China — Steel industry decarbonisation biannual review — H2 2024

Urge for reform :

Blast furnace glut in China erodes profitability and hinders green steel transition

Xinyi Shen, Belinda Schäpe

February 2025

CREA
Centre for Research on Energy and Clean Air

CREA is an independent research organization focused on revealing the trends, causes, and health impacts, as well as the solutions to air pollution.

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Urge for reform: blast furnace glut in China erodes profitability and hinders green steel transition

China's crude steel production surpassed 1 billion tonnes in 2024 for the fifth consecutive year. Steel consumption has slumped over the past four years, leading to severe oversupply that has continued eroding profitability to near-zero margins for over three years. Meanwhile, China's climate ambitions necessitate a profound green transition in the steel industry within this decade to pave the way for carbon neutrality by 2060. However, overcapacity also weighs down on the breakthrough of low-carbon development.

This biannual review of China's steel sector in 2024 examines the gap between the industry's current trajectory and the requirements needed to meet the country's broad and steel sectoral climate objectives.

Key findings

- China remains off track for its 2025 climate targets for the steel sector, as low-carbon electric arc furnace (EAF) steelmaking remains stuck at below 10% of total output, far from the government's 15% goal for 2025. EAF share is weighed down by relatively low recycling rates and economic incentives that lead to the use of scrap steel in blast furnaces-basic oxygen furnace (BF-BOF) rather than EAF.
- Steel exports surged to 111 million tonnes in 2024, the highest in nearly a decade. Rising global trade frictions pose increasing challenges for Chinese steelmakers in 2025 to offset waning domestic demand through exports.
- Tackling the glut and deepening the green steel transition in China require a net reduction in BF capacity of at least 200 million tonnes per annum (Mtpa) by 2025 from the base in 2020, which is about 15% of China's total steelmaking capacity and equal to the EU's current total steelmaking capacity. An additional net reduction of 150 Mtpa is required from 2026 to 2030.
- In 2024, provincial authorities also greenlit 11.04 Mtpa of new BF capacity, bringing the total approved BF capacity from 2021 to 2024 to over 140 Mtpa. Given China's overcapacity in coal-based steelmaking and commitment to carbon neutrality,

significant reductions in BF capacity are imperative. If constructed, these newly approved coal-based BF projects will face significant return-on-investment pressures and risk becoming stranded assets, with potential losses estimated at 140 billion yuan.

- Hydrogen-based metallurgy is critical for carbon neutrality, yet only 2.3 Mtpa of capacity was approved between 2021 and 2024—far below the pace needed to meet 2060 carbon neutrality targets.

The market expects a new round of supply-side reform, focusing on industry consolidation, stricter production controls, and carbon market inclusion. The suspension of new iron and steel project approvals in August 2024 signals a policy shift, but further action is needed.

Policy recommendations

- Speed up the adoption of low-carbon technologies, such as EAF and green hydrogen metallurgy, with financial incentives and policies that support innovation and large-scale implementation across the industry.
- Reduce the capacity of coal-based BFs and BOFs and halt new project approvals. This will help avoid stranded assets and facilitate a smoother transition to greener technologies.
- Support research into alternative steelmaking methods and enhance international collaboration to promote innovation and differentiation in the steel sector. This will drive competitiveness and sustainability across the industry.
- Maximise the potential of renewable energy from wind and solar to create synergies between the decarbonisation of electricity and industrial processes, aiding a smoother transition to a low-carbon economy in China.
- Strengthen the carbon market by expanding its scope to include steel, cement, and aluminium industries, as proposed in a draft policy in September 2024. A transition from an intensity-based approach to a tightening cap-and-trade system is also needed to ensure significant emissions reductions across these sectors.

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Introduction

China is the world's largest steel producer, accounting for over half of global output. However, this dominance comes with significant environmental challenges. The steel sector, heavily reliant on coal, is China's second-largest carbon emitter, responsible for approximately 17% of the country's total emissions. When emissions from the steel industry's electricity consumption are included, it becomes the largest emitter, highlighting its critical role in achieving China's climate goals.

In September 2020, President Xi Jinping announced China's dual carbon goals: peaking carbon emissions before 2030 and achieving carbon neutrality before 2060. Given its substantial carbon footprint, the steel industry must align with these targets by developing clear strategies and taking decisive action.

The government introduced steel industry development guidelines in January 2022 to support this transition, aiming to peak the sector's carbon emissions before 2030. Key decarbonisation targets for 2025 include increasing scrap steel usage and raising electric arc furnace (EAF) production to 15% of total crude steel output, up from 10% in 2020. By 2030, EAF steel production should exceed 20%.

