China's steel sector invests USD 100 billion in coal-based steel plants, despite low profitability, overcapacity and carbon commitments

Xinyi Shen, Lauri Myllyvirta

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CREA
Centre for Research on Energy and Clean Air

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

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The Centre for Research on Energy and Clean Air (CREA) is an independent research organisation focused on revealing the trends, causes, and health impacts, as well as the solutions to air pollution. CREA uses scientific data, research, and evidence to support the efforts of governments, companies, and campaigning organisations worldwide in their efforts to move towards clean energy and clean air, believing that effective research and communication are the keys to successful policies, investment decisions, and advocacy efforts. CREA was founded in Helsinki and has staff in several Asian and European countries.

Disclaimer

China’s steel sector invests USD 100 billion in coal-based steel plants, despite low profitability, overcapacity and carbon commitments

Key findings

- Chinese steel firms are making significant investments in new, coal-based steelmaking capacity. Companies received approvals from provincial governments for 384.3 million tonnes per annum (Mtpa) of new ironmaking capacity, and 425.9 Mtpa new steelmaking capacity from 2017 until the first half of 2023. On average, approximately 30 Mtpa steelmaking capacity was approved every six months, which is almost equal to the total steel capacity of Germany. These new approvals are under the capacity replacement policy, which requires a larger quantity of existing capacity to be retired for all new capacity that is added.
- Approximately 90% of crude steel production in China is using coal-based blast furnace–basic oxygen furnace (BF–BOF) routes, wherein coal is used to extract oxygen from iron ore in BF. This method generates significant carbon emissions, thereby contributing substantially to the high carbon emission intensity in China's steel sector. However, new iron and steel capacity is continuously dominated by the BF–BOF route. Blast furnaces (BF) account for about 99% of the new ironmaking capacity and basic oxygen furnaces (BOF) account for 70% of the new steelmaking capacity approved in 2017–2023 H1. That is to say, at least one-quarter of China's existing steelmaking capacity has been renewed to further lock in carbon intensive production during their 40-year lifespan.

- In spite of the ‘dual carbon’ goal pledge announced in 2020, during 2021–2023 H1 there was a total 119.8 Mtpa BF and 76.6 Mtpa BOF approved. To meet the 2060 carbon neutrality goal requires early retirement of carbon-intensive steelmaking facilities. Therefore, the new BF–BOF approved after 2020 alone would result in nearly USD 100 billion (CNY 700 billion) in stranded assets.

- We also saw promising progress on shifting investments into facilities that are less carbon-intensive. New proposed electric arc furnace (EAF) projects significantly increased in 2021–2023 H1, with a total capacity of 52.5 Mtpa approved. EAF steelmaking is promoted under the latest capacity replacement policy. The share of EAF in the newly announced steelmaking capacity grew to 30-40% from 2021. Several non-BF projects with a total capacity of 4.7 Mtpa, applying incremental technology or zero-emission technology in the ironmaking process also received approval.

- By 2025, nearly all new permitted iron and steel projects will commence operations. Through these replacements, approximately 40% of China’s iron and steelmaking capacity will be renewed. China’s steel capacity replacement policy requires steel firms to present both “exit” capacity and “addition” capacity in the capacity replacement application. The exit capacity needs to be larger or equal to the addition capacity, which could ensure a net capacity reduction. However, in practice, effective operating capacity might increase, worsening the excess supply in the market. This is because some of the “exit” iron and steelmaking facilities have remained idle for years, and even though they are not a part of currently effective operating capacity, steel companies use these idle capacities as allocation to apply for new capacity approvals under the capacity replacement policy. In this case, when the new facilities commerce operation, the effective operating capacity will exhibit a net increase.

- The majority, specifically 69%, of the new iron and steel projects development are spearheaded by private steel enterprises, followed by regional state-owned enterprises and central state-owned enterprises, accounting for 26% and 5%, respectively.

Policy recommendations

China's crude steel output has declined since 2021 due to output control by the government and the decline in downstream demand. However, new investments in iron and steelmaking capacity have so far not adjusted to the new reality. There is an urgent need to align investments in new production capacity in the steel sector with the goal of peaking and reducing CO2 emissions before 2025.

We therefore propose the following recommendations.

- Include the steel sector in China's emissions trading system (ETS) within the 14th five-year-plan period, and the emissions trading system should shift from an intensity-based allocation to an absolute cap.
- Limit new investments in blast furnace capacity and speed up the adoption of electric arc furnaces and hydrogen-based steelmaking technology, to peak CO2 emissions from the iron and steel sector before 2025.

Contents

Introduction

Chinese President Xi Jinping pledged that China would achieve carbon neutrality before 2060 and peak CO2 emissions before 2030 (known as the 'dual carbon' goal). The steel sector is the second largest contributor to China's emissions, accounting for 17% of annual CO2 emissions[1]. The central government requires the steel sector to peak emissions along the same timeline as the economy as a whole before 2030.

China currently produces more than 1 billion tons of crude steel annually, which is more than half of the world's steel production. The dominance of the coal-based blast furnaces-basic oxygen furnace (BF–BOF) method in the Chinese steel sector, along with its large scale, presents significant challenges for decarbonisation efforts. Coal is burned to strip oxygen from the iron ore and this process generates substantial carbon emissions.

Moreover, the sector's persistent overcapacity and thin profitability further complicate the transition to cleaner steelmaking methods. Steel production needs high capital investment but relatively low technical barriers to enter. In common with other sectors in China, excessive investments inundated the steel industry over the past two decades, resulting in persistent overcapacity. Latest official data reveal a precipitous decline of more than 90% in the gross profit of the steel sector in 2022 compared to 2021[2], with a capacity utilisation rate of 76%[3].

