



The Future of American Steel

March 2026



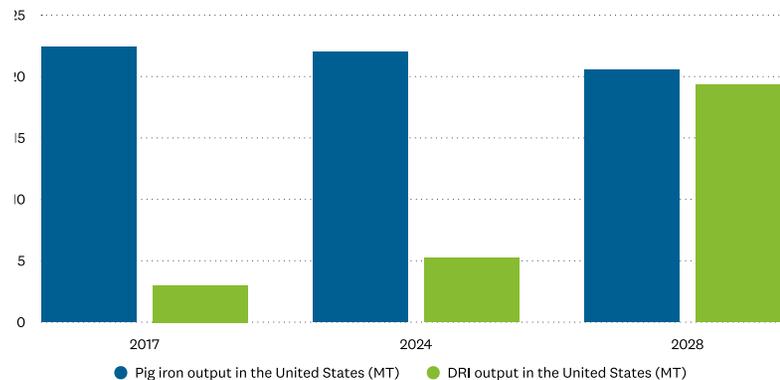


Introduction

American steel is undergoing a major technology transition that will make the industry more competitive, productive, and cleaner. Propelled by market forces, including demand from key customers such as automakers and trade policies, large steelmakers in the U.S. are now investing in a new generation of mills designed to supply the high-quality iron needed to produce advanced steel that is also less polluting.

Over the past year, [U.S. Steel](#) and [Hyundai](#) announced plans to build two new Direct Reduced Iron (DRI) mills in the United States at a cost of \$8.5 billion. (See Table, Appendix) These mills would increase annual U.S. DRI capacity to 19.36 million tons, nearly matching the output of traditional “pig iron” produced in blast furnaces. (See Figure 1.)

Figure 1: Anticipated growth of DRI production in the United States through 2028.



DRI plants can supply iron to a variety of steel making plants — including the furnaces at existing integrated steel mills — but are especially suited to electric arc furnaces (EAF) that already produce 70% of American steel. Together, the two technologies appear poised to define the future of American steel.

Including the U.S. Steel and Hyundai mills, we estimate that \$18 billion could flow into American DRI capacity, capturing the entire U.S pig iron market. This figure is just for new natural gas-fired DRI plants; it doesn’t include the additional green hydrogen infrastructure that could enable DRI to realize its full promise. The estimate would be higher if it also included conversion of existing blast furnaces to DRI.

This report outlines the forces that are reshaping American steel production. We also outline recommendations for how investors, policy makers, and automobile manufacturers can capitalize on this shift and manage risks by accelerating and supporting the industry’s transition.

In coming weeks, Ceres will conduct a formal analysis supported by a panel of advisors drawn from finance, the steel industry, and independent institutions to assess the full technical and economic potential of DRI in the United States.



Disruption in Steel: Electric Arc Furnaces and Direct Reduced Iron

Harvard Business School professor Clayton Christensen famously highlighted the American steel industry as a case study in disruptive innovation. Prof. Christensen's work described how scrap-fed EAFs took market share away from the ore-based blast furnace/basic oxygen furnace (BF-BOF) industry, also known as integrated steel producers. EAF steelmakers initially focused on making the simplest steel products, starting with the low-margin rebar. But as they improved their production methods, they began to systematically take additional market segments, one by one over the course of four decades. Today, EAF's account for 70% of U.S. steel production and one-third of the high-quality, high-margin automotive steel market.

As shown in the first panel in Figure 2, steelmaking involves two primary steps: first, the conversion of iron ore into pure iron in a coal-fired blast furnace (BF) and then the conversion of iron into steel in a basic oxygen furnace (BOF). As shown in the third panel of Figure 2, EAF steelmakers took a different path: first, they replaced iron

ore with recycled scrap steel and then used an electric arc furnace to melt the steel scrap into new, crude steel.

