

An Exploration of Export Green Upgrading Paths from the Perspective of Policy Shocks and Carbon Trading

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Abstract: Amid the ongoing reform of global climate governance, green trade barriers have been tightening worldwide. The combination of overseas carbon border control measures and domestic carbon trading systems has profoundly changed the development pattern of China's foreign trade, and low-carbon development has become the mainstream trend for the export industry. This article conducts research from the perspectives of policy shocks and carbon trading, integrating public data from the Ministry of Ecology and Environment, the General Administration of Customs, and the European Commission for analysis. The EU Carbon Border Adjustment Mechanism (CBAM) will be officially implemented in 2026, covering six high-carbon categories such as steel and aluminum, directly raising the overall operating costs of similar domestic export commodities. In 2024, China's domestic carbon market achieved steady trading growth, and the carbon pricing system guided enterprises to conduct energy-saving retrofits. In the same period, the export of domestic wind turbines increased by 71.9% year-on-year, and the export volume of photovoltaic products exceeded 200 billion yuan for four consecutive years. As global demand for green products continues to rise, this paper puts forward five transformation directions based on industrial realities: institutional coordination, market optimization, technological R&D, supply chain collaboration, and participation in international rule making. These findings help exporters avert green trade risks and maintain market shares, while offering practical insights for regulators to improve supporting policies.

Keywords: Policy shock, carbon trading, export green upgrading, carbon border adjustment mechanism, green trade barriers.

1. Introduction

Low-carbon development has reshaped the pattern of global trade, and carbon border policies and regional carbon trading are no longer just climate governance measures, but have now become the core rules governing cross-border trade [1]. Among numerous overseas green regulatory measures, CBAM has the most significant impact on China's export business. Low-carbon rules have become mainstream in global trade, making the traditional low-price and high-energy business model less competitive. Starting from January 1, 2026, the levy of carbon tariffs will be fully implemented.

By the end of 2024, China's domestic carbon emission trading market achieved steady expansion, with 1,471 key emission enterprises participating in quota transactions with cumulative traded quotas hitting 630 million tons, and they proactively optimized production methods under the influence of the carbon market. In 2025, the carbon market further expanded. Steel, cement and aluminum smelting were incorporated into the regulatory scope, bringing the total number of key emission units to 3,378. Thus, a sound system for carbon pricing and regulation has gradually been established across the industry.

Various carbon regulatory rules at home and abroad have reshaped the operational mode of the domestic export industry. The major trading entities in Europe and America have successively introduced carbon-trading-related clauses, and the compliance and tariff expenses of high-carbon industrial products have increased synchronously. The domestic carbon market mainly operates through quota control and market-oriented trading, requiring enterprises to include carbon emission costs in overall business accounting.

The 2024 foreign trade data fully demonstrates the advantages of green products. New energy product shipments

rose steadily, with lithium battery exports hitting a record high. Green trade maintains robust development momentum. Traditional high-carbon products still occupy part of the market, and there are obvious obstacles to industry transformation. By sorting out the internal logic of carbon policies and carbon trading, and exploring the direction of upgrading in combination with the current industrial situation, we can consolidate the foundation of foreign trade and help achieve dual-carbon goals. This article combines public policies and industry data to conduct empirical analysis and sort out practical directions that are in line with industry development.

2. Policy Shocks and the Global Development Trend of Carbon Trading

Ongoing low-carbon reforms are reshaping the landscape of global trade and carbon trading models, with carbon control policies implemented in many countries around the world and various pilot projects being promoted in an orderly manner. Low-carbon requirements have become standard constraints for cross-border trade [2]. CBAM is a widely used carbon regulatory tool internationally, with outstanding research value. The mechanism entered a transitional period in October 2023, during which companies were required to declare product carbon footprint data on a quarterly basis, including direct and indirect emissions. Enterprises did not need to pay carbon fees during this period. The carbon tariff will be officially imposed in January 2026, and the EU plans to expand its regulatory scope to include downstream industries such as steel and aluminum in its management. This mechanism is aligned with Corporate Sustainability Due Diligence Directive (CSDDD), which took effect in July 2024, requiring multinational corporations to compile carbon

emission data for their supply chains and increasing the complexity of industry regulations. The UK plans to introduce a similar carbon border policy in 2027, while the relevant bill in the US Congress is still under review. Carbon pricing has become a key factor reshaping global trade patterns.

