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Study on the Impact of ESG Ratings on Green Technology Innovation of Chinese Equipment Manufacturing Enterprises under Dual Carbon Targets

Wenjie Shi, Yu Chen, Ju Wang, and Xiaoxu Zhang*

School of Business Administration, University of Science and Technology Liaoning, Anshan 114051, China

*Corresponding Author

Abstract

This paper explores the impact of ESG ratings on green technology innovation of Chinese equipment manufacturing enterprises in the context of dual-carbon targets. Through literature review and current situation analysis, it reveals the current problems in ESG practice and green technology innovation of equipment manufacturing enterprises, including the imperfection of ESG rating system, insufficient attention of enterprises, and weak green technology innovation capability. Aiming at these problems, this paper proposes coping strategies such as improving ESG rating system, strengthening corporate ESG awareness, and enhancing green technology innovation ability. The study shows that ESG rating plays an important role in promoting green technology innovation of Chinese equipment manufacturing enterprises, which helps to realize the dual-carbon goal and sustainable development.

Keywords

Dual Carbon Target; ESG Rating; Equipment Manufacturing Enterprises; Green Technology Innovation; Sustainable Development.

1. Introduction

In the face of the increasingly serious problems of global climate change and environmental pollution, governments have set carbon emission reduction targets to meet this global challenge. China, as a responsible big country, has put forward a dual-carbon target of striving to achieve carbon peaking by 2030 and carbon neutrality by 2060. The proposal of this target not only reflects China's determination to combat climate change, but also points out the direction for the green transformation of various industries. As an important pillar industry of the national economy, the equipment manufacturing industry, with its large energy consumption and carbon emissions, plays a key role in realizing the dual-carbon goal. ESG (Environmental, Social and Governance) ratings, as an important indicator for evaluating the sustainable development capability of an enterprise, are increasingly highlighting their importance in guiding the enterprise to realize green technological innovation.

The ESG rating system provides investors and other stakeholders with detailed information on corporate sustainability capabilities through a comprehensive assessment of corporate performance in environmental protection, social responsibility fulfillment, and corporate governance practices. In the context of achieving peak carbon and carbon neutral targets, ESG ratings have a significant impact on the enhancement of corporate green technology innovation capabilities. On the one hand, higher ESG ratings help to enhance corporate image, attract more investment resources, and provide necessary financial support for green technology innovation activities; on the other hand, higher ESG rating standards also force enterprises to increase their investment in environmental protection and sustainable development, which in turn

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promotes the process of green technology innovation. The study of the impact of ESG ratings on the green technological innovation of equipment manufacturing enterprises in the context of the dual-carbon target helps to elucidate the role mechanism of ESG ratings in promoting green technological innovation. By deeply exploring the intrinsic connection between ESG ratings and green technological innovation, this study aims to provide targeted strategic recommendations for the government, enterprises and investors, so as to promote the sustainable development of equipment manufacturing enterprises and provide useful references for the green development of other industries.

2. Literature Review

Shen and Wang(2023) point out that ESG concepts are highly compatible with the goal of "dual-carbon", and ESG ratings not only focus on the environmental performance of enterprises, but also involve social responsibility and corporate governance, which is consistent with the core requirements of the "dual-carbon" goal of reducing carbon emissions and promoting green development. This is consistent with the core requirements of reducing carbon emissions and promoting green development in the "dual carbon" goal. They emphasized that vigorously promoting ESG concepts can help guide enterprises to develop in a low-carbon, environmentally friendly and sustainable direction, thereby realizing the "dual-carbon" goal.

In recent years, several studies have shown a significant positive correlation between ESG ratings and enterprises' green technology innovation. Huang,Yao, and Liu(2023), based on the data of Chinese A-share manufacturing enterprises from 2010-2021, found that the higher the ESG rating, the higher the enterprises' green innovation output. They point out that ESG ratings not only directly promote green innovation, but also help alleviate financing constraints and provide financial support for green innovation. This finding is particularly significant in non-state-owned enterprises and high-environmental-risk industries, suggesting that ESG ratings have a positive effect in different firm characteristics and industry contexts. Huang (2023) similarly examined the impact of ESG rating disclosure on corporate green innovation and reached similar conclusions. He argues that ESG rating disclosure can enhance corporate environmental and social responsibility awareness, which in turn promotes green innovation activities. Xie andJian (2024) further explore the mechanism of ESG's role in promoting enterprises' radical green technology innovation. They point out that ESG ratings stimulate enterprises' motivation and ability to engage in radical green technological innovation by enhancing their environmental performance and social responsibility.

