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THE STRATEGIC INTERACTION BETWEEN CHINA'S CARBON POLICIES AND ENTERPRISE GREEN SUPPLY CHAIN DECISIONS FOR SUSTAINABLE TRADE COMPETITIVENESS

Jin Jun¹ | Akhmad Saufi²

¹ Faculty of Economic and Business, University of Mataram, Indonesia
 Corresponding author: jinjun000000@163.com

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Abstract

The worldwide transition to low-carbon trade requires a thorough comprehension of how governmental environmental regulations influence corporate strategic adaptations to preserve international competitiveness. This research, conducted via a Systematic Literature Review (SLR), consolidates 16 articles pertaining to China's dual-carbon policies and enterprise supply chain management within the period from 2024 to 2025. The study aims to elucidate the mechanisms by which policy instruments interact, how firms strategically adapt across various sectors, and how these dynamics influence sustainable trade results. Findings establish the principle of Strategic Policy Co-governance, demonstrating that policy effectiveness depends on the coordinated application of instruments (market mechanisms, subsidies, and taxes) adapted to particular technological phases. Enterprise response entails a pivotal strategic decision between remanufacturing and recycling versus technological enhancement, complemented by the utilization of digital transformation and carbon information disclosure as key competitive drivers. The conclusion is that sustainable trade competitiveness emerges as a property of a co-governance equilibrium involving multiple stakeholders, a system maintained by well-defined governmental constraints that incentivize firms to adhere strategically and promote resilience within supply chains. This synthesis provides essential strategic insights for policymakers and managers operating within the intricate realm of global environmental trade governance.

Keywords: Strategic Policy Co-governance, Sustainable Trade Competitiveness, Green Supply Chain, Digital Transformation, Emissions Trading

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1 Introduction

The recent global transition to low-carbon development has transformed the competitive dynamics of international trade, necessitating the incorporation of environmental governance into economic strategies by nations (Mukherjee & Chakraborty, 2016). China, the largest manufacturing and exporting nation

globally, encounters increasing pressures from carbon-related trade barriers, such as the EU's Carbon Border Adjustment Mechanism (CBAM) and more rigorous sustainability requirements from key international markets (L.-X. Zhang et al., 2024). The Chinese government has expedited the establishment of a comprehensive carbon governance framework (Yu et al., 2025), which includes carbon pricing, emissions trading systems, carbon taxation (N. Wang & Chang, 2014), dual-credit policies for the automotive sector, and specific green subsidies (Shao et al., 2025). The policies are designed to decrease domestic emissions while simultaneously improving China's long-term trade competitiveness through the promotion of enterprise-level innovation and the transition to green supply chains (J. Zhu et al., 2025). Examining the interaction of these policies with corporate decision-making is essential for assessing China's capacity to uphold and enhance its position in global trade amidst evolving environmental standards.

Recent studies indicate that government carbon policies significantly impact enterprise behavior (Mu & Zhao, 2023), influencing decisions related to production processes, technology upgrades, supply chain coordination (L. Zhang et al., 2024), and pricing strategies (C. Wang et al., 2017). Market-based mechanisms, including carbon cap-and-trade, Energy-Consuming Rights Trading (ECRT), and emissions quotas, modify cost structures, prompting firms to realign their investment priorities and operational decisions to achieve compliance and gain competitive advantage. (Tvinnereim & Mehling, 2018) Agent-based modeling studies reveal increased efficiency and decreased carbon intensity in the context of strategic quota trading schemes. Carbon tax revenue recycling and green financial incentives can accelerate technological progress by mitigating investment risks, particularly in the context of macroeconomic uncertainty (Y. Zhu et al., 2018). The findings indicate that Chinese enterprises are increasingly perceiving carbon governance as a catalyst for modernization, cost optimization, and market differentiation rather than a constraint.

The relationship between government regulation and enterprise strategy is increasingly intricate, encompassing various stakeholders and developing models of co-governance. Research on ecosystem service payments, consumer-driven quality assurance, and cooperative innovation alliances demonstrates that the transformation of sustainable supply chains is not solely the responsibility of enterprises; it arises from the collaborative efforts of government agencies, firms, cooperatives, and consumers (Luan et al., 2025). Policies like the dual-credit system in the new energy vehicle (NEV) sector illustrate how regulation can promote collaborative innovation, allowing firms to share resources, co-develop technologies, and stabilize market positions in emerging green industries (Jun et al., 2024). Evolutionary game analyses indicate that firms' behavioral responses are significantly influenced by the structure of incentives and penalties (He et al., 2025). This suggests that the effectiveness of carbon policies is contingent upon their alignment with corporate motivations and the reduction of free-riding behaviors. This expanding research indicates that China's low-carbon transition is primarily a multi-actor process influenced by strategic interactions rather than unilateral compliance.

