The Quality of Carbon Accounting Information Disclosure: A Case Study of Baosteel Co., Ltd.

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Abstract. Against the backdrop of increasingly severe global climate change, carbon accounting information disclosure has become an important tool for enterprises to fulfill their environmental responsibilities. This paper takes Baosteel Co., Ltd. as an example to study the quality of its carbon accounting information disclosure, analyze the existing problems and their causes, and put forward improvement suggestions. By analyzing Baosteel's sustainable development reports and annual reports from 2020 to 2024, this study finds that the company's carbon accounting disclosure had deficiencies in completeness, accuracy, relevance, and comparability, with prominent issues including the lack of Scope 3 emission data and ambiguous emission reduction targets. The research results show that insufficient policy drive, cost-benefit trade-off, and imperfect internal management mechanisms are the main reasons for the low quality of disclosure. This study suggests that enterprises enrich the content of carbon accounting disclosure and standardize disclosure formats and channels; meanwhile, policymakers should expedite the formulation of unified carbon accounting standards. This research not only fills the case gap of carbon accounting information disclosure in the steel industry but also provides theoretical support and practical reference for the low-carbon transformation of the industry.

Keywords: Carbon Accounting, Information Disclosure, Disclosure Quality.

1 Introduction

Global climate change has become a major challenge in the 21st century. According to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change of the United Nations, if global temperatures rise by more than 1.5°C, it will trigger a series of ecological crises such as frequent extreme weather events, rising sea levels, and loss of biodiversity [1]. To address this challenge, the international community has pushed countries to set emission reduction targets through the Paris Agreement. As the world's largest developing country, China proposed the "dual carbon" goals of "carbon peaking and carbon neutrality" in 2020, and committed to achieving carbon peaking before 2030 and carbon neutrality before 2060 [2]. This strategy not only demonstrates China's responsibility and commitment to global climate governance

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but also sets stricter emission reduction requirements for high-carbon emission industries such as steel, energy, and transportation. As a core basic industry of China's national economy, the steel industry accounts for over 15% of China's total carbon emissions, making it a key sector for achieving the "dual carbon" goals. Baosteel Co., Ltd., as a leading enterprise in China's steel industry, has strong industry representativeness and is therefore selected as the case object of this study.

At present, a unified carbon information disclosure standard has not yet been established in China, and there are significant differences in the quality of disclosure among enterprises [3]. Some steel enterprises only disclose their total carbon emissions, lacking key information such as calculation methods and emission reduction paths, which affects the comparability of information and the implementation effect of policies [4]. Therefore, establishing a scientific and standardized carbon accounting information disclosure system has become an urgent need for policy-making.

The steel industry is an energy-intensive sector. It consumes a large amount of coal and electricity during the production process, and its carbon emission intensity is significantly higher than that of other industrial sectors [5]. Baosteel Co., Ltd. accounts for over 10% of the global crude steel output, with a carbon emission intensity of 1.8 tons, lower than the industry average of 2.2 tons, demonstrating its advanced nature in energy efficiency improvement and emission reduction technology. However, it still has problems, such as the absence of Scope 3 data and unclear target setting in the disclosure of carbon accounting information. Selecting Baosteel Co., Ltd. as the research object can not only reflect the advanced level of the industry but also reveal common problems, providing a basis for policy optimization. By comparing with international leading enterprises (such as ArcelorMittal), the gap and development direction of domestic enterprises in carbon information disclosure can be further identified. There are still several deficiencies in the current research in the field of carbon accounting information disclosure. Firstly, case studies on carbon accounting disclosure in the steel industry are relatively scarce, especially in-depth analyses of representative enterprises, which makes it difficult to systematically identify common challenges in the industry's carbon disclosure practices [6]. Secondly, the mechanism of interaction between domestic carbon accounting policies and disclosure quality remains unclear, and the policy effects lack empirical support. Finally, existing research has failed to fully integrate the dynamic requirements of the "dual carbon" goals to assess the improvement paths for corporate disclosure [7]. This paper systematically analyzes the quality of carbon accounting information disclosure of Baosteel Co., Ltd., aiming to fill the above-mentioned research gap and construct an evaluation framework applicable to high-carbon industries, providing references for academic research and policy-making.

This study focuses on three core research questions: (1) What is the current status of Baosteel's carbon accounting disclosure, and whether it complies with international standards (e.g., the TCFD framework)? (2) What are the main deficiencies in Baosteel's current disclosure, and what are the underlying causes? (3) How can the quality of carbon accounting disclosure be improved through the synergy between corporate self-discipline and policy supervision? The discussion of these issues holds

significant practical significance for the low-carbon transformation of Baosteel Co., Ltd. itself and the entire steel industry. The theoretical significance of this study lies in expanding the application of stakeholder theory and signal transmission theory in the steel industry, constructing a carbon information disclosure evaluation framework aligned with China's policy context, and providing a new perspective for the theoretical integration of climate governance and corporate social responsibility. In practice, this study provides a path reference for steel enterprises to optimize carbon information disclosure, offers a case basis for regulatory authorities to formulate carbon accounting standards, and is conducive to promoting the low-carbon transformation and high-quality development of the steel industry under the "dual carbon" goals.

