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Analysis of the Impact of Technological Innovation on Carbon Emission Efficiency in the Logistics Industry

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Abstract: Under the goals of carbon peaking and carbon neutrality, technological innovation stands as a key driver for the logistics industry's low-carbon transformation, significantly enhancing its carbon emission efficiency. This study utilizes panel data from 30 Chinese provinces (2013 - 2022) to measure technological innovation levels and logistics carbon emission efficiency. By applying the fixed effect model and examining mediating effects, the research uncovers three main findings: Firstly, during the study period, logistics carbon emission efficiency in China generally declined from east to west. Secondly, technological innovation notably improves logistics carbon emission efficiency, with more pronounced emission reduction effects in eastern and western provinces. Thirdly, technological innovation indirectly boosts logistics carbon emission efficiency through industry agglomeration and structural upgrading. These results highlight the importance of regional considerations and technological advancements in promoting sustainable development in the logistics sector.

Keywords: Technological Innovation; Carbon Emission Efficiency of the Logistics Industry; Agglomeration of the Logistics Industry; Upgrading of the Logistics Industry Structure.

1. Introduction

The construction of an ecological power and the green transformation and upgrading of the economic development model are of profound significance for building a modern pattern of harmonious coexistence between humans and nature. The implementation and application of the "dual carbon" strategy serve as an important trigger for achieving this goal. As an industry with broad comprehensiveness and strong interconnection, the logistics sector emits a large amount of CO_2 due to large-scale tourism activities and horizontal industrial linkages. Therefore, the green development model of the tourism industry has become the main battlefield for the implementation of the "dual carbon" strategy. Technological innovation is an important way to promote industrial transformation and upgrading and productivity development. Green technological innovation is the primary approach to achieving the "dual carbon" goals in the new era. Relevant studies have shown that technological innovation can help reduce the total carbon emissions of the logistics industry and thereby lower the carbon emission intensity. However, the impact of technological innovation on the carbon emissions of the logistics industry has not yet been explored. Therefore, from an empirical perspective, exploring the influence mechanism of provincial technological innovation on the carbon emission efficiency of the logistics industry can provide theoretical and practical references for exploring the path of technological reduction of carbon emissions in the logistics industry and achieving high-quality development of the logistics industry under the "dual carbon" goals.

Regarding the interaction between technological innovation and carbon emission efficiency, the main focus is on their mutual influence. From the vantage point of examining the influence of technological innovation on carbon emission efficiency[1], divergent viewpoints exist among scholars. Some posit that technological innovation fosters a reduction in carbon emissions, as it facilitates the effective substitution of traditional energy sources with cleaner alternatives. This transition, in turn, diminishes both the cost and volume of carbon emissions[2,3]. Conversely, other scholars contend that the carbon emission implications stemming from technological innovation-driven economic growth outweigh its inherent carbon reduction benefits, thereby suggesting that technological innovation may, to a certain extent, exacerbate carbon emissions. Additionally, a subset of scholars asserts that the "rebound effect" engenders a notable surge in output levels, carbon emissions, and energy consumption, rendering the relationship between technological innovation and carbon emission efficiency indeterminate. In terms of scrutinizing the impact of technological innovation on carbon emission efficiency, scholars have undertaken empirical investigations into the interplay between these two variables from global, national, and provincial standpoints[4]. They have employed panel vector autoregression, error correction models, and other panel regression techniques to construct analytical frameworks. Their findings reveal that, under varying conditions, investments in technological innovation can either promote or impede enhancements in carbon emission efficiency[5].

1.1. Direct Impact: The Influence of Technological Innovation Level on the Carbon Emission Efficiency of the Logistics Industry

With the continuous expansion of the scale of the logistics industry and the improvement of its intensification level, its demand for energy continues to grow, thereby maintaining a high level of carbon emissions in the logistics industry. By enhancing the level of technological innovation, it is possible to reduce the carbon emissions of the logistics industry. (1) Technological innovation has changed the traditional operation mode of the logistics industry. With the continuous advancement of science and technology and the concurrent progress of the technological and industrial revolutions, the logistics industry is at the cusp of transformation. It can leverage the support of related technologies such as big data

