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GREEN STEEL PREMIUM: PRICING AND MARKET DEVELOPMENT IN CHINA

An analysis of the Green Steel Premium for China and the EU in 2022, and how policy instruments and pricing have to develop to make China competitive

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KEY TAKEAWAYS

- Green Steel Premium (GSP) refers to the difference in cost per ton of steel between the fossil-based BF-BOF route and the near zero emissions EAF route. GSP1 and GSP2 indicate the difference in unit costs between production via the BF-BOF route and 100% scrap-based EAF production (powered by RE) and the green H_2-based DRI-EAF route, respectively;
- China's GSP1 was high in 2022 at around $100/t Steel and driven by high scrap prices; and
- Supply-side stimuli - to improve liquidity and competitive pricing in the scrap market, to deliver new EAFs using scrap and DRI as raw materials, and to ensure these EAFs are powered by reliable renewable energy systems - are crucial. Both to accelerate the development of the green steel market in China and to maintain China's industrial competitiveness.

WHICH GREEN STEEL PREMIUM? HOW GREEN IS THE STEEL?

Our research examines the economics and opportunities for green steel coming from two production processes. Firstly, using EAF that is charged with 100% scrap (Scrap-EAF) and powered by as much renewable energy as possible. This is the most available and commercial route pre-2030. Secondly, using H_2-DRI-EAF where the scrap in the EAF can be supplemented by DRI, a production process where green hydrogen replaces fossil fuels to make iron. (In a separate paper[1], we have provided a basic steel explainer to guide readers through these and current production processes).

By extension there are two Green Steel Premia of interest:

1. Green Steel Premium 1 (GSP1) - the difference in cost per tonne of steel between BF-BOF and Scrap-EAF (powered by RE); and
2. Green Steel Premium 2 (GSP2) - the difference in cost per tonne of steel between BF-BOF and H_2-DRI-EAF.

In this paper we present an analysis of GSP1 for China and the EU. Since steel is a complex business and inputs vary across the different production processes we are grounding this analysis of GSP1 in commercial reality by:

- Introducing LCOS based on NPV accounting with a fixed discount rate to calculate cost per tonne of steel of both the BF-BOF and Scrap-EAF routes separately and define the difference as GSP1;
- Modelling a BF-BOF route which is predominantly coking coal and iron ore but does consider the average industrial scrap ratio (10%) added to BOF; and

1 https://transitionasia.org/wp-content/uploads/2023/02/TA-Steel-Explainer2023-1.pdf

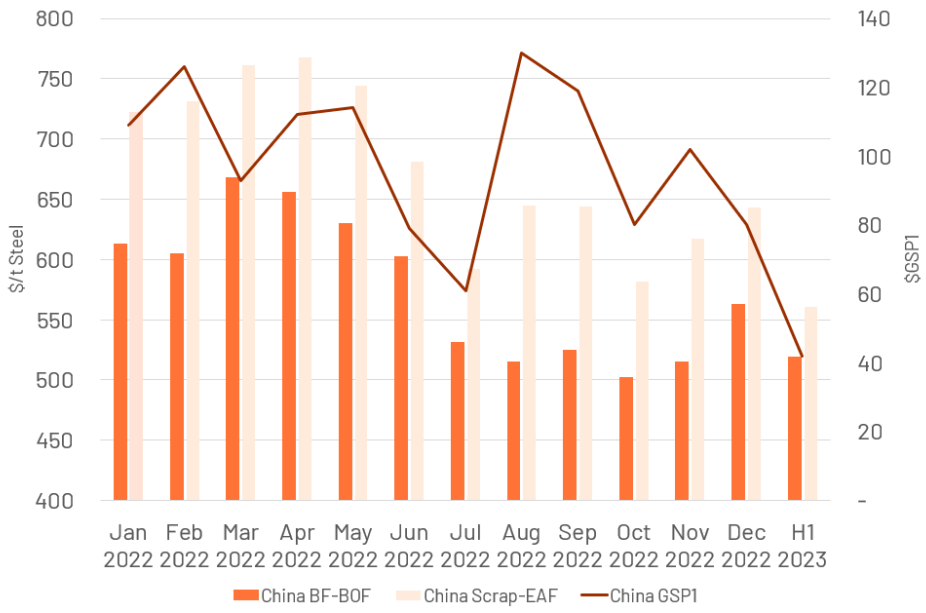
- Modelling a Scrap-EAF route that uses 100% scrap and a semi-islanded energy system with 75% of power fed directly from captive, multiple-sourced RE from solar and wind, and 25% from the grid as a backup for green steel production.