Scrap-fed EAF steel making worked well for the lower-grade, "long" steel products typically used for construction. But the EAF industry faced a more difficult challenge, breaking into the high-end, high-margin "flat" steel market. Automotive sheetsteel — a market valued at **\$15 billion** in the United States — must meet exact safety and aesthetic requirements. These can only be achieved with steel made with a high proportion of pure iron, roughly a 50/50 blend of iron and scrap.

As the center panel of Figure 2 shows, DRI is manufactured by injecting gases — either natural gas or a mix of hydrogen and carbon monoxide — into a column of iron ore pellets inside a shaft furnace. The gases convert the iron ore at temperatures below the iron's melting point, saving energy and reducing emissions by half in comparison with the blast furnace. Green hydrogen can be used in lieu of natural gas as its cost comes down over time, reducing emissions even more.

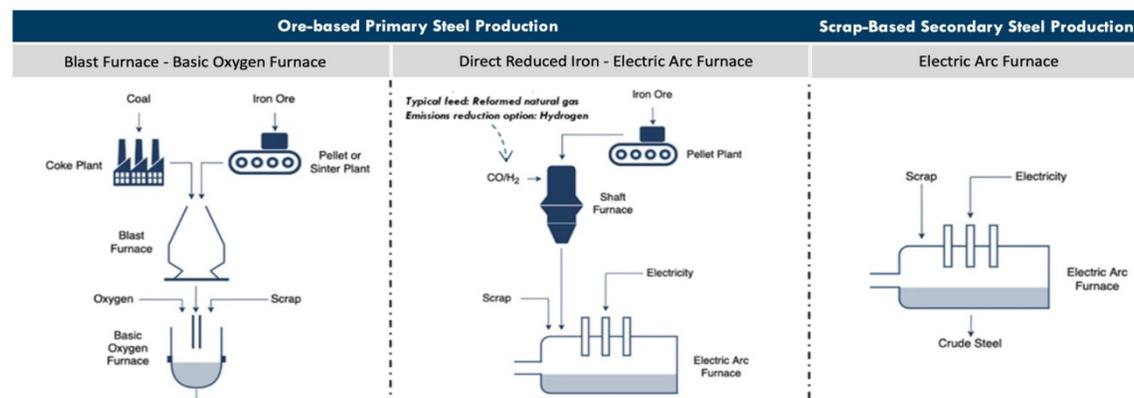


Figure 2: Representation of leading steelmaking processes

Source: [RMI opportunities for near-zero-emissions steel production in the Great Lakes](#)



The Forces Reshaping America Steel

Electric arc furnaces (EAFs) can use “pig iron” produced in a blast furnace, but they are increasingly turning to direct-reduced iron (DRI) as a source of pure iron for the reasons we outline in this section. By combining natural gas-based DRI EAFs, steelmakers get the best of both primary and secondary steel production. Because of these advantages the natural gas DRI-EAF route is likely to emerge in the next five years as the dominant steelmaking route.

1. DRI-EAF is cost competitive compared to the blast furnace

According to industry insiders, sponge iron or hot briquetted iron made from direct reduction is typically priced at a slight discount relative to pig iron from a blast furnace. The discount derives mostly from relatively lower primary energy-intensity. Hot briquetted iron also has the advantage that it oxidizes more slowly than pig iron, so it can be transported and stored more readily.

Likewise, raw steel can be manufactured in the United States through the natural gas DRI-EAF route at \$550 per ton compared with the coal-fired BF-BOF route at \$565 per ton, according to Hasanbeigi, et al (2024). In the near term, DRI-EAF steel produced using green hydrogen will be cost-competitive only with a substantial subsidy; however, as green hydrogen production achieves sufficient scale, costs could fall to the point where green hydrogen DRI-EAF steel becomes cost competitive.

2. Relatively low U.S. energy prices favor DRI-EAF

Relatively low electricity prices in the United States drove the growth of EAFs. For the last 20 years, industrial electricity prices have been the lowest among OECD countries. While electricity prices increased over 100% in other OECD countries in recent years, the price of electricity in the U.S. **grew by just 21%**, helping U.S. EAF steelmakers to maintain their price advantage.

