

Furnaces, Fossils, and the Future of Chinese Green Steel

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Emma Rutkowski (erutkowski@rhg.com), Hannah Pitt (hpitt@rhg.com), Kate Larsen (kmlarsen@rhg.com)

In recent years, China has emerged as the undisputed leader in both manufacturing and deployment of many clean technologies, from solar and batteries to electric vehicles, thanks to strong political support for these industries. However, Beijing has put less policy focus on steel decarbonization, especially green hydrogen-based steel. Industrial policy in the US and Europe directed subsidies and support towards building out first-of-a-kind, emissions-free steel plants, but policy in China has been more muted, focusing largely on incremental plant-level emissions reductions. Regardless, the role of China looms large over any discussion of steel decarbonization. Given the outsized role of China in steel production—in 2025, China produced over half of the world’s total crude steel—the direction it takes in the coming years will be pivotal to determining whether the industry continues business as usual or achieves the technological transformation necessary to reduce emissions. While it may not be a major policy priority yet, the building blocks for a green steel industry are being laid now through the build-out of supporting iron and hydrogen infrastructure, setting China up to emerge as a major player in green steel if that policy focus changes.

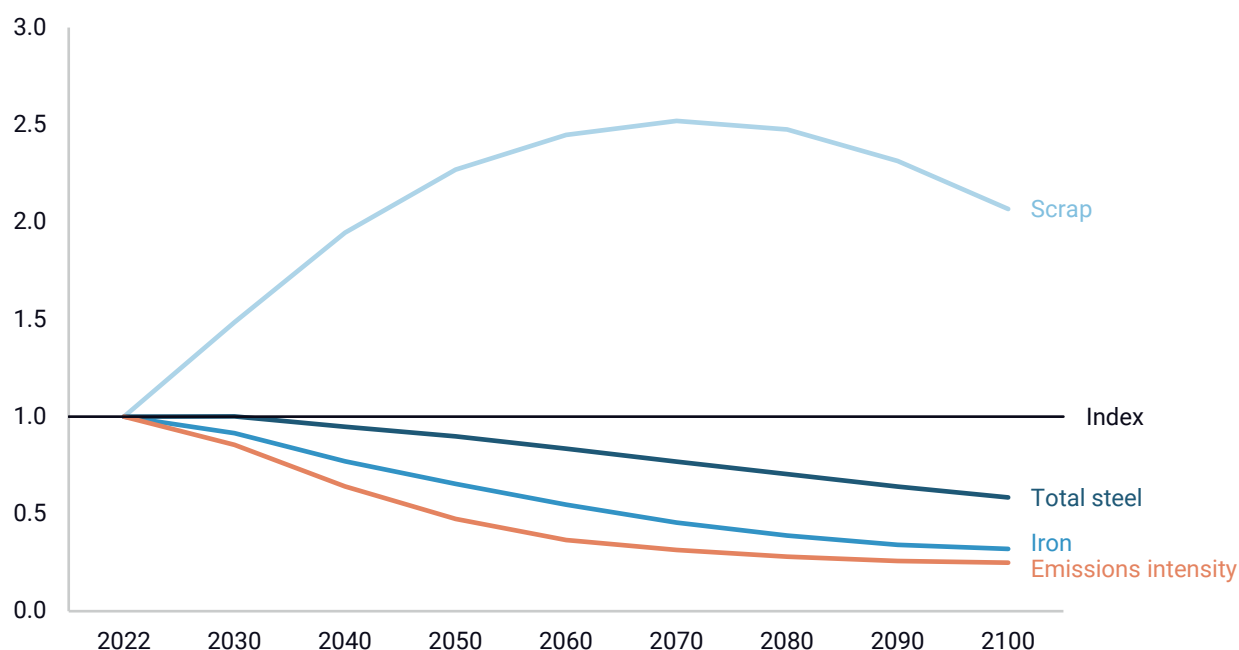
Falling demand, lasting fossil capacity

Although China dominates the steel industry today, a long-term decline with profound implications for the future of decarbonization is likely already baked in. China’s steel production developed rapidly, expanding from 128 metric tons (Mt) of crude steel produced in 2000 (15% of global production) to 961 Mt in 2025—a 7.5x increase in just a quarter of a century. Most of that steel fed rapid infrastructure build-outs, real estate, and a growing auto industry. Given the typical 80+ year lifetime for buildings and 12-15 years for vehicles, the vast majority of this steel has yet to enter the scrap market, buoying short-term demand for virgin iron. However, as has happened in most developing economies transitioning to developed, Chinese demand for steel has leveled out in recent years. The pace of economic growth has slowed, the property sector in particular has undergone a major contraction, and the period of rapid growth is likely coming to an end.