The low carbon transition of the Chinese steel sector is essential for China's carbon neutrality target by 2060, as well as for decarbonising the global steel sector. Deep decarbonisation would require substantial investments in zero-emission steelmaking technologies, as well as the early retirement of carbon-intensive facilities.

[1] https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/metals/090721-analysis-chinas-steel-industry-consolidation-gathers-pace-to-aid-output-and-emission-cuts
[2] http://www.csteelnews.com/sjzx/hyyj/202302/t20230215_71470.html
[3] http://lwzb.stats.gov.cn/pub/lwzb/bztt/202306/W020230605413586261007.pdf

The current state of zero-emission technology and the market scale of green steel does not offer sufficient promise to compel Chinese steelmakers to transition their production and investments. Therefore, it is essential that the Chinese government set up policies to guide the steel industry and tackle the two challenges strategically.

Overinvestment resulted in structural overcapacity in the steel sector

The expansion of the Chinese steel industry demonstrates a close correlation with the nation's economic development. From 2003–2007, China experienced a remarkable growth in gross domestic product (GDP), reaching 14%. Concurrently, there was a substantial increase in crude steel production, accompanied by extensive capacity expansion within the sector. However, following the global financial crisis of 2007–2008, GDP growth decelerated to approximately 10%, slowing down even further to roughly 7% during the late 2010s and to 5% post-2020.

Subsequently, the growth of crude steel demand exhibited a corresponding deceleration. Nevertheless, excessive investments persistently inundated the industry, thereby transforming the customary cyclical and short-term overcapacity situation into a protracted and persistent overcapacity issue, referred to as structural overcapacity.

The consequences of this overcapacity significantly impact the sector's profitability because steel firms find it challenging to operate sustainably at levels below approximately 80% capacity utilisation.

Cyclical overcapacity over the short term is normal due to fluctuations in demand. However, the Chinese steel sector has been trapped in persistent structural overcapacity, which indicates overinvestment in steelmaking facilities.

Previous studies show that structural overcapacity in China’s steel sector is caused by subsidised energy and other inputs, access to cheap finance, and national versus subnational government dynamics, notably the financial and tax incentives of provincial and local government to increase steelmaking capacity independent of market prices and the mandates of China's central government[4].

Contrasting dynamics of significant fixed asset investment and declining profitability

The completed fixed asset investment of the steel sector has experienced double digit growth since 2018, and has remained at a record high level over the past two years (Figure 1). The 12-month moving sum of the completed fixed investment of the Chinese steel sector has consistently exceeded USD 110 billion (CNY 790 billion) since September 2021. A portion of this investment, roughly one-quarter, USD 30 billion (CNY 210 billion) annually, is estimated to be allocated towards new capacity construction[5]. This amount of investment in new capacity is equal to the expenditure that would be required over three decades to decarbonize Germany's entire steel sector, according to government estimates[6]
.

[4] "Overcapacity in Steel: China's Role in a Global Problem", Lukas Brun, Center on Globalization, Governance & Competitiveness, Duke University, September 2016
[5] According to China Iron and Steel Industry Yearbook 2022, the total completed fixed investment of member companies of China Iron & Steel Association in 2021 is USD 18 billion (CNY 128 billion), in which 24% is used for new capacity construction, and 20% is for environmental protection.
[6]https://www.bmwk.de/Redaktion/EN/Publikationen/Wirtschaft/the-steel-action-concept.pdf?__blob=publicationFile&v=3

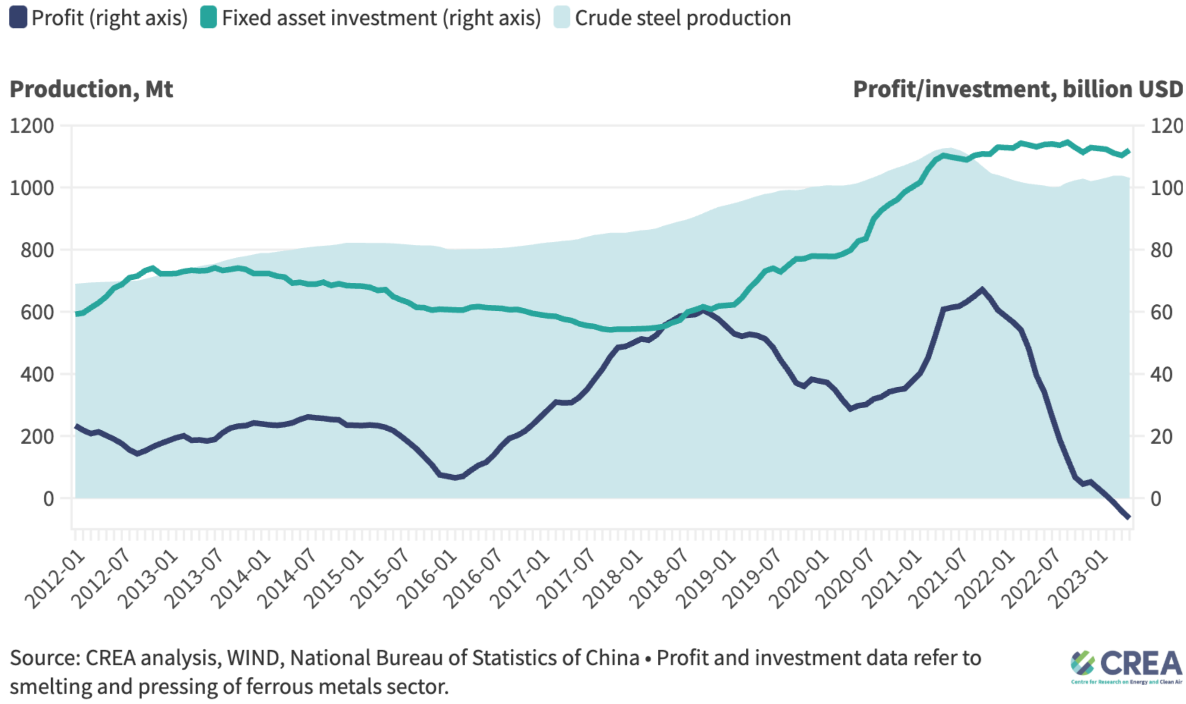


Figure 1 - China's crude steel production, profit and completed fixed asset investment of the steel sector, 2012–2023 May (12-month moving sum)

