complete production chain on our Monterrey site.

Will automotive steels become less relevant once electric cars are more common?

Nares: No, not at all. Electric cars still require steel, even if they have to be lighter and despite the fact that electric cars use comparably less steel in terms of overall weight. There are even new parts that are necessary in the construction of electric cars, for instance, for protecting the battery. Carmakers have tried materials such as aluminum in the past, but they found that steel worked better for them in terms of stiffness, so they reverted to using steel again.

In your personal opinion, will hydrogen-powered cars soon succeed today's electric cars?

Nares: I asked my husband about this, since he is a big car aficionado. It seems that hydrogen cars these days are still quite dangerous as the technology is not »

“I admire Galileo. He was both an innovator and an artist. If your work is ultimately results-oriented, it’s not always easy to infuse it with artistic beauty.”

Lucia Nares

mature yet. So I would not expect to see hydrogen-powered cars become mainstream any time soon.

How long do your R&D projects take, for instance, the development of a new steel grade?

Nares: At least a year and a half. The definition of the material—the chemistry, the thermomechanical process, and the right cooling strategy—usually takes a few months. Aside from meeting the specification, the material will also have to satisfy our client, so we’ll align with them repeatedly in order to ensure they’ll be able to use our products for the intended applications. Once this is done, we can scale up production step-by-step.

What tends to be the most common challenge?

Nares: Ensuring that the material will work “in the field.” It has to be functional, in addition to meeting specifications.

Where do you draw inspiration from for new R&D ideas?

Nares: We get it from working with our clients. It is our job to make sure they’ll achieve their goals. This is what drives us.

Is there any innovator that you particularly admire?

Nares: I admire Galileo. He had a unique duality: he was both an innovator and an artist. If your work is ultimately results-oriented, it’s not always easy to infuse it with artistic beauty. Galileo achieved this.

What technology would you like to see invented, even if it probably never will be?

Nares: Producing drinkable water. I think that we might see shortages in the future. We should be more environmentally conscious, for ourselves but also for our children. ●



TERNIUM IN MONTERREY, MEXICO

The Monterrey location plays a central role in Ternium’s larger company structure—this is where the headquarters is located, so most operational and strategic decisions are made in Mexico. Monterrey is not only responsible for orchestrating production centers in Argentina, Brazil, Guatemala, Colombia, and the U.S.A., but also excels in hot and cold rolling as well as product development. While Ternium is regarded as one of the world’s most relevant manufacturers of flat and long products, the Monterrey location has more recently been building a reputation as a highly dependable supplier to the automotive industry, which has grown dramatically in the region due to its proximity to the U.S.A.—its largest export market. Ternium is on a similar growth trajectory and plans to make substantial strategic investments over the coming years in terms of technology and even more sustainable processes, in order to strengthen its position.



FIG. 1: Ternium has several plants in Monterrey—this one features the iconic balloon tower.

FIG. 2: Coil logistics are executed with great care and with immense precision.

FIG. 3: The coil yard, full of identical-looking products, showcases Ternium's focus on quality.

FIG. 4: Trucks are used to transport finalized coils to their next destination.

FIG. 5: In the distance, you can make out the saddle-shaped profile of the Cerro de la Silla mountains.

GREAT PIONEERS

THAT INSPIRE US



At Primetals Technologies, we constantly strive to pioneer new and groundbreaking solutions for the steel industry. We work with passion, inspired by our close partnerships with steel producers from all around the world. Another source of inspiration are the great pioneers that have come before us—innovators who have made a profound impact on the way we live and changed the course of history. In this series, we look at the life, the challenges, and the achievements of some of the most outstanding pioneers of all time.

TIMELINE

1749

Born May 17 in Berkeley, Gloucestershire, England, the son of a vicar.

1754

Jenner is orphaned.

1763

Becomes apprentice to a surgeon in Sodbury, near Bristol.

1770

Jenner is apprenticed in surgery and anatomy under surgeon John Hunter at St. George's Hospital, London.

1772

Returns to Berkeley as a trained doctor.

EDWARD JENNER

THE “FATHER OF IMMUNOLOGY” AND PIONEER OF THE WORLD’S FIRST VACCINE

If you're meticulous about keeping your shots up-to-date, or you're an avid traveler, especially to tropical countries, it's highly likely you will have a vaccination certificate full of all manner of colorful stickers bearing exotic names that quite frankly could suit any character in a Philip K. Dick novel. Regardless of how you might feel about vaccinations, they save lives, and one man is credited with having saved more lives than any other human: the English physician and scientist Edward Jenner, whose fascination with an urban legend and an unwavering faith in a potentially fatal experiment ultimately led to the world's first vaccine.

In 1757, an 8-year-old boy in England was inoculated with smallpox. He developed a mild case, and became immune to the disease. The boy was Edward Jenner, and it is believed that his crusade to prevent the disease was driven by his own traumatic childhood experience of inoculation (he was starved and locked in a stable with other infected boys until the disease had passed) as he strove to find a safer and less terrifying alternative. Jenner went on to become a relentless advocate of vaccination and devoted himself at considerable personal cost to its research, and his work changed the way medicine was practiced and earned him the epithet “the father of immunology”.

IN THE GRIP OF THE SPECKLED MONSTER

Smallpox, a serious, infectious, and disfiguring disease caused by the variola virus, was the scourge of 18th Century Europe, where it is calculated to have killed some 400,000 people every year, and one third of those who survived went blind. The symptoms were horrendous: pus-filled skin lesions would form, eventually drying out, dropping off, and leaving deep, pitted scars, which led to smallpox becoming affectionately known as the “speckled monster” in 18th Century England. »



DID YOU KNOW ...?

- ... that childhood vaccines save over 4 million lives every year, equating to 11,000 children every day, 450 children every hour, or 8 children every minute of every day, according to the World Health Organization (WHO).
- ... that the Latin words for cow and the cowpox virus are “vacca” and “vaccinia” respectively, which prompted Edward Jenner to call his new procedure “vaccination”.
- ... that an antigen is the most important ingredient in a vaccine. Antigens are the active ingredient that cause an immune response in the body.
- ... that vaccine efficacy measures a vaccine's capacity to protect against a disease in ideal conditions, such as a controlled vaccine trial. Vaccine effectiveness, on the other hand, refers to a vaccine given outside a clinical trial—in the real world.
- ... that honors to Jenner include a statue in Kensington Gardens, London, as well as the eponymous lunar crater.
- ... that “herd immunity”, where most of a population becomes immune to an infectious disease, is achieved either through vaccination or previous infection. The WHO supports the vaccination route, which prevents unnecessary cases and deaths.

1788

Marries Catherine Kingscote, goes on to father three children; his eldest son and wife would die of tuberculosis in 1810 and 1815 respectively.

1796

Makes a breakthrough after successfully testing his hypothesis that infecting a person with cowpox could protect them from smallpox.

1798

Word of Jenner's success spreads following self-publication of his “Inquiry” pamphlet.

1821

Appointed physician extraordinary to King George IV.

1823

Dies of apparent stroke on January 26, aged 73.

“A world less burdened by preventable disease would be a world of more balance and greater opportunity for all.”

Nelson Mandela

Former President of South Africa and
founding Chair of the Vaccine Fund Board

Before Jenner, it was already known that smallpox survivors were immune to the disease, and although not without high risk, inoculation became a standard practice. In 1717, Lady Mary Wortley Montagu (see box), having lost her brother to smallpox and survived the disease herself—which left her face severely disfigured—, witnessed inoculation first hand while in the Ottoman Empire, where her husband was British Ambassador in Constantinople (now Istanbul).

Inoculation, or variolation, was used to prevent rather than cure smallpox by introducing live smallpox virus into the scratched skin of a healthy person. With the shadow of her husband’s recall to England hanging over the family, Lady Mary quickly decided to have her own four-year-old son, Edward, inoculated, making him the first Englishman to undergo the—ultimately successful—procedure. Lady Mary is credited with introducing the technique to England.

JENNER AND THE MILKMAID

Edward Jenner was not the first to discover the link between cowpox infection and subsequent immunity to smallpox, and neither was he the first to carry out cowpox inoculation. But he was the first to scientifically attempt to control a disease through vaccination, and his relentless work lies at the heart of immunology, the study of the immune system and today a key branch of the medical and biological sciences.