However, persistent overcapacity in coal-based steelmaking presents significant challenges. The Chinese sector remains heavily dependent on the carbon-intensive blast furnace-basic oxygen furnace (BF-BOF) process, which uses iron ore and coke, leading to high CO_2 emissions. In contrast, EAF technology, which utilises scrap steel, can cut emissions by up to 70%. Yet, limited scrap supply and weak economic competitiveness hinder its expansion. Meanwhile, excess coal-based capacity and declining profitability further complicate the industry's decarbonisation efforts.

Severe overcapacity leads to near-zero margins

China's crude steel production surpassed 1 billion tonnes in 2024 for the fifth consecutive year (Figure 1), reinforcing its global dominance. However, output declined by 5.6% compared to the record high in 2020. Simultaneously, steel consumption has steadily declined over the past four years, contracting by 15.6%. The prolonged downturn in the real estate sector—traditionally a major consumer of steel—has significantly dampened demand.

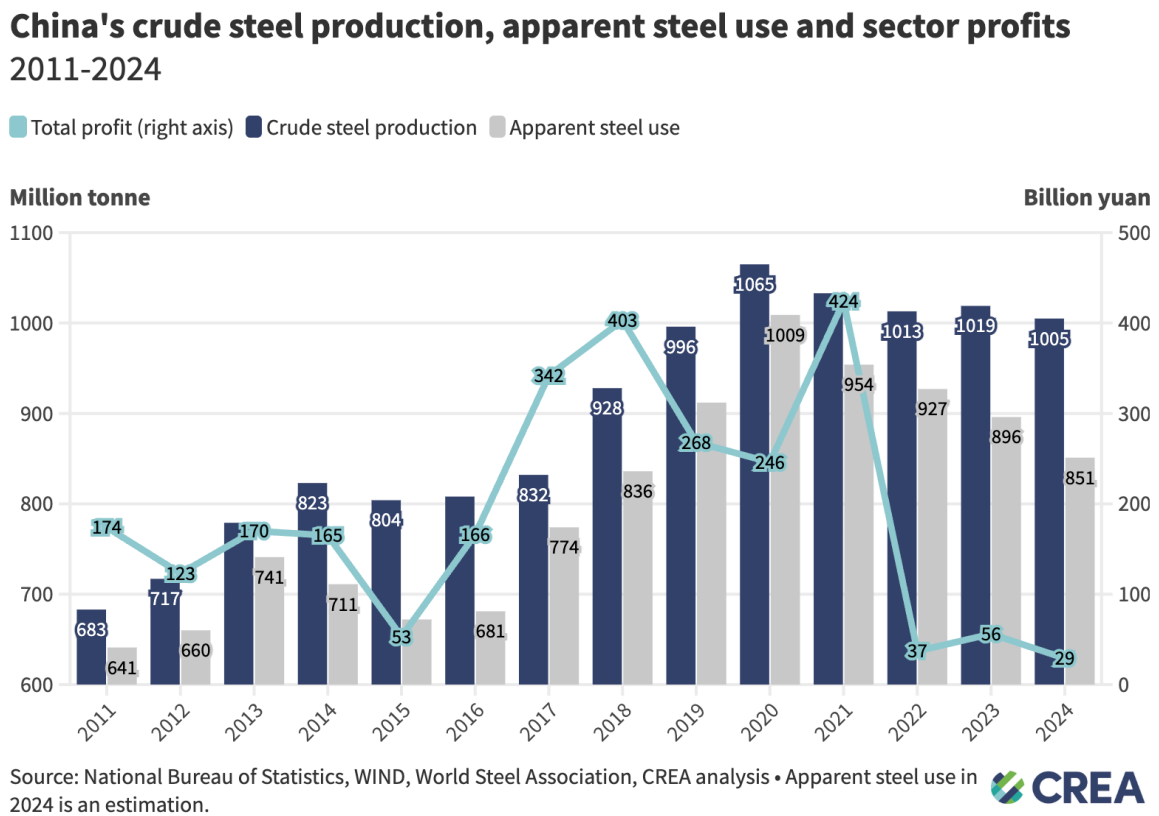

Figure 1 - China's crude steel production, apparent steel use and sector profits, 2021-2024

This growing imbalance between production and domestic consumption has exacerbated the industry's overcapacity problem. Despite maintaining its position as the world's largest producer, the sector faces mounting pressure, with excess capacity eroding profitability. Over the past three years, profit margins have shrunk to near-zero levels, highlighting the financial difficulties confronting many steel companies.

In 2024, the total profits of China's steel industry plummeted to a historic low of just 29 billion yuan, exposing the sector to a deepening financial crisis. Without corrective measures, the situation risks further deterioration. Urgent policy adjustments are needed to rebalance production, stimulate domestic demand, and accelerate the transition toward greener and more sustainable growth models.