However, despite the high levels of investment, the profit of the steel sector has declined to historically low levels. The 12-month moving sum entered negative figures from March 2023 (Figure 1). The decline in profitability raises concerns about the financial risks faced by the sector, especially given that the sectoral asset-liability ratio exceeds 60%[7].

The combination of high investment and low profitability can create financial strains for companies in the steel sector. It's crucial for businesses in the industry to carefully manage their financial situation and find ways to improve profitability to mitigate the associated risks.

[7] http://lwzb.stats.gov.cn/pub/lwzb/fbjd/202306/W020230605413586261007.pdf

State-led measures to address overcapacity and carbon emissions

The Chinese central government promulgated its inaugural policy in 2006 to address the issue of overcapacity within the steel industry[8], with the objective of eliminating inefficient facilities and curbing excessive investments. The overcapacity in the steel sector has persisted, which has prompted the central government to issue a series of policies over the years. Noteworthy measures include the implementation of capacity replacement policy, the forced closure of inefficient facilities, and steel output cut.

- The capacity replacement policy was introduced by the Ministry of Industry and Information Technology (MIIT) in 2014 to alleviate the overcapacity of steel, aluminium, cement and glass in China[9], and updated in 2017[10]. Capacity replacement requires a larger quantity of existing capacity to be retired for all new capacity that is added, and new iron and steel projects must get permission for capacity replacement before construction. Some steel mills have expanded production capacity under the guise of capacity replacements, which led to halting the issue of new permits from 24 January 2020[11]. MIIT released the latest strengthened replacement policy in April 2021 and became effective from June 2021[12], with joint measures on reducing air pollution and promoting low carbon technology.

- MIIT published its “Steel Industry Adjustment and Upgrading Plan for 2016–2020” in 2017[13], in which one target was to reduce steelmaking capacity to below 1 billion tonnes by 2020, a net reduction of 150 Mt from the 1.13 billion tonnes in 2015. This

[8] https://www.gov.cn/zwgk/2006-03/20/content_231376.htm
[9] https://www.gov.cn/xinwen/2014-08/02/content_2728800.htm
[10] https://www.miit.gov.cn/zwgk/zcwj/wjfb/yclgy/art/2020/art_d47c0caa853f4de5bba1313447cec413.html
[11] https://www.ndrc.gov.cn/xxgk/zcfb/tz/202001/t20200123_1219768.html?code=&state=123
[12] http://www.gov.cn/zhengce/zhengceku/2021-05/07/content_5605092.htm
[13] https://www.ndrc.gov.cn/fggz/fzzlgh/gjjzxgh/201706/t20170621_1196816.html

policy documented that overcapacity in the Chinese steel sector worsened during the 12th five-year-plan (FYP) period (2011–2015), with the capacity utilisation rate dropping from 79% in 2010 to 70% in 2015. Moreover, the sector's biggest top ten steel firms' market share, namely concentration ratio CR10[14], decreased from 49% in 2010 to 34% in 2015, failing to meet the target of 60%. It is reported that in 2016–2018, 150 million tonnes per annum (Mtpa) of inefficient steelmaking capacity was closed[15], which meant steel firms could recover their profit and utilisation rate after 2017.

The crude steel output reached 1,065 Mt in 2020, the highest output on record, in response to a quick recovery in construction and manufacturing demand after Covid-19 lockdowns. The gap between the capacity control target has widened to well over 200 Mt[16]. The discrepancy may be caused by unreported capacity expansions, higher production efficiency and revival of low-quality steel production.

- In September 2020, China's top leader pledged that the country would reach a carbon emissions peak in 2030 and become carbon neutral before 2060. The state planner established objectives for peaking the emissions of the steel industry before 2030, and started to curb carbon emissions through output reduction in 2021[17] and 2022. China's annual crude steel production fell 2.8% in 2021, and 1.7% in 2022. The 2023 full-year steel output is set to keep at the 2022 level[18].

- Additionally, to support its carbon reduction efforts, the Chinese government has discouraged the export of primary steel production. It has imposed higher export

[14] In regions such as the European Union, United States, Japan, and South Korea, the level of concentration is measured by the conventional CR4, which means the concentration ratio of the top four steel firms, measured by their combined output over the industry total. In contrast, the Chinese steel sector is highly fragmented, resulting in a significantly lower CR4 compared to the aforementioned nations. Consequently, the CR10 is employed as an alternative gauge to capture the concentration levels in China's steel sector.
[15] http://www.csteelnews.com/xwzx/djbd/202009/t20200929_40835.html
[16] https://www.carbonbrief.org/analysis-surge-in-chinas-steel-production-helps-to-fuel-record-high-co2-emissions/
[17] https://www.cnii.com.cn/gxdt/202204/t20220421_374798.html
[18] https://companies.caixin.com/2023-04-14/102018852.html

tariffs on iron and eliminated tax refunds for a range of iron and steel products from 2021[19]. However, due to the weakening yuan and competitive prices, China's steel exports surged to seven-year high according to May 2023 data[20]. Strong demand for steel was mostly from Asia and Africa.

