The Green Steel Premium for Cars and Buildings is Negligible

Call for More Government Investment and Green Steel Procurement to Support New Green H_2-DRI Steel Plants

- The green steel premium for cars and buildings results in **less than a 1% increase** in the average price of these end products, while for shipbuilding, it leads to around 10% increase in costs, as 95% of a ship consists of steel.
- **Green hydrogen cost and carbon pricing** will impact green steel premium across steelmaking countries.
- **China is set to be one of Asia's most competitive** in green H_2-DRI-EAF steel production.
- Japan, South Korea, and the EU experience a higher Levelized Cost of Steel ("LCOS") for green steel unless policies to reduce hydrogen production costs are implemented.
- Across Asia Pacific, implementing **carbon pricing at a minimum of US$15 per ton of CO_2** will accelerate green steel production in both speed and scale.

25 July 2024 - **Transition Asia ("TA"), Global Efficiency Intelligence ("GEI") and Solutions for Our Climate ("SFOC")** today jointly published a research report ("the report") assessing the costs of green H_2-DRI-EAF steel production 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 regions, including Australia, Brazil, China, EU, Japan, South Korea and the US.

"Green steel premium" is the comparison of the costs associated with steel production using both traditional and green H_2-DRI-EAF steelmaking routes.[1] The report finds that the **green premiums related to notable downstream sectors such as automotive ($/car) and construction ($/building unit) are minimal and low for shipbuilding ($/ship).** These premiums can be managed through effective policy interventions and green procurement initiatives. These sectors are crucial for widespread adoption as they represent significant steel consumption and have substantial potential for driving the demand for green H_2-DRI-EAF steel.

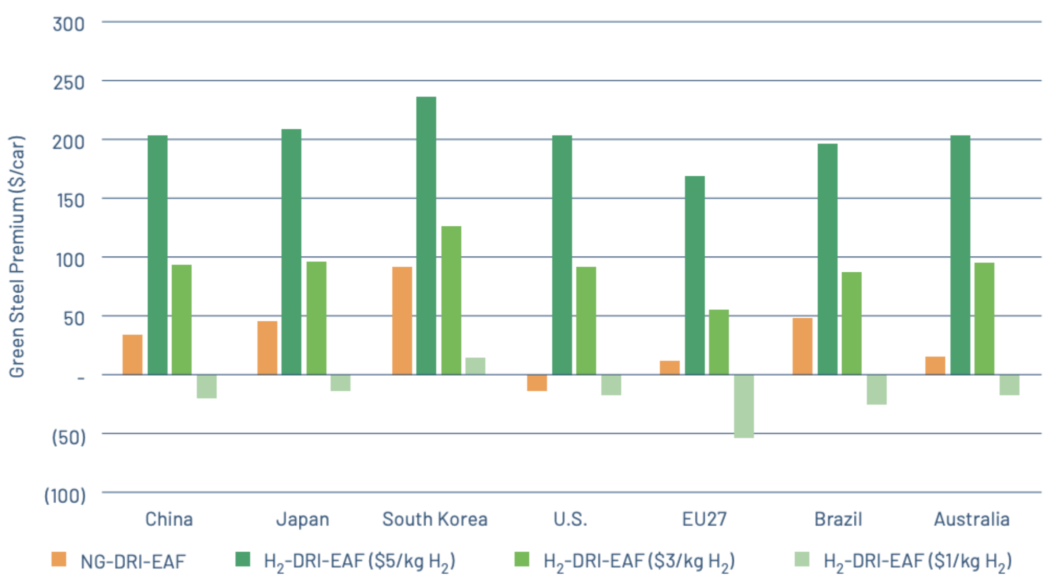
[1] Refer to the methodology section of the release for further details

The impact of green premium on final product costs is minimal for downstream sectors: Automotive, Construction, and Shipbuilding sectors.

