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# Prospects for Integrating the Steel Industry into the National Carbon Market

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# Preface

Achieving deep decarbonization in the steel industry holds significant importance for realizing China's "dual carbon" goals. The steel industry stands out as a focal point of carbon emissions in the industrial sector worldwide, accounting for approximately 7% of global greenhouse gas (GHG) emissions. China's steel industry accounts for over 60% of these global emissions, and for approximately 15% of the nation's total carbon emissions. It is the largest emitter among China's 31 manufacturing industries, with annual carbon emissions growing from 490 million tons in 2000 to approximately 2.23 billion tons in 2019, marking an increase of about 3.5 times.[1]

China's steel industry faces internal and external pressure to reduce emissions. To fulfill climate commitments outlined in the "European Green Deal" and safeguard the competitiveness of EU domestic enterprises while preventing carbon leakage, the European Commission introduced the Carbon Border Adjustment Mechanism (CBAM) in July 2021. After completing all legislative procedures, CBAM officially became EU law on May 16, 2023. CBAM is set to take effect on October 1, 2023, initiating a transition phase, with full implementation slated for 2026. The steel industry is among the first sectors covered by CBAM. According to CBAM, if foreign manufacturers have already accounted for carbon costs related to their product manufacturing processes, such as through carbon markets or carbon taxes, importers can offset their carbon expenses accordingly.

In this context, incorporating the steel industry into the national carbon emission trading market (hereafter referred to as the "national carbon market"), and leveraging carbon costs to drive steel production enterprises towards adopting lower-carbon manufacturing processes and procedures, will be an effective approach to address both external emission reduction tasks and internal emission reduction demands. This briefing provides an outlook on the inclusion of the steel industry into China's national carbon market, drawing from the experiences of regional carbon markets and the national market to date.

[1] Li Jin, Xie Canyang, Cai Wenjia, Wang Can. Low-Carbon Development Path for China's Steel Industry in the Context of Carbon Neutrality. China Environmental Management, 2022, 14(1): 48-53.

# 1. Current Status of the National Carbon Market Trading

In recent years, a series of documents related to carbon trading have been issued, laying the foundation for the launch and operation of the national carbon market. In March 2021, the Ministry of Ecology and Environment (MEE) released the "Interim Regulations on the Management of Carbon Emission Trading (Draft Amendment)," soliciting public comments. MEE is continuing to work with the Ministry of Justice to promote the timely promulgation of the "Regulations," clarify the regulatory responsibilities of relevant departments, and further study and improve related management systems in line with the development needs of the national carbon market. In May 2021, MEE announced a series of regulations, including the "Rules for the Administration of Registration of Carbon Emission (for Trial Implementation)," the "Rules for the Administration of Trading of Carbon Emissions (for Trial Implementation)" and the "Rules for the Administration of Settlement of Carbon Emission (for Trial Implementation)," providing guarantees for the smooth operation of the national carbon market. On July 16, 2021, China officially launched the online trading of the national carbon market, with the power generation industry, which covers 45% of national carbon emissions, as the first industry to be included. The plan is for other high-energy-consuming industries such as steel, building materials, and chemicals to be gradually included in the market.

In 2022, the national carbon market entered its second compliance period. As of December 31, 2022, the cumulative trading volume of carbon allowances reached approximately 50.86 million tons, with a total transaction value of 2.8 billion yuan ($0.4 billion). Compared to the previous year, these figures represent a significant decrease of approximately 72% and 63%, respectively.[2] This decline can primarily be attributed to the structure of the national carbon market, where compliance periods occur every two years. According to MEE's "Implementation Plan for Allowance Cap Setting and Allocation for the National Carbon Emission Trading in 2021 and 2022 (Power Generation Industry)," the carbon allowances for the second compliance period (2021-2022) of the national carbon market need to be settled by December 31, 2023. Therefore, there were no compliance settlement requirements at the end of 2022.[3] Throughout 2022, the price of carbon allowances fluctuated within the range of 50-62

[2] "2022 China Carbon Market Annual Report" is published by the International Institute of Green Finance at the Central University of Finance and Economics.
[3] "Implementation Plan for Allowance Cap Setting and Allocation for the National Carbon Emission Trading in 2021 and 2022 (Power Generation Industry)", Ministry of Ecology and Environment.

yuan ($6.8-$8.5) per ton, with an annual average price of 55.3 yuan ($7.6) per ton and a peak price of 61.6 yuan ($8.4) per ton.