and the Internet of Things to achieve sustainable and low-carbon development. (2) The improvement of the technological innovation level plays a crucial role in promoting the optimal allocation of resources in the logistics industry and reducing carbon emissions. Based on the theory that technology drives the rational allocation of resources, technological innovation can revolutionize the resource usage model of the logistics industry, achieving a fundamental transformation in the way resources are utilized. By introducing advanced logistics technologies and management systems, the logistics industry can more accurately predict and plan resource demands, effectively reducing the disorderly waste and excessive consumption of resources, thereby lowering the carbon emission intensity. At the same time, technological innovation significantly enhances the utilization efficiency of logistics resources. With the help of intelligent and automated logistics equipment and systems, the logistics industry can achieve the optimal allocation and efficient utilization of resources, improving the efficiency and accuracy of logistics operations, and thereby reducing energy consumption and carbon emissions. (3) In addition, the improvement of technological innovation can enhance logistics efficiency, opening up new paths for reducing carbon emissions. With the deep integration of Internet of Things (IoT) and big data technologies, logistics enterprises can achieve intelligent and precise management of goods transportation. Every link from goods' outbound, transportation to final delivery can be finely monitored and optimized. This not only optimizes the transportation routes, reduces the empty running rate and unnecessary detours, but also greatly improves the utilization efficiency of resources and effectively lowers the carbon emissions caused by ineffective transportation. Therefore, technological innovation is not only the core driving force for the high-quality development of the logistics industry, but also an important way to achieve the green transformation of the logistics industry and reduce carbon emissions.

Based on this, this paper proposes Hypothesis 1: The improvement of technological innovation level has a significant promoting effect on the carbon emission efficiency of the logistics industry.

2. Research Design

2.1. Model Design

2.1.1. Benchmark Model

Based on the aforementioned analysis and referencing relevant scholarly research, we construct an ordinary panel regression model to investigate the direct effects of technological innovation levels on carbon emission efficiency in the logistics industry.

To mitigate heteroscedasticity, we logarithmically transform the relevant data. The benchmark regression model is specified as follows:

$$lnLog_{it} = c_0 + c_1 lnTe_{it} + c_2 CONX_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (1)$$

Where: i denotes the province; t denotes the year; Log_{it} represents the carbon emission efficiency of the logistics industry in province during year; $CONX_{it}$ signifies the control variables; μ_i and denote individual and time fixed effects, respectively; ε_{it} represents the random error term.

2.1.2. Mediating Effect Models

Drawing on Jiang Ting's [7,8] mediating effect models, we construct the following models to investigate the mediating roles of logistics industry agglomeration and structural upgrades (Equations 2-4):

$$lnLog_{it} = \alpha_0 + \alpha_1 lnTe_{it} + \varepsilon_{it} \quad (2)$$

$$lnLog_{it} = \beta_0 + \beta_1 lnTe_{it} + \beta_2 lnMid_{it} + \eta_{it} \quad (3)$$

$$lnMid_{it} = \gamma_0 + \gamma_1 lnTe_{it} + \theta_{it} \quad (4)$$

Where:Mid_{it} represents the mediating variables, including logistics industry agglomeration and logistics industry structural upgrades (, representing the tertiary sector);Equation (2) examines the impact of technological innovation levels on carbon emission efficiency in the logistics industry; Equation (3) investigates the impact of technological innovation levels on the mediating variables, establishing a causal chain of technological innovation levels — mediating variables — carbon emission efficiency in the logistics industry;

2.2. Variable Selection

2.2.1. Dependent Variable

Carbon emission efficiency in the logistics industry (Log). Drawing on relevant literature, we employ the non-expected output SBM model to measure carbon emission efficiency in the logistics industry, selecting fixed asset investment, the number of employees in the logistics industry, and energy consumption as input indicators, and logistics industry GDP and CO_2 emissions as desired and undesired outputs, respectively[9,10]. Energy consumption is calculated based on the primary energy consumption of transportation, warehousing, and postal services in each region, encompassing raw coal, gasoline, kerosene, diesel, fuel oil, natural gas, and liquefied petroleum gas, converted into standard coal equivalents. Missing values are supplemented using interpolation. Logistics industry carbon emissions are computed based on terminal energy consumption in transportation, warehousing, and postal services, utilizing the following formula (Equation 5):

$$C = \sum_{i=1}^{7} E_i \times SC_i \times CF_i \quad (5)$$

Where: C denotes total carbon emissions; Ei represents the terminal consumption of the i energy source; SCisignifies the standard coal conversion coefficient for the i energy source; CFi denotes the carbon emission coefficient for the i energy source.

The standard coal conversion coefficients and carbon emission coefficients are sourced from the China Energy Statistical Yearbook and the 2006 IPCC National Greenhouse Gas Inventory Guidelines.

2.2.2. Independent Variable

Technological innovation level (T). Indicators for technological innovation level are selected from three dimensions: technological innovation input, technological innovation output, and technological innovation environment [11,13].

Technological innovation input encompasses the resources invested to achieve technological innovation, including funds, manpower, and materials. These inputs form the foundation for innovation activities, directly influencing their scale and quality. Therefore, selected indicators for technological innovation input include R&D expenditure intensity, R&D personnel full-time equivalent, the proportion of local fiscal science and technology expenditure, and new product development funds.