Many economies have built sophisticated carbon trading platforms, and the EU Emissions Trading System (EU ETS) boasts the largest trading volume globally. The average auction price of this system in 2024 was 64.74 euros/ton, a decrease from 83.60 euros/ton in 2023 [3]. Large carbon price differences among regions lead to different operating costs for exporters, forming invisible barriers to global trade. The national carbon emission trading system in China was officially launched in July 2021. Based on the data from the Ministry of Ecology and Environment in 2024, the domestic carbon market has been operating steadily throughout the year, and participation enthusiasm has grown steadily.

Except for mandatory carbon markets, voluntary carbon trading businesses in various countries are being carried out in an orderly manner. China's Certified Emission Reductions (CCER) mechanism was restarted in September 2024, and the first batch of 9 projects were registered in March 2025, with a total emission reduction of 9.48 million tons. This mechanism enables enterprises to offset carbon emissions and activate existing green assets, and cross-border carbon credit trading has become a new direction for the industry. The Hainan International Carbon Emission Trading Center has completed the first cross-border carbon trading in China, and multiple coastal areas are exploring ways to connect with the international carbon credit system. Low-carbon criteria have become mainstream in global trade, making the traditional high-energy and low-price model uncompetitive.

3. The Pressure and Challenges of Green Transformation in China's Export Trade under Policy Shocks

With deeper integration of global climate governance and trade rules, CBAM-related cross-border carbon policies have become more stringent. The related impact is no longer limited to a single high-energy-consuming industry, but extends to the entire upstream and downstream supply chain. Many domestic export-oriented manufacturing enterprises have faced multiple operational challenges in their transformation. The EU has included six high-emission industries in the first regulatory list of CBAM, which are also China's main export products to the EU. In 2022, the export volume of these products to the EU reached 199.6 million euros, and China is the largest source of imports for this category in the European Union. According to research data from the China Iron and Steel Industry Association in 2024, issues such as carbon data reporting and hidden carbon costs continue to increase the export costs of steel companies, leading to shrinking profit margins and declining price competitiveness in overseas markets.

Rising costs are only part of the industry's challenges, as domestic enterprises generally lack a comprehensive carbon compliance system. CBAM requires export enterprises to establish a full-process carbon footprint traceability system and obtain international third-party certification. China issued GB/T 24067-2024 Greenhouse Gases—Product Carbon Footprint—Quantification Requirements and Guidelines, but there are still loopholes in the detailed carbon accounting

rules for the main export products [4]. According to statistics from June 2024, there are only 15 verification agencies with CNAS accreditation and international mutual recognition qualifications. Hiring overseas certification institutions will increase audit costs and extend review cycles, further increasing operating costs.

The lack of smooth supply chain data further increases the difficulty of enterprise transformation. Most domestic export manufacturing enterprises are concentrated in the core areas of foreign trade such as the Yangtze River Delta and the Pearl River Delta, and have long been in the middle of the global value chain. Since most upstream small and medium-sized processors lack standardized carbon accounting records, downstream firms struggle to calculate full life-cycle product carbon footprints and comply with overseas declaration standards. Due to capital shortages and insufficient technological capabilities, small and medium-sized exporters struggle to procure professional emission reduction equipment and build dedicated carbon compliance teams.

The current global green trade rules are still being steadily updated, with numerous new regulations added. Enterprises need to assign dedicated staff to track and interpret relevant rules for a long time, which inevitably raises operating burdens for small and medium-sized enterprises.

Cost pressures, technical bottlenecks and compliance burdens collectively restrict the green transformation of export industries [5].

4. The Mechanism and Impact of Carbon Trading on the Green Upgrading of Export Enterprises

Divided into pricing, quota management and quota revenue models, China's domestic carbon trading market drives enterprises to pursue comprehensive green transformation from multiple levels such as production, planning, and foreign trade, and the market influence covers all aspects of enterprise operation. The carbon price is directly related to the environmental protection expenses of enterprises, and the environmental costs that were originally difficult to quantify are now accounted for as operating expenses through publicly traded prices. In 2024, the domestic carbon price exceeded 100 yuan/ton for the first time, and the average trading price for the whole year of 2025 was 62.36 yuan/ton. The higher an enterprise's carbon emissions, the more carbon quotas it must surrender, leading to a rise in operating pressure. High-carbon foreign trade enterprises also proactively optimize their production methods and reduce carbon emissions per unit product [6].

