

Green Steel Economics

Brazil Factsheet

Introduction

The global steel industry accounted for over 7% of global greenhouse gas (GHG) emissions and over 11% of global CO₂ emissions. The Hydrogen Direct Reduced Iron (H₂-DRI) process utilizing green hydrogen made with renewable/no-carbon electricity promises significant emission reductions and a transition to greener steel production in the sector. The adoption of green H₂-DRI-EAF steelmaking involves financial considerations varying by country, influenced by hydrogen costs and carbon pricing mechanisms. This study assesses the costs of green H₂-DRI-EAF steelmaking compared to traditional Blast Furnace-Basic Oxygen Furnace (BF-BOF) and Natural Gas Direct Reduced Iron-Electric Arc Furnace (NG-DRI-EAF) routes across seven major steel-producing countries.

Green Steel Premium across H₂ Prices and the Impact of Carbon Prices in Brazil

In Brazil, without carbon pricing, the LCOS of green H₂-DRI-EAF steelmaking is competitive at \$476 per ton with H₂ priced at \$1.0/kg, undercutting both the traditional BF-BOF method at \$504 and NG-DRI-EAF at \$557. As carbon pricing is implemented, green H₂-DRI-EAF becomes more cost-effective. At a carbon price of \$15 per ton of CO₂, the cost-parity with BF-BOF is achieved at \$1.9/kg H₂. This economic benefit is further amplified at higher carbon prices. For example, at \$30 and \$50 per ton of CO₂, the cost-parity point is at H₂ prices of \$2.2/kg H₂ and \$2.7/kg H₂, respectively.

Brazil is rapidly emerging as a major player in the green H₂ sector, with a framework outlined in its National H₂ Program (PNH₂) launched in 2021. The PNH₂ prioritizes six key areas, including research and development (R&D). A significant development is the recently approved Green H₂ Bill, which establishes a legal framework for low-carbon H₂ production. This framework includes the creation of the Low-Carbon H₂ Development Program (PHBC) that will offer economic incentives for producers through competitive bidding processes. Recognizing the potential for domestic applications, the bill also encourages the use of green H₂ in various sectors, particularly as an energy source and for agricultural fertilizer production. To further stimulate innovation, Brazil promotes “regulatory sandboxes” for the development of green H₂ production facilities and services.

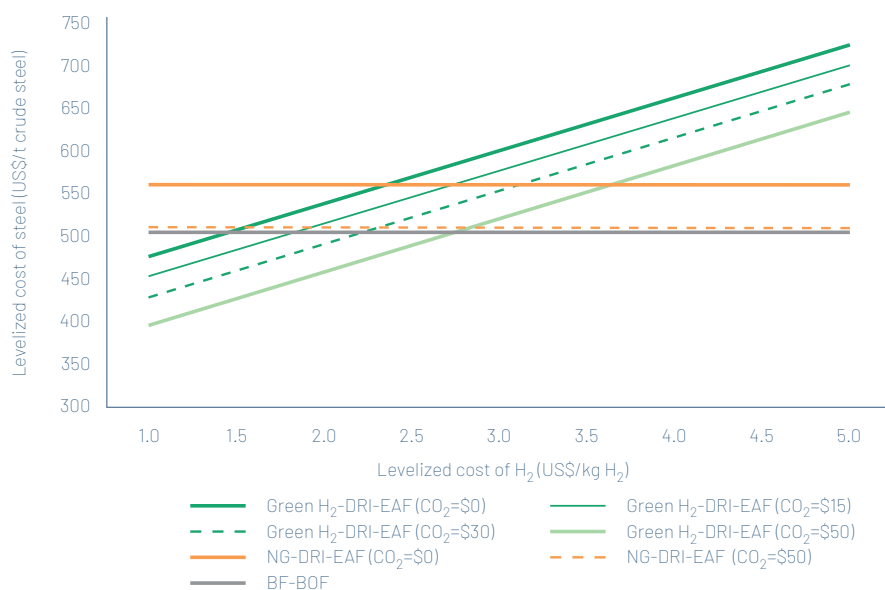
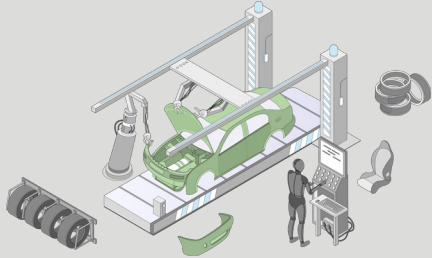


Figure 1. Levelized Cost of Steel (\$/t crude steel) with varied levelized costs of H₂ at different carbon prices in **Brazil** (Source: this study)

Notes: 5% steel scrap is assumed to be used in both BF-BOF and DRI route.