Despite these developments, the current body of literature continues to be fragmented and inadequately consolidated. Numerous studies concentrate on individual policy instruments or analyze enterprise strategies within particular sectors, leading to limited cross-sectoral integration and an incomplete comprehension of how carbon governance mechanisms collectively impact trade competitiveness

(Labaran & Masood, 2025). This fragmentation obstructs the recognition of systemic mechanisms that connect government policy interventions with enterprise strategic modifications and international trade outcomes (Du et al., 2023). Furthermore, most existing studies predominantly depend on theoretical modeling and simulation, with comparatively limited empirical data documenting real-time corporate responses to China's swiftly developing carbon governance framework. In particular, the crucial period from 2021 to 2025 characterized by the rapid expansion of the national carbon market and the implementation of more rigorous policy measures—has not been adequately studied through longitudinal or comprehensive analyses.

Accordingly, the main aim of this study is to synthesize existing empirical and conceptual research in order to elucidate the mechanisms by which government carbon policies and corporate strategies co-evolve within China's trade system. The study seeks to identify overarching patterns of strategic adaptation, evaluate responses across sectors, and generate insights into effective co-governance strategies that promote sustainable and competitive trade outcomes. In addition, this study examines China's carbon governance and corporate strategic adaptations within the framework of international trade, with specific emphasis on manufacturing, energy-intensive industries, and emerging sustainable sectors. The temporal scope highlights the interval from 2021 to 2025, representing a phase characterized by intensified policy execution and market expansion. As a synthesis-oriented study, the analysis is constrained by the extent and scope of existing literature and does not encompass original empirical data collection. Nonetheless, the research possesses considerable scholarly and practical significance. Academically, it advances the field by synthesizing disparate research strands into a unified analytical framework. Practically, it provides policy-relevant insights for developing carbon governance frameworks that harmonize regulatory goals with enterprise incentives, thereby promoting sustainable trade competitiveness.

Guided by these objectives, this study employs an integrative research framework that conceptualizes sustainable trade competitiveness as the result of dynamic interactions among government carbon policies, corporate strategic responses, and multi-actor co-governance mechanisms. Within this framework, policy instruments influence enterprise decisions concerning production, investment, and supply chain coordination, while enterprise responses contribute to policy effectiveness and trade performance. This framework offers a systematic foundation for synthesizing existing research and examining how coordinated policy–enterprise interactions can foster resilient, low-carbon, and competitive trade systems in China.

2 Method

This study employed a systematic literature review (SLR) methodology guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 framework to assure transparency, rigor, and reproducibility. The review process consisted of a two-phase screening procedure, beginning with an initial assessment of titles and abstracts, followed by a comprehensive full-text review, both conducted independently by two examiners to reduce potential selection bias. The literature search was conducted solely through the Scopus database because of its extensive coverage of reputable, peer-reviewed journals. A comprehensive search string focusing on government policies, corporate strategies, and trade-related topics was utilized, restricting inclusion to peer-reviewed English-language articles

published between 2021 and 2025 that concentrate on China. Non-peer-reviewed sources, conference proceedings, and studies deemed irrelevant to strategic trade management were omitted. From an initial collection of 163 articles, 16 studies fulfilled the eligibility criteria and were incorporated into the final analysis. Data were methodically collected utilizing a standardized form that records authorship, methodology, and principal findings. The selected studies were synthesized using thematic analysis, which involved iterative classification, pattern recognition, and theme development, facilitating the identification of prevalent strategic models, policy-enterprise interactions, and research gaps within China's trade management literature.

3 Results and Discussions

This section presents the findings and discussion from the 16 peer-reviewed studies that employed primary data and met the inclusion criteria of this review. The analysis is organized around principal themes derived from the data, demonstrating the strategic policies, interplays of the policies and the impacts on China's international trade competitiveness. The limited number of studies results from the stringent inclusion criteria (peer-reviewed, primary data, 2021-2025, Scopus indexed, China). This enhances methodological rigor while diminishing the total count of eligible research. Table 1 provides a summary of the selected investigations.

