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Steelmakers Aim for Net-Zero Future, Despite an Energy-Restricted Present

By Sam Kusic



Event Host



The war in Ukraine, inflation and the lingering effects of the COVID-19 pandemic are creating major disruptions for Europe's steel producers. Nevertheless, they are advancing investments in, and plans for, a carbon-neutral future, attendees of the 2022 European Steel Forum learned.

Decarbonization is the steel industry's greatest challenge; arguably, it is also its greatest opportunity, one for innovation and reinvention, for technical collaboration and knowledge sharing. No matter how you characterize it, though, challenge or opportunity, decarbonization must succeed — and swiftly.

On this point the European steel industry is aligned, as evidenced by the array of capital projects now on the table. But there are two questions that have yet to be answered: Given world events, can the industry decarbonize itself

within the next 25 years and meet EU climate goals? And what is the pathway to success?

These questions drove much of the conversation during AIST's 2022 European Steel Forum, held 28–30 September 2022 in Buttrio, Italy. Organized by the AIST European Member Chapter and hosted by Danieli, the conference offered a forum for industry peers in Europe, North America and from around the world to compare notes and exchange ideas.

Although the forum typically offers perspectives and opinions on a variety of issues, decarbonization was front and center this year,





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especially within the context of Europe's energy crisis and pervasive inflation.

Stéphane Tondo, who leads ArcelorMittal's climate action efforts within its governmental affairs office, summed up the predicament European steelmakers find themselves in.

"We will have to invest massively — and when I say massively, we speak about billions of euros in each of our plants — while not being sure we will get the main resource to feed those plants, which is the energy," he said. "It is very difficult for us to make a decision today, but the train has left and we need to make (these decisions) very shortly."

Meanwhile, energy and raw materials are both to be had in other world regions, setting up the potential for a major industry shift, he cautioned. "We could face a massive delocalization in Europe as we had in the 1970s," he told the audience of nearly 230 people, a record attendance for the annual conference.

Tondo's comments came during the conference's industry leader panel, a concluding session intended to provide attendees with high-level perspectives from North American and European executives.

He was joined on the panel by United States Steel Corporation senior vice president — European Solutions James E. Bruno, who is also president of





U. S. Steel Košice, and Nucor Corp. executive vice president Al Behr, who oversees the company's plate and structural products operations.

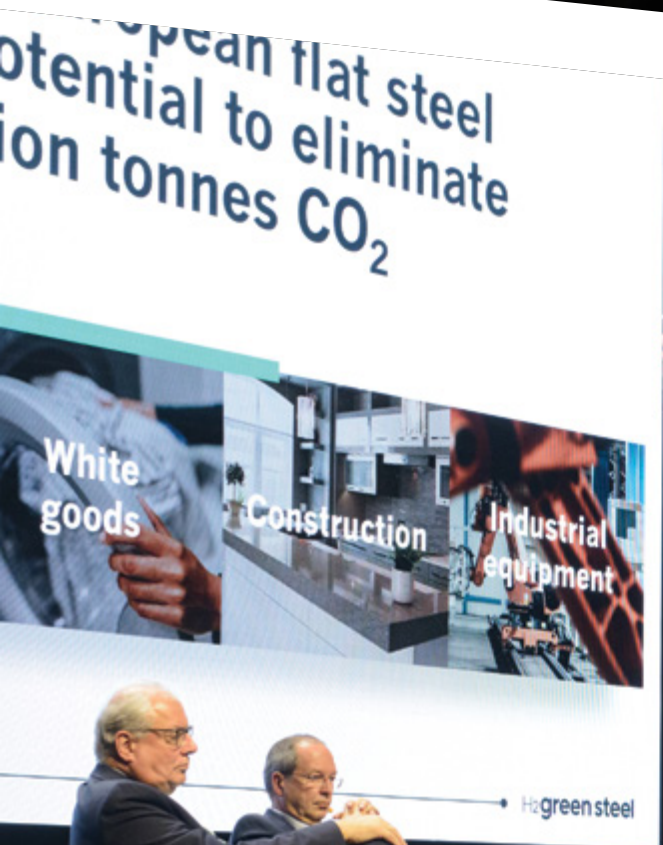
Bruno, too, spoke to the uncertainty that makes decarbonization investment decisions difficult.

“Europe is trying to be first, and whenever you go first, you always find all of the potholes in the road. And that’s exactly what we’re seeing,” he said.

“When you make (the type of capital investments the industry is making), you generally want some level of certainty that you’re going to get a financial return. And right now, it’s really hard.”

Despite current circumstances, Behr said he believes the industry will ultimately persevere.