Automotive

The automotive industry accounts for 12% of global steel demand.[2] The sector is a likely first mover for green steel procurement, as adopting green steel demonstrates a minimal impact on overall vehicle pricing. For example, in China, when the price of H_2 reaches $5/kg, the green premium for steel produced via Green H_2-DRI-EAF, compared to the traditional BF-BOF methods, stands at approximately $225 per ton steel. Assuming an average 0.9 ton of steel used in a passenger car, this translates to **an additional cost of about $203 per passenger car, which represents a less than 1% price increase** on the average price of a passenger car in China ($22,000), maintaining affordability and market stability. Similar conclusions can be drawn based on the analysis of green steel premium on car prices in other countries studied (Figure 1).

Figure 1. Impact of green steel premium on car prices in countries studied under different H_2 with no carbon prices.



Construction

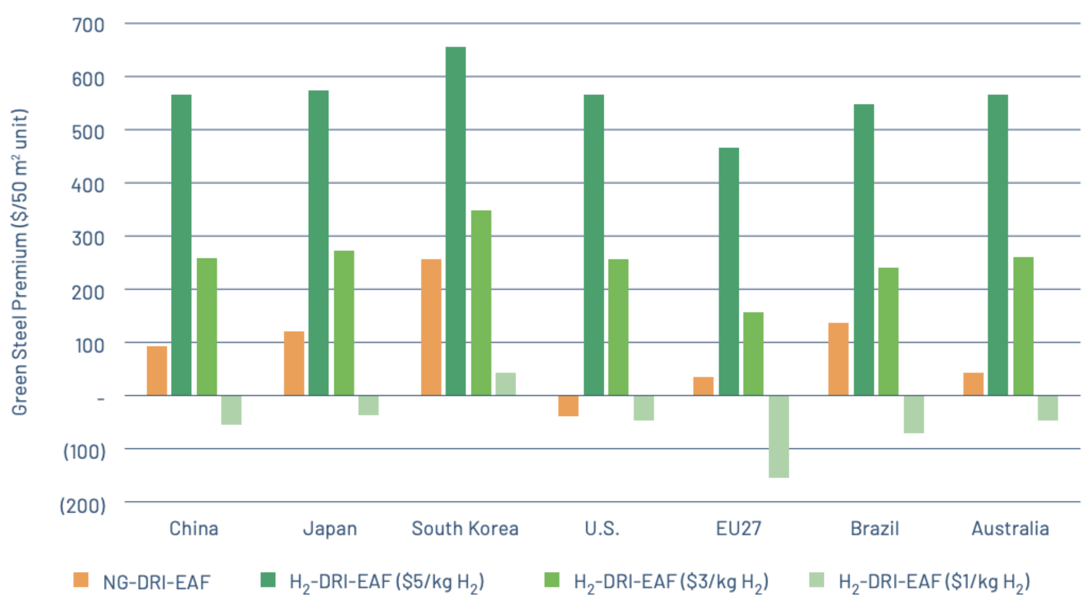
The construction industry (building and infrastructure) accounts for 52% of global steel demand.[3] In the context of building construction in China, the economic effect of adopting green steel produced by H_2-DRI-EAF route can be considered minimal when compared to the conventional

[2] Worldsteel 2023
[3] Worldsteel 2023

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 **$225 per ton of steel, translating into an added expense of about $563 for a 50 m^2** residential building unit (assuming 50 kg steel per m^2 used for a 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 H_2-DRI-EAF an economically viable alternative for building construction in China. Similar conclusions can be drawn based on the analysis of green steel premiums on building construction costs in other countries studied.