However, not all studies agree that ESG ratings have an entirely positive contribution to green innovation. Fan(2024) study points out that ESG rating divergence significantly inhibits corporate green innovation. Rating divergence reduces the credibility of information, increases enterprises' financing constraints and financing costs, which in turn discourages green innovation activities. She proposes that ESG report forensics can effectively mitigate this inhibiting effect by improving disclosure quality and narrowing rating divergence. This finding emphasizes the importance of disclosure quality and rating consistency in promoting green innovation.

As a high-energy consumption and high-emission industry, the equipment manufacturing industry is facing great pressure for green transformation under the "dual-carbon" goal. Su(2024) studied the impact of ESG performance on green innovation of listed manufacturing enterprises and found that enterprises with better ESG performance are more inclined to carry out green innovation activities. He pointed out that ESG ratings can effectively promote green technological innovation in equipment manufacturing companies by enhancing their environmental performance and social responsibility awareness. Wu(2024), on the other hand, discusses the pushback effect of ESG ratings on corporate green innovation. He argues that as

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society's attention to ESG increases, companies will be forced to carry out green innovation activities in order to improve their ESG ratings and meet market expectations. This pushback effect is particularly evident in equipment manufacturing companies, as they face greater pressure and challenges in green transformation. Yao, Xu, and Kou (2024) conducted a study on equipment manufacturing enterprises and found that ESG ratings have a significant positive impact on enterprises' green technology innovation. They emphasized that ESG ratings not only enhance enterprises' environmental and social performance, but also promote the development and application of green technologies by enhancing enterprises' market reputation and attracting external financing support.

3. Assessment of the Current Situation and Analysis of Problems

Driven by the "double carbon" target (peak carbon and carbon neutral), the impact of ESG rating on equipment manufacturing enterprises is becoming more and more significant, and its current situation can be specifically analyzed from the following aspects.

3.1. Overall Low Level of ESG Disclosure

First, the industry disclosure rate is insufficient. As an important branch of equipment manufacturing, the ESG report disclosure ratio of the machinery and equipment industry is still significantly lower than the industry-wide average of 48.62%, although it has increased from 22.25% in 2021 to 28% in 2024. In particular, the disclosure of environmental dimensions generally scored low, for example, hazardous waste management and water resource management scored more than 30 points, and some companies even close to 0 points. Secondly, environmental performance has become a major shortcoming. Equipment manufacturing enterprises are lagging behind in carbon emissions, energy efficiency and other environmental indicators due to the production characteristics of high energy consumption and high emissions. Machinery and equipment industry ratings show that the environmental dimension of C grade accounted for 58.9%, much lower than the social and governance dimensions. Typical cases such as Tongrun Equipment (002150.SZ), its environmental rating is only C grade, industry ranked 37th, mainly due to climate change response and resource utilization efficiency is insufficient.

3.2. ESG Disclosure is Gradually Becoming Standardized

First, the transition from voluntary to semi-mandatory disclosure. China's ESG disclosure is being gradually standardized, and the "Guidelines for the Preparation of Sustainability Reports (Exposure Draft)" issued by the Shanghai and Shenzhen Stock Exchanges requires headline companies to improve the quality of disclosure. Equipment manufacturing companies need to adapt to this trend, or they may face compliance risks. Second, characteristic indicators and localized practice. The ESG system with Chinese characteristics emphasizes the integration of "dual-carbon" targets, for example, requiring companies to set quantitative indicators such as the proportion of clean energy. Equipment manufacturers need to strengthen their investment in low-carbon technologies (e.g., energy storage, carbon capture) in the environmental dimension and disclose social contribution data such as rural revitalization in order to improve their ratings.