- The national government has also implemented policies to foster the growth of the recycling economy and has set a target to raise the proportion of scrap-based secondary steel production through EAF from 10% of the total crude steel output in 2020 to 15% by 2025, and 20% by 2030[21]. Utilising EAFs for scrap-based steel production has the potential to reduce carbon emissions by up to 70% per ton of crude steel, in comparison to the BF–BOF method. The increased scrap utilisation target will reduce demand for pig iron produced from blast furnaces.

Newly proposed iron and steel projects through capacity replacement plans

We diligently monitor the latest proposals put forth by provincial governments that are regulated by the capacity replacement policy. Our most recent analysis reveals that steel firms continue to actively apply for new projects, even as the issue of excessive supply worsens. The steel sector stands as China's second-largest contributor to China's carbon dioxide emissions. Despite the nation's commitment to carbon neutrality and the prevailing structural overcapacity within the steel sector, there are no strong indications to stop investments in coal-based iron and steelmaking technologies.

Specifically, our analysis shows:

[19] http://www.csteelnews.com/xwzx/jrrd/202108/t20210802_53075.html
[20] https://www.reuters.com/markets/commodities/china-steel-exports-seen-surging-seven-year-high-home-demand-wilts-2023-06-29/
[21] http://www.csteelnews.com/xwzx/jrrd/202305/t20230508_74460.html

1. *Steel firms received approvals from provincial governments for large amounts of new iron and steelmaking projects in the past six and half years (2017–2023 H1). On average, approximately 30 Mtpa of steelmaking capacity was approved every six months, which is almost equal to the the total steel capacity of Germany[22].*

    a. The capacity replacement policy requires steel firms to present both “exit” capacity and “addition” capacity in the capacity replacement application. The exit capacity needs to be larger or equal to the addition capacity, which could ensure a net capacity reduction. Overall, from 2017–2023 H1, provincial governments approved 384.3 million tonnes per annum (Mtpa) of new ironmaking capacity, including 379.6 Mtpa BF and 4.7 Mtpa non-BF capacity (Table 1, Figure 2). Correspondingly, 456.2 Mtpa of ironmaking facilities were set to exit after the new facilities were completed, a net 71.9 Mtpa capacity reduction.
    In the meantime, 425.9 Mtpa of new steelmaking capacity was approved, including 296.2 Mtpa BOF, 120.1 Mtpa EAF, and 9.5 Mtpa AOD[23] capacity, which will replace 496.1 Mtpa in existing steelmaking facilities, a net 70.2 Mtpa capacity reduction.

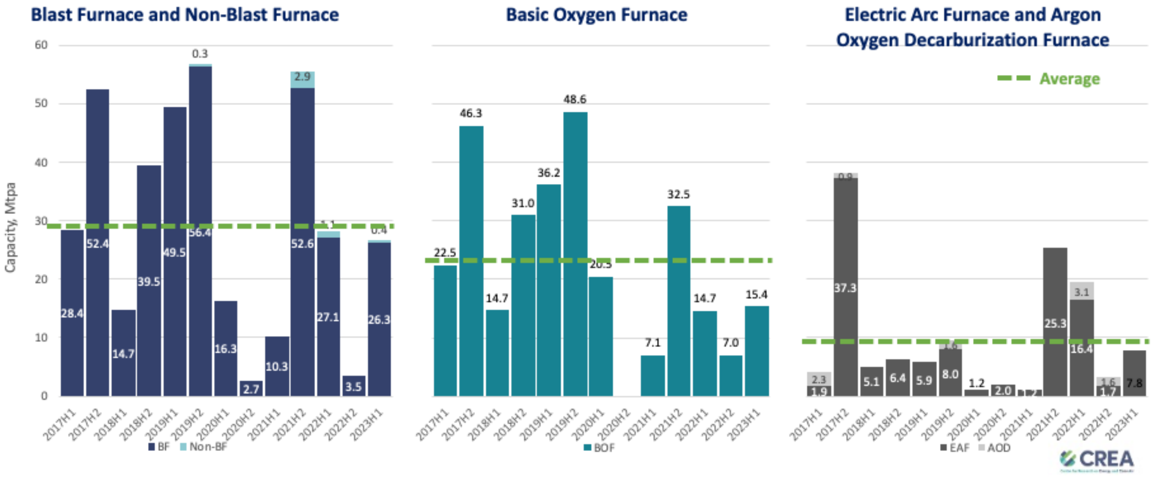
Table 1 - Exit and addition of iron and steelmaking capacity announced through capacity replacement plan, 2017–2023H1, Mtpa

		Year	2017	2018	2019	2020	2021	2022	2023H1	Total
Ironmaking	Addition	BF	80.8	54.2	105.9	19.0	62.9	30.6	26.3	379.6
		Non-BF	0.0	0.0	0.3	0.0	2.9	1.1	0.4	4.7
	Exit	BF	108.3	64.1	117.7	18.2	77.1	35.8	33.5	454.7
		Non-BF	0.0	0.0	1.5	0.0	0.0	0.0	0.0	1.5
	Net change		-27.5	-9.9	-13.0	0.7	-11.3	-4.1	-6.8	-71.9
	Non-BF % in the addition		0.0%	0.0%	0.3%	0.0%	4.3%	3.5%	1.6%	1.2%
Steelmaking	Addition	BOF	68.7	45.7	84.8	20.5	39.6	21.7	15.4	296.2
		EAF	39.1	11.4	13.9	3.2	26.5	18.1	7.8	120.1