# 2. Prospects for Integrating the Steel Industry into the National Carbon Market

## 2.1 Discussion of the Inclusion of the Steel Industry in the National Carbon Market is Increasingly Gaining Momentum.

The allocation of carbon quotas and the compliance of key emitting units in the national carbon market are based on accurate and reliable carbon emission data. The data foundation for the power generation industry is relatively robust, which is one of the primary reasons for its early inclusion in the national carbon market. However, due to the intricacies of the steel industry's carbon accounting boundaries, process flows, and energy consumption characteristics, only six major production processes – coking, sintering, pelletizing, blast furnace ironmaking, converter steelmaking, and electric arc furnace steelmaking – have been incorporated into the national carbon market for carbon accounting, reporting, and verification (MRV). [4] This has been driving data infrastructure enhancements for the steel industry.

In recent years, various government departments have issued notices and requirements to promote research related to the inclusion of the steel industry in the national carbon market, aiming to improve the carbon emission data foundation. In 2021, MEE's Department of Climate Change sent a letter to the China Iron and Steel Association, entrusting them with tasks related to carbon emission rights trading in the steel industry. This included the formulation of quota allocation schemes for the steel industry, research on the MRV system, and the development of foundational capabilities for the national carbon market.5 In 2022, MEE issued "Notice Regarding Key Tasks for the Management of Enterprise Greenhouse Gas Emission in 2022," requiring companies in industries other than electricity to submit their 2021 greenhouse gas emission reports and undergo verification. In June 2023, two

[4] Tong Qing, Guo Yuefeng, Qian Jing, Chen Lin, Zhou Sheng, "Research on the Coverage of Industrial Sectors in the National Carbon Market," China and Foreign Energy, 2022, 27(03): 7-11.
[5] Gu Yan, Chen Yu. The Impact of the Carbon Market on the Steel Industry and Recommendations for Enterprise Responses. Metallurgical Management, July 2022, Issue 7 (Part 2).

specialized research conferences on the inclusion of the steel industry in the national carbon market were held at the Chinese Academy of Environmental Planning. These conferences gathered industry regulatory authorities, industry associations, research institutions, third-party verification organizations, and other experts to discuss critical issues such as the carbon accounting boundaries for the steel industry, allocation of quotas for different steel production processes, and reporting and accounting methods. During these conferences, efforts were made to promptly determine the main production processes for carbon quota allocation in steel enterprises, establish allocation benchmarks, and develop methods for calculating carbon emissions. This work aimed to complete the initial plan for the inclusion of the steel industry in the national carbon market.

Based on recent trends and expert opinions within the industry, it is likely that the steel industry will become one of the key emission-intensive sectors to be included in the national carbon market, following the power generation sector. Many observers expect that by the end of the 14th Five-Year Plan period (2021-2025), a carbon quota allocation plan for the steel industry will be formulated, officially integrating it into the national carbon market. Additionally, the European Union's CBAM may have an impact on China's steel product exports, potentially accelerating the inclusion of the steel industry into the national carbon market to avoid additional carbon costs resulting from a lack of carbon pricing mechanisms.

## 2.2 The Operation of Both the National and Pilot Carbon Markets Laid the Foundation for the Inclusion of the Steel Industry in the National Carbon Market

### 2.2.1 Base One: Carbon Allowance Allocation Methods

Carbon quota allocation is a crucial component of the top-level institutional design of the carbon market. The relevant national authorities have not yet finalized which quota allocation method will be adopted once the steel industry is included in the national carbon market.

Currently, the carbon quota allocation in the steel industry is primarily based on two methods: historical allocation and benchmark allocation.[6] Historical allocation can further be divided into

[6] Zhao Yonghui., Cong Jianhui, Yang Jun, et al. Exploration of Quota Allocation Methods in the Chinese Carbon Market [J]. Resource Science, 2019 (5).

historical carbon intensity and historical total carbon methods, which allocate carbon quotas based on a key emitter's historical carbon intensity or total carbon emissions. The benchmark allocation method determines carbon quotas based on industry benchmark carbon intensity, allowing for a horizontal comparison among enterprises. The benchmark value is typically calculated as the average carbon intensity of companies within a certain percentile range, such as the top 10% of most carbon-efficient companies, as seen in the EU Emissions Trading System (EU ETS).