Figure 2. Impact of green steel premium on building construction cost in countries studied under different H_2 with no carbon prices[4]



Shipbuilding

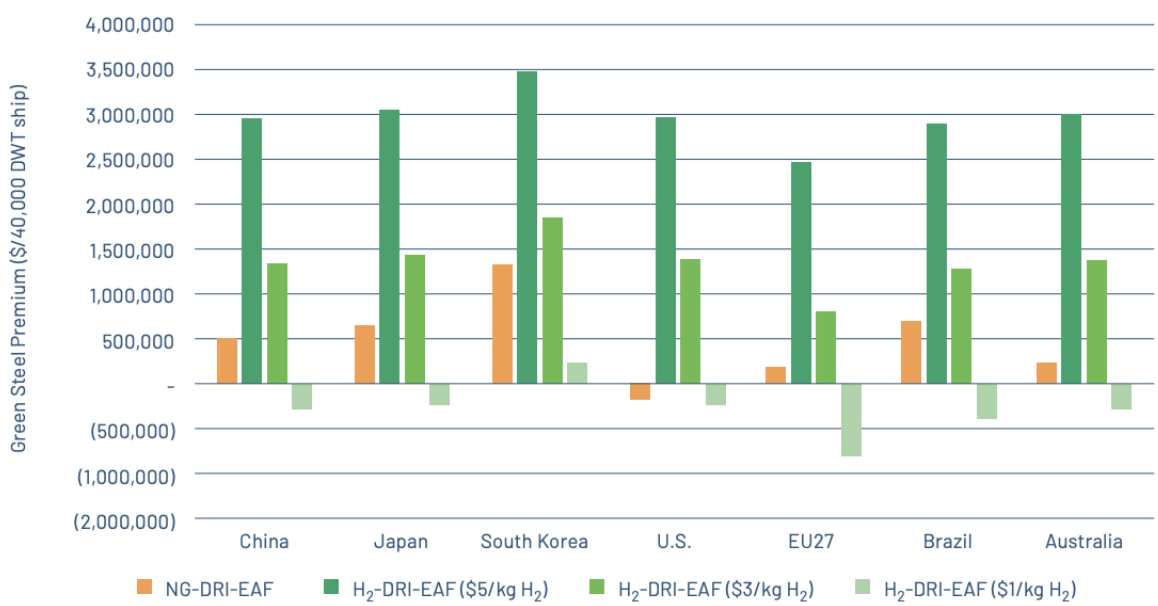
The top three shipbuilding nations, China, South Korea, and Japan, account for over 90% of global shipbuilding. Incorporating green H_2-DRI-EAF steel into shipbuilding shows a small cost increase for shipbuilding but could have large implications for green steel demand. In the case of China, which is the world's largest steelmaker and shipbuilder, a H_2 cost of $5/kg entails the green steel premium reaching around $225 per ton of steel. In the case of South Korea, the green steel premium is $263 per ton of steel at $5/kg H_2.

[4] This is for a 50 m^2 residential building unit assuming 50 kg steel per m^2 used for a low to mid-rise residential building.

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 to build this ship in China, the additional cost would be about $3 million per ship. In the case of South Korea, the additional cost would be $3.5 million per ship. Considering the average cost of a new 40,000 DWT bulk ship is over $30 million, this represents **less than 10% increase in the overall ship's price for China and 11.6% in South Korea**, adding a new green competitive dynamic between the two shipbuilding giants.

The reason for this relatively higher green steel premium as a share of total cost for shipbuilding compared to the automotive and construction industries is a higher share of steel cost in the shipbuilding cost. Over 95% of a ship consists of steel. Similar conclusions can be drawn based on the analysis of green steel premiums on shipbuilding cost in other countries studied.

Figure 3: Impact of green steel premium on shipbuilding cost in countries studied under different H2 with no carbon prices[5]