The story goes that Edward Jenner, intrigued by folklore that people who had caught cowpox, a mild viral infection frequent among dairymaids, were naturally immune to smallpox, and inspired by his personal experience of variolation as a boy, decided to carry out his own, very risky experiment. In 1796, young milkmaid Sarah Nelms approached Jenner with cowpox lesions on her hands and arms, having caught the infection from her cow, Blossom. He used material from one of the pocks on Sarah’s hand to inoculate 8-year-old James Phipps, who subsequently suffered only a mild fever. Two months later, Jenner inoculated

young James with material from a fresh smallpox lesion, and he proved immune to the disease. This was the birth of the science of immunology (sidenote: Blossom has also been immortalized—her hide is on display on the wall of the library at St George’s Medical School in London).

REJECTED BY THE ESTABLISHMENT

In the wake of the success of his—let’s face it, by today’s standards highly unethical—experiment, and despite Jenner’s own lack of understanding of how the science behind his discovery actually worked, Jenner ploughed on and repeated this process several more times. In 1797 his observations were rejected by the Royal Society, who dismissed his ideas as “too revolutionary.” Undeterred, and after a few more experiments, he privately published his findings in 1798 in “An Inquiry into the Causes and Effects of the Variolae Vaccinae,” where he coined the word “vaccine.” Again, the medical community was less than impressed by his paper.

Not only did Jenner face opposition from the medical profession, there were also plenty of “anti-vaxxers” who feared the consequences of being deliberately infected with material from cows, and who rejected the practice on religious grounds.

Jenner’s belief in his vaccination process was nevertheless so unwavering that he set up a vaccination center, his Temple of Vaccinia, in the summerhouse in his garden, providing free vaccinations to the poor. He offered samples of the vaccine material to other physicians so that they could garner trust among their own patients. Eventually, word of his success spread throughout England and then overseas, and, with the backing of other physicians as well as prominent figures such as King Charles IV of Spain and Thomas Jefferson in Virginia, U.S.A., advocating the practice, by 1800 the use of vaccination had gained unstoppable momentum.

It is remarkable that within 20 years of its discovery, millions of lives were being saved by the vaccine, and



THE WOMEN BEHIND OUR MODERN-DAY VACCINES

With pioneers such as Edward Jenner, Louis Pasteur, or Alexander Fleming hogging the limelight, you could be forgiven for never having heard the names of many of the exceptional female scientists whose work contributed to vaccine development and who paved the way for modern medicine, such as Drs. Pearl Kendrick and Grace Eldering (whooping cough), Dr. Margaret Pittman (HIB), Dr. Isabel Morgan (polio), or Dr. Anne Szarewski (HPV). Difficult as it is to single out anyone in particular, here are just a few:

Lady Mary Wortley Montagu (1689–1762):

This British aristocrat preceded Edward Jenner by introducing smallpox inoculation into Western medicine. After witnessing inoculations against smallpox in the Ottoman Empire, she had her four-year-old son inoculated in 1718, and upon returning to London began a campaign to promote the procedure in spite of strong resistance from the medical establishment.

Dr. Dorothy Horstmann (1911–2001):

An epidemiologist and virologist, Dr. Horstmann's research proved that poliovirus reaches the brain through the blood, a discovery that led to the development of a polio vaccine. Polio has been all but eradicated, with cases down more than 99% since 1988.

Dr. Anna Wessels Williams (1863–1954):

She was the first to isolate the bacteria that causes diphtheria in 1894, leading to the development of the first diphtheria antitoxin and subsequently a diphtheria vaccine. Today, diphtheria is preventable, and children can be protected through the combined diphtheria, tetanus, and pertussis (DTP) vaccines.

although later in the 19th Century it became clear that revaccination was necessary (because it turned out that smallpox immunity was not lifelong), the number of deaths from smallpox was declining. Vaccination eventually replaced variolation, which became prohibited in England in 1840.

Despite falling victim to ridicule and encountering resistance from within the medical profession and from the clergy, Jenner's achievements were eventually recognized and he received the honors he deserved. He was undoubtedly a remarkable scientist, and a man of many talents; his interest in zoology also led him to the discovery—contrary to the theory of the time—that the young, newly hatched cuckoo was responsible for evicting the eggs and fledgling chicks out of the host's nest rather than the adult cuckoo. Indeed it was Jen-

“Jenner didn't seek to make any money from his vaccine, he wasn't interested in patenting it.”

Owen Gower

Manager of Dr. Jenner's House Museum

ner's familiarity with animal biology that made him even more of an expert in human-animal disease transmission. And however questionable the ethics of his original experiments, his work and dedication led to the eventual eradication of smallpox; the World Health Organization (WHO) launched a campaign to eradicate the disease in 1967, when there were still up to 15 million cases a year, and by 1980 the WHO declared that “Smallpox is Dead!”—finally fulfilling Jenner's prophecy about vaccination that “the annihilation of the smallpox, the most dreadful scourge of the human species, must be the result of this practice.”

Since Jenner's original experiment, progress in the development of vaccinations has been astounding, but the science of immunology remains complex and challenging. On the one hand we have seen how a vaccine for Covid-19 was developed in a matter of months, while on the other hand there is still no vaccine for HIV after 40 years. But life-saving breakthroughs are being made all the time and it is thanks to the pioneering work of Edward Jenner, the self-proclaimed “Vaccine Clerk to the World,” that vaccine technology, as well as the processes involved in ensuring the safety and efficacy of vaccines, continues to progress. ●

**ANDREAS VIEHBÖCK ...**

... is one of Primetals Technologies' most experienced executives. He has overseen the development of many pioneering innovations.

IN THIS SPECIAL INTERVIEW FORMAT, WE ASK AN EXPERT FROM PRIMETALS TECHNOLOGIES TO USE THEIR IMAGINATION.

Andreas Viehböck is the Global Head of Casting and ESP at Primetals Technologies. He cares deeply about creating an environment in which team members can create groundbreaking innovations for the company's customers in the global steel industry. In this interview, Metals Magazine speaks with Andreas Viehböck about leadership, innovation management, his sources of inspiration—and about his personal view on *what if* ...

“A good leader needs to make sure that their team not only sees the vision but lives and breathes that vision.”



... YOU WERE ASKED TO PICK THE MOST PROMISING INNOVATION FROM A LARGER GROUP OF CANDIDATES?

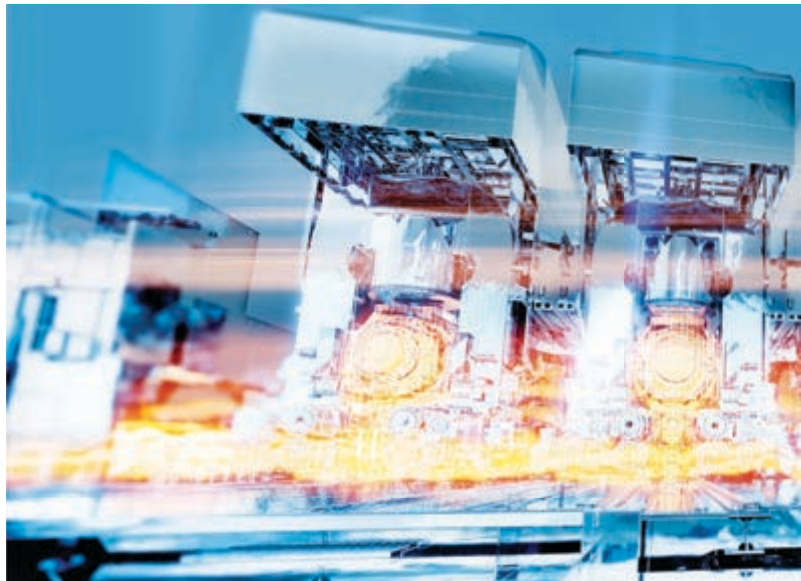
Andreas Viehböck: Managing innovation is never easy, but I think the challenge is particularly pronounced in the metals industry because of its rather conservative nature. Steel producers traditionally expect new solutions to be “tried and tested” before they consider investing in them. This leads to a paradoxical situation: Generally, you are supposed to have numerous references for a solution—but when you are pioneering something that will push the limits, there is no way you could have these references from the get-go. Thankfully, our customers trust us to make the right recommendations in terms of what technologies will enable them to reach their business goals. At Primetals Technologies, we always design our solutions for reliability. We know they have to work 24/7 and in tough conditions. One example of successful innovation is Arvedi Endless Strip Production (ESP). When I was first presented with the concept, I knew it was far ahead of its time. It was Giovanni Arvedi’s inspired idea that convinced me of its potential, and together, our great teams brought it to life. Today, I can proudly say that all of our customers who bought ESP lines thus far have ordered additional ones or have entered negotiations to obtain them.