### 1) The Carbon Quota Allocation Methods for the Steel Industry in Pilot Carbon Markets

Since 2013, China has established pilot carbon markets in eight different regions. Six of these regions – Tianjin, Hubei, Shanghai, Fujian, Chongqing, and Guangdong – have included the steel industry in their carbon markets. The primary method of carbon quota allocation for the steel industry in these regions has been the historical allocation method. However, Guangdong has adopted a combination of process-based benchmark allocation (for processes like coking, lime production, pelletizing, sintering, ironmaking, and steelmaking) and historical allocation (for processes like steel rolling, pressing, and external fossil fuel co-combustion for power generation) (Figure 1). Given the complexity of the steel industry's processes, variations in technologies, products, and variations in data accounting among different steel enterprises, setting benchmarks has been challenging. As a result, most pilot carbon markets have leaned towards using historical carbon intensity or historical total emissions as the primary carbon quota allocation methods for the steel industry.

The historical method design mechanism has a significant drawback in that it does not incentivize enterprises with outdated processes to improve efficiency and emission reduction performance. Based on a company's past performance, enterprises that have already carried out extensive emission reduction efforts and have high energy efficiency may receive fewer carbon quotas due to their low historical emissions. In contrast, enterprises with higher carbon emissions intensity and outdated processes may have relatively lenient carbon quota restrictions. The benchmark method, on the other hand, tends to allocate carbon quotas more favorably to technologically advanced enterprises within the industry, placing a burden on enterprises with medium to low energy efficiency levels. It incentivizes all enterprises to develop beyond the industry benchmark. This is because enterprises with low carbon intensity actually generate fewer carbon emissions than they receive

based on the benchmark, while enterprises with high carbon intensity generate more carbon emissions than their benchmark-based allocation.

At the current stage, the national carbon market has adopted a quota allocation scheme based on carbon intensity, implementing free quota distribution. However, key emitting units still face pressure from decreasing quotas. Based on the reduction in carbon intensity per unit of GDP, energy intensity targets, and considering factors such as historical emissions and emission reduction potential in each industry, comprehensive emission control coefficients can be determined for each industry. By setting these coefficients, different emission reduction pressures can be imposed on various industries. The larger the emission control coefficient, the more quotas the industry will receive, and the smaller the emission reduction responsibility it will bear. In China's pilot carbon markets, different emission control coefficients are applied to the steel industry. From the setting of industry-specific emission control coefficients, one can observe the varying levels of regulatory stringency imposed by different regional pilot carbon markets on steel enterprises. For instance, the carbon market in Guangdong applies a uniform emission control coefficient of 1 to the steel industry, while Tianjin uniformly uses 0.98. Hubei's carbon market increased its coefficient from 0.9638 in 2020 to 0.9888 in 2021.

Table 1: Carbon Quota Allocation Schemes in Pilot Carbon Markets for the Steel Industry

| Quota Allocation Methods | | Pilot Carbon Markets | Quota Allocation Methods | |
|---|---|---|---|---|
| Historical Method | Historical Total Method | Tianjin | Enterprise Quota = Historical Emissions × Control Coefficient | |
| | | Hubei | Enterprise Quota = Historical Emission Baseline × Industry Control Coefficient × Market Adjustment Factor / 365 × Normal Production Days | |
| | | Chongqing | Steel Rolling and Processing Process | Enterprise Quota = Historical Total Emission Benchmark × Adjustment Coefficient |
| | Historical Carbon Intensity Method | Shanghai | Enterprise Quota = Σ (Historical Intensity Baseline n × Annual Product Output n) | |
| | | Fujian | Enterprise Quota = Historical Carbon Intensity × Emission Reduction Coefficient × Main Product Output × Adjustment Coefficient | |
| | | Chongqing | Steel Industry Smelting Process | Enterprise Quota = Historical Intensity Benchmark × Current Year Annual Output × Adjustment Coefficient |
| | | Guangdong | Steel Rolling and Processing Process | Enterprise Quota = Product Output × Historical Average Carbon Intensity × Annual Reduction Coefficient |
| | | | Cofiring of Purchased Fossil Fuels for Power Generation | Enterprise Quota = Electricity Generation × Historical Average Electricity Generation Carbon Intensity × Annual Reduction Coefficient |
| Process-based Benchmark Allocation | | Guangdong | Coking, Lime Production, Pelletizing, Sintering, Iron Smelting, Steel Smelting Processes: | Enterprise Quota = $\sum_{i=1}^{n}$ (Product Output of Each Process × Benchmark Value of Each Process × Annual Reduction Coefficient) |