Similarly, the relatively **low cost of natural gas** in the United States makes gas-fired direct reduction economically competitive with the blast furnace. According to [Hasanbeigi, et al](#), the combination of relatively cheap gas and electricity accounts for DRI-EAF’s competitive advantage in the United States compared to other countries.

3. DRI-EAF mitigates energy price risks

The diversification of steelmaking technologies has been matched by a diversification in energy resources used by the industry. In 1960, coal used onsite was the dominant primary energy resource for American steelmaking. The transition to EAFs and now to DRI has broadened the primary energy options available to steelmakers to include not only coal, but also natural gas and clean electricity resources, including hydro, solar, wind, biofuels, and nuclear energy. These resources are used both directly in steelmaking but also indirectly to produce electricity, hydrogen, and biochar.

This energy diversity allows steelmakers to choose a fuel mix that minimizes energy price risk, enhancing competitiveness over the long run. While ironmaking in blast furnaces is largely dependent on coal, DRI could eventually enable steelmakers to choose between natural gas and hydrogen, as hydrogen prices fall. Owing to its



relatively concentrated emissions stream, DRI is also better suited to carbon capture and storage or use than the blast furnace. Over the long run, energy diversity helps steelmakers control prices and manage supply constraints.

4. DRI-EAF alleviates health impacts

As of 2024, emissions from U.S. coal-fired steel plants caused an estimated **892 premature deaths, over 250,000 cases of asthma, and \$13.2 billion in health costs** every year. DRI-EAF production has lower hazardous air pollutant intensities than BF-BOF mainly because it doesn't rely on coke ovens and can use cleaner fuel and electricity.

5. DRI-EAF mitigates climate impacts

DRI-EAF is more climate-resilient than BF-BOF steelmaking because it is less emissions-intensive per ton of steel produced. In addition, it has greater flexibility to reduce emissions should customers demand cleaner steel. For instance, EAFs can reduce emissions by acquiring low- or zero-carbon power, either from behind the meter or from a cleaner grid. Nucor's mill in Sedalia, Missouri runs on 100% wind because of a 75-MW power purchase agreement. U.S. Steel's Big River mill in Osceola, Arkansas draws from the 250-MW Driver solar farm.

In addition, DRI mills can substitute green hydrogen for natural gas, as **Hyundai Steel** plans to do at its new mill in Louisiana. Further, DRI-EAF mills have more concentrated emissions than BF-BOFs, so can more easily capture emissions for storage or use.

6. DRI-EAF mitigates workforce impact

While DRI-EAF production requires fewer workers than BF-BOF mills per ton of steel produced, DRI-EAF production could also provide long-term stability for a workforce hard hit by job losses over the last four decades by improving the U.S. industry's long-term global competitiveness. To alleviate the impact on workers, DRI-EAF plants can be developed at existing BF-BOF sites. It's also in the interest of companies to retrain workers, provide voluntary early retirement, and top off pensions for those short of full retirement. Decision makers should also consider that the construction of DRI-EAF mills and energy infrastructure will also add temporary construction and manufacturing jobs.

7. DRI-EAF enhances steelmaker competitiveness

The combined price and risk reduction advantages of DRI-EAF positions for steelmakers to compete in key markets.

The critical automotive market

Blast furnaces once dominated the automotive sheet steel market because only steel made mostly from pure iron ore could meet the automobile industry's safety and aesthetic standards. Through continual cost and quality improvements, EAF producers have seized a sizeable portion of the high-margin market for the high-strength steel used in automobile frames. EAF producers are taking market share with improved methods to sort "tramp elements" from scrap, then blending high shares of scrap with pure iron to make automotive grade sheet steel coils. The higher scrap content allows EAF producers to then undercut prices of integrated steel producers while reducing emissions. Nucor is poised to encroach on the



market for exposed auto panels when it opens a new DRI-fed EAF in Apple Grove, West Virginia. While [automakers once voiced doubts](#) about the quality of EAF steel, all the major American EAF producers have since signed contracts to supply the OEMs.