3.3. Significant Differences in Segmentation and Urgent Need to Improve Corporate Governance Capacity

First of all, there are significant differences in the performance of segments. In the environmental protection industry ESG rating, 160 companies disclosure rate of more than half of the emissions management to be improved mentioned in the rail transportation equipment enterprises ESG disclosure rate of 52.9%, far more than the general equipment (23.3%) and

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automation equipment (19.3%), reflecting the differentiated impact of policy regulation and market demand. As shown in the figure below, the information error of sustainability in the environmental protection industry is increasing year by year from 2021 to 2024. Differences between companies are gradually significant.

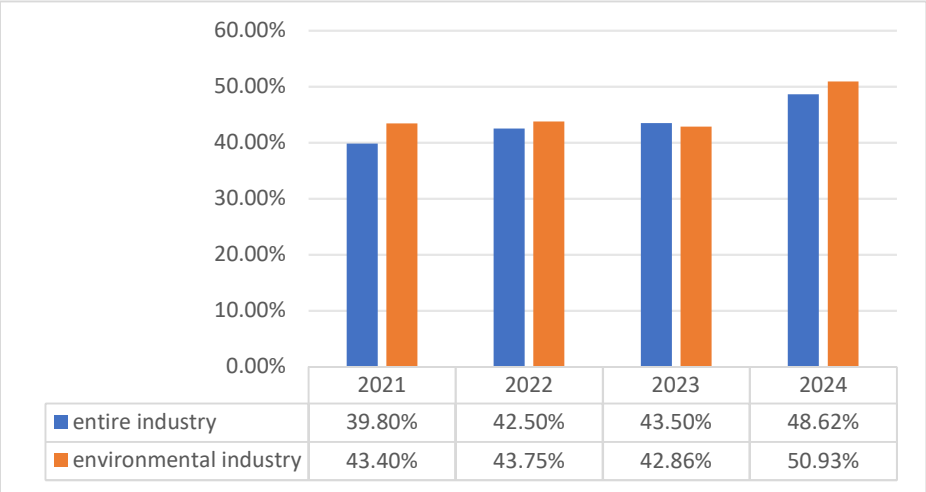

Fig. 1 Disclosure rate of information in the environmental protection industry

Second, there is a strong need to improve corporate governance. Although some enterprises scored higher on the governance dimension than the environmental dimension, there are still deficiencies. Take Tongrun Equipment as an example, its governance rating is BB. Analyzing its detailed scores in detail, Tongrun Equipment scored 59.5 in item E, with a rating of C, and a ranking of 35/63 in the industry (the scoring dimensions of item E cover climate change, resource utilization, environmental pollution, environmental friendliness and environmental management); scored 80.75 in item S, with a rating of BBB, and a ranking of 35/63 in the industry (the scoring dimensions of item S cover human capital, product responsibility, Supplier Management and Social Contribution); and a score of 76.35 on item G, with a rating of BB and an industry ranking of 52/63 (the scoring dimensions of item G relate to shareholders' rights and interests, governance structure, quality of information disclosure, governance risks, external penalties and business ethics). The main issues are insufficient protection of shareholders' rights and insufficient transparency of information disclosure.

4. Strategies and Paths

4.1. Strengthening Policy Synergies and Market Mechanism Drivers

1) Policy orientation and incentives. The government promotes enterprises to reduce emissions through legislation and financial assistance (e.g., green credit, tax incentives). For example, the Securities and Futures Commission (SFC) supports the listing and financing of green industry enterprises, improves the green financial standard system, and guides capital investment in the research and development of low-carbon technologies. Shandong Province has sold a total of 133 million tons of allowances through the carbon emissions trading market, with a turnover of 8.472 billion yuan, proving the effectiveness of the market mechanism.

2) Carbon market and green financial innovation. With the help of the regulating mechanism of the carbon trading market, enterprises have been promoted to trade carbon emission rights in order to reduce the cost of compliance. For example, power enterprises in Shandong Province have achieved a compliance rate of 100% in the national carbon market for three consecutive years, providing the industry with experience that can be drawn upon. Meanwhile, financial

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instruments such as green bonds and ESG-themed funds are being developed to optimize the financing structure. By the end of 2023, the PBoC had cumulatively disbursed funds of RMB 541 billion and RMB 274.8 billion based on carbon emission reduction tools and coal clean and efficient utilization refinancing, respectively, totaling RMB 815.8 billion. The amount of carbon emission reduction tools and coal clean and efficient utilization refinancing increased by 74.69% and 238.84%, respectively, compared with the end of 2022, which reflects the support of green finance to enterprises.