The [Rhodium Climate Outlook](#)—our annual global baseline energy modeling—provides probabilistic energy and emission projections under population, economic, fuel cost, and clean technology cost uncertainty. On average, we project a significant decline in steel demand in China in the coming decades. Widespread urbanization has already occurred, large infrastructure projects have already been built out, and these factors, paired with a declining population, are likely to reduce future demand. At the same time, we project the market for steel scrap to expand relative to the historic baseline, as the steel locked into physical goods during China’s industrialization ages out. These two factors serve to drive down both overall emissions and the emissions intensity of steel, even in the absence of any significant policy or progress on iron decarbonization, as shown in Figure 1. While steel demand falls by about 40% by 2100, emissions intensity falls by 75% on average, simply due to a greater share of scrap utilized to meet new demand and reduced demand for emissions-intensive ironmaking.

FIGURE 1

Steel demand in China falls while emissions from the Chinese steel industry fall further
Chinese steel production inputs and emission intensity, indexed to 2022



Source: Rhodium Climate Outlook

However, several factors complicate this outlook. Despite population projections and the construction slowdown indicating a likely structural decline in steel demand, China shows no signs yet of accelerating blast furnace retirements. Blast furnaces typically require large capital investments every 15-20 years to relined to refractory material and keep the furnace operational; a significant share of Chinese capacity was built out after 2000, and is now reaching the end of its first capital cycle. If furnaces are relined rather than retired, their emissions are likely to be locked in for decades. In addition, although construction is slowing, China’s growing role as a major global automaker and expanding need for high-quality grain-oriented electrical steel for the electrifying energy system could help sustain demand for higher-quality, iron-derived steel in particular. Scrap-based steel tends to be

lower quality, and while sufficient for construction uses, autos often require higher-purity steel made from virgin iron. Whether China takes steps to move such ironmaking to lower-emission routes and accelerates retirements of coal-based blast furnaces will have a major effect on global emissions.

Decarbonized iron in China starts with retrofits, but builds towards hydrogen

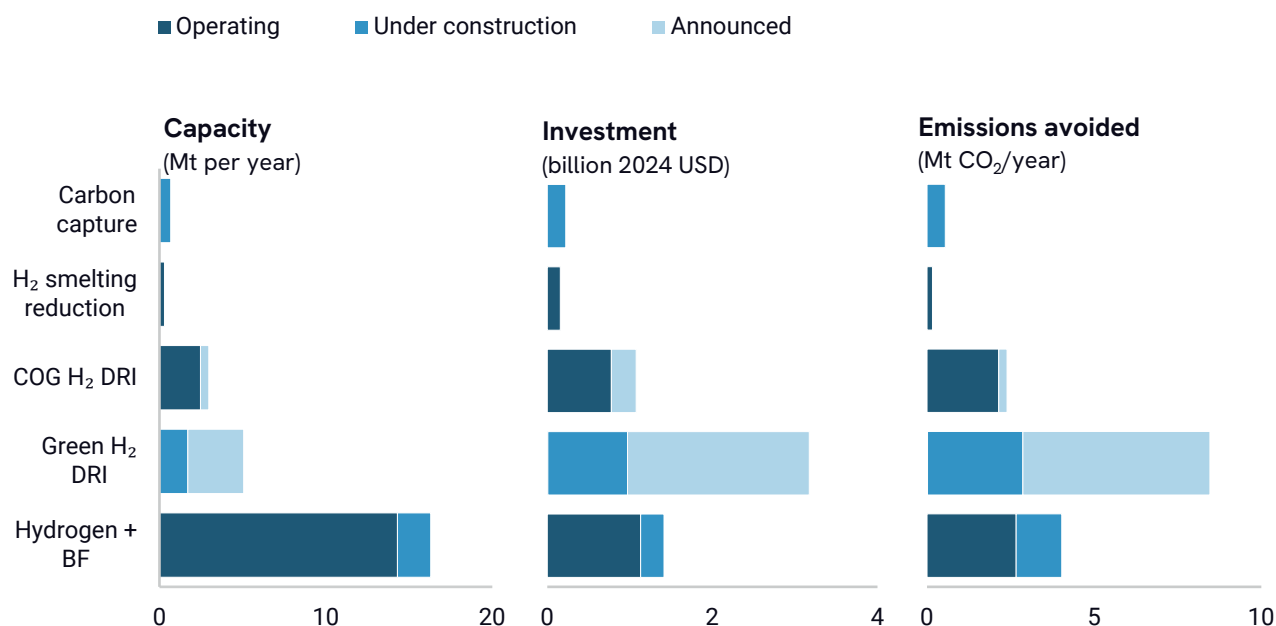
Globally, most iron decarbonization efforts to date have focused on direct reduction (DRI)—either plants utilizing hydrogen immediately or flexible natural gas-based facilities engineered to run off either fossils or pure hydrogen as it becomes available. While fossil DRI is a well-established technology, it is largely concentrated in regions with low gas prices like the Middle East, and China has very little existing DRI capacity of any type. China relies heavily on LNG imports and, consequently, the pipeline of iron decarbonization projects underway is concentrated in several alternative technologies that better utilize domestic resources.