Source: Latest Annual Carbon Emission Quota Plans Released by Various Pilot Carbon Markets

### 2) Outlook on Carbon Quota Allocation Methods for the Steel Industry in the National Carbon Market

The carbon quota allocation method widely used in major global carbon markets for the steel industry is the benchmark method. For instance, the European Emission Trading Scheme (EU ETS) uses benchmark values to set free quota allowances for six major steel production processes and products. If China's national carbon market were to adopt the benchmark method used in major global carbon markets, it would face significant challenges in terms of data calculation. It would be difficult to establish carbon quota benchmark values that align with the specific characteristics of the steel industry in the short term. This challenge makes it unlikely for the steel industry to be included in the national carbon market in the near future.

While the steel industry has not yet been included in the national carbon market, during the 12th Five-Year Plan and 13th Five-Year Plan periods, enterprises like Baosteel, WISCO (Wuhan Iron and Steel Corporation), Shougang Group, and others participated in regional pilot carbon markets. They collaborated with local governments to complete the groundwork for the steel industry, including carbon accounting methods, historical carbon emissions inventory, and quota allocation methods. These efforts also led to the development of management systems related to quota trading, laying a solid foundation for steel enterprises to adapt to the national carbon market.[7] Steel enterprises with annual greenhouse gas emissions exceeding 26,000 tons of carbon dioxide equivalent are actively cooperating with local governments in conducting carbon inventory and verification. The data collected through these efforts are submitted to the MEE, serving as essential reference data for determining benchmark values and carbon quota allocation methods in the future national carbon market. The primary steel production processes include raw material mixing, sintering, pelletizing, steel refining, iron refining, and steel rolling. Currently, six major steel production processes, including coking, sintering, pelletizing, iron refining, blast furnace steelmaking, and converter steelmaking, have been incorporated into the data reporting and verification processes for the national carbon market. This lays the preliminary groundwork for using benchmark methods to allocate carbon quotas within the industry.[8]

[7] In preparation for inclusion in the national carbon market, the steel industry has been soliciting specialized standards related to carbon emissions, 21st Century Business Heral, linke: https://m.21jingji.com/article/20210701/herald/f65e13038a86511ab669d01b850fbd10.html

[8] Tong Qing, Guo Yuefeng, Qian Jing, et al. Research on the Coverage of Industrial Sectors in the National Carbon Market. Chinese and Foreign Energy, 2022, 27(03): 7-11.

Currently, the national carbon market in China uses a benchmark-based approach to allocate carbon quotas to the power generation sector. Therefore, determining the benchmark values for industries to be included in the national carbon market is a crucial foundational step for the market's expansion. During the specialized research meeting held in June 2023, when the steel industry was included in the national carbon market, it was emphasized that the carbon quota allocation benchmarks for the steel industry should be established as soon as possible. Furthermore, considering the demands of addressing the EU CBAM, it is likely that the steel industry, once included in the national carbon market, will adopt the benchmark-based method for carbon quota allocation.

### 2.2.2 Base Two: Setting Baselines for the Steel Industry in Carbon Markets

Differing from countries like the EU, where steel production primarily relies on the recycling of scrap steel, China's steel production predominantly utilizes the long process, with over 90% of it based on iron ore as the primary raw material. According to statistics from the World Steel Association, in 2019, China's crude steel production was composed of more than 90% long-process steelmaking and less than 10% short-process steelmaking. Beyond China, overseas production includes approximately 52% long-process steelmaking and 48% short-process steelmaking.