<1%

price increase on an average price of passenger car in Brazil

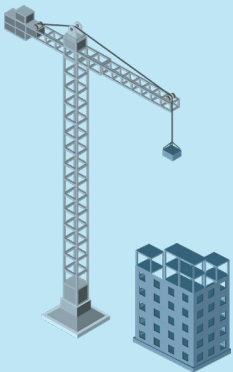


Impact of Green Steel Premium on Car Prices

The automotive industry accounts for 12% of global steel demand. The additional cost attributed to using green H₂-DRI-EAF steel in passenger vehicles—known as the green premium—is aligned with studies that estimated automotive sector as a likely first mover for green steel procurement and demonstrates minimal impact on overall vehicle pricing. For example, in Brazil, when the price of H₂ is at \$5/kg, the green premium for steel produced via green H₂-DRI-EAF, compared to the traditional BF-BOF methods, stands at approximately \$219 per ton steel. Assuming on average 0.9 ton of steel used in a passenger car, this translates to an additional cost of about \$197 per passenger car, which represents a **less than 1% price increase on an average price of passenger car in Brazil** (\$22,000), maintaining affordability and market stability. Future projections suggest that with H₂ costs potentially reducing to \$1.4/kg, the green premium could effectively disappear, making green H₂-DRI-EAF steel economically comparable to conventionally produced steel. With the introduction of carbon price/credit, the green premium for H₂-DRI-EAF steel can substantially drop even further.

Impact of Green Steel Premium on Building Construction Cost

The construction industry (building and infrastructure) accounts for 52% of global steel demand. In the context of building construction in Brazil, the economic effect of adopting green steel produced by H₂-DRI-EAF route can be considered minimal when compared to conventional BF-BOF steelmaking route. Using the green H₂-DRI-EAF route, the additional cost of steel at a H₂ price of \$5/kg is approximately \$219 per ton of steel, translating into an **added expense of about \$548 for a 50 m² residential building unit** (assuming 50 kg steel per m² used for low to mid-rise residential building). This represents a small fraction of the total cost of a residential building. In addition, with future reductions in H₂ cost or the introduction of carbon pricing, the green premium could diminish or even disappear, making green H₂-DRI-EAF an economically viable alternative for building construction in Brazil.



small added expense of about

\$548

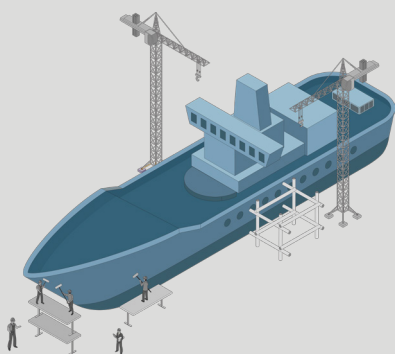
for a

50 m²

residential building unit

<10%

increase in the ship's price for Brazil



Impact of Green Steel Premium on Shipbuilding Cost

The top three shipbuilding nations, China, South Korea, and Japan, account for over 90% of global shipbuilding. Incorporating green H₂-DRI-EAF steel into shipbuilding shows a small cost increase for ship building. While there are many types of ships in the global market. This study focused on bulk carrier ships which are built in large numbers every year around the world. For example, to build an average 40,000 DWT (Deadweight tonnage) bulk ship, approximately 13,200 tons of steel are needed. If green H₂-DRI-EAF at \$5/kg H₂ is used in Brazil to build this ship, the additional cost would be about \$ 2.9 million per ship in Brazil. Considering the average cost of a new 40,000 DWT bulk ship is over \$30 million, this represents **less than 10% increase in the ship's price for Brazil**.

The reason for this relatively higher green steel premium as a share of total cost for shipbuilding compared to cars and buildings is higher share of steel cost in the shipbuilding cost. Over 95% of a ship consists of steel. Anticipated reductions in H₂ costs in the future could nullify this green premium, aligning the costs of green H₂-DRI-EAF steel with those of traditional BF-BOF steelmaking. Moreover, the introduction of carbon pricing could further reduce the green premium costs, enhancing the financial attractiveness of adopting green H₂-DRI-EAF steel in the maritime sector.

Our Recommendations

Financing the transition to H₂-DRI steelmaking requires both public and private investments to mitigate financial risks. Our recommendations for stakeholders include:

Government:

- Enact tax rebates and other incentives for green H₂ production to make it more economically viable.
- Invest in R&D and infrastructure to drive down the costs of green hydrogen production.
- Implement public procurement policies that prioritize green steel in publicly funded projects to boost market demand.
- Provide enabling policy support to develop a renewable energy infrastructure needed for green H₂ production.

Steel Companies:

- Transition from traditional BF-BOF routes to green H₂-DRI by forming partnerships for a reliable hydrogen supply.
- Engage in industrial-scale pilot projects to demonstrate the feasibility and benefits of green H₂-DRI.
- Secure market demand through long-term supply agreements with major end-use sectors and share the costs of the green premium.

Automotive and Construction Companies:

- Integrate green steel into procurement strategies to stimulate demand and help cover the green premium.
- Enhance market positioning by promoting the climate, environmental, and health benefits of green steel.
- Cater to climate-conscious clients by engaging in green private procurement practices.

Shipbuilding and Shipping Companies:

- Utilize both public and private procurement strategies to boost the adoption of green steel in the industry.
- Establish robust supply chains with green H₂-DRI steel manufacturers to ensure a steady demand for green steel.
- Promote broader industry adoption through government policies and commercial agreements to reduce the green premium.

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Download the full report from <https://transitionasia.org/green-steel-economics>.

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