... YOU THEN HAD TO TURN THAT PROMISING INNOVATION INTO A HIGHLY SUCCESSFUL PRODUCT?

Viehböck: I focus a lot on choosing the right people to lead specific efforts. Leadership is not only important in the context of promoting innovation but also when bringing new technologies to market. A good leader needs to make sure that their team not only sees the vision but lives and breathes that vision. They also have to be able to network. A good networker will have an easier time involving the talented people they need to get results. Relationship building is another crucial factor, because so much in the steel industry depends on mutual trust—which has to be earned over time. I have always felt that in order to be understood, I first had to understand the other person’s perspective, to really appreciate their point of view and see their objectives. Only then will I be in a position where I can help to solve the challenges that person—or that company—is actually facing. I have also found that it is good to be humble and not to assume that I already know everything. The overall complexity of the technologies we are working with in metals production is so immense that you can never stop learning. Finally, finding the right lead customer is another cornerstone of making a new solution a reality.

Artistic rendering of the 5-stand mill section that is part of Arvedi Endless Strip Production.



... COVID OR ANOTHER CRISIS AGAIN MADE IT IMPOSSIBLE TO TRAVEL AND MEET WITH PRODUCERS IN PERSON?

Viehböck: I think we have learned from the experience of Covid that even under extreme circumstances it is possible to ensure business continuity. When Covid happened, it deeply impacted the ways we collaborated with customers and partners. All of a sudden, in-person meetings had to be replaced by video conferences and phone conversations. Our industry is still very much a "people's business," and my experience during Covid was that it seemed easier to maintain existing customer relationships; it was harder to build new ones. So the better you know someone, the less you lose when switching to "long-distance" mode. But when there is no alternative, you have to build trust using digital forms of communication. Honesty and authenticity are best conveyed in person, but 2020 and 2021 have shown that it is doable over video. Also, your reputation becomes an even more elemental factor when face-to-face meetings are out of question. "What goes around, comes around," is a saying that I have found to be quite true. Finally, it helps to focus on how you can be of service to your partners—with things like the eagle-eye perspective on the steel industry that we have here at Primetals Technologies.



... YOU WERE ASKED TO HELP WITH COST OPTIMIZATION? ANY MEASURES YOU HAVE FOUND TO ALWAYS WORK?

Viehböck: I think there is a right and a wrong way to optimize for cost. Let me first outline the "wrong" approach: what you should not do is draw up simplistic PowerPoint slides with, say, a minus 20 percent target and then identify areas that you can cut in a straightforward yet very crude manner. What's usually much more successful is to do a "deep drill" into the architecture of the solution in question. This involves examining every nut and bolt of the construction for areas that may have been "over-engineered" and could be re-designed without any loss of bottom-line functionality. You may then, for instance, discover that you could use different, more affordable parts, or parts that are simply lower in weight. To give you an example: When we did this deep drill into Arvedi ESP, we found that certain steps of the production chain had originally been engineered much like individual units, with features that were not necessary in the unique setup that is Arvedi ESP. As a result, these units could be carefully changed to reflect their specific purpose. We achieved a significant reduction in material costs, which made Arvedi ESP even more competitive. I feel this is the way all cost cutting should be done.



... ARVEDI ESP BECOMES A NEW DE-FACTO STANDARD FOR THE PRODUCTION OF HOT-ROLLED COILS?

Viehböck: This is actually quite a realistic scenario. We have received testimonials from all the companies who bought Arvedi ESP production lines thus far. They are all very pleased with the performance of their lines—and with the new portfolio elements they can now realize. ESP delivers excellent energy efficiency and great end-product quality at the same time. It is without equal. The strip made with Arvedi ESP is on par with strip traditionally made with cold mills, and car makers can directly use it for automotive applications. As a consequence, there will be less slab casting and hot rolling in the future.

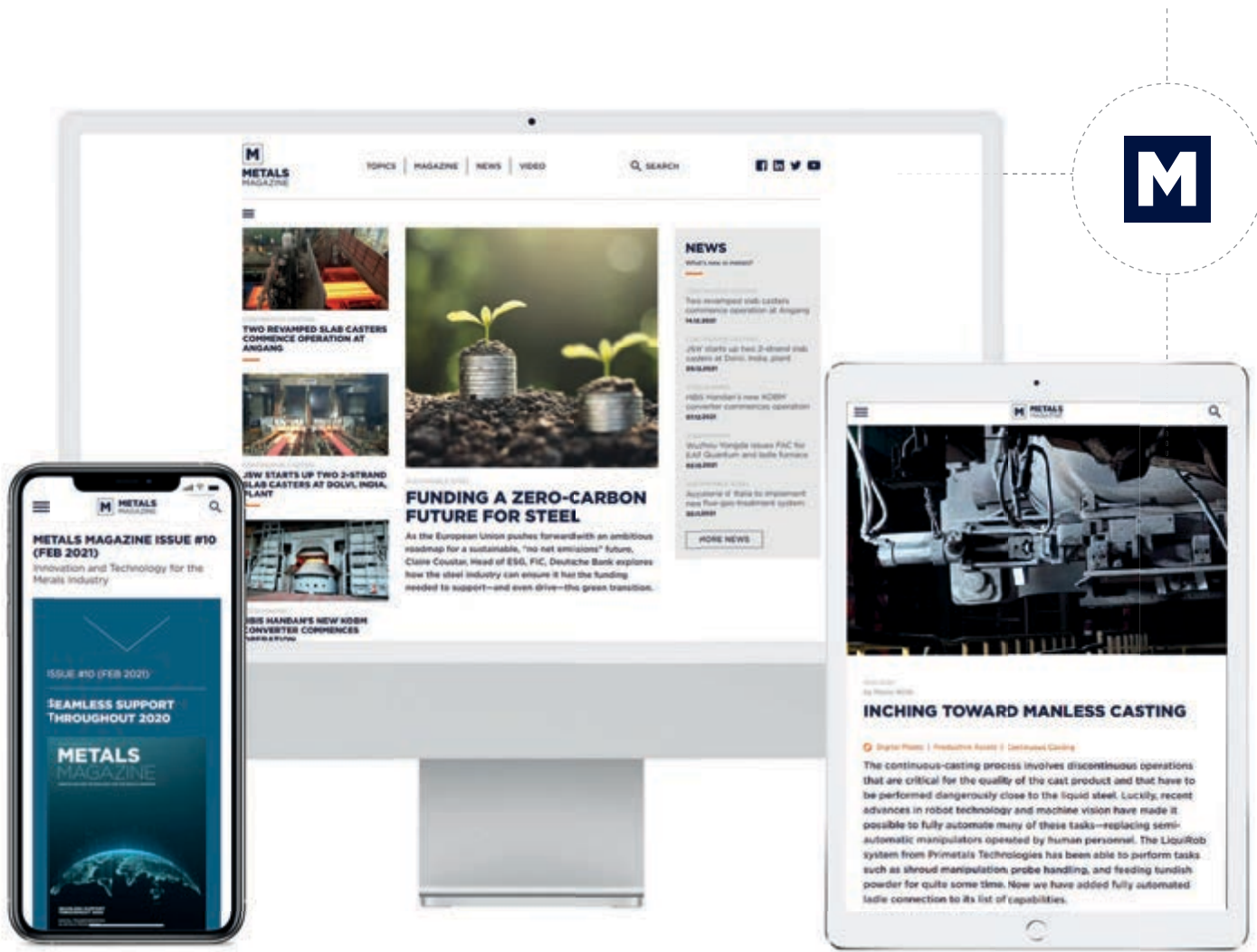


... YOU HAD TO GIVE ADVICE ON HOW TO KEEP STRESS LEVELS LOW WHEN MANAGING A HIGH-STAKES PROJECT?