There is no universally accepted definition of green steel, so it is important to spell out the carbon intensity of each production process for GSP1. Using simple definitions of emissions covering Scope 1, 2 and 3, we arrive at 2.23 tCO_2e/t Steel for BF BOF and 0.22 tCO_2e/t Steel for Scrap-EAF. The latter is driven by the use of grid electricity, which otherwise would be near zero. We believe pricing will vary by carbon intensity of green steel, i.e. a de facto adjustment to price by carbon content, but that 0.22 "tonnes per tonne" represents a realistic and commercial example of green steel (at present) that creates a meaningful analysis of GSP1.

GREEN STEEL PREMIUM I

We have modelled GSP1 for China in 2022:

Chart 1 - China BF-BOF, Scrap-EAF and GSP1 $/t

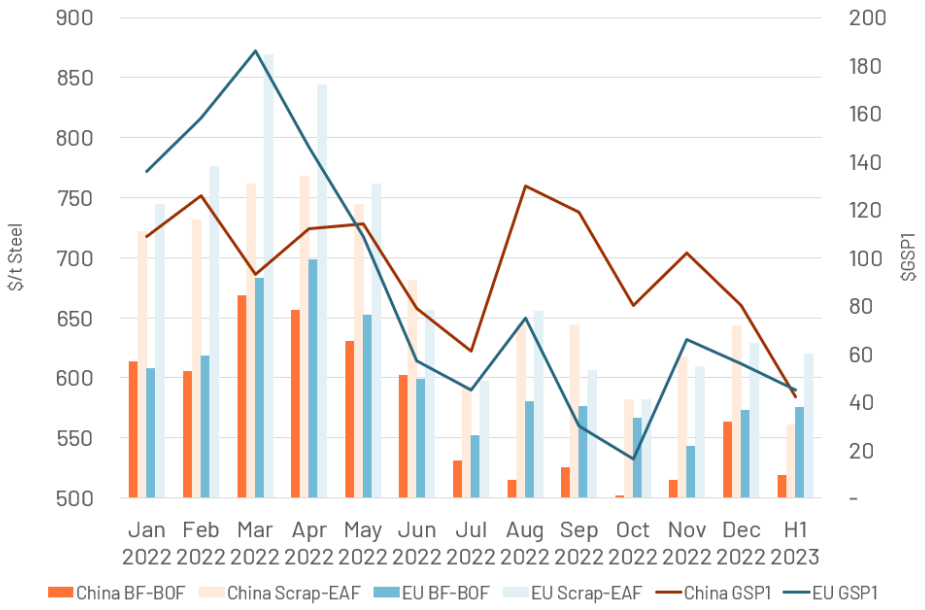


2022 was a volatile year for commodity prices like coal and iron ore which drive BF-BOF steel production, but this also led to high electricity prices and scrap prices. While the steel from the two production processes is not perfect substitute, analysts expect the market to move in parallel to some extent. As a consequence, we see high LCOS levels for both BF-BOF and Scrap-EAF in the first half of 2022.

Nevertheless, having followed steel industry predictions for GSP1, especially in Europe, we think GSP1 is both high and volatile for China throughout the year. The average GSP1 in China is around $100 for 2022. This is too high to develop a green steel market in China, in any circumstance, at around 20% above the BF-BOF price. However, our forecast for H1 2023 (which inputs commodity prices from financial futures) suggests GSP1 will drop to nearer $50 by mid-2023.