Research Cluster	Included Studies & Concluding Findings
Policy & Fiscal Mechanisms (Subsidies, Taxes, & Incentives)	Wang et al. (2025), Mao et al. (2025), Chen et al. (2025), Yang et al. (2025), and Zhang et al. (2025) all emphasize that optimal government intervention specifically through reward/punishment mechanisms, subsidies, and carbon tax recycling is essential for stabilizing green M&A, maximizing recycling efficiency, and incentivizing S&T innovation platforms ² .
Collaborative & Multi-Agent Governance	Pan et al. (2025), Zhang et al. (2025), Sun et al. (2025), Zhou et al. (2025), and Chang et al. (2024) highlight that achieving net-zero goals and stable green production requires a robust, multi-party framework involving the government, firms, media, and public participation to manage behavioral drivers and social networks ³ .
Resource & Supply Chain Optimization	Han et al. (2025), Leng et al. (2025), and Wu et al. (2025) focus on operational strategies, finding that Energy Consuming Rights Trading (ECRT), blockchain integration, and strategic choices between remanufacturing versus technology upgrading drive sustainable transitions in high-consumption industries ⁴ .
Digitalization & Information Transparency	Xu et al. (2025) and Yang et al. (2024) demonstrate that carbon information disclosure and digital transformation are key drivers in reducing emission intensity and enhancing corporate financial performance by reducing information asymmetry ⁵ .
Sector-Specific Constraint Mechanisms	Li et al. (2024) specifically identifies that within the tourism sector, strong governmental constraint mechanisms are the primary requirement to ensure stable stakeholder participation in carbon offsetting ⁶ .

3.1 Policy Interaction: Technology-Dependent Instrument Synergy

The results indicate that policy efficacy is realized via the combined application of market-oriented

instruments and financial inducements, with the selection of specific instruments being contingent upon the technological advancement or strategic objective of the relevant industry. Market-based instruments, such as Energy Consuming Rights Trading (ECRT), have demonstrated empirical efficacy in attaining macro-level reduction targets within dual constraint frameworks (Han et al., 2025). The efficacy of carbon allowance mechanisms is, however, significantly influenced by micro-level behavioral considerations, including corporate risk preferences, thereby necessitating behavioral governance to ensure market stability (Zhang et al., 2025). Fiscal instruments should also be customized. The most effective allocation of carbon tax revenue necessitates alignment with technological objectives, emphasizing subsidies that promote both high rates of innovation (technological evolution) and broad-based adoption (technology diffusion), as detailed by Yang et al. (2025). Empirical findings further support this differentiation, demonstrating that direct subsidies are a more effective mechanism than taxation in accelerating the market adoption of environmentally friendly products, such as bioplastics (Chen et al., 2025). Moreover, strategic subsidies are crucial for promoting the advancement of Science and Technology (S&T) innovation platforms, which offer fundamental support for green technologies (Zhang et al., 2025). These platforms ultimately facilitate firms' low-carbon transition strategies through policy-driven incentive structures (Wang et al., 2025). This concerted strategy necessitates the harmonization of governmental intervention methodologies with the deployment of blockchain technology to augment sustainable practices within resource-intensive sectors (Leng et al., 2025).

3.2 Strategic Firm Response: The Dual Imperative of Operations and Transparency

Companies confronted with emerging carbon regulations are compelled to make essential, strategic decisions regarding operational procedures and market positioning, frequently harmonizing primary production techniques with supporting digital technologies. Under carbon cap-and-trade systems, organizations encounter a pivotal operational challenge, necessitating a strategic decision to prioritize either substantial investments in recycling and remanufacturing (a circular economy approach) or internal technological enhancements (an efficiency approach) as their main method for reducing emissions (Wu et al., 2025). This decision directly influences their cost competitiveness. Furthermore, optimizing battery recycling efficiency in sectors such as New Energy Vehicles (NEVs)—a vital objective within the supply chain—necessitates intricate coordination and the implementation of optimal policies across various enterprise types (Mao et al., 2025). Beyond operational activities, strategic compliance is significantly facilitated through digitalization and enhanced transparency. Digital transformation has been demonstrated to decrease the intensity of corporate carbon emissions (Yang et al., 2024), thereby providing a contemporary competitive advantage. Crucially, Carbon Information Disclosure (CID), although incurring costs, improves financial performance in highly polluting industries by mitigating information asymmetry and securing essential government and regulatory backing (Xu et al., 2025), thereby converting transparency into a strategic advantage.