As shown in Figure 2, most capacity in operation is blast furnaces retrofitted for hydrogen injection. These facilities reduce coal demand from furnaces by enriching the reducing gas with hydrogen, often derived from the waste of onsite coal coking ovens. While these projects take advantage of existing infrastructure and thus require minimal investment, they also achieve limited emission reductions.

FIGURE 2

Fossils dominate existing capacity in China, but green hydrogen leads announced investment

Iron capacity, investment, and emissions avoided



Source: Clean Investment Monitor, Rhodium Group

Note: COG DRI is direct reduction using coke oven waste gas as a hydrogen source. Hydrogen + BF is a traditional blast furnace with hydrogen injected to supplement the reducing gas and reduce coal demand.

A smaller share of operational capacity similarly uses coke oven gas (COG) as a source of hydrogen for direct reduction. Relative to blast furnace hydrogen retrofits, the investment required for these projects is larger on a per ton basis, as are the emission reductions, but they are still dependent on fossils and far from fully decarbonized. However, they are a potential stepping stone to more decarbonized pathways, providing an opportunity for learning on the direct reduction processes China has minimal experience with, as well as hydrogen in ironmaking. A small amount of investment has gone towards pilot projects for carbon capture and hydrogen smelting—an alternative reduction technique that avoids the high iron quality requirements of direct reduction—but commercial scale-ups have yet to move forward.

The next round of projects under construction and announced in China builds on this experience, with the majority of investment going to fully green hydrogen DRI. Although investment in this technology achieves limited capacity, it results in much larger emission reductions than the transitional fossil-based techs. However, the high investment requirements relative to more incremental technologies necessary to build out both ironmaking and fuel infrastructure for hydrogen DRI risk a major drag on deployment. Given the economic disadvantage of green hydrogen DRI and the fact that China has yet to give significant policy attention to fully green steel, the amount of capacity under development is notable—1.7 Mt of capacity with a secure hydrogen source is under construction in China, compared to 2.6 Mt in Europe, where policy support has been far stronger.

An incremental policy push

Compared to the direct grants and funding given to steelmakers in Europe especially, policy in China to steer investment toward the highest-impact green steel pathways described above has been more minimal, and most deployment to date has been undertaken with private dollars. Recent policy language does indicate Beijing increasingly sees hydrogen DRI as worth pursuing—the 3-year action plan released in June 2026 explicitly names it as a technology to work on implementing—but with less specific timelines than those given to efficiency gains in traditional technologies. The clearest signal of direct support to date has been the selection of Baowu Zhanjiang, the first full-scale green H₂ DRI facility in China, for the “List of Demonstration Projects for Advanced Green and Low-Carbon Technologies” in June 2025. This designation made future site development eligible for central government funding mechanisms, but occurred after the first hydrogen furnace was already in operation.