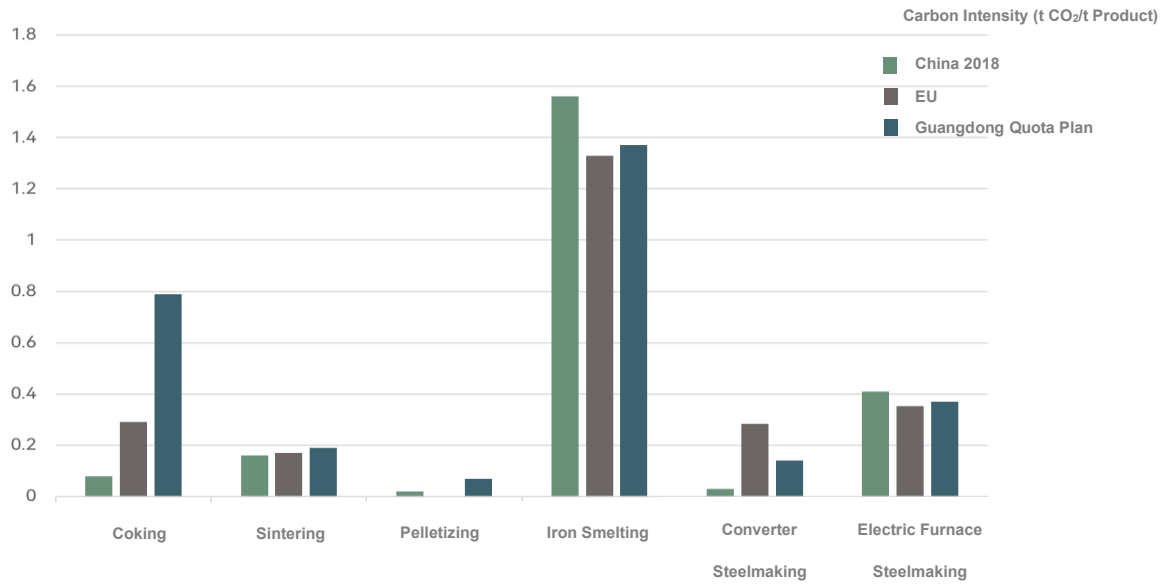
Guangdong is the only pilot carbon market in China that employs the industry baseline method for carbon quota allocation in the steel industry. In December 2022, the Guangdong Provincial Department of Ecology and Environment released the "Guangdong Carbon Emission Quota Allocation Plan (2022)." This plan establishes baselines for seven processes and products: coking, quicklime production, pelletization, sintering, iron smelting, converter steelmaking, and electric arc furnace steelmaking, with baseline values set at 0.79, 0.87, 0.08, 0.19, 1.37, 0.14, and 0.37 $tCO_2$ per ton of product, respectively.[9] However, it is important to note that these baseline values are based on carbon intensity benchmarks specific to Guangdong's steel enterprises and may not be universally applicable across the country.

In the research on the baseline values for the major processes and products in the steel industry, previous studies have used the data from the "2018 Supplementary Data Sheet for Greenhouse Gas

[9] "Guangdong Carbon Emission Quota Allocation Plan (2022)," Guangdong Provincial Department of Ecology and Environment.

Emissions in the Iron and Steel Industry" published by the Energy Research Institute of the National Development and Reform Commission. This data includes overall and process-specific product output and $CO_2$ emissions from reporting enterprises. Baseline values (average carbon intensity) for the six processes and products, including coking, sintering, pelletizing, ironmaking, converter steelmaking, and electric furnace steelmaking, were calculated as follows: 0.08, 0.16, 0.02, 1.56, 0.03, and 0.41 $tCO_2$/t product, respectively.[10] The research findings indicate that in 2018, the baseline values for the sintering, ironmaking, and electric furnace steelmaking processes in the national steel industry were comparable to those in the EU ETS and the Guangdong carbon market. However, the baseline value for the coking process was notably lower. This difference can be attributed to variations in the types of raw materials used in the coking process. In the national context, the coking process primarily relies on low-pollution washed coking coal, whereas the EU ETS and Guangdong carbon market predominantly use blend coking coal.