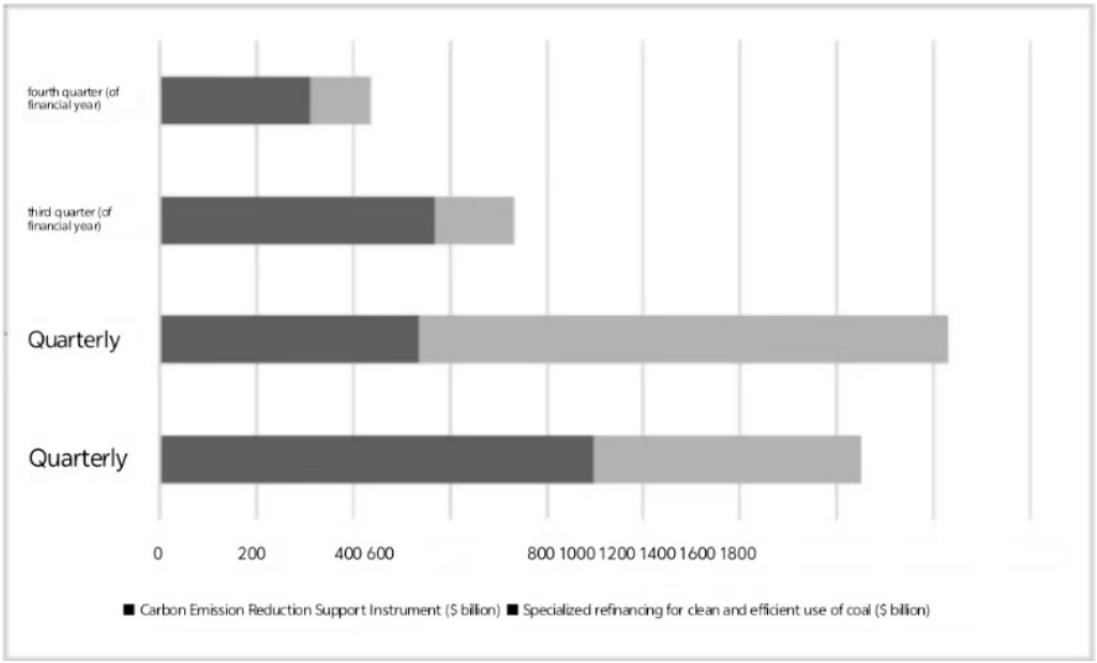

Fig. 2 Carbon Emission Reduction Support Tool and Specialized Refinancing to Support Clean and Efficient Utilization of Coal Funding by Quarter in 2023

4.2. Promote Green Technology Innovation and Energy Structure Optimization

1) R&D and application of low-carbon technologies. Increase investment in clean energy technologies, such as hydrogen energy, energy storage and carbon capture technologies. For example, ZTE Corporation has passed the SBTi 1.5°C temperature control certification, reducing its operational carbon emissions by 13.4%; Shandong promotes carbon reduction and substitution for "two high" projects, reducing carbon emissions by more than 7 million tons. The company also promoted the use of green power, for example, Guizhou Maotai achieved a reduction of 94,000 tons of carbon dioxide equivalent through green power procurement, covering 100% of its electricity demand.

2) Energy efficiency improvement and circular economy. Improve production processes and energy structures, and adopt energy-saving equipment. For example, reduce carbon emissions annually through recycled material packaging and promote greening upstream and downstream of the industrial chain. Promote a circular economy model to reduce resource consumption and waste generation. For example, designing recyclable products and enhancing material recycling.