Domestic policy puts efficiency gains first, green hydrogen later

Chinese policy directed at emissions in the steel sector to date largely serves to encourage incremental efficiency and emission reductions at plants rather than large-scale transformative change. Notably, China is currently in the process of integrating blast furnace ironmaking and sintering into its emissions trading system (ETS). In 2024, plants were given emission allocations equal to their emissions, and in 2025 and 2026, only plants with emissions worse than the sector average are forced to pay for additional credits.

From 2025 onwards, the emissions allowances are slated to tighten, with plants evaluated on an emissions-intensity basis—so plants do not need to purchase additional credits

simply for increasing production. This approach aims to force the shutdown of the most emissions-intensive plants, while rewarding those that are able to achieve efficiency gains to meet the narrowing emissions intensity bar. However, since the allocations are based on a plant's own emissions, there is no reward for building a new green steel plant under this system—a plant with no emissions would receive no allowances, while a plant that reduces its emissions from the higher baseline on which allowances were based would end up with surplus credits to sell.

In 2025, China also issued a directive on “zero-carbon industrial parks,” which could support more transformative industrial projects. This set of guidelines allows provinces to establish a boundary around industrial clusters with near-zero emissions, which can then receive preferential regulatory treatment, access to special loans and bonds, and other perks. To date, 52 parks have been proposed, and although several are adjacent to major steel zones, none yet explicitly include the steelworks themselves. Under the stringent emission requirements, green hydrogen DRI plants would be the only steel technology under development in China that could qualify for inclusion—blast furnace hydrogen retrofits and coke oven gas-based hydrogen DRI, which benefit from the ETS policy, are barred from inclusion due to their dependence on fossil.

In tandem, China also laid out guidelines for “zero-carbon factories,” with slightly more permissive emission accounting rules that encourage waste-based hydrogen (like COG DRI) as well as green hydrogen. This scheme covers multiple industrial products, and steel is designated as a second-level priority industry—in choosing facilities to designate as “zero-carbon,” provinces are instructed to focus on other industries for now and prepare to give more attention to steel post-2030. The main advantage of a plant being labeled “zero-carbon” is market access and product labeling, especially for foreign markets and to establish compliance with external rules like the EU's Carbon Border Adjustment Mechanism (CBAM).

CBAM favors incremental gains, but other trade measures bite more

Domestic policy isn't the only force shaping green steel incentives in China, and foreign trade policy like the EU's CBAM attempts to steer the global technology direction by penalizing high-emission imports. Under CBAM, the main mechanism is the application of Europe's own carbon market prices to imports, with a phase-in period of technology-specific benchmark emission allowances that apply carbon pricing to only a portion of embedded emissions, ramping up over a decade. These benchmark allowances put uneven pressure on Chinese steelmakers in ways that reinforce China's own focus on incremental emission reductions.

Looking across the distribution of China's steel facility emissions intensities, most plants in China have emissions exceeding the emission benchmark allowances and would be charged a fee on embedded carbon emissions for exports to Europe. But the size of the fee currently rewards retrofits to blast furnaces more than it rewards lower emissions-intensity steelmaking pathways. That's because under CBAM, the benchmark varies depending on if steel is primarily DRI, blast furnace, or scrap based. The allowance for scrap-based electric arc furnace (EAF) finished steel is very low at 72 kg CO₂/ton in 2026, and most Chinese EAFs have significantly higher emission intensities; production routes using DRI or blast furnaces however are compared against benchmarks of 481 kg CO₂/ton