Low-carbon steel fails to gain traction, stalling the green transition

Decarbonising China's vast steel industry requires a comprehensive, multi-pronged approach. According to the Carbon Neutrality Technology Roadmap for China's Steel Industry by China Iron and Steel Research Institute Group, cumulative carbon reductions from 2021 to 2060 will primarily come from:

- A decline in crude steel production (45%)
- The expansion of EAF steelmaking using scrap steel (39%)
- The adoption of hydrogen metallurgy (9%)
- Improvements in energy efficiency, interface technologies, and digitalisation (7%)

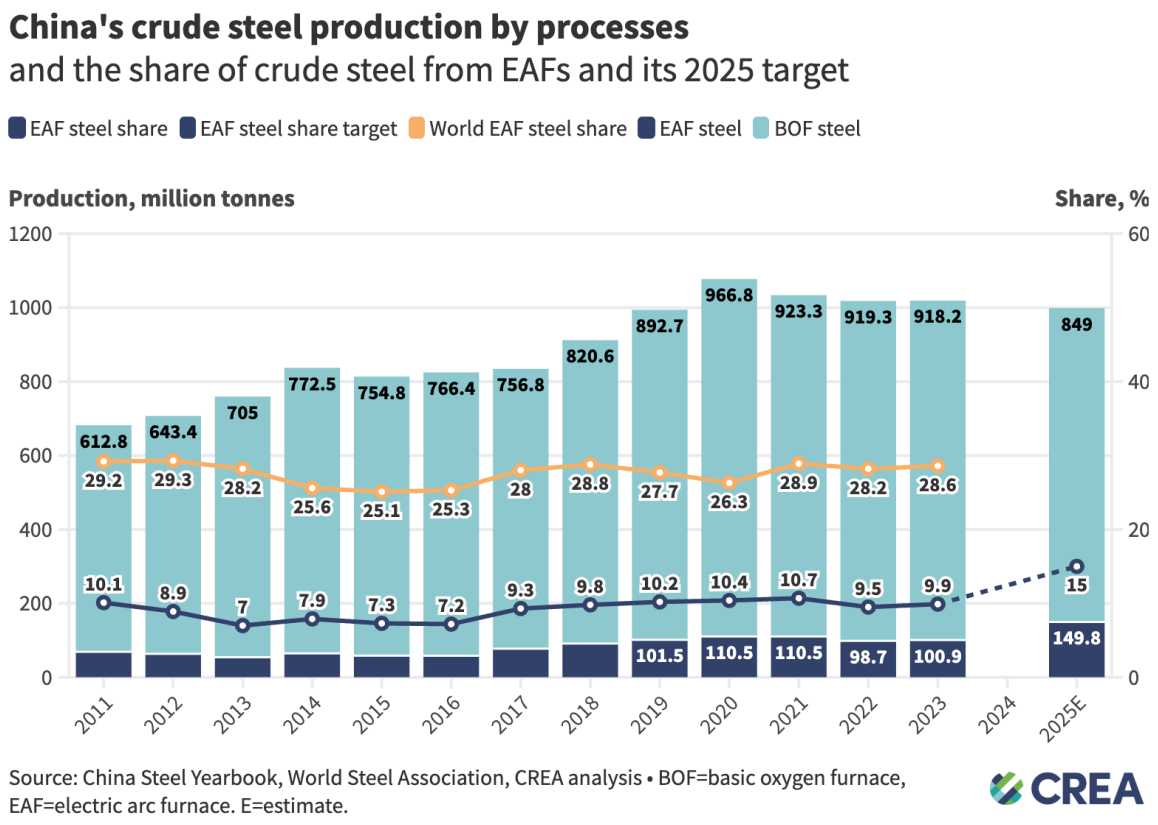

Figure 2 - China's crude steel production by processes

These projections underscore the pivotal role of EAF technology in China's green steel transition. EAF steelmaking, which relies on scrap steel, consumes significantly less energy than the BF-BOF route. Its carbon intensity per tonne of steel is roughly one-third that of

BF-BOF, making it one of the most effective decarbonisation strategies. Furthermore, EAF is a relatively mature low-carbon technology that offers an immediate pathway to reducing emissions.

Following China's 2020 carbon neutrality pledge, policymakers introduced measures to accelerate this transition, including increasing EAF's share to 15% of crude steel output by 2025 and 20% by 2030 and boosting scrap steel utilisation to 300 million tonnes by 2025.