Technological innovation output represents the results of innovation activities, typically manifested through patents, scientific papers, technical standards, and new

products. Output indicators reflect the efficiency and outcomes of innovation activities. Hence, selected indicators for technological innovation output include the number of domestic patent applications received, the number of domestic invention patent applications received, new product sales revenue, the number of scientific papers published, and technology market transaction volume.

Technological innovation environment denotes the external conditions and internal atmosphere conducive to technological activities, providing essential support and services for innovation. A favorable innovation environment attracts and nurtures talent. Consequently, selected indicators for technological innovation environment include the number of high-tech industrial enterprises, the number of regular higher education institutions, total telecom business volume, and internet broadband penetration rate.

2.2.3. Control Variables

For control variables[14,18], we select economic development level (Income), government intervention (Gov), environmental regulation (Erg), urbanization level (Urb), and openness to the outside world (Open). Specifically, per capita GDP measures economic development level, the ratio of fiscal general budget expenditure to regional GDPs government support, the ratio of industrial pollution control completion investment to industrial added values environmental regulation, the urbanization rates urbanization level, and the ratio of total goods import and export volume multiplied by the USD-to-RMB exchange rate to regional GDPs openness to the outside world.

2.3. Data Sources

Data primarily originate from the China Statistical Yearbook, China Energy Statistical Yearbook, China Science and Technology Statistical Yearbook, and relevant statistical yearbooks of individual provinces spanning from 2013 to 2022 (with data from the China Energy Statistical Yearbook updated until 2022, hence the selected cutoff year of 2022). Missing data are supplemented using interpolation. To mitigate heteroscedasticity, relevant data are logarithmically transformed.

3. Empirical Results Analysis

3.1. Benchmark Regression

Table 1 presents the benchmark regression results of the model constructed based on Equation (1). Column (1) of Table 1 shows that the level of technological innovation has a significant positive effect on the carbon emission efficiency of the logistics industry without any control variables. Columns (2) and (3) of Table 1display the benchmark regression results after introducing control variables. According to the empirical analysis in Table 1, regardless of whether control variables are included or not, the level of technological innovation has a significant positive impact on the carbon emission efficiency of the logistics industry, which fully validates the positive correlation between the level of technological innovation and the carbon emission efficiency of the logistics industry. That is, Hypothesis 1 is empirically verified, indicating that the level of technological innovation has a clear positive promoting effect on the carbon emission efficiency of the logistics industry. With the continuous progress of technology, the digitalization and intelligence of logistics enterprises are accelerating, which simultaneously promotes the comprehensive transformation and upgrading of the logistics industry. On the one hand, it promotes the deep integration of logistics enterprises with green technologies, effectively reducing carbon emissions in the production and operation process of logistics by upgrading production equipment, optimizing operation processes, and reducing the use of high-energy-consuming equipment. On the other hand, technological innovation, as the core driving force for the green and low-carbon transformation of the logistics industry, provides strong kinetic support for the green development of the logistics industry.

Table 1. Benchmark Regression Results

	(1)	(2)	(3)
LnCee	Reg	Fe	Re
lnT	0.501***	0.497***	0.365***
	(4.422)	(4.367)	(3.756)
LnIncome		-2.053***	-1.012***
		(-4.888)	(-3.666)
LnGov		-1.955***	-1.419***
		(-5.095)	(-3.490)
LnErg		1.309***	1.117***
		(3.475)	(2.794)
LnUrb		0.680**	0.053**
		(2.327)	(1.990)
Open		0.391	0.319
		(1.254)	(1.112)
_cons	0.778**	13.659***	14.676***
	(2.435)	(2.670)	(4.073)
N	300.000	300.000	300
r2	0.094	0.246	0.185

The core mechanism of technological innovation in leading the logistics industry towards a green and low-carbon direction lies in: promoting the cross-integration and innovative development of digital technology and logistics technology through the innovative achievements of basic scientific research, and simultaneously driving the innovative reconstruction of the logistics service ecosystem, jointly shaping and improving the framework of green innovation; and by gathering core elements and optimizing resource allocation, laying a solid foundation and providing

continuous impetus for the green and low-carbon transformation of the logistics industry, forming regional industrial agglomeration, generating scale effects and spillover effects; and further cultivating new concepts, new technologies, new applications, and new models, extending the industrial chain, and reconstructing the green development model of the logistics industry, achieving the harmonious unity of economic value, environmental value, and social value. Among the control variables, economic development level and government intervention have significant negative impacts, while environmental regulation and urbanization level show significant positive impacts.