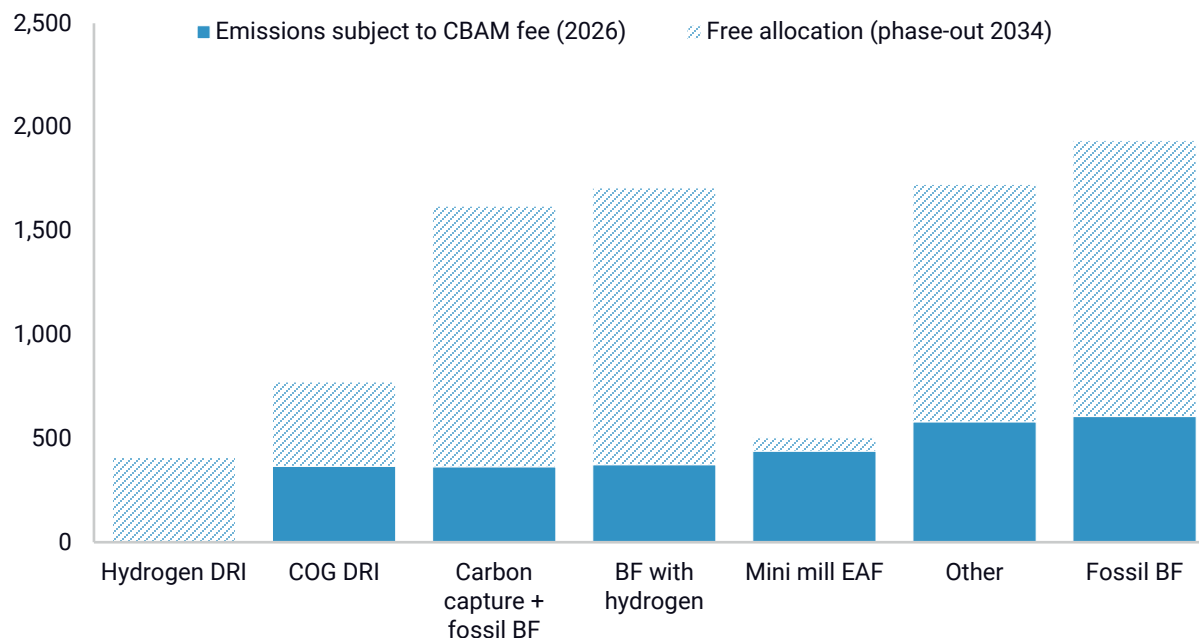
and 1370 kg CO₂/ton respectively and thus facilities that have implemented incremental changes like blast furnace hydrogen injection or COG reduction pay lower carbon fees despite having higher overall emissions.

However, this advantage is temporary. The emission allowances phase out by 2034, closing the gap that favors incremental blast furnace improvements. Long term, the hydrogen DRI facilities are the only iron producers with near-zero fees levied on emissions

FIGURE 3

CBAM free allocations benefit the cleanest fossils over alternative fuels, but phase out by 2034

Average estimated plant emission intensity (kg CO₂/ton steel)



Source: Rhodium Group

Note: Technologies include coke oven gas (COG) DRI and blast furnaces (BFs)

How much CBAM matters for Chinese producers remains an open question. Today, China's exposure to CBAM is narrow: China exports only 7% of raw steel production, with 7.5% of those exports going to Europe. Therefore, for raw steel alone, CBAM would have little impact on Chinese producers. However, proposals to expand CBAM to cover downstream products such as auto parts, appliances, and electronics would have implications for a much broader swathe of China's exports to Europe. An estimated 14.5% of these products are exported, with Europe representing 12.3% of that market. Under an expanded CBAM, a carbon price would be levied on the embedded steel in select products, and exporters would need to provide documentation of the steel origin or be subject to fees calculated against high assumed default emissions intensities.

But even if CBAM evolves, the overall economic impact on Chinese producers is likely small relative to mounting EU trade barriers on steel and many downstream products. For raw steel, we estimate Chinese facilities with verified emissions would currently pay a maximum of around 50 EUR/ton under CBAM. By comparison, tariffs and anti-dumping measures levied on Chinese imports by the EU as of July 2026 range from 20-70%+ of the steel value, amounting to hundreds of euros per ton depending on the product. Anti-

dumping and countervailing duties on EVs and some construction equipment show how aggressive the bloc is willing to be on finished Chinese products once it decides to act.

