In the Austrian mining town of Eisenerz, local legend tells of a merman-like creature called the “Wasserman,” or “Waterman,” which was said to inhabit a grotto in the surrounding hills.

As the story goes, the people of Eisenerz often spotted the Wasserman around the grotto, and believing that he was in possession of great treasure, one day decided to catch him. Baiting him into a nap with food and drink, they succeeded, nabbing him as he lay sleeping along the shore of a pond.

But the Wasserman did not go quietly, fighting and thrashing as the townspeople took him away. Eventually, the Wasserman relented, and in
exchange for his release, offered the townspeople their choice of gold for 10 years, silver for 100 years or iron forever.

The locals chose iron.

And with a point of a finger, the Wasserman declared that the iron could be found in a nearby mountain, a mountain that would become the largest open-pit mining operation in Central Europe.

Today, the Erzberg (literally “ore mountain”) is a landmark facility producing more than 3 million metric tons of iron ore for voestalpine’s Linz and Donawitz plants. Although an abundant supply of iron ore seems assured for years to come, the same can’t be said of demand for European steel, given persistent global overcapacity and maturing domestic economies, among other things.

Yet, despite the uncertain landscape, European steel industry leaders are investing billions of euros in transformational decarbonization projects, projects that are now being moved in earnest from the drawing board to reality, as attendees of the 2023 AIST European Steel Forum learned last fall.

Held in October at the University of Leoben, Austria’s renowned mining, metals and materials university, the annual conference highlighted the accelerating evolution
of Europe's steel producers, the business challenges they're confronting and the technical solutions they are developing.

The 2023 conference was hosted by INTECO Group and brought together more than 200 of the industry's technical and business leaders from Europe, North America and elsewhere.

A key takeaway was that decarbonization of European industry is moving apace.

“The (European) transformation has started, and I'm very confident that we are in a good way,” said Cappel Stahl Consulting managing director Jürgen Cappel, who moderated a panel discussion about the decarbonization strategies of major European mills.

Among many initiatives is SSAB's HYBRIT project, which has brought the Nordic steelmaker together with iron ore producer LKAB and energy producer Vattenfall.

Martin Pei, SSAB executive vice president and chief technical officer, said his company is advancing toward a 2026 start-up of an electric arc furnace at its Oxelösund plant in Sweden. The furnace, along with ancillary equipment to handle biofuels, scrap and sponge iron, represents a SEK6.2 billion (approximately

Panelists: Chris Barrington, International Iron Metallics Association; Denis Reuter, TSR Recycling; Emile Scheepers, VALE; Alexander Fleischanderl, Primetals Technologies; José Noldin, GravitHy; Moderator: Felix Firsbach, Badische Stahl-Engineering GmbH
US$600 million) investment that ultimately will replace a coking plant and two blast furnaces.

Further out, he said, SSAB aims to build two electric arc furnace (EAF)-based mini-mills at sites in Luleå, Sweden, and Raahe, Finland, with a decision on which one to build first due next year. All told, the company is aiming to complete its transformation by around 2030.

In the meantime, SSAB is experimenting with underground hydrogen storage, having established a 100-cubic-meter facility that sits 30 m below ground. The facility, which is next to its pilot-scale direct reduction plant, recently reached a new commercial milestone, demonstrating potential savings of 25% to 40% on the variable costs associated with hydrogen production.

As SSAB recently explained, the mission was to produce hydrogen using fossil-free electricity at a variable electricity price with the lowest possible cost, for example, during certain parts of the day or for longer periods when weather-dependent electricity generation was in good supply. The hydrogen was delivered in a steady flow to SSAB.

Used on a large scale, hydrogen storage can have a dampening effect on electricity price variations, which would favor investments in new electricity generation from all forms of fossil-free power.

In Germany, thyssenkrupp is moving forward with installation of a EUR1.8 billion project that will transform its hot metal production. Under the project, the company is building a direct reduction plant that will be coupled with two melting units, together annually producing 2.5 million metric tons of direct reduced iron (DRI).

thyssenkrupp has chosen SMS group as its technology partner, and start-up is planned for the end of 2026.

It is one of the largest industrial decarbonization projects in the world, Nils Jäger, team leader for CO₂ research at thyssenkrupp Steel Europe’s Competence Center of Metallurgy, said.
“The question arises: Do we really need primary steel production? At thyssenkrupp, we strongly believe it’s needed to meet the demand of our customers,” he said. “If you want to decarbonize our industry, then you have to decarbonize primary steel production.”