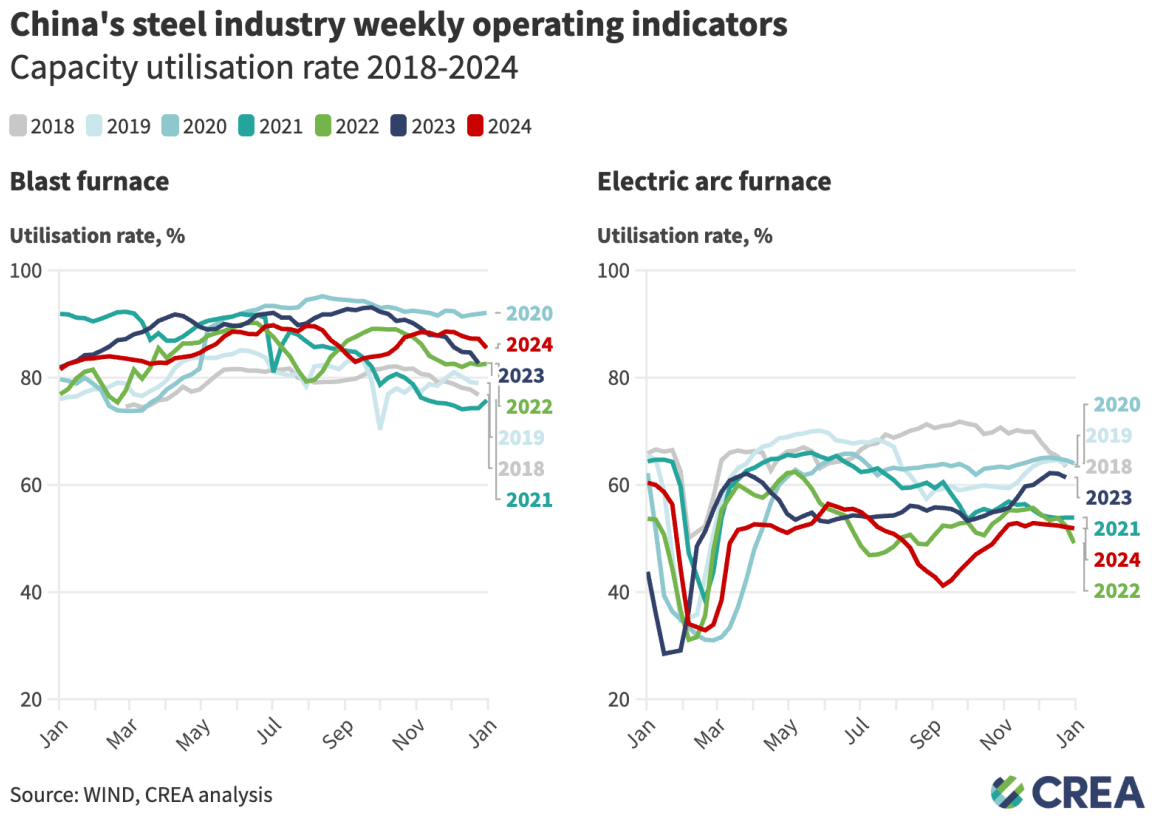

Figure 3 - China's steel industry weekly operating indicators, 2018-2024

However, progress has been sluggish. Over the past five years, EAF's share has stagnated at around 10% (Figure 2), with no significant breakthroughs. EAF share is weighed down by relatively low recycling rates and lack of economic incentives that lead to the use of scrap steel in blast furnaces-basic oxygen furnace (BF-BOF) rather than EAF. The production cost of EAF steelmaking in China is roughly 200 yuan higher than the BF–BOF route per tonne of steel produced. Additionally, 75% of China's EAF production is geared toward construction steel, a market severely impacted by the real estate downturn.

To achieve China's 2025 targets for steel decarbonisation, EAF utilisation rates will have to increase significantly over the coming year. As Figure 3 illustrates, BF capacity utilisation in 2024 remained relatively stable at an annual average of 86%, whereas EAF utilisation fell to a historic low of 50%. Despite China having over 200 million tonnes per annum (Mtpa) of EAF capacity, realising the 15% EAF target will require raising utilisation rates to 75%—a 25% increase from 2024 levels. Given the economic challenges facing EAF producers, substantial policy support and financial incentives will be necessary.