[22] https://gmk.center/en/news/germany-increased-steel-production-by-2-7-m-m-in-may/
[23] Argon Oxygen Decarburisation Furnace, the main facility for stainless steel production

		AOD	3.2	0.0	1.6	0.0	0.0	4.7	0.0	9.5
	Exit	BOF	116.4	64.0	108.9	24.2	59.5	25.9	15.2	414.2
		EAF	29.4	3.8	8.9	3.4	15.3	12.9	8.2	81.9
		AOD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Net change		-34.8	-10.7	-17.5	-4.0	-8.7	5.6	-0.2	-70.2
	EAF % in the addition		35.2%	20.0%	13.9%	13.5%	40.1%	40.8%	33.8%	28.2%

Source: CREA, provincial government websites. As a certain number of exit capacities of one furnace were divided for several capacity replacement projects, and may be announced in different years, we count the divided capacity into the major part of the exit capacity as a whole. BF=blast furnace, Non-BF=non-blast furnace (here includes COREX, hydrogen-based direct reduction plant, Hydrogen plasma smelting reduction plant and HIsmelt plant), BOF=basic oxygen furnace, EAF=electric arc furnace, AOD=Argon Oxygen Decarburisation Furnace.



Source: CREA analysis, provincial government websites. BF=blast furnace, Non-BF=non-blast furnace (here includes hydrogen-based direct reduction plant, Hydrogen plasma smelting reduction plant and HIsmelt plant), BOF=basic oxygen furnace, EAF=electric arc furnace, AOD=argon oxygen decarburization furnace.

Figure 2 - Newly proposed iron and steelmaking capacity announced through capacity replacement on a half-yearly basis, 2017–2023 H1

b. Due to the temporary 16-month approval halt from late January 2020 to May 2021, the approvals in 2020 and the first half of 2021 are much lower than the rest periods, but increased soon after approval resumed (Figure 2). In 2021–2023 H1, provincial governments approved in total 124.2 Mtpa new ironmaking and 133.7 Mtpa new steelmaking capacity. In 2023 H1 only, 26.7 Mtpa ironmaking and 23.2 Mtpa ironmaking capacity received new approval, which is close to the half-year average.

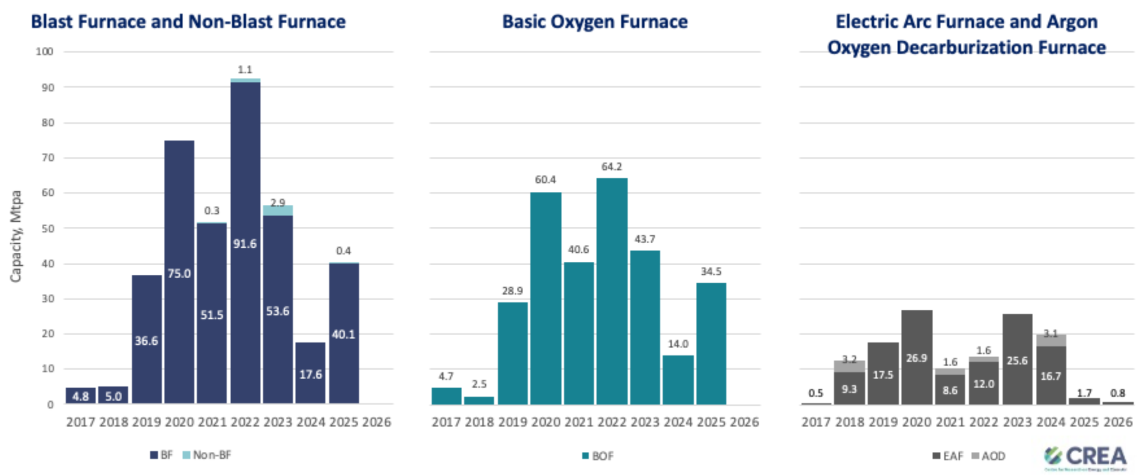
2. ***New iron and steel capacity is continuously dominated by the coal-based BF–BOF route, the most polluting steelmaking process.***

   a. Approximately 90% of crude steel in China is using coal-based BF–BOF routes, wherein coal is used to extract oxygen from iron ore in BF. This method generates significant carbon emissions, thereby contributing substantially to the high carbon emission intensity in China's steel sector. However, new iron and steel capacity is continuously dominated by the coal-based BF–BOF route. BF accounts for about 99% of the new ironmaking capacity and BOF accounts for 70% of the new steelmaking capacity approved in 2017–2023 H1 (Table 1, Figure 2). That is to say, at least one-quarter of China's existing steelmaking capacity has been renewed to further lock in carbon intensive production during their 40-year lifespan.

   b. In spite of the 'dual carbon' goal pledge announced in 2020, during 2021–2023 H1, the approved total was 119.8 Mtpa BF and 76.6 Mtpa BOF (Table 1, Figure 2). To meet the 2060 carbon neutrality goal requires early retirement of carbon-intensive steelmaking facilities. Therefore, the new BF–BOF approved after 2020 alone would result in nearly USD 100 billion (CNY 700 billion)[24] in stranded assets.

[24] The capital cost of a new integrated BF–BOF steelmaking facility is approximately 1–1.5 billion USD/Mtpa.