To put this in perspective, we now turn to the analysis of EU GSP1.

Chart 2- China and EU BF-BOF, Scrap-EAF and GSP1 $/t



There are two observations here. Firstly, the volatility in commodity prices was more pronounced in the EU and led to a higher premium. Secondly, this EU premium is lower than the China premium after this volatility passes. Our forecast GSP1 for both markets is similar.

What will be of concern for policymakers in China is that in both markets, the Scrap-EAF price in the EU is only slightly higher than in China throughout 2022, making both BF-BOF and Scrap-EAF exports to Europe vulnerable to the introduction of the Carbon Border Adjustment Mechanism (CBAM).

MARKET DEVELOPMENT IN CHINA

The Ministry of Industry and Information Technology (MIIT) in China is addressing the development of green steel and scrap markets in China. Our concern is the acceleration of these developments rather than any lack of ambition. For example, MIIT wants "The orderly development of electric furnace steelmaking…to promote the high-quality and efficient utilisation of scrap steel resources, and guide the development of electric furnace steelmaking in an orderly manner".[2]

2 https://www.miit.gov.cn/jgsj/ycls/gt/art/2022/art_368e1aae99704e9281a618dc73c046f7.html

This leads to the key question: what can policymakers do to accelerate the green steel market in China?

Supply side:

- Scrap, its price and availability, is a key driver of GSP1, and a key differentiator between China and other steel-producing countries. Clearly, it is not enough to simply divert scrap from BF-BOF to EAFs but stimulating this market - post peak Steel - is essential. While there are various estimates, China uses 250-300m tonnes of scrap in primary and secondary production and has regional markets with minimal imports. But many analysts continue to view the market as fragmented, with low barriers to entry, cheap labour and minimal operating costs creating a market that needs consolidation in tandem with the planned rationalisation of the steel industry itself. While many analyses point to a virtuous circle of EAF and scrap market development, our recommendation is that the scrap market joins iron ore and steel producers with a rationalisation plan of its own.
- The growth rate and price of RE in China are a competitive advantage for Chinese steel producers. But a reduction to zero carbon green steel relies on stable RE supply systems. Access to these systems by steel companies and last mile connections should be a priority for state government and energy companies alike.
- The share of EAFs is increasing and is expected to reach 15-20% by 2025. However, the reality, even for China, is that a new generation of hybrid EAFs needs to be brought online to offer flexibility in the production of both the charge (Scrap/DRI) and the power source (PPA/grid/captive). Here subsidies for CAPEX should be considered, and a "leapfrogging" of current EAF technology as China's EAF share catches up with other major steel-producing countries.

Demand side:

- China is a leader in EVs, and auto manufacturers are looking at green steel for further opportunities in decarbonisation. Fiscal incentives and supply chains between major producers and buyers of steel can be strengthened.

Pricing:

- A carbon price of $\$50/tCO_2e$ would mean that GSP1 is 0 in China. This is imaginable in the context of $\$80\text{-}90/tCO_2e$ in the EU. We believe this is a crucial lever inside the steel industry in China and should be taken into consideration by policy makers as the steel industry is forced to rationalise in the 2020s.

All of these are designed to develop a green steel market in China and accelerate the decarbonisation of the industry while maintaining international competitiveness.

FUTURE WORK

We will return to both green steel premia in future work, and we are currently looking at GSP1 in Japan and GSP2. To stay posted and learn more, please visit our research at https://transitionasia.org/research

GLOSSARY

BF	Blast Furnace
BOF	Basic Oxygen Furnace
DRI	Direct Reduced Iron
EAF	Electric Arc Furnace
H_2-DRI	Direct Reduced Iron from Hydrogen
PPA	Power Purchase Agreement

DATA AND DISCLAIMER

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