Quota management imposes rigid cost constraints on enterprise production. According to the Interim Regulations on the Administration of Carbon Emission Trading (State Council Decree No. 775), the Ministry of Ecology and Environment allocates annual carbon quotas to key emission enterprises. Enterprises that fail to fully surrender their quotas will be fined 5 to 10 times the carbon price, and those who refuse to rectify will be ordered to suspend production. Constrained by rules, the competitiveness of traditional high-energy consumption production models continues to decline. After long-term practice, carbon trading has gradually transformed the business logic of enterprises, and foreign trade enterprises in multiple pilot areas have included low-carbon indicators in the assessment scope of production line transformation and new product research and development.

Carbon trading also has an incentive effect. By upgrading technologies, optimizing energy structures and achieving emission reductions, enterprises can profit from surplus carbon quota transactions. In June 2026, China National United Petrochemical sold 1,000 tons of carbon quotas, generating a profit of 104,000 yuan. This income can supplement research and development funds and promote the implementation of energy-saving and carbon reduction technologies. The practice of leading domestic manufacturing enterprises has proven that after participating in carbon trading, their investment in green technologies has significantly increased, and the application scenarios of low-carbon processes, new energy, carbon capture and other technologies continue to expand [7].

In the international market, products with formal carbon footprint certification are more popular among overseas buyers. Companies such as LONGi Green Energy and Zhangxuan Technology rely on low-carbon products to sustain their overseas market positions. Carbon trading has both constraint and incentive properties, promoting foreign trade enterprises to shift from passive carbon abatement to active green upgrading, enhancing their ability to respond to EU policies such as CBAM, and underpinning the steady growth of China's export business.

This market-oriented regulation model is gradually guiding the industry to establish a long-term low-carbon concept, transforming green development from a short-term task to a normalized business goal for enterprises.

5. A Feasible Path for Policy and Market Synergy to Drive Green Upgrading of Exports

Policy guidance and carbon trading markets complement each other, and various entities jointly promote the green upgrading of export industries. Based on the domestic industrial foundation and the current situation of foreign trade, the industry is working in five directions: institutional coordination, market optimization, technological upgrading, supply chain construction, and international cooperation. All measures are implemented in an orderly manner based on existing policies and market foundations.

The improvement of supporting services is an important support for the green transformation of foreign trade. Relevant departments including commerce, ecology and environment, and customs strengthen cooperation to integrate public services such as carbon accounting, compliance declaration, and policy interpretation for export enterprises, reducing the pressure on enterprises to cope with overseas green rules. Multiple export-oriented cities have established comprehensive service platforms, connected to industry carbon emission databases, and provided free simple carbon footprint accounting services for small and medium-sized enterprises, effectively reducing compliance costs.

With the continuous improvement of supporting services and the continuous optimization of the national carbon market, the constraint effect of market-oriented emission reduction is becoming increasingly evident [8]. In March 2025, steel, cement, and aluminum smelting were included in the carbon market control, and the carbon emission coverage ratio was increased from 40% to over 60%. At present, quotas are allocated through a combination of free and paid methods, and carbon prices can truly reflect the cost of emission reduction, guiding the orderly transformation of high-carbon

industries. Industry leaders have taken the lead in completing low-carbon transformation, using carbon trading to reduce costs and increase efficiency, providing practical experience for industry enterprises to learn from.

Market constraints drive the industry to value technological innovation, which is also the key to cultivating export competitive advantages [9]. Photovoltaics, new energy equipment, and energy-saving and environmentally friendly products are the main export categories in China, and related enterprises are steadily increasing their research and development investment to maintain international competitiveness. Traditional high-carbon industries are synchronously updating their processes to gradually reduce the carbon emissions of existing products.

Individual enterprises cannot achieve satisfactory decarbonization results through technological upgrades alone. Collaborative carbon reduction in the supply chain is necessary to fundamentally optimize product carbon indicators. Leading exporters pass down carbon management requirements to upstream and downstream partners and promote carbon accounting and energy-saving transformation across the entire supply chain. Liugong, Geely and other enterprises have built a full life-cycle green supply chain, and the actual operational effect is outstanding.