3. *With the announcement of the 'dual carbon' goal and the new setup of the capacity replacement policy from 2021, we saw promising progress on shifting investments into less carbon intensive facilities in 2021–2023 H1.*
    a. New proposed EAF projects significantly increased to a total of 52.5 Mtpa, which is promoted by the latest capacity replacement policy (Table 1). The share of EAF in the newly announced steelmaking capacity grew to 30-40% from 2021.
    b. Several non-BF projects, with a total capacity of 4.7 Mtpa, apply incremental technology or zero-emission technology in the ironmaking process (Table 1). The projects include HIsmelt, hydrogen plasma smelting reduction (HPSR), and hydrogen direct reduction (HDRI).
4. *The capacity replacement policy for the steel sector aims to ensure that operating capacity does not increase, as "exit" facilities have to be retired as a precondition to building new ones. However, in practice, effective operating capacity might increase, worsening the excess supply in the market.*
    a. We mapped the newly proposed projects according to their estimated commission year stated in the replacement announcements (Figure 3). A substantial number of new iron and steelmaking facilities have been integrated into service since 2019. By 2025, nearly all new permitted iron and steel projects will commence operations.



Source: CREA analysis, provincial government websites. Data include announcements made during 2017-2022 H1. BF=blast furnace, Non-BF=non-blast furnace (here includes COREX, hydrogen-based direct reduction plant, Hydrogen plasma smelting reduction plant and HIsmelt plant), BOF=basic oxygen furnace, EAF=electric arc furnace, AOD=argon oxygen decarburization furnace.

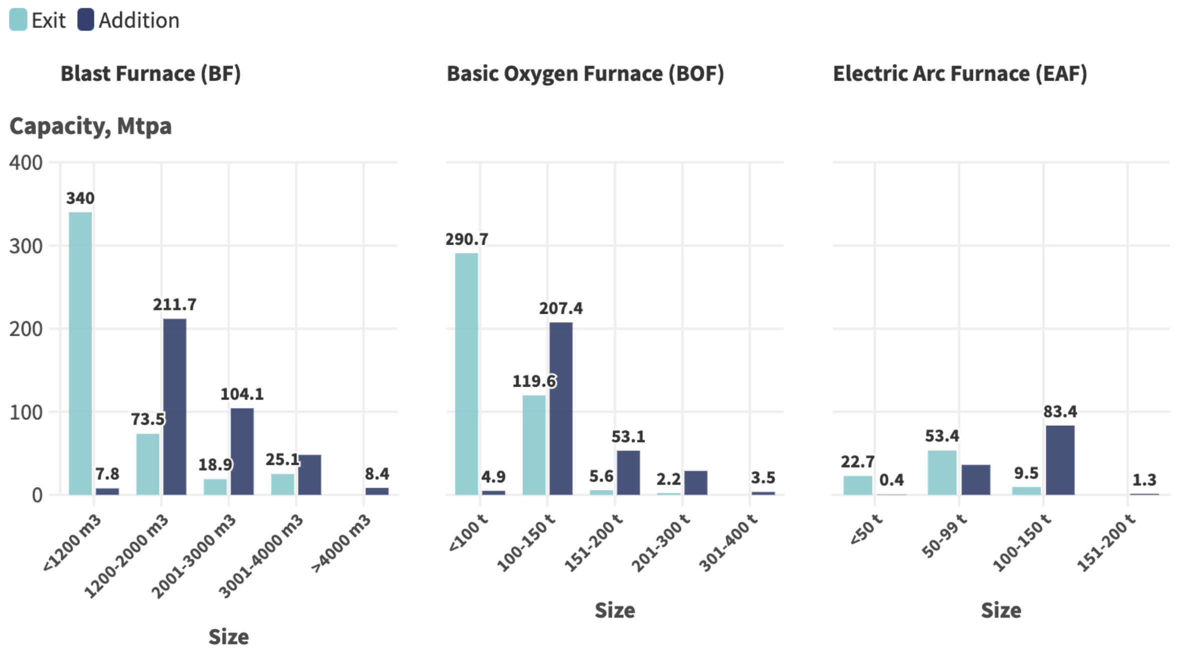
Figure 3 - Newly proposed iron and steelmaking capacity by their estimated commission year, 2017–2023 H1

b. According to S&P Global Commodity Insights, China's operating iron and crude steel capacity has been marking a modest growth in 2023[25]. This is because some of the “exit” iron and steelmaking facilities have remained idle for years, and even though they are not a part of currently effective operating capacity, steel companies use these idle capacities as allocation to apply for new capacity approvals under the capacity replacement policy. In this case, when the new facilities commerce operation, the effective operating capacity will exhibit a net increase.

[25]https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/metals/041023-chinas-huge-steel-capacity-beleaguers-steel-market-government-to-order-output-cuts-soon

5. *The energy efficiency and environmental performance of new iron and steelmaking facilities will improve through replacements. A proportion of the existing iron and steelmaking capacity in regions experiencing serious air pollution is moving to the coastal areas.*

   a. Small size facilities are replaced by larger ones, which are generally those with high energy efficiency and less pollutant emissions[26]. For example, a total of 340 Mtpa BF with a size smaller than 1200 cubic metres will be retired, accounting for 74% of the exit capacity (Figure 4). While the majority of the new furnaces stand in groups of 1200–2000 cubic metres and 2001–3000 cubic metres, accounting for 83% in total.



Source: CREA analysis, based on the data from provincial government websites. • The unit for BF size is cubic meter (m3), the unit for BOF and EAF size is ton (t).