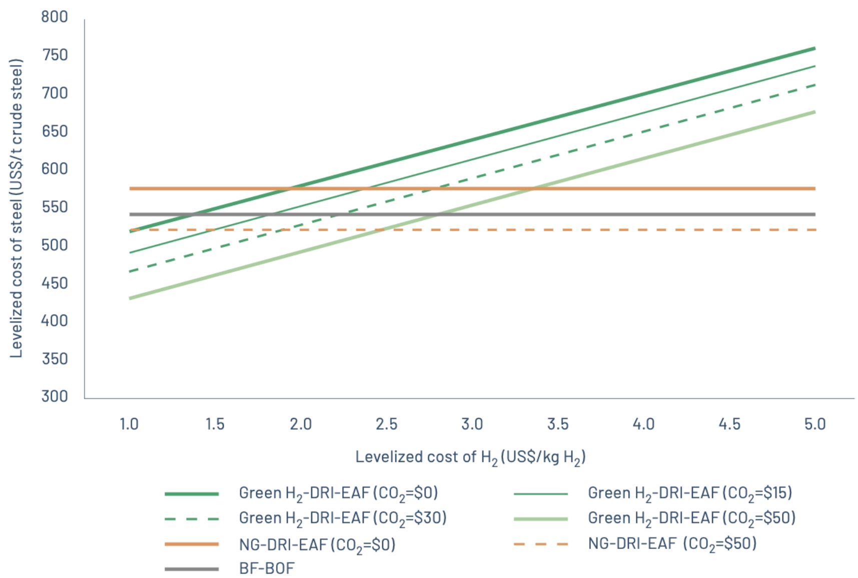
Carbon pricing, when factored in as in a form of credits or allowances, will enhance the economic viability of green steelmaking processes.

The report also finds that carbon pricing can accelerate the adoption of green H_2-DRI-EAF in steel production, both in speed and scale. For instance, in China (Figure 4), a carbon price of $15 per ton of CO_2 shifts the cost-parity point. At this carbon price, producing steel via green H_2-DRI-EAF with hydrogen at $1.0/kg will cost $48 per ton less compared to the BF-BOF method. This illustrates a substantial economic incentive for adopting greener steel production methods. Notably, this

[5] This is for an average 40,000 DWT (Deadweight tonnage) bulk ship.

carbon pricing level is feasible, as the average spot price of emissions traded on the Shanghai Environment and Energy Exchange, used as a proxy for carbon price here, exceeded the 100 yuan milestone for the first time and reached 101.51 yuan ($14.05) at the end of April 2024.

Figure 4: Levelized Cost of Steel ($/t crude steel) with varied levelized costs of H_2 at different carbon prices in China



China's green hydrogen vision and the anticipated expansion of its Emission Trading System (ETS) has reinforced its position as a global leader in green steel production

According to our model, the cost advantage of green steel becomes even more pronounced with a carbon price of $30 per ton, where the LCOS for green H_2-DRI-EAF matches the BF-BOF cost at a hydrogen price of $2.2/kg. China is rapidly advancing its green hydrogen production capabilities, aiming for 80 GW of installed electrolyzer capacity by 2030 under its Green Hydrogen Energy Plan, making green hydrogen cost-competitive with fossil-fuel-derived hydrogen. Coupled with the anticipated wider participation in the emissions trading system, which could drive up carbon prices, the significant competitive cost advantage of green steel is within reach, positioning China to lead the world in green steel production.

Initiatives in hydrogen production by APAC governments will benefit green steel production.

Across the Asia Pacific (APAC) region, implementing carbon pricing at a minimum of $15 per ton of CO_2 will accelerate green steel production in both speed and scale. This is true for Japan, South Korea, and Australia, where governments have also announced strategies to scale up green hydrogen production, further benefiting the LCOS of green steelmaking.

In Japan, a carbon price of $15 per ton of CO_2 significantly shifts the dynamics. At this price, producing steel with hydrogen at $1.7/kg in the green H_2-DRI-EAF process achieves the same LCOS as the BF-BOF method. The economics of green steel further improve with a carbon price of $30 per ton, aligning the costs of green H_2-DRI-EAF with BF-BOF at a hydrogen price of $2.0/kg.

In South Korea, the introduction of carbon pricing similarly enhances the competitiveness of green H_2-DRI-EAF. With a carbon price of $15 per ton of CO_2 and H_2 at $1/kg, the cost of green H_2-DRI-EAF offers savings over the BF-BOF method. This trend strengthens with higher carbon prices, further boosting the economic viability of green steel.

Our Recommendations

Financing the transition to H_2-DRI steelmaking requires both public and private investments to mitigate financial risks. Our recommendations for stakeholders are:

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.
- Provide enabling policy support to develop a renewable energy infrastructure needed for green H_2 production.