After completing the internal carbon reduction layout of the industry, aligning with global rules has become a new focus of work. China continues to deepen international exchanges, using multilateral platforms to convey industry demands and promote mutual recognition of international carbon credit and certification systems. China has established a carbon emissions trading market open alliance with Brazil and the European Union to create a fair international business environment and enhance the ability of enterprises to respond to carbon border policies.

6. Support System and Safeguard Measures for Green Upgrading of Exports

The green transformation of foreign trade covers multiple fields, and the industry needs to establish a complete support and guarantee system. The whole industry needs to address deficiencies in policies, services, technology, talent and risk management, ensuring the orderly progress of transformation work [10].

The country steadily optimizes the linkage mechanism between low-carbon standards and foreign trade policies. Relevant competent departments refer to international common rules to promote the compilation and updating of national standards related to export carbon footprint and carbon emissions, and narrow the gap between Chinese and foreign standards. Multiple financial and tax support policies have been introduced domestically, focusing on assisting small and medium-sized foreign trade enterprises with weak resistance, reducing the cost of green transformation and boosting enterprises' enthusiasm for green transformation.

Local authorities integrate public resources and optimize the layout of carbon-related supporting services, support the development of local carbon verification and certification institutions, break the monopoly of foreign institutions, and reduce communication costs. Domestic financial institutions have innovated carbon finance categories and launched services such as carbon quota pledge and green credit.

The sector relies on industry-university-research

cooperation to implement technological upgrades. Universities, research institutes, and leading enterprises jointly tackle core technologies such as low-carbon manufacturing and carbon capture. Mature energy-saving and carbon reduction technologies are widely promoted across the market. Meanwhile, public technology platforms are accessible to small and medium-sized enterprises, cutting green technology costs via equipment and process sharing.

The industry provides tiered training covering carbon accounting and cross-border compliance for both practitioners and corporate managers. Professional industry experts provide long-term consulting services to address talent shortages in the carbon industry.

The competent department monitors changes in global green trade policies in real-time and establishes a dynamic monitoring system. The EU carbon border adjustment mechanism has entered the formal collection stage. Relevant authorities track updates to carbon regulations worldwide, issue risk warnings according to industries, guide enterprises to adjust their business layout and product structure, and avoid international trade barriers.

Various regions are actively advancing the cooperation mechanism between governments and industrial parks, relying on the centralized integration of various public resources in industrial parks to provide one-stop comprehensive services for foreign trade enterprises settling in [11]. Industry associations have also taken the initiative to develop practical guidelines to help enterprises quickly understand policy details and implement related work, comprehensively consolidate the guarantee foundation of green transformation, and assist enterprises in smoothly passing through the transformation period.

7. Conclusion

Driven by international carbon regulations and domestic carbon trading mechanisms, China's export industry is undergoing profound green transformation. The two major influencing factors not only increase the operating and compliance costs of enterprises, but also prompt enterprises to phase out backward production modes, bringing new development opportunities for low-carbon products and green manufacturing. According to monitoring data from the General Administration of Customs, the Ministry of Ecology and Environment, and industry associations, China's green transformation of exports has shown initial results, and the export volume of low-carbon products such as photovoltaics and new energy has steadily increased. The slow transformation of traditional high-carbon industries and insufficient risk resistance of small and medium-sized foreign trade enterprises are long-term practical problems that the industry needs to face. The green transformation of foreign trade cannot rely solely on administrative control or spontaneous market regulation. Policies and markets need to be synchronized. Based on the current situation of the foreign trade industry, this article outlines five major transformation paths and supporting guarantee plans, covering five directions: system, carbon market, technology, supply chain, and international cooperation. All plans are designed based on the domestic industry and policy status, and have strong practicality. In the process of promoting transformation, the government, enterprises, and industry associations have different roles and focuses: the government improves industry standards and optimizes public services; Export enterprises should follow the international low-carbon trend and

complete technological upgrades and carbon management construction; Industry associations integrate various resources to guide the industry towards self-regulatory development and overall improvement. Low-carbon global trade has become a long-term trend, and the domestic and foreign trade industries need to steadily strengthen their green development capabilities, proactively connect with international rules, and participate in the construction of the global green system based on industrial advantages. While advancing the dual-carbon goals, the sector will keep improving trade quality and maintain long-term stable development. In the future, it is necessary to steadily optimize the coordination mechanism between policies and the market, upgrade supporting services, and further enhance China's comprehensive competitiveness in the global low-carbon field of foreign trade.

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