Overcapacity fuels record-high exports, escalating trade frictions

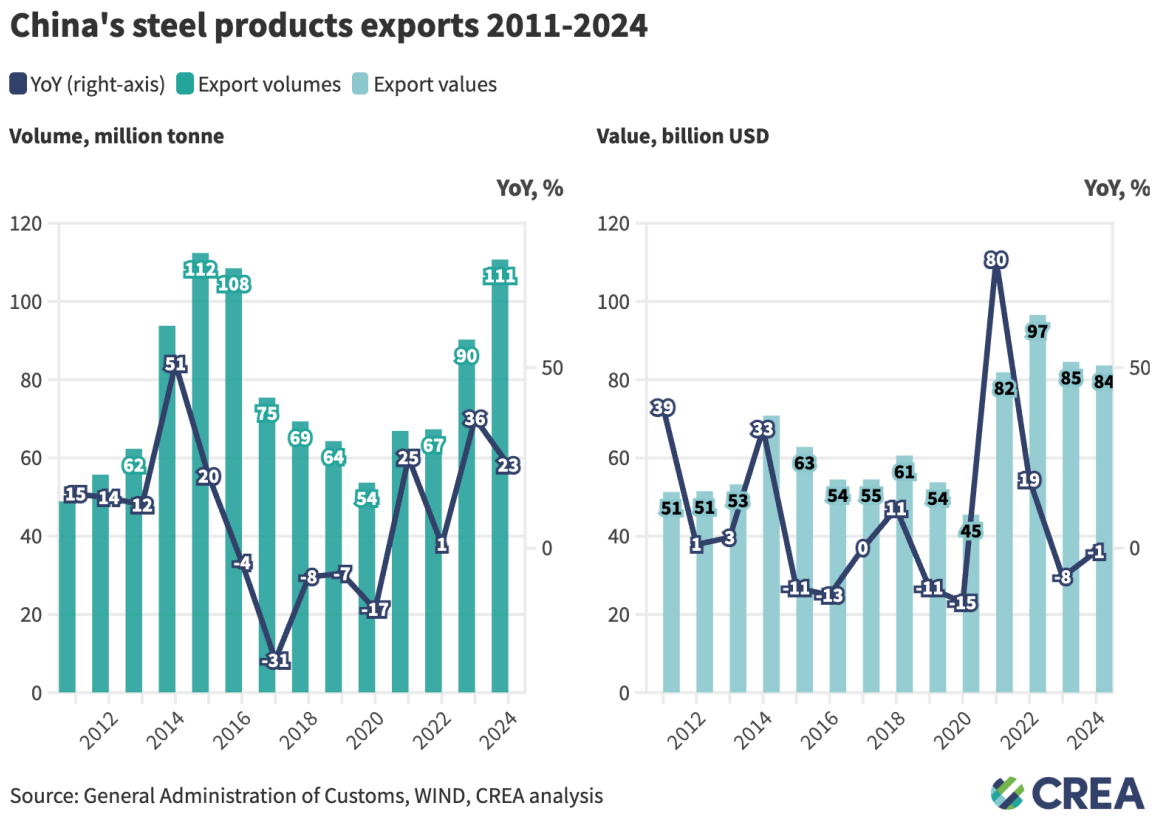

Figure 4 - China's steel products exports 2011-2024

To offset the decline in domestic demand, Chinese steel producers are selling overproduction overseas, exacerbating global oversupply. Chinese steel exports surged to their highest level in nearly a decade in 2024, reaching 111 million tonnes—up 23%

year-on-year and more than double the volume of 2020 (Figure 4). Chinese exports are now roughly equivalent to Europe's steel production, totalling 129.5 million tonnes in 2024.

This export expansion continues to drive tensions over global steel overcapacity, estimated at around 560 million tonnes in 2024. As a result, steel prices have hit their lowest levels since 2017, further depressing steel profits.

Rising trade tensions have prompted several countries to impose protective measures. Brazil introduced a 25% tariff on Chinese iron and steel imports, citing risks to its domestic industry. In the United States, newly inaugurated President Donald Trump reinstated a blanket 25% tariff on all aluminium and steel imports, including finished products, suspending any exemptions. While direct US steel imports from China are relatively low, Washington has accused China of circumventing trade barriers by routing exports through third countries.

These tariffs will further intensify tensions and uncertainty for global steel markets. While some countries aim to secure an exemption, the EU has already announced countermeasures.

The second largest global steel producer, Luxembourg-registered ArcelorMittal, has also called on the EU to restrict imports, particularly from China. They also urged to strengthen the upcoming EU Carbon Border Adjustment Mechanism (CBAM) to prevent "steel imports from countries that circumvent climate protection by selling into Europe from a few 'clean' installations while selling their higher emissions steel into domestic and non-EU markets." Given that China's steel fleet comprises 90% coal-based blast furnaces, this also appears to be targeted at China.

These trade frictions further complicate Chinese steel makers' efforts to sell domestic overcapacity overseas. To ease these tensions, output reduction and greening of China's domestic steel production would have to accelerate significantly.