3.3 Sustainable Trade Outcomes: The Imperative of Co-governance and Systemic Resilience

The ultimate result of sustainable trade, defined by system stability and resilience, fundamentally relies on establishing a balanced co-governance among multiple stakeholders, guided by both constraints and incentives. Stability in corporate green strategies, including Green M&A initiatives and broader green production practices, is attained through stable tripartite or quadripartite evolutionary game equilibriums involving the government, enterprises, the public, and the media (Sun et al., 2025; Chang et al., 2024).

These models affirm that achieving net-zero emissions necessitates organic, collaborative governance rather than exclusive governmental authority (Zhou et al., 2025). Attaining high-quality voluntary environmental regulation similarly necessitates a committed four-party co-governance framework (Pan et al., 2025). Although incentives influence behavior, robust governmental constraint mechanisms are frequently essential to initiate and sustain the active, stable engagement of all stakeholders (Li et al., 2024). This multi-party collaboration, in conjunction with strategic policy alignment, guarantees that enterprises attain competitive compliance, ultimately resulting in a more resilient and collaboratively managed supply chain capable of supporting trade outcomes.

To find the research trend of the current title, the researcher provides a graph containing the frequency of the research within five years from 2021-2025 as displayed below.

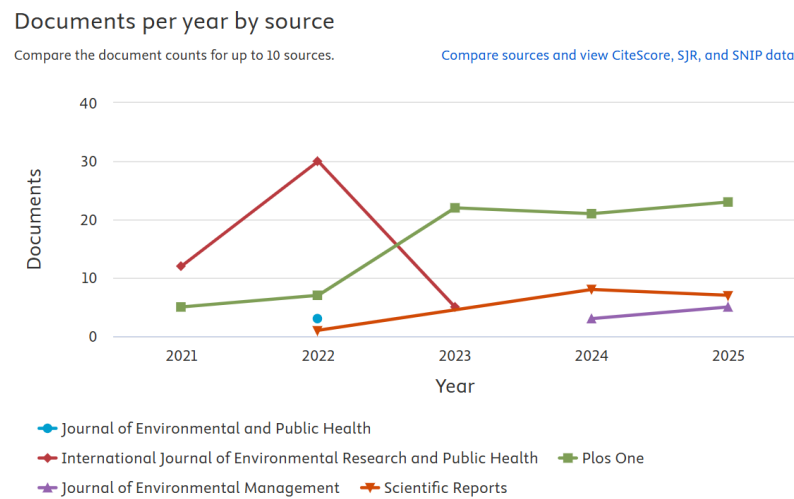


Figure 3.1 Trend of Articles Publication from 2015 to 2025

The publication trends illustrated in the graph demonstrate a marked increase in scholarly focus on the strategic interplay between China's carbon policies and corporate green supply chain decisions, especially from 2021 to 2025, reflecting the broader academic response to China's expedited development of its national carbon market and dual-carbon objectives. The significant increase in publications in multidisciplinary journals such as PLoS One and Scientific Reports from 2023 onward indicates a transition from descriptive policy evaluation to more analytical and model-driven research that investigates how firms strategically adjust their production, innovation, and coordination practices in response to carbon pricing, emission caps, and government subsidies. Conversely, the reduction in output from public-health-focused journals such as the International Journal of Environmental Research and Public Health following its 2022 peak signifies a shift in discourse toward economics, supply chain management, and environmental engineering, rather than encompassing broader societal impacts. The steady rise in contributions from the Journal of Environmental Management further emphasizes an increasing focus on integrating environmental governance with operational decision-making, illustrating how carbon regulations influence cost structures, technology implementation, and international trade competitiveness. Overall, the changing pattern of publications across journals indicates that research on the nexus between China's carbon policy and supply chain is becoming progressively more specialized,

quantitatively rigorous, and strategically focused, underscoring its growing importance in fostering sustainable industrial transformation and enhancing international trade performance.