2 The Theory and Policy of Carbon Accounting Information Disclosure

2.1 Theoretical Basis

Carbon accounting disclosure refers to the practice of enterprises publicly disclosing carbon-related information (e.g., carbon emission data, emission reduction measures, carbon assets, and carbon liabilities) to external stakeholders [8]. The disclosed content mainly includes total carbon emissions, emission intensity, emission reduction targets, carbon costs, and carbon assets. Its theoretical basis mainly stems from the stakeholder theory and the signal transmission theory. The stakeholder theory holds that enterprises need to respond to the information demands of multiple subjects such as investors, governments, and the public. For instance, investors use carbon data to assess the climate risks and sustainability of an enterprise [9]. The government relies on enterprises' carbon information to formulate emission reduction policies and promote the implementation of the "dual carbon" goals.

Signal transduction theory emphasizes that high-quality carbon disclosure helps reduce information asymmetry and enhance a company's market credibility and financing capacity. For every 10% increase in the carbon disclosure score, the debt cost of enterprises decreases by 0.5%, reflecting the enhanced emphasis of the market on carbon information [10]. The above theory has laid a theoretical foundation for the necessity and value of carbon accounting information disclosure. Based on the practice of Baosteel Co., Ltd., the stakeholder theory explains the intrinsic motivation behind its disclosure of carbon information - as a leading enterprise in the industry, it needs to obtain policy support and social recognition through disclosure. The signal transduction theory, however, reveals the deficiencies in its disclosure. For instance, the absence of Scope 3 data may lead to an insufficient assessment of its emission reduction potential by the market.

2.2 Policies and Industry Requirements

The internationally commonly used Carbon Information Disclosure Quality Evaluation Framework includes four dimensions: completeness, accuracy, relevance, and comparability. The integrity requirement covers all emissions within Scope 1, 2, and 3. Accuracy emphasizes the transparency and reliability of data accounting methods. Relevance emphasizes the matching of information with the enterprise's strategy. Comparability requires the provision of historical and industry benchmarking data.

In recent years, the Chinese government has continuously refined policies related to carbon information disclosure. In 2022, the Ministry of Ecology and Environment issued the Measures for the Administration of Enterprises' Lawful Disclosure of Environmental Information, which mandates that key polluting enterprises disclose their carbon emission data. The Ministry of Finance has also issued the "Interim Provisions on Carbon Accounting Treatment" to regulate the accounting treatment of carbon assets and liabilities. Carbon emissions in the steel industry mainly originate from energy consumption and production processes. Steel enterprises should classify and disclose their carbon emissions in detail based on Scope 1 (direct emissions), Scope 2 (indirect emissions from purchased electricity), and Scope 3 (indirect emissions from the entire value chain, including raw material procurement, production, and product sales).

3 The Current Status of Carbon Accounting Information Disclosure

3.1 Forms and Channels of Disclosure

Baosteel mainly discloses carbon information through three channels: the notes to its annual report (accounting for approximately 70% of its total carbon disclosure content), the "Environmental Performance" section in its independent sustainable development report, and the "Carbon Neutrality Actions" column on its official website. This multi-channel and decentralized disclosure has led to a prominent issue of information fragmentation. Carbon assets and liabilities are not presented separately in the balance sheet but are only consolidated into "Other Current Liabilities". Major emission reduction projects (such as the hydrogen-based shaft furnace project in 2023) only issued temporary announcements, lacking continuous tracking and benefit assessment.

Compared with ArcelorMittal, an international peer, which fully integrates carbon data into its financial reports, Baosteel's disclosure is clearly lacking in systematization and traceability. According to the assessment of the GRI 305 standard, the integration degree of its disclosure channels is only 45% of that of leading enterprises in the industry. As shown in Table 1, Baosteel lags behind its domestic and foreign counterparts in many key disclosure indicators, especially in the accounting of Scope 3, quantification of emission reduction targets, and the standardization of the disclosure framework, where there are significant gaps.

3.2 Analysis of Disclosed Content

In terms of carbon emission data, Baosteel disclosed that its 2024 Scope 1 emissions totaled 120 million tons, a year-on-year decrease of 5%, but did not specify whether it adopted the IPCC accounting guidelines. The emission coefficient of the blast furnace process (1.6 tons of CO_2 per ton of steel) is lower than the industry-recommended emission coefficient (1.8 tons of CO_2 per ton of steel), indicating a risk of underestimating carbon emissions. Scope 2 emissions disclosure: 32 million tons of emissions related to purchased electricity, but not corrected for regional grid factors, which may result in a deviation of up to 15%. Scope 3 emissions only claim to "advance accounting", with a complete absence of data in the supply chain links.

In terms of emission reduction targets and measures, environmental protection investment is expected to reach 8.5 billion yuan in 2024, representing a year-on-year growth of 22%. However, the emission reduction effects of projects such as hydrogen-based shaft furnaces are only qualitatively described, without quantifying the carbon reduction volume. The company has set the goals of "carbon peak by 2030 and carbon neutrality by 2050", but it lacks annual breakdown indicators, making it less operational. In terms of carbon asset management, there will be a surplus of 2 million tons of carbon quotas in 2024, but the source and transaction price have not been disclosed. Carbon costs are categorized under "Administrative Expenses – Others" and are not presented separately in accordance with the Interim Provisions on Carbon Accounting Treatment, resulting in low transparency of carbon-related financial information.