“The strategies being developed, the technologies being developed to overcome (decarbonization and geopolitical) challenges and threats — it’s inspiring,” he said. “I think we’ll overcome the challenges — I’m not minimizing them, but it’s inspiring to watch what’s happening in the industry,” he said.





“Steel is critical as we build the green economy. Steel can be a part of the global climate solution and not just part of the problem.”

That was evident in the range of solutions showcased during the conference.

Tenova, for example, highlighted its Energiron direct reduced iron (DRI) process developed in partnership with Danieli. The technology, which can operate with variety of reduction gases or pure hydrogen, is central to some mills’ decarbonization plans.

Acciaierie Bertoli Safau offered attendees a look at its new wire rod mill, an advanced facility that will soon feature a Danieli DigiMelter furnace that can operate on solar power.

SMS group called attention to its investment in electrolysis specialist Sunfire, which is developing high-temperature solid oxide electrolysis cell technology.

INTECO, meanwhile, talked about a twin-shell electric arc furnace (EAF) solution for integrated steel plants. The furnace boasts high productivity and short tap-to-tap times, allowing it to be easily integrated with existing continuous casters.

Arvedi Group chief technology officer Andrea Bianchi presented a case study in decarbonization, explaining how his company’s flat-rolled plant in Cremona has achieved net-zero certification.

With 4 million metric tons of capacity, Cremona is the largest electrical steel plant in Europe, and in 2022, international testing and certification group RINA certified it as a net-zero Scope 1 and Scope 2 producer.

Bianchi told attendees the plant zeroed out emissions in a number of ways. First, it revised its metallurgy and reduced the percentage of ore-based metallics — pig iron and DRI — in its melt. It also installed a new 300-ton Constel EAF. Equipped with scrap pre-heating and electromagnetic stirring and waste heat recovery, the furnace boosted efficiency and reduced electrical consumption.

It then further offset emissions through the purchase of certified renewable electricity. And remaining emissions were netted out through the purchase of forestry carbon offsets.

“It is evident that because of the technologies and the processes, the problem of carbon emissions for Arvedi is (significantly less) than for integrated plants,” Bianchi said. “The fact that the remaining problem of emissions can be basically solved with electric energy consumption from renewable energy sources makes it a practical and realistic solution.”

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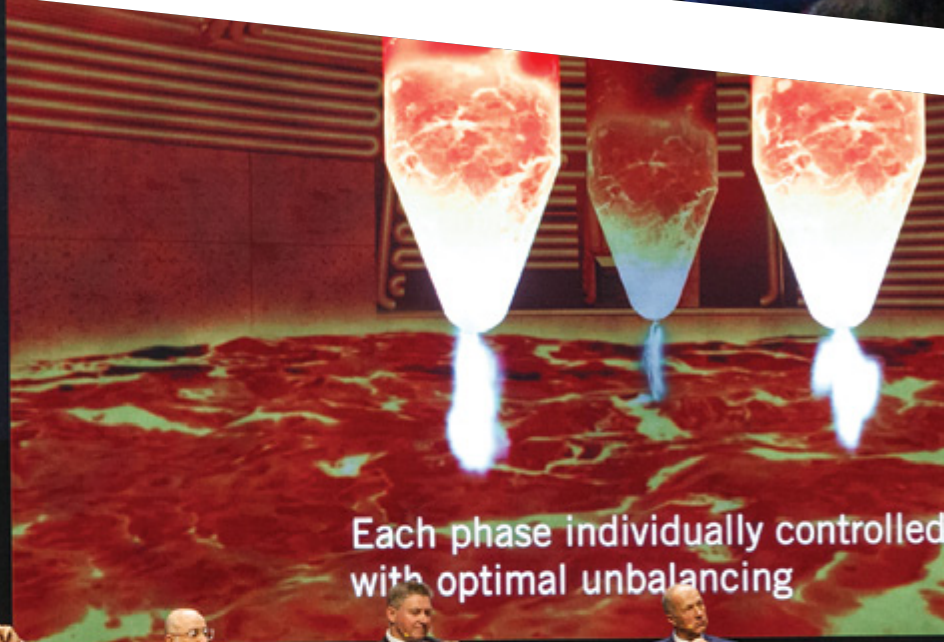
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Still, this is not to say that decarbonization will be easy, or inexpensive, especially in light of current circumstances. At the moment, a major obstacle for the integrated producers moving to adopt less carbon-intensive process routes is insufficient renewable electricity generation and a lack of a green hydrogen infrastructure.

