Green Steel Economics

EU27 Factsheet

Introduction

The global steel industry accounted for over 7% of global greenhouse gas (GHG) emissions and over 11% of global CO_2 emissions. Germany and Türkiye are the only two EU members that are among the top 10 steel producers in the world. The Hydrogen Direct Reduced Iron (H_2-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 H_2-DRI-EAF steelmaking involves financial considerations varying by country, influenced by hydrogen costs and carbon pricing mechanisms. This study assesses the costs of green H_2-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: Impact of Hydrogen Prices and Carbon Prices in EU

The EU has one of the highest levelized cost of steel (LCOS) across all steelmaking routes. In the EU, the cost dynamics of green H_2-DRI-EAF steelmaking showcase a compelling transition away from traditional methods under different carbon pricing scenarios. Without any carbon tax, green H_2-DRI-EAF reaches cost-parity with BF-BOF route at a H_2 price of $2.0/kg H_2. This is the highest H_2 price at which green H_2-DRI-EAF becomes cost-competitive with BF-BOF among the seven countries studied. At a carbon price of $50 per ton of CO_2, the LCOS for green H_2-DRI-EAF drops further at cost-parity with BF-BOF is achieved at a much higher H_2 price of $3.3/kg H_2. The carbon price in the EU ETS market in early May 2024 was over $75 per ton of CO_2. At this carbon price, the cost parity point can be achieved at H_2 price of $4/kg H_2. In June 2024, the carbon price in EU ETS market was above $75 per ton of CO_2.

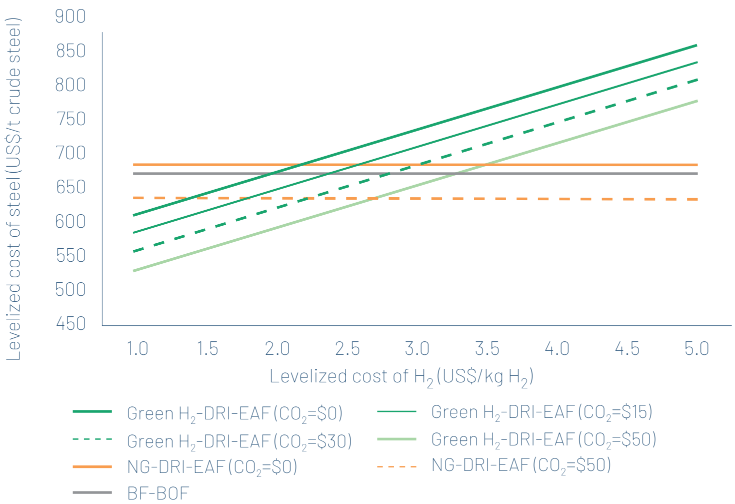


Figure 1. Levelized Cost of Steel ($/t crude steel) with varied levelized costs of H_2 at different carbon prices in the EU. (Source: this study)

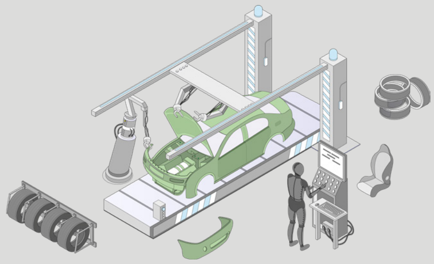
Notes: 5% steel scrap is assumed to be used in both BF-BOF and DRI route.

The European Union (EU) is one of the frontrunners in driving the development of a robust green H_2 market. Its ambitious strategy, outlined in the 2020 EU H_2 Strategy, focuses on five key areas: investment support, stimulating production and demand, creating a H_2 market and infrastructure, research and cooperation, and international collaboration. A critical piece of this strategy is the establishment of the European Clean H_2 Alliance, which supports collaboration between public and private stakeholders to develop an investment agenda and project pipeline. Financially, the EU leverages instruments like the Innovation Fund and the European H_2 Bank to support large-scale renewable H_2 projects, aiming to bridge the cost gap with conventional methods. Additionally, the recently adopted delegated acts under the Renewable Energy Directive define clear criteria for "renewable H_2" and establish methodologies for calculating life-cycle emissions. In April 2024, the first European H_2 Bank auction awarded €720 million to seven green H_2 projects from Finland, Spain, Portugal and Norway. The second auction is expected to be published in the third quarter of 2024.

Impact of Green Steel Premium on Car Prices

<1%

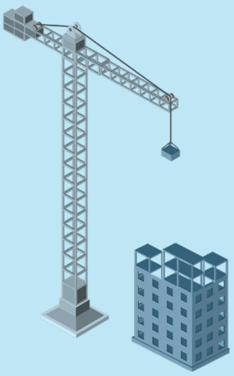
price increase on an average price of passenger car in the EU



The automotive industry accounts for 12% of global steel demand. The additional cost attributed to using green H_2-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 the EU, when the price of H_2 is at $5/kg, the green premium for steel produced via green H_2-DRI-EAF, compared to the traditional BF-BOF methods, stands at approximately $186 per ton steel. Assuming on average 0.9 ton of steel used in a passenger car, this translates to an additional cost of about $167 per passenger car, which represents a less than 1% price increase on the average price of a passenger car in the EU ($30,000), maintaining affordability and market stability. Future projections suggest that with H_2 costs potentially reducing to $2/kg, the green premium could effectively disappear, making green H_2-DRI-EAF steel economically comparable to conventionally produced steel. With the introduction of carbon price/credit, the green premium for H_2-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 the EU, the economic effect of adopting green steel produced by H_2-DRI-EAF route can be considered minimal when compared to the conventional BF-BOF steelmaking route. Using the green H_2-DRI-EAF route, the additional cost of steel at a H_2 price of $5/kg is approximately $186 per ton of steel, translating into an added expense of about $465 for a 50 m^2 residential building unit (assuming 50 kg steel per m^2 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 H_2 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 the EU..



small added expense of about

$465

for a

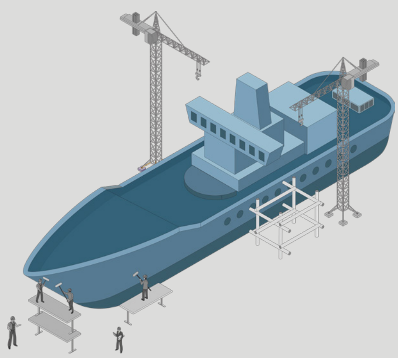
50 m^2

residential building unit

Impact of Green Steel Premium on Shipbuilding Cost

<8%

increase in the ship's price for EU



Incorporating green H_2-DRI-EAF steel into shipbuilding shows a small cost increase for shipbuilding. While there are many types of ships in the global market. This study focused on bulk carrier ships, which are built in large numbers around the world every year. For example, to build an average 40,000 DWT (Deadweight tonnage) bulk ship, approximately 13,200 tons of steel are needed. If green H_2-DRI-EAF at $5/kg H_2 is used in the EU to build this ship, the additional cost would be about $2.45 million per ship in the EU.. Considering the average cost of a new 40,000 DWT bulk ship is over $30 million, this represents less than 8% increase in the ship's price for EU.

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 H_2 costs in the future could nullify this green premium, aligning the costs of green H_2-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 H_2-DRI-EAF steel in the maritime sector.

Our Recommendations

Financing the transition to H_2-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 H_2 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.

Steel Companies:

- Transition from traditional BF-BOF routes to green H_2-DRI by forming partnerships for a reliable hydrogen supply.
- Engage in industrial-scale pilot projects to demonstrate the feasibility and benefits of green H_2-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 H_2-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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