4 Evaluation of the quality of Accounting Information Disclosure

A four-dimensional scoring system is constructed based on the GRI 305 standard. As shown in Table 1, there are systematic deficiencies in the quality of Baosteel's carbon accounting information disclosure. The main reason for the score deduction in completeness is the lack of Scope 3 data. The score deduction in accuracy stems from uncorrected regional grid factors for Scope 2 emissions calculations. The insufficient correlation is reflected in the failure to quantify the contribution of project emission reduction. Comparability is affected by the frequent changes in the disclosure framework. The format has changed three times within five years, and the historical data gap rate has reached 60%.

Table 1. Quality Scores of Carbon Accounting Information Disclosure.

Dimensionality	Company score (10 points)	Industry benchmark	Main reasons for score deduction
Completeness	4.2	8.5	Scope 3 is missing, and the objective has not been decomposed
Accuracy	5.1	7.8	Range 2: Uncorrected area factor
Relevance	3.5	7.2	The emission reduction contribution of hydrogen-based shaft furnaces has not been quantified
Comparability	4.0	8.0	The disclosure format has changed three times in the past five years

The main issues include: First, the absence of Scope 3 is not due to technical limitations but rather an active choice made by enterprises. Only 40% of Baosteel's over 200 small and medium-sized supply chain partners have carbon monitoring capabilities. Full disclosure of Scope 3 data would require an annual investment of over 3 million RMB, and there are no mandatory policy constraints to compel such disclosure [11]. Second, the scope 2 calculation did not adopt the official regional power grid factor, resulting in an underestimation of 12% to 18%. Thirdly, the data systems of the finance and environmental protection departments have not been connected. Carbon quotas are listed as "intangible assets" in the finance department, while the Ministry of Environmental Protection conducts statistics based on physical quantities. The data contradiction rate between the annual report and the sustainable development report has reached 25%.

In terms of causes, the absence of policies has led enterprises to selectively disclose information by taking advantage of "encouraging provisions". For Scope 3 disclosure, the marginal cost of accounting far exceeds the benefits from green credit. Under rational decision-making, enterprises tend to avoid such disclosure [12]. The lack of interdepartmental assessment indicators has led to the obstruction of carbon data flow.

5 The Path to Improving the Quality of Carbon Accounting Information Disclosure

Enterprises should establish a strategic disclosure mechanism: First, by 2025, Baosteel should jointly establish an ISO 14064-compliant Scope 3 accounting system with its suppliers, requiring core suppliers to install carbon monitoring equipment and secondary suppliers to adopt factor-based estimation methods. Second, break down the carbon neutrality goal into annual targets (such as reducing emissions per ton of steel to 1.75 tons by 2025) and relate them to the carbon reduction volume of each project. Third, fully adopt the TCFD framework, add a chapter on climate-related financial disclosure in the annual report, recognize carbon assets in accordance with the standards, and disclose changes in fair value. Fourth, appoint a carbon accounting director to coordinate financial and environmental protection data and establish a linked report system for carbon flow and capital flow.

At the policy level, an incentive and binding governance mechanism should be established: First, the "Carbon Accounting Standard" should be issued before 2025, mandating listed companies to disclose Scope 3 data and clarifying the correction norms for regional power grid factors. Second, implement a mechanism linking disclosure quality with green credit interest rates: enterprises with Grade A disclosure quality should enjoy a 20% reduction in green credit interest rates, and leading enterprises in disclosure should be awarded additional carbon allowances. Thirdly, the Ministry of Industry and Information Technology should build an industrial carbon data platform, which will provide regional emission factor libraries and accounting tools to reduce enterprises' compliance costs.

6 Conclusion

This study analyzes Baosteel's carbon accounting information disclosure from 2020 to 2024 and finds obvious deficiencies in completeness, accuracy, relevance, and comparability, including the lack of Scope 3 emission data, ambiguous quantified emission reduction targets, and opaque financial recognition and measurement of carbon assets. The causes of these problems mainly include insufficient policy enforcement, cost-benefit imbalance of enterprises, and imperfect internal management systems.

To enhance the quality of disclosure, enterprises should improve their carbon accounting systems, quantify emission reduction targets, optimize disclosure forms, and strengthen internal coordination. The government needs to accelerate the establishment of a policy system that combines mandatory and incentive measures, introduce carbon accounting standards, strengthen third-party audits, and promote the improvement of disclosure quality. The main contribution of this study lies in filling the gap of case studies on carbon accounting information disclosure in the steel industry, establishing an evaluation framework that conforms to the domestic policy context, and providing practical references for the low-carbon transformation of enterprises under the "dual carbon" goals. Future research can be extended to more case enterprises, combined with quantitative analysis methods, to further explore the relationship between disclosure quality and enterprise performance, and track and evaluate the implementation effect of policies.

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