Steel Companies

- Transition from traditional BF-BOF routes to green H_2-DRI by forming partnerships for a reliable green 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 use.
- 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.

Lauren Huleatt, Program Manager and Investor Lead at Transition Asia commented, " Green H_2-DRI steelmaking will only succeed when steel companies step out of their comfort zones. Governments also must take the initiative to provide support to companies in order to signal the private sector to contribute to the shift toward green steel production. Financing H_2-DRI projects is crucial for this transition, requiring both public and private funding to mitigate the financial risks associated with green H_2-DRI technology.

In countries like China, where renewable energy costs are expected to drop much sooner than in other countries and with the imminent launch of a carbon tax regime, some countries will need to play catch-up or risk losing the first-mover advantage, as we are likely to see in China."

Ali Hasanbeigi, PhD (Lead Author), CEO and Research Director at Global Efficiency Intelligence commented, "The findings of our 'Green Steel Economics' study underscore how small the green premium for green H2-DRI steel is, resulting in less than a 1% increase in the average price for cars and buildings. It also highlights the importance of government support in financing H2-DRI steelmaking projects in the near term and implementing green public procurement policies to pay for this initial yet very small green steel premium. With hydrogen prices expected to drop significantly in the near future, the green premium will likely vanish, making green steel a cost-effective option compared to conventional coal-based BF-BOF steelmaking. We call on car manufacturers and the private sector to step up their procurement of green steel, as the additional costs per unit of final products (per car or per building units) are negligible and will further reduce as hydrogen prices decrease."

Daseul Kim, Policy Analyst at Solutions for Our Climate commented, "Green steel is vital for South Korea's manufacturing-heavy economy to stay competitive. However, Korea is the only country in the report where H2-DRI-EAF production does not reach cost parity with coal-powered BF-BOF even when hydrogen cost falls to $1/kgH2 due to expensive renewable energy generation. South Korea must implement policies, such as reducing renewables PPA prices, to incentivize renewable energy growth and green steel production."

-ENDS-

Notes to Editor

Link to Full Report: [To be included on 25th Jul]

Methodology

The study utilizes a detailed financial model to calculate the levelized cost of steel (LCOS) ($/ton of steel) using expenses such as capital investments, raw materials, labor, and energy costs, adjusting for varying levels of hydrogen use. The analysis method incorporates net present value calculations to distribute initial capital outlays over time and aggregates annual operational costs, enabling a detailed assessment of the economic viability and emissions reduction potential for transitioning to low-carbon steel production routes.

About Transition Asia

Founded in 2021, Transition Asia is a non-profit think tank that focuses on driving 1.5°C-aligned corporate climate action in East Asia through in-depth sectoral and policy analysis, investor insights, and strategic engagement. Transition Asia works with corporate, finance, and policy stakeholders across the globe to achieve transformative change for a net-zero, resilient future. Visit transitionasia.org to learn more.

About Global Efficiency Intelligence

Global Efficiency Intelligence is a U.S.-based research and consulting firm specializing in industrial decarbonization. The firm offers market-based solutions alongside comprehensive analyses of technology, systems, industry practices, business strategies, and policies relevant to the industrial sector. Utilizing systems thinking, integrative modeling, and data analytics, GEI transforms data into actionable insights and delivers science-based engineering solutions for global industrial decarbonization.

About Solutions for Our Climate

Solutions for Our Climate (SFOC) is an independent nonprofit organization that works to accelerate global greenhouse gas emissions reduction and energy transition. SFOC leverages research, litigation, community organizing, and strategic communications to deliver practical climate solutions and build movements for change.

Media Contact

Ali Hasanbeigi (Global Efficiency Intelligence, U.S): hasanbeigi@globalefficiencyintel.com
Jinny Kim (SFOC, South Korea): euijin.kim@forourclimate.org
Monica Wong (Transition Asia, Hong Kong): monica@transitionasia.org