Europe's low-carbon market

The **European Union's Carbon Border Adjustment Mechanism**, implemented starting [January 1st, 2026](#), offers an export [opportunity](#) for America's increasingly carbon-efficient steelmakers, one that could come at the expense of Asian steelmakers, whose coal-based BF-BOF production spells high taxes at Europe's borders.

While the United States is not now a major exporter, it could gain market share in Europe in the next few years. U.S. steelmakers are well-positioned relative to other large producers to leverage, first, natural gas DRI and then, green H₂ DRI to produce low-cost, low-emissions steel to sell into a CBAM protected European market.

European steelmakers are fighting to hold onto their domestic market. Swedish steelmakers [SSAB](#) and [Stegra](#) will begin production of net zero steel in 2026. Similar potential exists in Spain, Portugal, and Germany. Due to its abundant hydro, wind, and solar resources, Brazil will also vie for a share of the European market.

Recommendations

As the steel industry moves toward more advanced, less polluting production technologies that will define the next few decades, investors, policymakers, and automakers each play a critical role in enabling the transition. The recommendations below outline steps that these stakeholders can take to mitigate risk, strengthen competitiveness, and unlock value.

For investors

Investment in DRI — especially when combined with green hydrogen or carbon capture and storage and utilization — and the shift to new steelmaking technologies represents a [transition risk](#) as defined by International Financial Reporting Standards (IFRS). In particular, it is important to understand the technology pathways and capital allocation strategies of different steelmakers, which vary based on their production processes, energy access, end products, and access to scrap or ore, among other factors.

1. Encourage steelmakers to adopt science-based targets

Science-based targets — validated by either the Science Based Targets initiative (SBTi) or the [Global Steel Climate Council](#) (GSCC) — signal to investors that steelmakers are effectively managing emissions. The largest American steelmakers have all set ambitious targets. The secondary steelmakers, Nucor and Steel Dynamics, have set targets certified by GSCC. Facing a much more difficult decarbonization challenge, the integrated steelmakers U.S. Steel and Cleveland Cliffs have adopted net zero near- and long-term targets covering scope 1 and 2 emissions. These are ambitious in their own right but reflect challenges in measuring and controlling upstream scope 3 emissions. A practical interim step would be to measure and disclose upstream emissions.



2. Encourage steelmakers to disclose climate transition action plans

Climate transition Action Plans help investors understand the investments steelmakers plan to make to meet their GHG reduction targets. The leading American steelmakers have all begun to disclose such plans. (See Figure 3.) Ceres published a CTAP framework, generally aligned with IFRS S2 requirements, that steelmakers can use to improve these disclosures over time.

3. Encourage steelmakers to certify sites to ResponsibleSteel

Certification to the multi-variable **ResponsibleSteel** standard ensures that steelmaking sites are managing a full suite of risks. Already, 80 sites globally are certified to the standard. In the United States, U.S. Steel's Big River Steel facility is among those certified, and in 2024 U.S. Steel became the first steelmaker in the world to certify its products under the **standard**.

Surveys show that sustainability disclosures improve business outcomes. The Center for Sustainability and Excellence finds a **92% correlation between medium-to-high** sustainability ratings and profitable companies. The Boston Consulting Group reported that **82% of companies surveyed have captured economic benefits from decarbonization**, including 6% which reported a value that exceeds 10% of annual revenue.



For policymakers

As demonstrated by the recent surge in investment, DRI is a commercial technology that does not depend fundamentally on public incentives at greenfield sites. Additional research is required to understand the costs involved in transitioning existing blast furnace sites to DRI. Public funding might be needed to help a strategic industry to modernize while preserving existing investments in energy and feedstock supply lines, proximity to customers, steelmaking capacity, and a skilled workforce.

In addition, to support capital investment in DRI at selected locations, federal and state policymakers will want to consider several other areas where policy support could be helpful.

1. Enable energy diversification

Both the federal government and steel producing states should implement targeted policies — including power subsidies, rate structures, and permitting reform — to ensure affordable, reliable clean energy supplies for strategic industries, such as steel, that are at risk of being crowded out by data center growth.