Viehböck: First, we should differentiate between positive and negative stress. Positive stress can be a consequence of people taking responsibility and making tough decisions. This is good and necessary, because it is sometimes unavoidable for a team to take calculated risks. But then, there's also negative stress, which may result from a lack of communication or unclear targets—all of which should be avoided in the first place by implementing dependable leadership. In general, what helps me to deal with stressful situations is to have a good and reliable sparring partner—a sounding board I can trust. Depending on the matter at hand, this could be a colleague or a business partner. Mutual trust, to me, is the single greatest asset in meeting stress-inducing challenges. Also, it's a good idea to celebrate success and to recognize important contributions from individual team members. When people feel valued, they will be more open to innovate within their team. Focusing on the positive also helps to prevent the build-up of negative stress. Another tip: do remind yourself of the things that inspire you. Personally, I get a lot of inspiration from talking to our customers, from learning about their operations and their challenges. Every time a steel producer decides to start a new project with us as their preferred partner, I feel great excitement and satisfaction. I am also very proud of the fact that Primetals Technologies has become the industry leader in endless strip production and market leader in continuous casting. And we will continue to pioneer new things in these areas.

“Mutual trust is the single greatest asset in meeting stressful challenges.”

INNOVATION ON-DEMAND: METALS MAGAZINE ONLINE



We are proud to present Metals Magazine Online: an integrated on-demand platform committed to providing customers and stakeholders with up-to-date information regarding innovations, developments, and breaking news from Primetals Technologies. The online platform features current press releases, news articles, current and past Metals Magazine editions, and new episodes of "Pioneers Talk," offering insights from specialists.



SCAN ME

Follow the link through the QR code to gain direct access to the Metals Magazine Online homepage. Bookmark the magazine for easy access and to remain up-to-date on all of the current happenings at Primetals Technologies. Add Metals Magazine Online to your browser's favorites and homepage of your mobile device, and check back regularly to see the latest news from Primetals Technologies.

magazine.primetals.com

Our principles have consistently posited that showing is often more powerful than telling. To demonstrate our commitment to digitalization in the metals industry in all aspects, we are proud to present Metals Magazine Online. Our approach has shifted to an online-first publication to provide updates on solutions, technologies, and innovations developed by Primetals Technologies. Metals Magazine has consistently offered customers valuable insight into new developments and recent activities. By shifting our focus online, we provide the same quality associated with Metals Magazine through an easily accessible platform.

RIGHT AT YOUR FINGERTIPS

Metals Magazine has always been right at its customers' fingertips in the form of a high-quality print magazine. While digitalization often implies a shift away from the analog, the online platform involves an integrated approach with an online-first publication accessible on all devices with reliable links via QR codes in the magazine itself (follow the QR code shown above to access to meta.ls/magazine on your mobile device). Metals Magazine will remain at customers' fingertips with seamlessly linked multimedia resources.

NEWS, PRESS, MEDIA

Digital devices have become commonplace in most parts of the world, and the field of publishing keeps evolving. However, Metals Magazine remains in close contact with Primetals Technologies experts, looking to inform about the latest developments in the world of metals production. While customers and stakeholders may follow Primetals Technologies on various channels and platforms, including social media outlets and the company website, Metals Magazine Online provides a convenient location to access essential news articles and press releases.

Features of the online platform include the ability to sort articles, press releases, and videos based on a topic from green steel to electrics and automation. While offering all published media in one location, the platform also allows you to save and bookmark news items while the webpage is open. In addition, the familiar Metals Magazine is presented in a streamlined layout—highlighting the articles of each issue from features to spotlights, as well as presenting technologically oriented pieces, interviews, and inspirational stories. Not to mention that all current and previous magazine issues are readily available for download or to read online.

A TRADITION GONE DIGITAL

Metals Magazine will remain a key provider of news, updates, and information regarding Primetals Technologies' innovations year after year. Whether in its digital or analog format, the focus of Metals Magazine is to represent Primetals Technologies' philosophies and passion for innovation by continuing the tradition of providing regular high-quality print editions and demonstrating innovation through publications on a user-friendly digital platform. To further provide the most up-to-date information to our customers and stakeholders, Metals Magazine Online has premiered its new "Pioneers Talk," providing an opportunity to "sit down" with specialists at Primetals Technologies to hear about new developments directly. We see it as our goal to query the hearts and minds of key members of the Primetals Technologies community to provide customers with the truest sense of our passion and enthusiasm (read more about Pioneers Talk on the following pages). With a dedicated team at the helm, Metals Magazine is, above all, dedicated to creating and publishing informative and valuable articles and media on all platforms. »



LET'S TALK: INTRODUCING "PIONEERS TALK"

METALS MAGAZINE SITS DOWN WITH METALS EXPERTS IN A NEW VIDEO SERIES

Pioneers Talk is a new video series introduced by Primetals Technologies, which focuses on informative and empowering interviews with specialists in metals production and beyond. Topics include breakthroughs in green-production solutions, success strategies for steel producers worldwide, and recent advances in digitalization and automation. By presenting Primetals Technologies' community members in an intimate setting, customers and stakeholders can sit back and listen directly to the innovative hearts and minds of experts. Join us by typing meta.ls/talk into your browser.



meta.ls/pioneers-talk01

PIONEERS TALK #1:

PLANT LOGISTICS SIMULATIONS



In the first episode of Pioneers Talk, we sit down with plant-logistics expert Stefan Mühlböck to discuss how his simulations are helping steel producers to make the right investment decisions. Stefan

Mühlböck is a senior expert in plant logistics with a degree in industrial mathematics from Johannes Kepler University in Linz, Austria. His passion for discovering solutions to super-complex logistics problems helps steel producers optimize their plant operations.



meta.ls/pioneers-talk02

PIONEERS TALK #2:

MEETING EAF PERFORMANCE TARGETS USING DATA ANALYTICS



In episode two of Pioneers Talk, moderator Dr. Christoph Stangl and data analyst Manuel Sattler discuss how data utilization can improve the operation of electric arc furnaces. Manuel Sattler's experience

working in mechanical and industrial engineering gives him a keen eye for data analytics and how they might inform industrial projects. Dr. Christoph Stangl's inquiries focus on the needs and questions steel producers have and on Primetals Technologies' automation, optimization, and digitalization solutions.



meta.is/pioneers-talk03

PIONEERS TALK #3:

COP26, CLIMATE GOALS, AND GREEN PRODUCTION



In episode three, after his return from the climate conference COP26, Dr. Alexander Fleischanderl shares his thoughts on what contribution the metals industry can make to global climate action. Host Dr. Tom Widter asks, "How can steel production become even greener, can carbon capture, use, and storage technologies contribute to a lower-carbon economy, and what goals can we anticipate for next year's COP27?" As Technology Officer and Head of Environmental Solutions at Primetals Technologies, Dr. Fleischanderl is used to tricky questions and provides answers based on his expertise in sustainable metals production, covering areas from off-gas cleaning and by-product recycling to decarbonization.



meta.is/pioneers-talk04

PIONEERS TALK #4:

FROM AUTOMATION TO DIGITALIZATION



In episode four of Pioneers Talk, we sit down with Industry 4.0 expert Kurt Herzog to discover how steel producers can improve operations based on production data. With steel producers wondering how to grow and apply digitalized corporate know-how, Kurt Herzog demonstrates why the "right automation solution" is essential to converting generated insights into standardized actions. Kurt Herzog's focus on automation efforts attempts to make the complexity of steel-plant operations more manageable.



meta.is/pioneers-talk05

PIONEERS TALK #5:

GREENING THE BF-BOF STEEL-PRODUCTION ROUTE



Steel production will soon become more environmentally compatible than ever before. Episode five of Pioneers Talk features Dr. Gerald Wimmer, who shares his insights into the transformation ahead.

With a reliance on the blast furnace and the basic oxygen furnace, two of the primary sources of CO₂ emissions in integrated production, innovations—such as a move toward electric steelmaking, the increasing relevance of direct-reduction, and advancements in technologies for carbon capture, storage, and use—offer a "greener" outlook for the future of steel production.