Dillinger, too, has launched its own decarbonization effort, an initiative that began with the 2021 acquisition of the Liberty Ascoval electric arc furnace in France. The acquisition gave the company 300,000 tons of clean steelmaking capacity, which it will build on with commissioning of a 2.5-million-metric-ton direct reduction plant. The plant will feed two electric arc furnaces in Völklingen and Dillingen, together providing approximately 3.5 million metric tons of annual crude steel capacity.

An investment of EUR3.5 billion will allow the company to close a blast furnace and two basic oxygen furnaces (BOFs) in 2030. Afterward, with the increased use of commercial hydrogen and installation of a third EAF, the company will shut down its other blast furnace and three remaining BOFs.

Dominik Schöne, steel plant meltshop manager at AG der Dillinger Hüttenwerke, said that from a technical perspective, the company is well prepared for the transition, but to succeed, it will need outside support.

“Our success depends on the political funding and regulatory conditions, and what we need is a fast and unbureaucratic political process. Success also depends on political funding, regulatory conditions and framework.”
But to be sure, their success, and the success of every other company making steel, will require access to a stable supply of raw materials, including high-quality iron ore to feed new direct reduction furnaces.

In fact, all of the new DRI plants will require 600 million to 800 million metric tons of iron ore by 2050, depending on estimates, according to Chris Barrington, chief adviser to the International Iron Metallics Association.

In the future, then, producers might see constrained supplies.

“When it comes to high-grade iron ore, we’re all fishing in a pretty small pond,” he said.

Barrington said there are a number of potential workarounds including the use of fines-based direct reduction technology, use of other iron ore agglomerates, and pairing the use of electric smelting with lower-quality, blast-furnace-grade pellets ahead of the BOF/EAF.

“Understanding and optimizing the ore-to-steel value chain is key to the transition to carbon-neutral steelmaking,” he said.

That comment was echoed by José Noldin, chief executive officer of GravitHy, a startup that is planning to build a hydrogen-based direct reduction plant in France. In Noldin’s view, the value chain will be redesigned, with ironmaking becoming a separate business.

“Steel should be focused on new products, improving efficiency in steelmaking, not making iron,” he said. “Let iron be done by someone else, where it needs to be — close to affordable, low-carbon electricity.”
One of those places may very well be the Middle East and North Africa, and, in particular, six countries in the region: Morocco, Algeria, Tunisia, Libya, Egypt and Saudi Arabia.

As Karim Badr, RHI Magnesita technical director for the MENA region, argued, the region will likely be able to meet a significant portion of the European steel industry’s coming demand for green hydrogen, given access to low-cost hydrogen production potential and existing gas infrastructure.

Badr suggested that steel producers, either on their own or through consortiums, build direct reduction plants in those countries or North America and transport the offtake. The countries have the resources for green direct reduced iron production, he said, as well as long-standing technical know-how.

It could be “a way-out route,” he said.

At the same time, the industry would stand to benefit from a way forward, at least with respect to defining green steel and to regulating trade of carbon-intensive materials.
As to the former, Kristian Notebaert, chief technology officer for decarbonization at ArcelorMittal’s European flat products business, said that defining green steel is a critical puzzle piece. “I think that is a very serious issue, probably very underestimated,” Notebaert said, adding that the lack of a common definition will only create confusion among customers. James Bruno, president of U. S. Steel Košice, and senior vice president for European solutions, agreed. “At the end of the day, it is important that we find a way as an industry to come to one standard. If not, there’s going to be a lot of, what I would say, games being played. I think it’s very hard for an end customer to come to a conclusion (about how a steel product can help them achieve their goals) unless there is a standard.”

As to the latter, the U.S. and EU are continuing to work toward agreement on the Global Arrangement on Sustainable Steel and Aluminum, an attempt to promote fair trade of responsibly produced materials.

“There’s a real pressure for all the stakeholders to find something because we know right now in America we have issues with dumped steel and circumvented steel,” said Barry Schneider, AIST president and Steel Dynamics Inc. president and chief operating officer.

But even as the industry looks to find resolution on issues such as these, it can be certain of one thing: steel’s overall importance as a material that is strong, durable, formable and a cost-effective solution in a wide variety of applications.

So asked if steel faces an existential crisis amid the industry uncertainty, Notebaert said no. “Our product is still a very sound product that our customers want to use,” Notebaert said. “For the customer there is no alternative.”