Figure 4 - Furnace size changes in the exit and addition iron and steelmaking facilities, 2017–2023 H1

[26] https://www.gov.cn/ztzl/2006-07/01/content_325173.htm

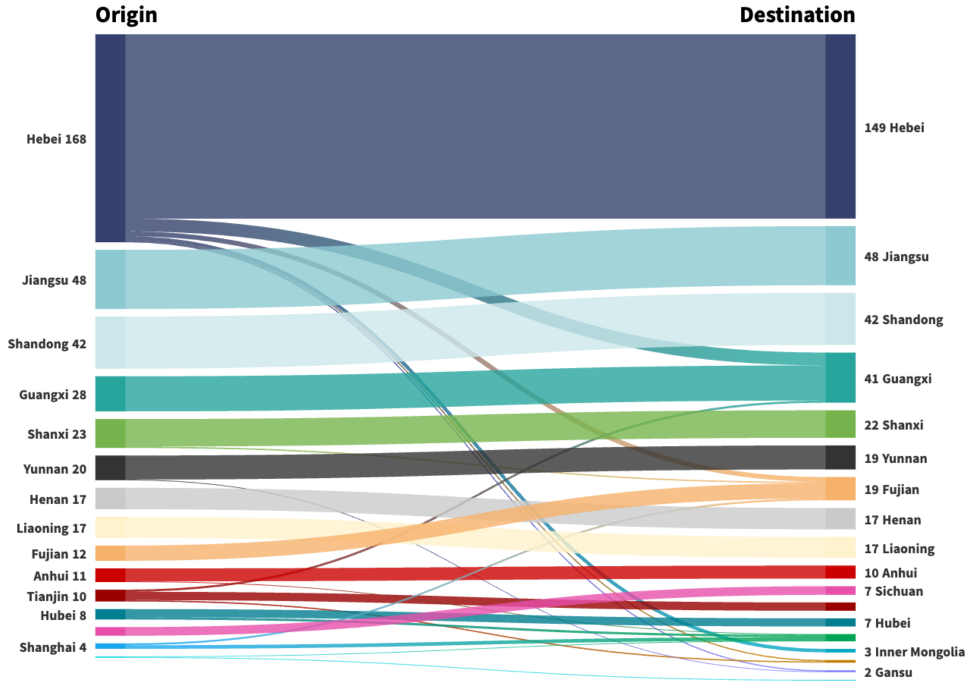
b. The capacity replacement policy allows the proprietor of the “exit” iron and steelmaking facilities to sell the corresponding capacity as an allocation for building new capacity in the market between different steel companies and across provinces. A certain portion of the retired iron and steelmaking capacity allocation in the Jing-Jin-Ji[27] and Fenwei plains[28], the key air pollution control regions, have been sold to steel firms in the coastal areas for new projects (Figure 5, Figure 6).

   Hebei province is the biggest steel production province in China. More than 20% of the country’s crude steel is produced within this province[29], which accounts for less than 2% of the country's total land area. This has led to serious air pollution in the cities of Hebei province, as well as the neighbouring city of Beijing.

   Hebei province is ranked top among the provinces that announced iron and steel capacity replacements. It is also the biggest capacity allocation exporter. 19 Mtpa out of 168 Mtpa exit ironmaking and 16 Mtpa out of 158 Mtpa exit steelmaking capacity allocation of Heibei province were sold to other provinces.

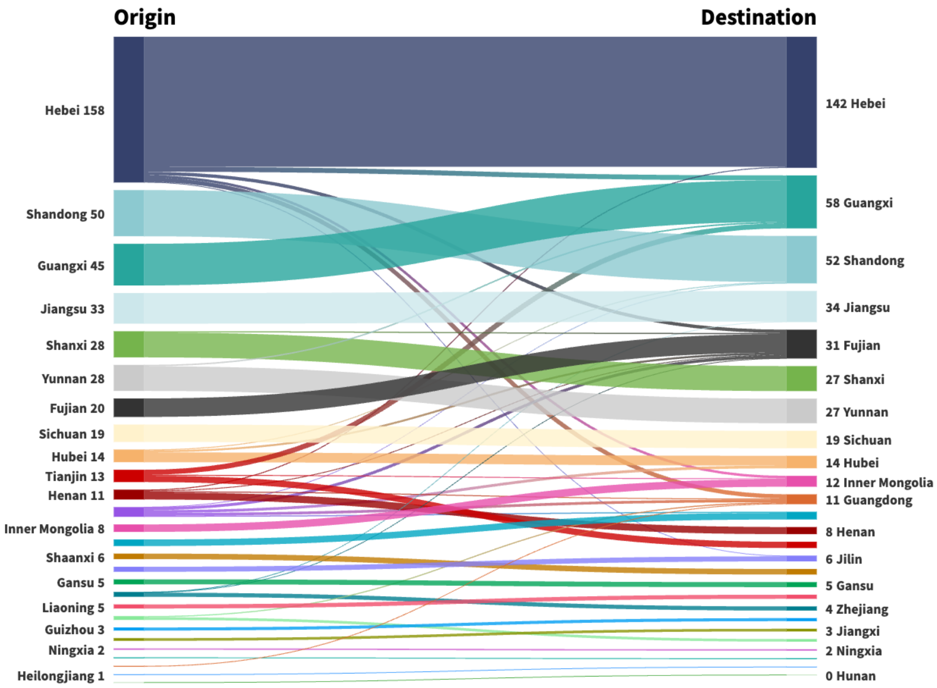
   In contrast, Guangxi on the southwest coast and Fujian province on the east coast are the two biggest capacity allocation importers. Guangxi province imported 12 Mtpa ironmaking and 13 Mtpa steelmaking exit capacity. Fujiang province imported 7 Mtpa ironmaking and 11 Mtpa steelmaking exit capacity.