THE RICH HISTORY **OF BRITISH STEEL**



1 Kelham Island is one of Sheffield's oldest manufacturing sites. The island was man-made in the 1100s. The museum welcomes you with a large Bessemer converter (left).

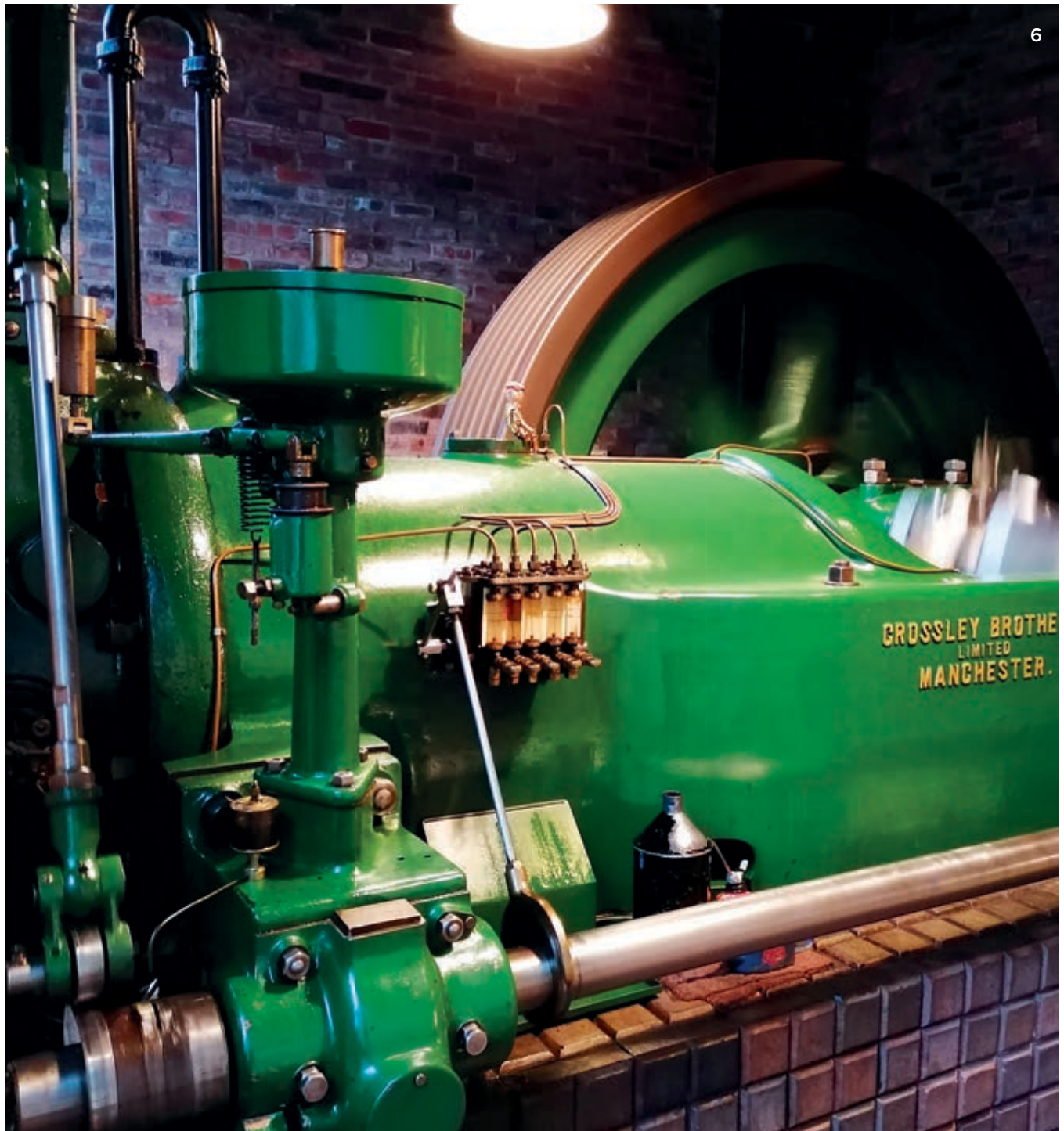
2 The River Don Engine—a steam engine—is a giant of a machine. It was made by Davy Brothers in 1905 to power the mill of plate-producer Grimesthorpe Works.

3 In the 1900s, smoothing and polishing metal objects such as spoons and teapots was the most common occupation for women in Sheffield's metals industry.

4 The steam hammer was invented in 1849 and made workers' lives dramatically easier. Charles Ross of Sheffield built the unit on display at the museum around 1900.

5 This armor plate was used in the U.K.'s first iron warship to set out to sea. The plates used for the HMS Warrior were five meters long and 90 centimeters wide.

Sheffield is steeped in history when it comes to steel production. It is therefore only fitting that the city operates a full-fledged steel museum on Kelham Island, a man-made island diverting the River Don. The multifaceted exhibition takes you back as far as the 14th century, when Geoffrey Chaucer, in his "Canterbury Tales," referred to a knife as a "Sheffield thwitel." Kelham Island Museum documents the unparalleled transformation of a small rural town into a world-class center of metals excellence.



6



6 The Crossley Gas Engine, powered by "town gas" made from coal, was used until 1970 to run a rolling mill at George Clarke Ltd. It produced rods and bars.

7 This slightly ominous-looking apparatus was employed to cut steel into shape. Highly skilled operators were required to properly and safely run the machine.



8

- 8 "Little Mesters' Lane" is a faithful depiction of what a typical street of craftsmen would have looked like. The "little mesters" were quality-focused specialist toolmakers.



9

- 9 Here, we get to peek into the shop window of one of the "mesters." They did jobs such as scythe grinding, file hardening, and handle finishing—all with precision.



10

- 10 In the era of electric vehicles, this may come as a surprise: this "milk float" is an early example of the battery-powered cars that were used to deliver milk in the 1940s.



11

- 11 Different shaped dies were fixed into this press to stamp out cutlery and small tools. The operator put a piece of metal between the two dies and squashed it into shape.



12

- 12 This hydraulic press was made in the early 1800s. From 1806 to 1874, the British army used it at the Tower of London for one of its responsibilities: map making.



13

- 13 Sheffield's Simplex Motor Works was the first British car company to include an electric starter motor in its designs—in 1913. Only U.S.-based Cadillac did so earlier.



HOW WILL WE LIVE?

TELEMEDICINE: STEERING THE PATIENT-DOCTOR RELATIONSHIP INTO THE DIGITAL AGE

What will tomorrow's world look like—a world that has implemented the innovations pioneered today? A world based on the groundbreaking technological, social, and political ideas that have only just surfaced? In this series, Metals Magazine's independent editor James Gray takes a peek into his crystal ball and lets us know what the future holds.

Let me introduce you to two very close friends of mine, Miki and his heavily pregnant wife, Ahnah. They are a young, fit, and adventurous couple, who live in the small town of Trapper Creek, population 423, some 117 miles by road from Alaska's largest city of Anchorage. I befriended them a few years ago during a running retreat in British Columbia. These days, they are excited and scared in equal measure at the prospect of becoming first-time parents. Miki works in oil and gas extraction and spends long hours away from home, which makes it all but impossible for the couple to follow the traditional prenatal care route of upwards of 14 in-person visits

throughout pregnancy. The pressures of significant travel time and time off work are simply too much.

Fortunately, Ahnah is in the care of a forward-thinking physician who recognizes that not all prenatal visits require in-person care—such as those for ultrasounds and lab tests—, and with Ahnah's pregnancy classed as low-risk, her physician was quick to recommend telemedicine for almost half of her consultations. Miki and Ahnah are equipped to monitor blood pressure, weight, fetal heart rate, and other maternal and fetal vitals at home, which allows continuity of care to be ensured

“With patients becoming accustomed to the level of access telemedicine provides, I don’t think we’re ever going to be able to go back. The box is open.”

Dr. Jeffrey English
Neurologist

while enabling the future parents to contribute to their care plan from the convenience of their own home.