Mike Grant, global technology director and international senior expert in steel production for industrial gas supplier Air Liquide, told attendees that while H₂-based iron reduction is probably going to be the decarbonization solution, it remains unclear when the green electricity for it will be available.

And Europe will need a lot, he said. To illustrate, he cited a recent paper that focused on the needs of the Rhine River Valley's integrated mills. Converting those mills to 100% hydrogen DRI would require the equivalent of around 6 gigawatts of electrolyzer capacity, he said.



That, he said, is around the capacities of the world's three largest nuclear power plants.

"That's what you'd need dedicated just for the steel industry, and you have to remember there are other industries competing for the hydrogen, too. It just seems overwhelming," he said.

A more immediate solution, therefore, will likely be some form of carbon capture.

"H₂ is not the silver bullet of the energy transition, but it is one of the solutions we need for sure," he said.

Joachim von Scheele, global director commercialization, Linde, agreed that hydrogen and renewable energy remains a way off. He believes the most important ingredients for near-term decarbonization will be increased energy efficiency and greater use of scrap.

"Hydrogen is the end game for the reduction, but we are not there yet."

However, the industry should not necessarily accept a lack of renewables as a given,

said Thomas Kienberger, chair of energy network technology at Montanuniversität Leoben.

Kienberger said Europe's likely permanent loss of access to natural gas is nothing less than a societal shock, and such abrupt jolts often lead to abrupt change.

"Clearly it's not certain (a quick shift to renewables) can be done, but history has shown that technological changes can occur much quicker than first thought possible."

But one company isn't waiting to see how the energy picture develops. Steelmaking startup H2 Green Steel is pressing ahead with plans to build an integrated, hydrogen-fed DRI-EAF facility in northern Sweden. The company envisions a 2025 start-up, and recently announced that it had lined up EUR3.5 billion in debt financing for the project.

"We believe Europe needs a new steel mill. I have yet to meet someone who said they don't like that idea. It's time for Europe to get one, we want to be the people who do that," Denis Hennessy, the company's vice president of steel, told attendees.





Despite Europe's current energy situation, Hennessy argued that the mill can succeed, given its location in Boden, where there is ample wind and hydroelectric power.

Originally, he said, access to lime, iron ore and utilities governed the location of steel mills. Later, when the mini-mills came along, it was proximity to customers, scrap and power that drove location.

"The next generation of mills — and there are only so many places in the world that can really support them — will be where the green, renewable power is. In our case, that's northern Sweden," he said.

Although decarbonization took center stage, it wasn't the only issue to be explored during the panel discussions. Attendees, for instance, heard from several human resources representatives and university professors on another persistent industry challenge — recruiting and training the next generation of talent.

Drawing from his experience with the oil and gas industry, Gianluca Valenti, associate professor of energy engineering at Politecnico di Milano, told





attendees that to successfully recruit young talent, the steel industry must showcase work it is doing — and the money it is investing — to become sustainable.

“(Members of Generation Z) feel this world as their own and they (feel obligated) to do something to preserve it more than other generations,” he said. “They really want to see if a company is aligned with their values.”

He added: “They have to see that even this sector is spending a lot to become sustainable.”

Ron O’Malley, AIST past president and professor of materials science and engineering at Missouri University of Science and Technology, spoke to the importance of immersive, real-world experiences for students as a recruiting tool.

Reflecting on his own days as a student, O’Malley said a co-op put him on a new trajectory.

“When I first went to college, I had no idea what I wanted. I arbitrarily chose civil engineering, and what saved me was a co-op experience in industry,” he said. “That’s how I found metallurgy. Before that, I had never heard of metallurgy.”

He also said that the sooner students can be exposed to steelmaking, the better.

“It strikes me that one of the really important things we have to do as an industry is educate at the high school level,



or even before. At least introduce students to the possibilities in metallurgy. Materials science is an exciting field, and if we can find ways to get that in front of students, and engage their teachers, we could perhaps open a door for them.”

Although workforce issues aren't technical challenges, the answer to them, as O'Malley suggested, is to try new things, to innovate.

And as Danieli chairman Gianpietro Benedetti reminded the audience in his opening comments, innovation is everything in the steel industry.

He recalled that early in his career, there were fewer than 20 in the Danieli engineering office, and they were working on rolling mill equipment designed for 100,000 to 150,000 metric tons of production.

Now, the company is designing equipment that can produce those volumes in multiples, and in less time. Innovation, he said, has brought about what, to his mind, is one of Danieli's most important contributions: its direct rolling technology that allows slab and billets to be formed into finished product without the need for reheating, saving time and energy.

“With the competence of innovation, plus action, we can adapt to define our future,” he said. ♦



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