Oversupply and climate goals demand deeper cuts in coal-based blast furnace capacity

To tackle overcapacity and reduce carbon emissions, the Chinese government introduced crude steel production curbs in 2021 and continued them in subsequent years. However, mandated output cuts have not effectively addressed surplus supply, and the industry has

endured a prolonged profit slump of over three years. Challenging operating conditions have led some companies to slow technological innovation and product upgrades. At the same time, cost-cutting pressures have caused setbacks in key areas such as safety, environmental protection, and carbon reduction.

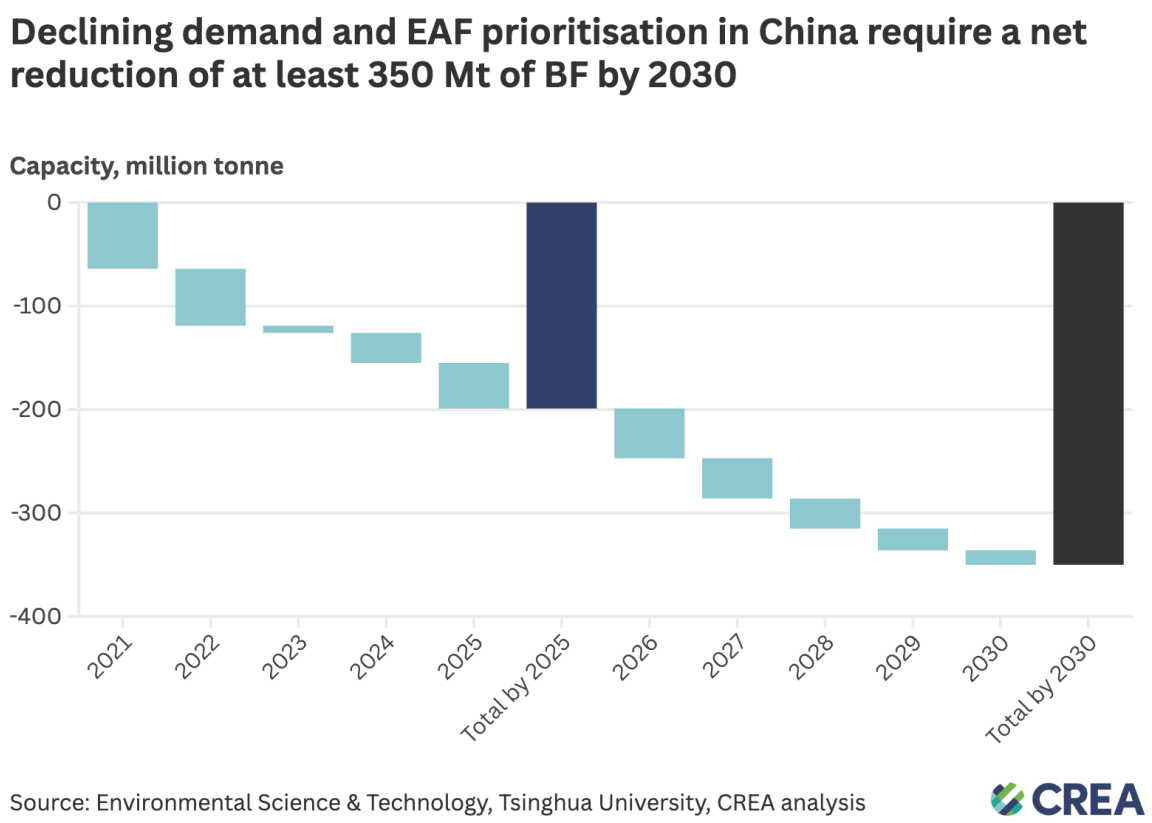

Figure 5 - Declining demand and EAF prioritisation in China require a net reduction of at least 350 Mtpa of BF by 2030

Industry experts and institutional investors stress that reducing steelmaking capacity and optimising production controls are essential to revitalising the sector. With China's crude steel production capacity estimated at 1.3–1.4 billion tonnes per annum, the country faces an overcapacity of at least 200 Mtpa, given that domestic demand is projected to decline to 850 million tonnes by 2025.

A phaseout strategy by Tsinghua University (Figure 5) highlights the urgency of reducing blast furnace capacity. The study suggests that demand contraction and prioritising EAF steelmaking necessitate a net reduction of at least 200 Mtpa of BF capacity by 2025, which is about 15% of China's total steelmaking capacity and equal to the current total EU

steelmaking capacity. An additional net reduction of 150 Mtpa is required from 2026 to 2030.

Large coal-based projects face high stranded asset risks, reinforcing the suspension of new permits

At the end of August 2024, China's Ministry of Industry and Information Technology (MIIT) abruptly halted approving new steel projects under the capacity replacement policy. Initially introduced in 2014 and revised multiple times, this policy aimed to reduce overall steel capacity by mandating that new projects eliminate more outdated capacity. However, the policy has failed to curb capacity expansion effectively due to weak enforcement and the higher efficiency of new facilities.