3.4 Implications of the Study

The research enhances the theoretical understanding of environmental governance by confirming and elaborating upon a Co-governance framework. This model demonstrates that the stability and efficacy of corporate green strategies are emergent properties of a collective, multi-party evolutionary equilibrium, requiring a departure from conventional single-policy assessment. Furthermore, the analysis emphasizes the essential importance of incorporating non-rational behavioral factors (such as risk preferences) directly into economic models of market mechanisms. Ignoring these micro-level influences can result in substantial distortions and inefficiencies within carbon markets, thereby challenging the validity of purely rational-actor assumptions.

In terms of policy, the findings necessitate the discontinuation of homogeneous "one-size-fits-all" approaches. Policy should incorporate instrument differentiation and sequencing, employing subsidies to promote technological innovation (evolution) while reserving income subsidies for the widespread market dissemination of existing green technologies. Critically, in order to stabilize the co-governance system, policymakers must implement robust governmental constraint mechanisms to ensure active participation from all stakeholders, thereby establishing cooperative stability on a solid regulatory foundation. Lastly, the findings advocate for the integration of regulatory objectives with digital infrastructure, aligning government initiatives with technologies such as blockchain to improve supply chain transparency and operational efficiency in resource-intensive sectors.

For managerial practice, the synthesis delineates a definitive dual operational requirement. Managers are required to regard the decision between remanufacturing/recycling and technology upgrading as a core strategic consideration within carbon cap-and-trade frameworks, as this choice significantly influences long-term cost dynamics and competitive advantage. This strategic decision must be complemented by a dedication to transparency: corporate leaders should regard Carbon Information Disclosure as a strategic asset, as it is demonstrated to reduce market risks, improve financial performance, and garner vital political backing. Ultimately, the evidence necessitates investment in digital transformation, affirming its position as the most effective facilitating technology for lowering carbon intensity and maintaining a competitive advantage in global sustainable commerce.

3.5 Future Recommendations

Future investigations should emphasize the validation and development of co-governance models through comprehensive empirical methodologies. This necessitates a crucial transition from solely theoretical and simulation-based modeling to extensive, longitudinal empirical analysis utilizing real-world firm-level and transaction-level data to verify the causal relationships between particular policy combinations and corporate responses over time. To ensure practical relevance, research must incorporate geospatial analysis to address the varied implementation of policies and outcomes across diverse geographic and industrial regions. Furthermore, the scope should be broadened internationally through the development of models that explicitly simulate the strategic adaptations necessary to mitigate the effects of significant foreign environmental policies, such as the European Union's Carbon Border Adjustment Mechanism

(CBAM), on various Chinese export sectors. This will require the integration of global trade models with the domestic co-governance frameworks outlined in this synthesis. Finally, scholars should enhance their understanding of systemic resilience by examining the dissemination of strategic decisions and policy modifications among interconnected industries, quantifying how alterations in a single supply chain sector generate ripple effects that either promote or hinder sustainability throughout the larger industrial network.

4 Conclusion

The synthesis of modern literature regarding the strategic interplay between China's carbon policies and corporate green supply chain decisions predominantly asserts that the country's ability to maintain and improve its global trade competitiveness depends on the effective execution of a Strategic Policy Co-governance framework, transcending disjointed, singular policy methods. This co-governance concept is based on three essential and interconnected mechanisms: The effectiveness of government intervention is contingent upon the strategic differentiation and synergy of policy instruments, wherein market mechanisms, such as emissions trading, are reinforced by mitigating behavioral risks, and fiscal incentives, including subsidies and taxes, are meticulously timed and directed to either promote technological innovation or expedite market diffusion, necessitating a sophisticated governmental role. Corporate compliance is influenced by a significant strategic duality in operational decisions, necessitating firms to prioritize either the development of comprehensive recycling and remanufacturing systems or the ongoing enhancement of technology to meet emissions reduction objectives; this decision is fundamentally bolstered by non-operational facilitators such as Digital transformation to enhance efficiency and proactive carbon information disclosure to obtain regulatory and financial support, so converting compliance into a competitive advantage. The ultimate achievement of systemic supply chain resilience and sustainable trade stability is realized solely through the establishment of a multi-stakeholder co-governance equilibrium. This state is initiated and sustained by clear, firm governmental constraint mechanisms that compel cooperation and ensure participation across complex, multi-entity supply chains, thereby providing the robust collective enforcement necessary to withstand escalating geopolitical and climate-related shocks and secure China's long-term position in the global sustainable economy.

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Ethical Considerations

Not Applicable

Conflict of Interest

The Authors declare there is no conflict of interest.

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