The role of hydrogen

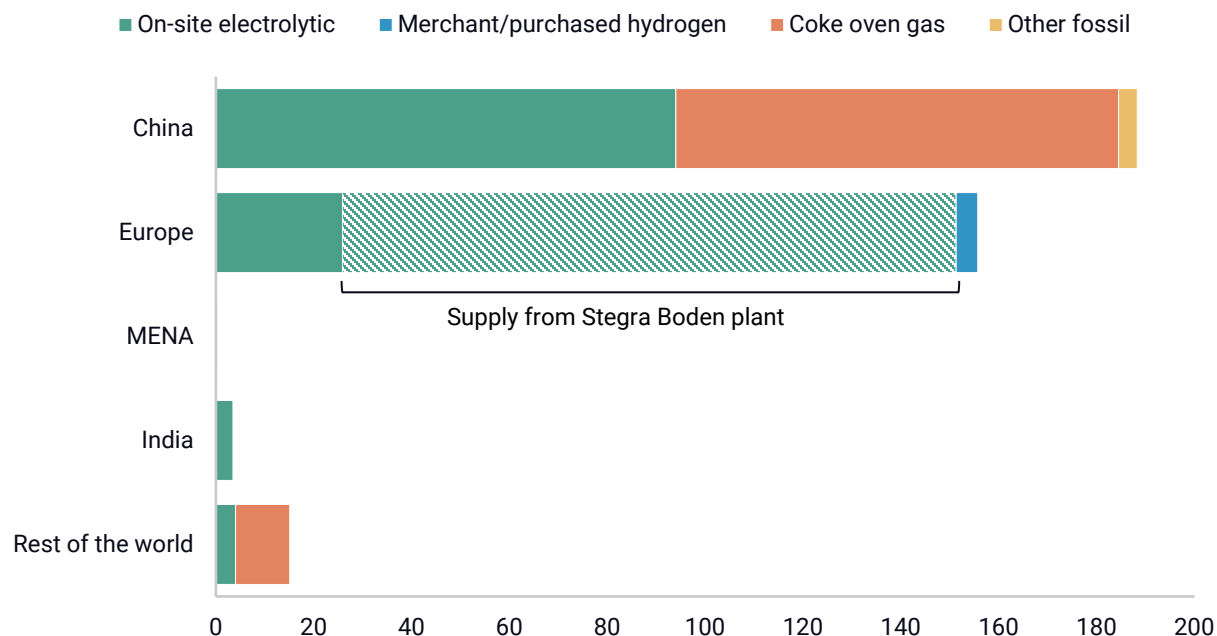
Although policy to date has largely favored incremental emissions savings at fossil-based steel plants, recent policy direction updates and increasing investment share indicate hydrogen DRI could play a major role in China's steel industry in the future. Blast furnace retrofits and COG DRI may dominate existing capacity, but project announcements are almost entirely hydrogen DRI. Given how nascent a technology hydrogen DRI is, whether China is able to follow through on and scale these projects beyond the pilot stage remains to be seen. Crucial to the ability to do so will be establishing reliable hydrogen sources.

In terms of developing a green hydrogen supply specifically for steel, China lags Europe, in line with coming in behind on total green hydrogen DRI capacity. China does lead slightly on total hydrogen deployed for the steel sector (Figure 4), but a significant share of that hydrogen is produced from waste coke oven gas or other fossils. On the other hand, while Europe leads on the development of electrolytic steel for hydrogen, the vast majority of that supply is wrapped up in a single project: the flagship Stegra Boden factory. This is a potential major risk for the steel industry in Europe—while Chinese supply is spread across a few smaller projects, delays, cost overruns, and financial distress for Stegra put nearly the entire pipeline at risk.