4.3. Improvement of ESG System and Information Disclosure

1) Build a localized ESG evaluation system. With regard to the "double carbon" goal, set up evaluation indicators with local characteristics, such as the proportion of clean energy use and investment in carbon capture technology. Shandong Province revised the first provincial-level carbon emission reduction and substitution measures for "two-high" projects, providing quantitative standards for enterprises. Improve the quality of disclosure of environmental

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dimensions, in particular data on carbon emissions (including Scope 1-3). Hong Kong Exchanges and Clearing Limited requires mandatory disclosure of GHG emissions by companies, with transparency of Scope 3 data (supply chain emissions) being particularly critical.

2) Strengthen the credibility of data and the role of third-party forensics. Utilize blockchain technology to ensure the immutability of ESG data, for example, SMEs can reduce the cost of data collection through the "ESG Toolkit". Introduce third-party authentication to enhance international recognition, so as to avoid adverse impacts on ratings due to insufficient data granularity (e.g., ZTE's disclosure of intensity data for Scope 3 emission reductions only).

4.4. Supply Chain Collaboration and Full Life Cycle Management

1) Deep supply chain integration. This study requires upstream suppliers to comply with environmental standards. For example, ZTE Corporation has pushed 100 core suppliers to complete a carbon inventory and reduce the overall carbon footprint through supply chain synergy. At the management level, this study fully applies domestic and international standards and guidelines related to carbon emissions and energy, and explores applicable internalization paths. It establishes a "dual-carbon" action promotion team led by executives to coordinate major policies and strategic planning; applies TPM tools and methods, and sets up an energy-saving and carbon reduction team to implement green and low-carbon lean management; Promoting ISO 50001 energy management system certification, realizing 100% coverage of our own factories; building the "DATA" four-dimensional data system for carbon emissions, formulating carbon emission accounting guidelines, and forming the "1+4" carbon emission MRV system, which includes guidelines, monitoring, accounting, reporting, and auditing. The company has set up a carbon emission "DATA" four-dimensional data system, formulated carbon emission accounting guidelines, and formed a "1+4" system of guidelines, monitoring, accounting, reporting, and auditing to achieve "standardized accounting and standardized accounting", ensure the quality of carbon emission data is controllable, and solidify the foundation of carbon emission management.

2) Strategies for dealing with international regulatory and market barriers. In order to adapt to the new regulations of the EU supply chain review, it is necessary to strengthen the transparency of the supply chain. Specifically, the progress of traceability of conflict minerals needs to be publicly disclosed to prevent negative impacts on export markets due to compliance issues.

5. Conclusion

In the context of global economic integration, ESG ratings, as a key indicator of corporate sustainability, have had a profound impact on equipment manufacturing enterprises. Especially in green technology innovation, the ESG rating has a particularly significant driving effect.

ESG rating has a significant impact on green technology innovation. A higher ESG rating of an equipment manufacturing enterprise usually means that the enterprise pays more attention to environmental protection and social responsibility, and thus is more inclined to invest in research and development of green technology. This kind of technological innovation can meet the social demand for environmental protection and bring higher economic benefits to the enterprise. In the equipment manufacturing sector, companies usually need to invest a lot of R&D resources in energy saving, carbon reduction and environmental protection to cope with the increasingly stringent environmental requirements. In this process, the guiding role of ESG ratings cannot be ignored. Dual-carbon targets play an obvious role. During the "14th Five-Year Plan" period, the state put forward the "dual-carbon" goal, i.e. carbon peak and carbon neutral. This goal has produced a huge impetus to the equipment manufacturing enterprises. In order to realize this goal, enterprises have generally increased their investment in green technology

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innovation. Among them, companies with higher ESG ratings tend to show a stronger drive. These companies are usually able to recognize the importance of environmental protection more clearly and thus invest more actively in green technology research and development. This drive helps companies achieve sustainable development and can bring higher competitiveness to the industry as a whole. Environmental protection and green technology innovation complement each other. In the field of equipment manufacturing, there is a mutually reinforcing relationship between environmental protection and green technology innovation. Environmental protection can provide enterprises with a better living environment and reduce losses caused by environmental pollution; green technology innovation can bring enterprises higher economic benefits and competitiveness. In the process of pursuing environmental protection goals, equipment manufacturing enterprises often find new technological innovation points, thus promoting the continuous development of green technology. This virtuous circle helps enterprises realize sustainable development and can bring higher vitality to the whole industry.

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