**Figure 1. Comparison of 2018 Baseline Values for Various Processes in the National Steel Industry with Those of the European Union and Guangdong Province.**




**Source: Research on the Baseline Method in the Chinese Steel Industry under National Carbon Trading.**

[10] Tan Qilu, Liu Lanting, Zhu Songli. "Research on the Benchmarking Method in China's Steel Industry under the National Carbon Trading," Climate Change Research Progress, 2021, 17(5): 590-597.

### 2.2.3 Base Three: Carbon Quota Allocation Methods

The carbon quota allocation methods primarily include free allocation and paid allocation. The "Implementation Plan for Allowance Cap Setting and Allocation for the National Carbon Emission Trading in 2021 and 2022 (Power Generation Industry)," released by MEE in March 2023, clearly states that the carbon quotas for the national carbon market in 2021 and 2022 will continue to be allocated for free. The "Interim Regulations on the Management of Carbon Emission Trading (Draft Amendment)" proposes that "in the initial stage, free allocation will be the main method, and paid allocation will be introduced as required by the state, gradually increasing the proportion of paid allocation," and it is expected that the national carbon market will transition gradually to a stage where the proportion of paid auctions increases.

Some pilot carbon markets are attempting to distribute quotas to enterprises through paid auctions. Guangdong, in particular, has taken the lead in introducing a paid auction mechanism nationwide, with the current proportion being around 3%. Among these, the free quota allocation proportion for industries such as steel, petrochemicals, cement, and manufacturing enterprises is set at 96%.

## 3. Summary and Outlook

The development of China's steel industry possesses distinct characteristics, with a predominant focus on long-process steelmaking technology. This long-process structure has held a dominant position in China's steel industry for an extended period, characterized by low production costs and high carbon emission intensity. Therefore, effective emission reduction measures for the industry should encompass a comprehensive consideration of energy-saving and efficiency-enhancing technologies, industrial restructuring, pollution reduction, and carbon mitigation measures. The judicious use of the national carbon market, as a market regulation measure, can contribute to the green and low-carbon development of the steel industry.

For high-emission, long-process steel enterprises in China, it is currently challenging to achieve significant carbon reduction through mature energy-saving technologies. The potential for further energy efficiency improvements has become quite limited within the existing framework. Under the

current production mode in the steel industry, especially for long-process operations, it is unlikely that carbon reduction capacity can be substantially reduced indefinitely.[11] With the inclusion of the steel industry in the national carbon market, enterprises with high levels of low-carbon development can generate additional economic benefits by selling surplus carbon quotas. These benefits can be reinvested in supporting technological innovation, optimizing process structures, and facilitating a virtuous cycle of transitioning steel enterprises toward greener and lower-carbon development. On the other hand, those with lower levels of low-carbon development will need to purchase additional carbon quotas to meet their obligations, which will compel them to accelerate their low-carbon transformation. This may include adopting lower-carbon short-process operations, as failure to do so could result in increased costs and a loss of market competitiveness. Based on the carbon quota trading in trial carbon markets that have covered the steel industry over the past few years, the average carbon quota prices in most of these markets have shown an upward trend. This indicates that the carbon emissions costs for non-compliant steel companies will gradually increase.[12]

Regarding the quota allocation method, considering that an increase in the proportion of paid auctions will lead to higher compliance pressure on steel companies, it is expected that in the initial stages of the steel industry's inclusion in the national carbon market, free quota allocation will be the primary method, with minimal impact on steel companies' production costs. The national carbon market can gradually introduce a carbon quota auction mechanism to increase the proportion of paid carbon quota distribution to the steel industry. The revenue generated from this can be used to support greenhouse gas emissions reduction efforts by companies and the development of the carbon market. Additionally, if the industry benchmark method is used to allocate carbon quotas to steel companies, further improvements in data infrastructure for carbon trading under the benchmark method will be necessary.

[11] Chen Xiaochun. Research on Carbon Emission Compliance Cost Management of Steel Enterprises[J]. Metallurgical Finance and Accounting, 2021, 40(03):7-13.
[12] Analysis of the Path to Achieve "Dual Carbon" Goals in the Steel Industry Supply Chain and Its Impact on Costs, National Development and Reform Commission (2021)."