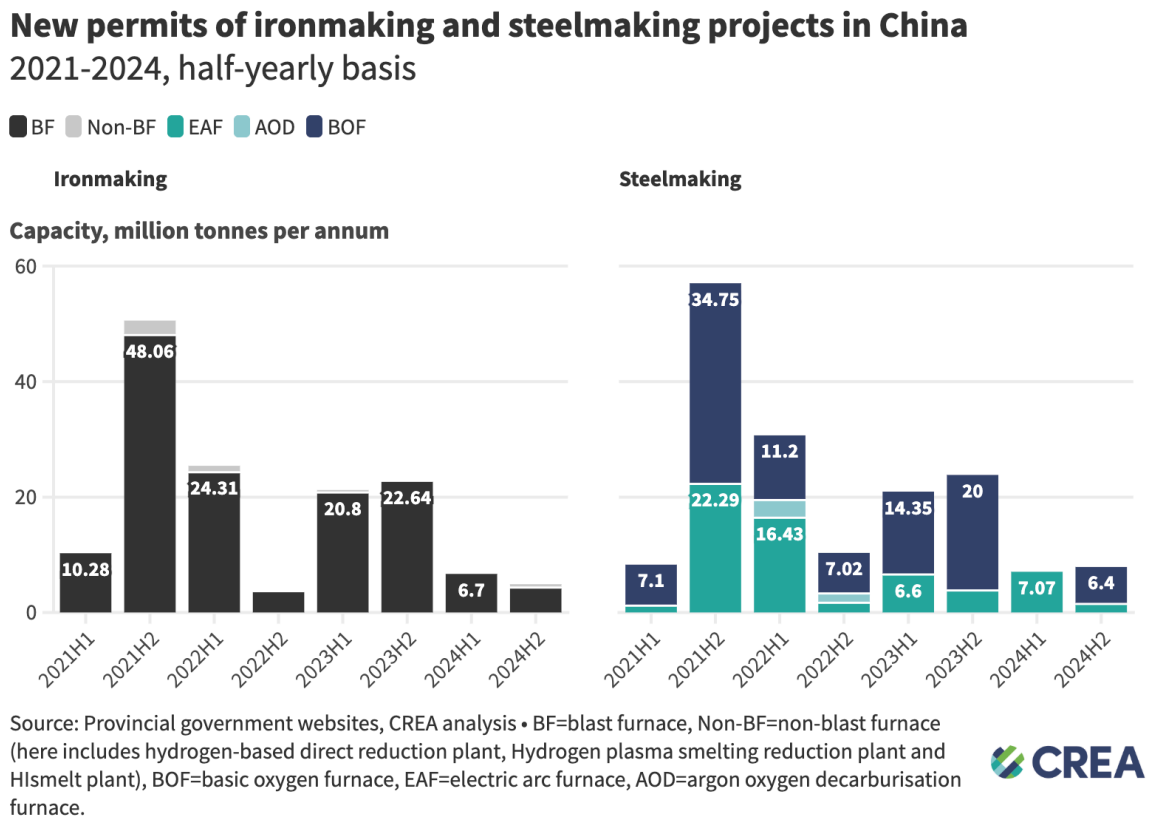

Figure 6 - New ironmaking and steelmaking project permits in China, 2021-2024, half-yearly basis

Our July 2024 analysis revealed a sharp decline in newly approved ironmaking and steelmaking capacity in the first half of 2024 (H1 2024), with all approved steelmaking

projects being EAF-based. However, in the weeks before MIIT's suspension at the end of August, 6.4 Mtpa of BOF capacity managed to secure approval (Figure 6). In 2024, provincial authorities also greenlit 11.04 Mtpa of new BF capacity, bringing the total approved BF capacity from 2021 to 2024 to over 140 Mtpa.

Given China's overcapacity and commitment to carbon neutrality, significant reductions in BF capacity are imperative. If constructed, these newly approved coal-based BF projects will face significant return-on-investment pressures and risk becoming stranded assets, with potential losses estimated at 140 billion yuan[1].

Urgent need to scale up zero-emission technologies for carbon neutrality

Redirecting these investments towards hydrogen-based metallurgy projects could offer a more sustainable path. The aforementioned Steel Carbon Neutrality Roadmap underscores that while energy efficiency improvements and increased EAF adoption contribute to emissions reductions, they are insufficient to achieve full decarbonisation. Hydrogen-based metallurgy, which relies on hydrogen produced via renewable-powered electrolysis, provides a viable pathway to enabling deep emissions cuts in primary steel production.