Bringing medical expertise to remote communities like Miki and Ahnah’s has obviously been life-changing—and there are plenty of small and often inaccessible populations throughout Arctic Alaska that do not even have a nurse practitioner, let alone a doctor, and where emergencies sometimes require a team of Huskies to transport patient records via sled. Out of necessity, Alaska became an early adopter of telemedicine as a solution to bridging the gap between patients and doctors, so telehealth services have already been available for more than two decades; the Alaska Native Tribal Health Consortium, for example, has been offering such services since 2001.

Any innovation in such a critical area as healthcare will take time to earn validation and gain traction, and telemedicine has been waiting to be embraced by the global medical community for years already. But there are many more factors in play than simply providing essential care to remote areas. Telemedicine has been threatening to transform the healthcare landscape for a while, and the coronavirus pandemic has unquestionably hastened its arrival. Hospitals overwhelmed with coronavirus patients have been forced to minimize the number of on-site medical procedures and postpone non-critical medical services, increasingly turning to telemedicine to maintain clinical services while also adhering to strict social distancing protocols.

SLOW ADOPTION RATES

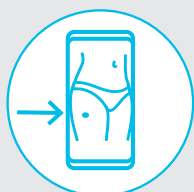
Why has the medical community been so slow to adopt telemedicine? Doctors have always cited the main factor as the difficulty in being able to make »



WHAT IS TELEMEDICINE?

Telemedicine is sometimes used interchangeably with telehealth, although there is a difference in that telemedicine, as defined by the U.S. National Institutes of Health (NIH), is “the use of technology to provide and support healthcare at a distance,” while telehealth refers to a broader scope of remote healthcare services that also include remote non-clinical services such as provider training, administrative meetings, and continuing medical education. Telemedicine, therefore, allows doctors to diagnose and treat patients remotely using telecommunications technology. It is both convenient and cost-effective. It relies on technologies that cover the entire spectrum from telephones and text messaging to transmitted images and videoconferencing.

THE 3 MAIN TYPES OF TELEMEDICINE



STORE-AND-FORWARD

Data acquired from the patient such as medical images or biosignals is sent to the physician. This practice is popular in dermatology, radiology, and pathology.



REMOTE MONITORING

Uses a range of technological devices to monitor a patient's health from a distance. It is effective in the management of chronic diseases such as cardiovascular disease, diabetes mellitus, and asthma.



REAL-TIME INTERACTIVE SERVICES

Are effective in providing immediate advice. This can be done by phone or using videoconferencing tools. Examples include teleneuropsychology, telenursing, telepharmacy, and telerehabilitation.

FIG. 1: Each of the three types positively impacts overall healthcare and there are substantial benefits for both healthcare providers and patients.

an accurate assessment from a distance, given that a physical examination is impossible in telemedicine scenarios, where they are forced to rely on the patient's own verbal description of their medical issue. During in-person visits, doctors are more sensitive to the visual clues that aid diagnosis. And the slow uptake has undoubtedly been compounded by the fact that many patients are not even aware of the availability of such an option.

Meanwhile the pandemic has reduced patients' access to doctors and provided a catalyst for significantly increased use of telemedicine by healthcare systems worldwide, which is in stark contrast to previously slow adoption of this innovative practice. According to a study conducted in April 2020 by Sermo, a collaborative platform built specifically for physicians, 63% of healthcare professionals have used telemedicine to consult with patients since the outbreak of the pandemic, with an average 57% of patients treated via telemedicine globally at its height. This represents a significant uptake in the use of telemedicine; in February 2020, some 66% of patients were reported to have never previously consulted with a doctor via telemedicine.

If telemedicine continues along this trajectory—and as the swirling mists inside my crystal ball begin to clear, all the evidence suggests that it will—, it is likely to completely redefine how health systems are run, how they deliver care, and how costs are managed.

POST-PANDEMIC UPTAKE

While the coronavirus has unquestionably accelerated the adoption of telemedicine, it's clear we have reached a tipping point from which there's no going back. Prior to Covid-19, annual revenues of telehealth stakeholders in the U.S.A. were reported at around 3 billion dollars, a figure which experts believe could easily skyrocket to as much as 250 billion. So I fully expect telemedicine to become a standard service that will be offered across all healthcare scenarios.

What this also leads me to believe is that patients will become increasingly selective. It is very likely that patients will prioritize criteria such as access to telemedicine services in their choice of healthcare provider. After all, if you can reduce waiting times, enjoy greater convenience, and still expect equally high-quality care, why wouldn't you go down the telemedicine route?



FIG. 2: Real-time, interactive services complement rather than replace in-person visits.

Equally, medical facilities prepared to embrace telemedicine can expect their revenues to grow exponentially. Telemedicine offers another revenue stream that can bridge the gap in the face of any future drop in patient numbers caused by unexpected events—such

as a pandemic. According to the American Hospital Association, hospitals in the U.S.A. lost an estimated 202.6 billion dollars between March and June 2020 alone. So it makes perfect sense for any medical facility to add telemedicine to their arsenal. Dr. Tom Tuzel, a New York Psychiatrist, says, “Patients are now requesting telemedicine. We’ve seen volumes and business increase significantly this year because the competition was slower to adopt and offer telemedicine.”

“If there’s a silver lining to Covid-19, it’s the advances made in telehealth.”

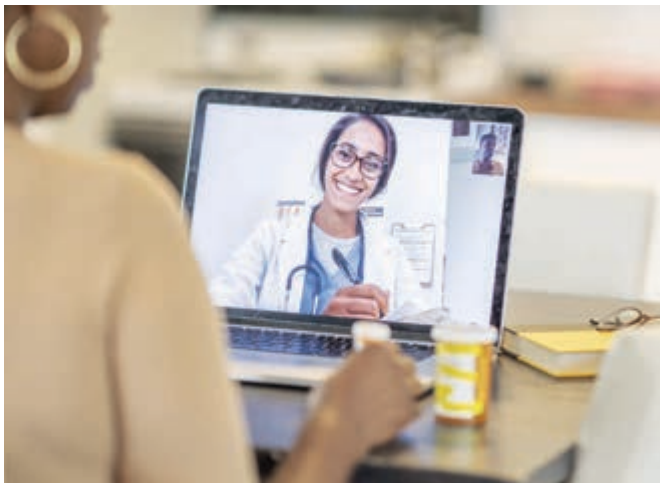
Thomas Ely

President of the American Osteopathic Association

Preventive care is another area that stands to benefit hugely from telemedicine. According to the Centers for Disease Control and Prevention (CDC), up to 75% of U.S. healthcare spending is accounted for by avoidable chronic diseases. Dr. Tom Tuzel goes on: “The goal of the future care is preventative and to make as many adjustments early on. How do you do that in a cost-effective, time-effective manner? With technology and telemedicine services.”

FROM EVOLUTION TO REVOLUTION

The shift toward greater use of telemedicine has been slow—until now. But while progress has so far been gradual, the pandemic could be regarded as the »



LONG COVID: NEW DIGITAL TREATMENT PROGRAM

In the absence of any official definition, “Long Covid” refers to symptoms such as breathlessness, fatigue, or anxiety that are still felt three months after the original infection. It is said to affect roughly two thirds of patients hospitalized by Covid, and around 10 percent of those who suffered only mild symptoms.

In the U.K., a revolutionary remote-treatment initiative is now being rolled out in hospitals: the Living With Covid Recovery program. It is a treatment plan provided to patients at home from a distance using a tablet device or smartphone app. Because rehabilitation is delivered entirely remotely, it allows National Health Service (NHS) staff to support many more patients than would otherwise be possible. The trial that preceded rollout showed that 122 people could be processed in one morning by a single person, compared with just 15 patients a week for in-person visits.

Combining evidence-based methods from physiotherapists, psychologists, dieticians, and respiratory physicians, it allows personalized treatment plans to be created and delivered remotely via a dashboard that is used by an assigned nurse or therapist to track a patient’s health and progress, and to adapt treatment accordingly. Project leader Elizabeth Murray, a general practitioner and professor of e-health at University College London, says: “I’ve worked in digital health for 20 years and I’ve never seen anything get taken up so fast and so widely as this.” The team behind the program is talking to the World Health Organisation about a global rollout.

“Telehealth will redefine patient expectations in all facets of quality healthcare.”