Renewable electricity paired with battery storage and transmission upgrades are the preferred near-term solutions, given that these are affordable and can be built quickly. Flexible gas-fired generation also has an important transitional role to play in supporting intermittent renewables as part of a cleaner system. Robust demand response incentives can enlist large industrial customers — such as steel makers — in helping address intermittency and curb peak power demand. Green hydrogen, small modular reactors, and enhanced geothermal will require medium-term support to mature, scale, and become cost competitive more broadly. Absent supportive U.S.

policy to maintain competitiveness, other nations will capture energy and modern steelmaking markets of the future.

2. Enable a just transition at BF-BOF sites

As BF-BOF mills modernize production methods, steelworkers who have been the backbone of the American economy for generations should be offered packages that include training them for work in new facilities or in new trades.

For automakers

Given the large volumes of specialized, energy-intensive steel that they procure, automakers play a crucial role in providing a market for cleaner steel (as well as aluminum, glass, and other materials). Companies including General Motors, Ford and Toyota are already taking important steps to foster cleaner supply chains, such as asking suppliers to set emission reduction goals and providing technical support to develop clean energy projects. Steelmakers themselves report that the combination of OEM expectations and support plays a key role in encouraging continuous improvement in their production methods.

Building on these efforts, the OEMs will want to consider several improvements that they can make in their procurement strategies.

1. Set targets, measure progress

Consider setting emissions reduction targets and disclosing emissions intensity across all major materials categories, including steel. Also consider adopting recycled content standards as long as doing so meets their safety and other performance standards.



2. Ensure comprehensive, like-for-like carbon accounting

Adopt a “boundary” approach to measuring and disclosing purchased steel emissions, such as those provided by ResponsibleSteel or the GSCC standards. The “boundary” emissions accounting method for steel is **endorsed** by 66 standard setting bodies, international organizations, steel producers, and industry associations. Boundary refers to the practice of accounting for all emissions, from mining ore to production of raw steel, irrespective of whether emissions are generated within or outside facilities owned by the steelmakers. Doing so ensures easier comparisons between steelmakers by accounting for emissions across the entire steelmaking process irrespective of how a particular company is integrated. Reporting and disclosure against a consistent accounting framework would enable comparability between suppliers and encourage progress.

3. Enable New Technology Finance

Consider signing offtake agreements to help underpin financing for demonstration and deployment of next-generation steel manufacturing, much as automakers have done in **Europe**.

About Ceres

Ceres is a nonprofit advocacy organization working to accelerate the transition to a cleaner, more just, and resilient economy. With data-driven research and expert analysis, we inspire investors and companies to act on the world’s sustainability challenges and advocate for market and policy solutions. Together, our efforts transform industries, unlock new business opportunities, and foster innovation and job growth — proving that sustainability is the bottom line. For more information, visit ceres.org.

Acknowledgments

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Cover photo: Courtesy of Nucor Corporation

Appendix

Table 1: DRI plants in the United States

Organization	Location	Status	Capacity (MMTpa)	Fuel source	Major product	Projected cost (USD billion)
U.S. Steel/Nippon	Osceola, Arkansas	Announced in September 2025	3			3
Cleveland Cliffs	Toledo, Ohio	Operational since 2020	1.9	Natural gas, hydrogen ready	HBI	1*
Arcelor Mittal	Portland, Texas	Operational since 2017	2	Natural gas, hydrogen ready	HBI	1
Nucor	Convent, Louisiana	Operational since 2013	2.5	Natural gas	HBI	3.4
Steel Dynamics	Butler, Indiana	Operational since 1996	0.26	Natural gas, biocarbon	Sheet	N/A
Hyundai Steel	Louisiana	Construction begins in 2026	2.7	Natural gas, blue hydrogen, green hydrogen	Auto coil steel	5.8
Messabi Metallica	Nashwauk, Minnesota	Under construction, to begin operation in 2026	7	Natural gas	HBI	2.3
TOTAL			19.36			16.5