The same level of investment in the aforementioned new BF could fund approximately 70 projects on Baowu's Zhanjiang hydrogen metallurgy plant scale, laying a solid foundation for China's steel sector to transition toward carbon neutrality. Baowu – a leading steelmaker in China – has invested 2.15 billion yuan in a pioneering hydrogen metallurgy project in Zhanjiang, which began production in December 2023. With a capacity of 1 Mtpa, it is China's largest hydrogen-based metallurgy project, offering significant emissions reductions of over 500,000 tonnes of CO_2 annually compared to BF-BOF.

According to the Roadmap, by 2060, China will require 150 Mtpa of hydrogen-based metallurgy capacity—equivalent to 150 Baowu Zhanjiang-scale projects. To meet this goal, one hydrogen metallurgy plant must be built and commissioned quarterly starting in 2023. However, from 2021 to 2024, only 4.6 Mtpa of non-blast furnace projects received approval, with just 2.3 Mtpa allocated to hydrogen-based metallurgy (Figure 6). This starkly

[1] The capital cost of constructing a new blast furnace is approximately 1 billion yuan per million tonnes of annual production capacity (Mtpa) in China, whereas the cost of hydrogen-based direct reduced iron (DRI) facilities is roughly twice.

illustrates the urgency of accelerating hydrogen-based technologies to align with China's carbon neutrality ambitions.

China's steel sector prepares for 'Steel Reform 2.0'

According to a January 2025 Morgan Stanley research report, a new round of supply-side reform, 'Steel Reform 2.0,' could begin as early as 2025. Amid macroeconomic headwinds and export challenges, the industry is expected to adopt self-discipline measures to ease supply-side pressures and stabilise profit margins. However, unlike the sweeping 2016–17 reforms, the next phase of structural adjustments is expected to be more moderate and cautious. The report also highlights potential industry consolidation.

Policy developments support this shift. In June 2024, the National Development and Reform Commission (NDRC) released the Steel Industry Energy Conservation and Carbon Reduction Action Plan, outlining continued crude steel production cuts and an accelerated transition to EAF steelmaking. The plan also proposes a comprehensive production control system based on efficiency, energy consumption, environmental impact, quality, and safety standards, alongside stricter limits on high-energy, low-value-added steel exports, including pig iron and coke.

Further reinforcing this direction, the Ministry of Ecology and Environment (MEE) issued a draft plan in September 2024 to include the steel industry in the national carbon market by the end of 2024, with the first compliance cycle to be completed by the end of 2025. This was followed by the MIIT's January 2025 release of revised industry standards, introducing a tiered management system to promote high-quality development.

While these policy shifts indicate a more measured approach to supply-side reform, the success of 'Steel Reform 2.0' will depend on several critical factors. These include drawing lessons from previous capacity replacement efforts and the 2016/17 reforms, ensuring strict implementation, securing local government cooperation, and encouraging industry players to shift from quantity-driven to quality-focused and low-carbon development strategies. The coming years will determine whether China's steel industry can successfully navigate this new transformation phase.

Policy recommendations

In addition to the immediate reform measures mentioned above, the following policy recommendations could help ensure both a mid- and long-term green transition.

- Accelerate the adoption of low-carbon technologies such as EAF and green-hydrogen metallurgy, supported by targeted financial incentives and policy frameworks that promote innovation and large-scale deployment across the industry.
- Implement a phase-out plan for coal-based BFs and BOFs, focusing on scaling down capacities and halting new project constructions. This will help avoid the risk of stranded assets and support a smoother transition to greener technologies.
- Encourage technological innovation and differentiation strategies within the steel sector, foster research into alternative steelmaking processes, and enhance collaboration with international partners. This will help drive both competitive advantage and industry-wide sustainability.
- Leverage the growing capacity of renewable energy from wind and solar power to create synergies between the decarbonisation of electricity generation and industrial processes, facilitating a seamless energy and industrial transition in China.
- Strengthen the carbon market after extending its coverage to include key steel, cement, and aluminium. The transition from an intensity-based approach to a progressively tightening cap-and-trade system ensures the market supports substantial emissions reductions across these sectors.

Methodology

The steel production and finance analysis data were compiled from China's National Bureau of Statistics, China Customs, and WIND Information, an industry data provider.

Information on new ironmaking and steelmaking projects was compiled from the websites of provincial Industrial and Information Technology Bureaus and Ecology and Environment Bureaus, which are responsible for implementing steel overcapacity and capacity replacement policies and environmental permitting of new steel plants,

respectively. New project announcements were mapped systematically, and total blast furnace (BF), basic oxygen furnace (BOF), and electric arc furnace (EAF) capacity, as well as capacity being replaced, was captured for each project. Duplicates were removed from the analysis.