[27] Jing-Jin-Ji covers Beijing, Tianjin and Hebei province.
[28] Fenwei plain encompasses parts of Shaanxi, Shanxi and Henan provinces.
[29] http://www.csteelnews.com/xwzx/jrrd/202302/t20230207_71218.html



Source: CREA analysis, based on the data from provincial government websites.

Figure 5 - Trade flow of capacity allocation of the retired ironmaking facilities, 2017–2023 H1, Mtpa



Source: CREA analysis, based on the data from provincial government websites.

Figure 6 - Trade flow of capacity allocation of the retired steelmaking facilities, 2017–2023 H1, Mtpa

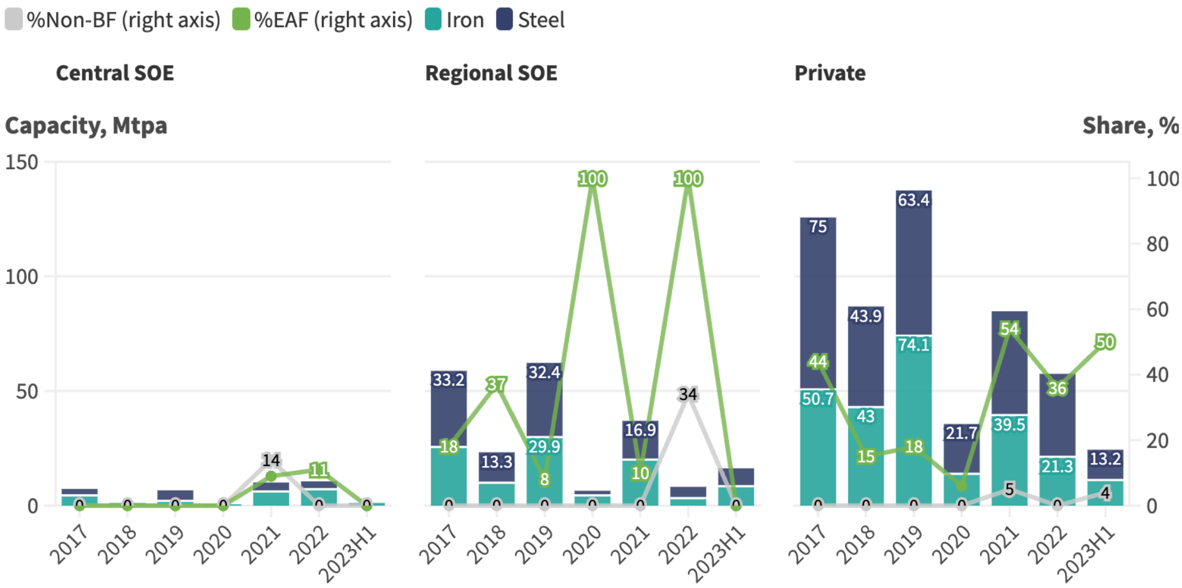
6. *The majority, specifically 69%, of new iron and steel projects are spearheaded by private steel enterprises, followed by regional state-owned enterprises (regional SOEs) and central state-owned enterprises (central SOEs), accounting for 26% and 3%, respectively.*

   a. Private steel firms play an important role in China's steel sector, accounting for more than 60% of China's steel production[30]. In the main steel production province, Hebei, private steel firms make up 70% of the provincial steelmaking capacity.

      Our analysis found that the majority, specifically 69%, of new iron and steel projects are spearheaded by private steel enterprises, followed by regional state-owned enterprises and central state-owned enterprises (Figure 7). A

[30] https://www.sohu.com/a/665426903_313737

key impetus behind this trend lies in the fact that private steel firms possess a substantial number of small size iron and steelmaking furnaces. As environmental and energy efficiency standards intensify, these facilities are compelled to either cease operations or undergo capacity replacements to procure superior equipment. The share of low-carbon iron and steelmaking facilities, non-BF and EAF, is also increasing in the new projects.



Source: CREA analysis, based on data from provincial government websites. • BF=blast furnace, Non-BF=non-blast furnace, EAF=electric arc furnace, %Non-BF = the share of Non-BF in the ironmaking capacity, %EAF = the share of EAF in the steelmaking capacity, SOE = State-owned enterprise.

Figure 7 - Addition of iron and steelmaking capacity announced in capacity replacement plans by company ownerships, 2017–2023 H1

Policy recommendations

China's crude steel output has declined since 2021 due to output control by the government and the decline in downstream demand. However, new investments in iron and steelmaking capacity have so far not adjusted to the new reality. There is an urgent need to align investments in new production capacity in the steel sector with the goal of peaking and reducing CO_2 emissions before 2025.

We therefore propose the following recommendations.

- Include the steel sector in China's emissions trading system (ETS) within the 14th five-year-plan period, and the emissions trading system should shift from an intensity-based allocation to an absolute cap.
- Limit new investments in blast furnace capacity and speed up the adoption of electric arc furnaces and hydrogen-based steelmaking technology, in order to peak CO_2 emissions from the iron and steel sector before 2025.

Methodology

Information on new iron and steel 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, basic oxygen furnace and electric arc capacity, as well as capacity being replaced, was captured for each project. Duplicates were removed from the analysis.

The cost of iron and steel projects was estimated based on Global Energy Monitor's report. These cost levels are indicative, because capital costs vary due to a host of factors including unit size; location; boiler, pollution control, cooling technology employed; and whether the plant is a combined heat and power or an electricity-only plant. The way in which the impact of asset stranding is realised in the economy can include unrecoverable initial investment, unpaid interest to bank loans, and the unrecoverable expected returns to equity due to forced early retirement and/or underutilization of new or existing assets. In future, the carbon price and the cost of carbon capture and storage will need to be included.