Jack Williams

President of VirtualMed Staff

straw that broke the camel’s back—and the eventual changes will be seismic. Make no mistake, it will require a change in mindset from both patients and doctors, the implementation and integration of new and groundbreaking technologies, and new ways of working. But every one of us is more than capable of adapting and learning. Just consider for a moment how many of us—however reluctantly at first, perhaps—have begun to take working from home in our stride and now use teleconferencing tools on an almost daily basis to communicate and collaborate.

It’s an exciting shift and the benefits are huge: greater convenience and easier access to high-quality healthcare will inevitably increase patient confidence and drive growth, leading to better patient outcomes and a more efficient and effective healthcare system. It’s an exciting time generally for the medical community: the European Patent Office recently reported that, despite the pandemic, innovation in healthcare was the main driver of European patent applications in 2020.

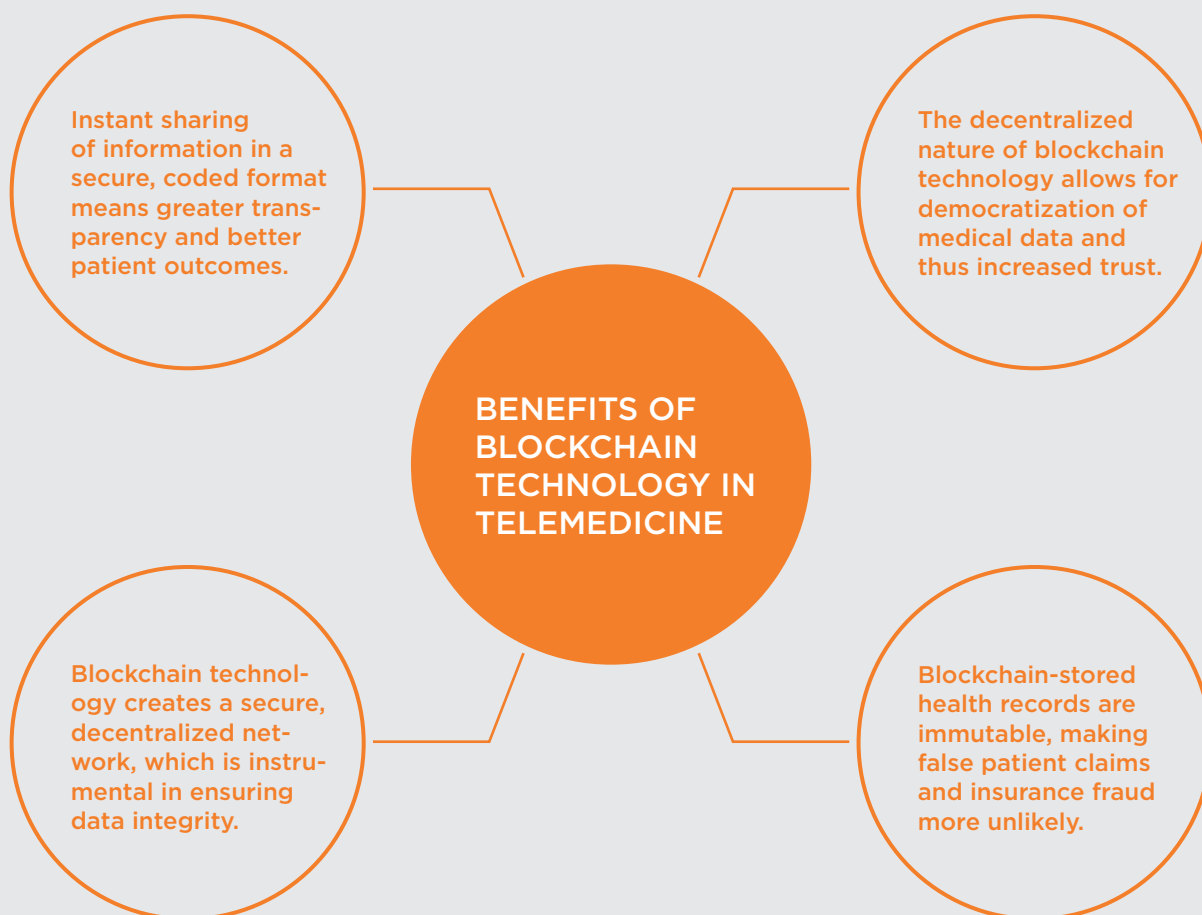
Telemedicine can without a doubt help to redress the balance in terms of disparities in the provision of care. For instance, the Inuit in Canada’s far north have lifespans 12 to 15 years shorter than the average Canadian’s, and telemedicine can help to bring much needed expertise to these remote populations so that they no longer have to rely on air transport to ensure access to specialists. In Alaska as well, telemedicine has the potential to balance out inequalities in care services between remote communities and more heavily populated urban areas. Which brings me neatly back to Trapper Creek, where, I think, Miki and Ahnah have every reason to be a lot more excited and a lot less scared about becoming parents. I, for one, have every confidence in their physician’s advice to embrace telemedicine, and I cannot wait for the birth of their healthy baby ... daughter. Oops, have I given it away? ●

CYBERSECURITY: TELEMEDICINE AND BLOCKCHAIN

A blockchain is a digital record of transactions, a growing chain of time-stamped and immutable blocks that contain information. Essentially, it is a database—or digital ledger—that is shared across a network of computers not owned by any single entity. The technology allows digital information to be shared but not copied, making it difficult or even impossible to change or hack the information.

So where might blockchain technology fit in with telemedicine? Half of all healthcare organizations in the U.S.A., for instance, have already adopted

telemedicine in some form, and with data security and privacy so crucial to patient data, especially in the context of what has been described as an increasingly “trustless society,” the advantage of blockchain technology lies in ensuring secure, immutable, and decentralized transactions. It is a sad truth that telemedicine is not a hundred percent immune to hacking, and because trust in telemedicine among patients and providers alike is at the very heart of telemedicine’s success, cybersecurity has to be made a top priority. Telemedicine platforms therefore have to be designed from the ground up to be bulletproof.



Potential stumbling blocks of Blockchain include the costs involved in implementing the technology, a lack of expertise on how to approach implementation, and a lack of standardization. However, these hurdles in all likelihood will soon be overcome. The cornerstones of blockchain—decentralization, immutability, and security—make this distributed ledger technology the ideal solution for allowing medical records to be stored and transferred securely within telehealth systems.



THE PIONEER'S GUIDE TO **BOOSTING CREATIVITY**

In this series, we look at different ways of getting the creative juices flowing. This time, we focus on how you can boost your creativity and maximize productivity by taking a risk and venturing outside of your comfort zone.



“ I am always doing that which I cannot do, in order that I may learn how to do it.”

Pablo Picasso

Painter, sculptor, printmaker, ceramicist and theatre designer

Eleanor Roosevelt, first lady of the thirty-second U.S. president Franklin D. Roosevelt and one of America's most important visionaries and leaders in her own right, dared us to expose ourselves to the risk of failure in order that we might achieve something remarkable. She said, “Do one thing every day that scares you.” And she was right on the money, because experts today agree that risk-taking and creativity go hand in hand, with studies showing that intellectual, or calculated, risk-taking is one of the cornerstones of creativity.

There are several kinds of risk—ethical, financial, and so on—but the kinds of risk that most encourage creativity are social and intellectual, where a person perceives their own risk of failure while also laying themselves open to possible criticism or ridicule from others. This level of anxiety or fear of failure is what pushes us out

of the so-called comfort zone and into what psychologists call the growth, or learning, zone (see graphic). Bearing in mind that most of us tend to be risk-averse, Eleanor Roosevelt's advice is good advice; it challenges us and increases our tolerance for risk, pushing us into the growth zone.