FIGURE 4

China leads hydrogen for steel, but large green projects give Europe an edge

Thousands of tons of hydrogen per year capacity



Source: Clean Investment Monitor (Rhodium Group) and IEA

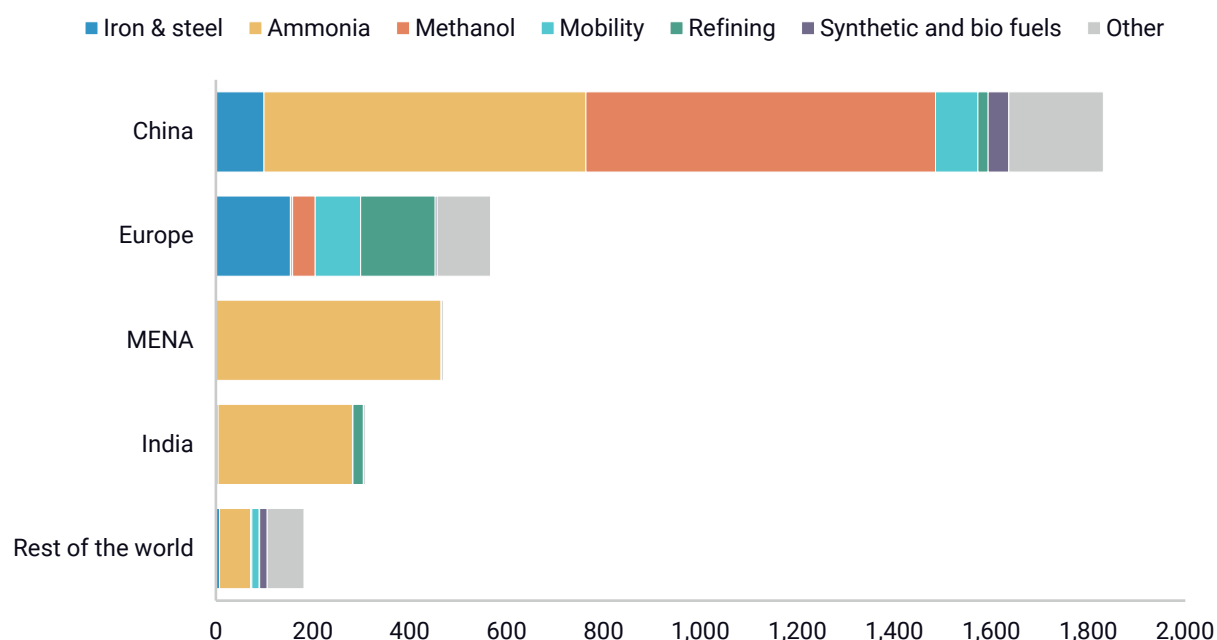
Looking at just the supply of hydrogen for steel obscures an important caveat: when considering hydrogen operating or under construction across all end uses, China

absolutely dominates (Figure 5). Europe leads the green hydrogen supply for steel, partially because it is uniquely focused on steel compared to most of the rest of the world. Most hydrogen supply in China is earmarked for the chemicals sector (ammonia and methanol), while Europe has minimal supply for these uses. Even considering China's significantly larger chemicals industry, this amounts to nearly double the hydrogen supply for chemicals per ton of current production compared to Europe—a direct result of policy. Europe's FuelEU mandates for low-carbon fuel for ships and aviation created a market for ammonia as a fuel, and specifically opted to allow imports to meet demand so that limited domestic capacity could focus on sectors with end products that are more difficult to transport. China aims to capture that market, specifically calling out green ammonia as a priority in the 15th Five-Year Plan. Iron, on the other hand, is less traded, mainly responsive to domestic emissions policy, and thus is currently a lower priority.

FIGURE 5

China dominates global green hydrogen production

Production by end-use application, thousands of tons per year



Source: IEA Hydrogen

Building the foundation of a green future

While it may not be a major policy priority yet, China is currently laying the building blocks for a green steel industry. Crucially, although China is mainly building electrolytic hydrogen capacity for the chemicals sector, learning and cost declines from doing so can be applied to hydrogen for steel. On direct reduced iron, China is essentially starting from scratch, but the early focus on COG-based DRI has gotten facilities up and running and allowed for learning on direct reduction processes with hydrogen, utilizing waste to keep costs down even for early plants. While the current emissions trading system favors incremental improvements to existing plants, recent policy directives signal increasing support for fully decarbonized industrial clusters. Even without a specific focus on steel,

this policy gives regulatory and resource access advantages to the kind of near-zero power and hydrogen infrastructure that zero-emission iron will depend upon.

Unlike other industrialized nations, which have largely already maxed out scrap recycling capabilities, China has plenty of runway to reduce emissions without addressing ironmaking at all, simply by increasing the scrap share and letting demand fall. This affords China the luxury of claiming progress while focusing on more profitable industrial sectors for integrating hydrogen, saving steel for a later date. For now, Europe remains a step ahead on clean iron development projects thanks to more targeted policy, but with the first million-plus ton capacity plants yet to come online, the window is still open for any player to take the lead on commercialization. China has signaled an intention for greater policy focus in the near future, and with a sizeable lead on hydrogen, is well positioned to accelerate deployment as soon as it becomes a priority.

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