INNOVATION = CREATIVITY x RISK-TAKING

All of the great innovators throughout history, from Leonardo da Vinci to Amelia Earhart, Thomas Edison to Steve Jobs, have one thing in common: that they have proven themselves willing to put their reputations on the line, to lay themselves open to criticism, in the name of innovation. In one of the most watched TED talks of all time, the late Sir Ken Robinson, education and creativity expert, said: “If you're not prepared to be wrong, you'll never come up with anything original.” »

HOW TO GO FROM RISK-AVERSE TO INTELLIGENT RISK-TAKER

We can't all be natural risk-takers, but becoming adept at taking intelligent risks in order to inspire creativity and boost productivity is something we can learn to do. Not only are more and more businesses recognizing that creativity is the cornerstone of innovation, but on a personal level learning to take risks can also lead to greater confidence and success as you continue to expand the boundaries of your comfort zone. Here are our top 5 tips for embracing risk:

1. Question what is stopping you from taking risks. Is it fear of failure or criticism? Once you have identified what's holding you back, you can begin to understand what it is you need to overcome.
2. Professionally, make sure you have the support of your superior. It's important they recognize the value of risk-taking, and encourage it.
3. Decide on an innovation you want to champion, and run with it. Focus on success, rather than failure.
4. Recognize that risk-taking is learned behavior. And practice. On a personal level, you might try taking up a new hobby or sport, or going for that new look.
5. Remember that inaction is the biggest risk of all. As author and motivational speaker Denis Waitley said, "Life is inherently risky. There is only one big risk you should avoid at all costs, and that is the risk of doing nothing."

The most successful businesses are those that have realized how much innovation depends on creativity, and have consequently given their employees the freedom and the space to experiment, to make mistakes, and most importantly, to learn from those mistakes. These are the companies that have created a culture of innovation by encouraging risk-taking, assuring their employees that it's acceptable to fail—as long as failure is seen and recognized as a learning experience. It is the fear of failure that kills innovation.

The Mercedes-AMG PETRONAS Formula One team, who have dominated the turbo-hybrid era of F1, is a prime example of an organization that encourages experimentation while avoiding blame culture at all costs. Toto Wolff, who is the CEO, Team Principal, and co-owner of the F1 team, says, "We have a motto that is 'see it, say it, fix it', which means that you have to create a safe environment for everybody to speak up." Mercedes' senior management approach is to blame the problem, not the person. Wolff goes on: "We're working really hard on not blaming the person, because the moment you do that people close up like a shell and you won't see any innovation, you won't see any risk taking. This is what we want—we are in a risk-taking business, an innovation business." Successful organizations like the Mercedes F1 team have recognized that to be more innovative, they need their people to be more creative.

NO RISK, NO REWARD

Creative people naturally tend to be risk-takers. Being labelled as crazy or deluded is water off a duck's back to creatives, as the passion for creating something novel far outweighs the fear of failure or exposure to criticism. Not everyone is comfortable with taking risks, though, so if you want to be a creative person, then learning how to overcome your fear of failure is something you are going to have to do. We all have the potential to be creative in the right environment. »

“ Risk causes the mind to stretch its muscles. It trains the brain to think in unusual ways. It trains the brain to be more creative.”

Steven Kotler
Author and journalist



THE LEARNING ZONE MODEL

The Learning Zone Model illustrates the three stages, or zones, we pass through when we do something completely new, or learn a new skill. Its original conception is attributed to psychologist, Lev Vygotsky. The premise is that in order to learn something successfully, we must be challenged, but the trick is to move out of the comfort zone and push ourselves just hard enough to enter the growth zone, where creativity flourishes. If we push too far, we become overwhelmed, or panicked. In the panic zone, it is all but impossible to learn successfully. Eventually, in the process of learning new things and continuing to push ourselves, it is possible to expand the comfort zone, i.e. the environment within which we feel most comfortable.

- The Comfort Zone:** the place where you feel most at ease, which might be watching TV, reading a book, or going for a walk in the park. Here, things are familiar and safe, but staying in this zone prohibits development.
- The Learning Zone:** also known as the Growth Zone, this is the sweet spot, where you are pushed just hard enough to keep you sharp and creative. With time, as you practice taking risks, the Comfort Zone expands, and the more things you are comfortable with.
- The Panic Zone:** the place to avoid at all costs, this zone is not conducive to learning. Here, the anxiety levels are so high that it is impossible to perform at your best.

But there is no getting around the fact that without risks, there are no rewards.

What's the worst that might happen when you present a new idea? A few words of criticism, perhaps? But consider that you might also receive constructive feedback that helps you to tweak your idea, or to come up with a new one. Your idea might be a springboard to an exciting innovation, a new product or service. By focusing on success rather than failure, the reward of your risk-taking is that your idea actually leads to something. And if it doesn't, so what? Learn from the experience; at least you will have the confidence to try again. Like everything, risk-taking simply takes practice, so that eventually it is something that becomes second nature—a habit that you become comfortable with. It's important to remember, however, that at the end of the day a good risk is calculated, but not reckless.

Creativity is the bedrock of innovation and of personal growth, and in a world where the rise of the machines is becoming a reality, businesses are placing a premium on learned skills like creativity, an area in which machines and artificial intelligence are still no match for humans. We must simply practice pushing ourselves beyond our comfort zones, overcome our fear of failure, keep on trying, and be prepared to learn from any failures that do happen. Every successful innovator has failed at some point; it's how we learn, pick ourselves up, improve, and grow. As underdog Rocky Balboa, the title character of Sylvester Stallone's "Rocky" film series, puts it, "It's not about how hard you hit. It's about how hard you can get hit and keep moving forward. That's how winning is done." ●

HOW BUSINESSES CAN ENCOURAGE INTELLIGENT RISK-TAKING

1. Establish a culture where it's okay to take risks. Risk-taking leads to creativity leads to innovation. And innovation gives your company a strategic advantage.
2. Nobody's perfect, so encourage your employees to experiment and fail. Failure takes you outside of the comfort zone and into the growth zone, where innovation thrives.
3. Lead by example. Senior management needs to demonstrate that risk-taking is both valued and encouraged. They also need to give their employees the freedom, time, and resources to take risks.

THE RISK-TAKERS WHO REAPED THE REWARDS

OPRAH WINFREY

One of the most successful entrepreneurs and generous philanthropists in the world, Winfrey overcame an impoverished childhood to gain her degree and break into TV and radio journalism. In the mid 1980s she signed a deal to host her own TV show—a calculated risk that yielded great reward. Winfrey said: "Do the one thing you think you cannot do. Fail at it. Try again. Do better the second time. The only people who never tumble are those who never mount the high wire."

HENRY FORD

American industrialist and founder of the Ford Motor Company, Henry Ford priced his new Model T at just \$850, while most cars at the time were selling for more than double. With sales rocketing, he adapted the concept of the assembly line, and then, to combat the monotony of the labor, cut his workers' hours and doubled their minimum wage. Ford was known for his relentless innovations and propensity for risk-taking, and said: "Failure is simply the opportunity to begin again, this time more intelligently."

SYLVESTER STALLONE

Down to his last hundred bucks, 'Sly' Stallone hunkered down for three days and thrashed out the screenplay for a movie about a down-and-out boxer. Although there were producers lining up to pay handsomely for his script, Stallone would only accept an offer that allowed him to take the starring role. In the end the risk of holding out for the lead part was worth the reward and "Rocky" became a box office hit that earned him millions. Stallone said: "This is one of those things, when you just roll the dice and fly by the proverbial seat of your pants and you just say, 'I've got to try it. I've just got to do it. I may be totally wrong, and I'm going to take a lot of people down with me, but I just believe in it.'"



Publisher: Primetals Technologies, Ltd., Chiswick Park, Building 11, 566 Chiswick High Road, W4 5YS, London, United Kingdom

Metals Magazine team: Dr. Tom Widter, Editor-in-Chief; Alexander Reindl, Art Director; Adam Merki, Lead Editor; James Gray, Independent Contributor and Editor; Dr. Rainer Schulze, Contributing Editor; Martin Reitbauer, Contributing Editor; Stefan Thiel, Illustrator

Publishing house: Red Sam Media GmbH, www.redsam-media.at

Publication date: May 2022

Circulation: 7,000 copies

ISSN: 2194-5381

Cover page: Impressions from the region of Puglia, Italy. Photo by Michele Rossetti. License obtained via Westend61.de

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THE GULF OF TARANTO

The region of Puglia, Italy, is one known for its exceptional natural beauty. Cities like Bari, Brindisi, and Lecce have attracted tourists for many decades. Visitors relish the combination of stunning beaches, sheer-limitless sunshine, and Mediterranean cuisine. But Italy's south is also home to the steel industry, which relies on the Gulf of Taranto for shipping. Primetals Technologies is supplying environmental solutions to the region to help preserve its nature.

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