3.2. Heterogeneity Analysis

Due to the differences in policies, resources, energy structures, and technological innovation capabilities among various regions, there are disparities in the levels of technological innovation and the carbon emission efficiency of the logistics industry. Therefore, the impact of technological innovation levels on the carbon emission efficiency of the logistics industry may have regional heterogeneity characteristics, making it necessary to conduct regional heterogeneity research. Specifically, this study divides China's 30 provinces into three major economic regions: the eastern, central, and western regions, and conducts regression analysis on the relationship between technological innovation levels and the carbon emission efficiency of the logistics industry in these regions. The relevant results are detailed in Table 2. Further analysis of the data in Table 2 reveals that the technological innovation levels in the eastern and western regions have a significant positive impact on the carbon emission efficiency of the logistics industry, while the technological innovation level in the central region does not have a significant impact in this paper. This difference may mainly be attributed to the more developed economic foundation and technological innovation capabilities in the eastern region, which enables these regions to more effectively apply clean energy and advanced logistics technologies, achieve efficient resource allocation, and actively adopt green logistics operation models and optimized distribution strategies. In the western region, due to the stable economic development in recent years, the logistics operation mode has transformed from traditional to modern, and the public's awareness and acceptance of green logistics concepts have gradually increased. Under the combined effect of these factors, the carbon emission efficiency of the logistics industry in the western region has improved. Additionally, it is particularly worth noting that the carbon emission efficiency of the logistics industry in the eastern region shows a trend of being higher than that in the central region. This may be closely related to the rapid economic development, continuous increase in technological innovation investment, and the introduction and implementation of a series of energy conservation and environmental protection policies in the eastern region in recent years. These favorable factors have jointly promoted the improvement of the carbon emission efficiency of the logistics industry in the eastern region, enabling it to surpass the central region to a certain extent.

Table 2. Results of Heterogeneity Analysis

Variable	(1)	(2)	(3)
LnCee	Eastern	Central	Western
lnT	0.600***	-0.145	0.886***
	(2.687)	(-0.587)	(4.089)
LnIncome	-3.696***	-2.141***	-1.653*
	(-4.768)	(-2.750)	(-1.857)
LnGov	-0.849	-4.312*	-2.457***
	(-1.495)	(-1.870)	(-4.124)
LnErg	0.979**	0.094	0.340
	(2.116)	(0.157)	(0.535)
LnUrb	0.485	-2.727	-0.326
	(1.215)	(-1.223)	(-0.291)
_cons	28.449***	17.437*	15.238
	(2.914)	(1.886)	(1.300)
N	130.000	60.000	110.000
r2	0.349	0.601	0.380

3.3. Endogeneity Test

This paper employs the instrumental variable method to conduct an endogeneity test, and the analysis is carried out from the following two dimensions: First, it explores the endogeneity issue from the perspective of omitted variables. Although some variables have been controlled when examining the carbon emission efficiency of the logistics industry, due to the complexity and diversity of its influencing factors, it is still difficult to ensure that the residual term does not contain the influence of other unconsidered factors. For instance, the omitted variable of per capita income may simultaneously have a significant impact on the level of technological innovation and the carbon emission efficiency of the logistics industry. Second, it analyzes from the perspective of bidirectional causality. On the one hand, the improvement of the technological innovation level promotes the innovation of logistics transportation methods, thereby reducing the carbon emissions of the logistics industry and enhancing the carbon emission efficiency. On the other hand, the improvement of the carbon emission efficiency of the logistics industry promotes the development of low-carbon economy and industries, achieving the optimal allocation of resources, which in turn prompts relevant stakeholders to increase investment in core low-carbon technology research and development, significantly accelerating the transformation of scientific research results, and further enhancing the technological innovation level. Based on the above analysis, to deeply explore the endogeneity issue, this paper refers to the research paradigm of relevant scholars and selects the lagged period method for the endogeneity test. Table 3 presents the regression results of the instrumental variables. Table 3 (1) shows the panel regression results of the lagged period of the independent variable, and Table 3 (2) and (3) present the two-stage least squares (2SLS) test results. The results show that the core explanatory variable, the level of technological innovation, is significant at the 5% level and the coefficient of the first-order term is positive, which is

consistent with the previous conclusion, once again proving the robustness of the results.

Table 3. Results of Endogeneity

Variable	L.lnTe	2SLS	
	(1)	(2) First-Order	(3) Second-Order
lnT	0.782*** (0.110)	0.7017*** (0.031)	0.0650** (0.030)
Constant	-0.0442 (0.0365)	-0.2216** (0.104)	-0.3416** (0.201)
Contral	Yes	Yes	Yes
R^2	0.135	0.176	0.204
Year	Yes	Yes	Yes
Region	Yes	Yes	Yes
Observation	300	300	300

3.4. Robustness Test

To ensure the robustness of the benchmark regression results, this paper employs the following methods for robustness testing: (1) Substituting with the Tobit model to re-examine the impact of the level of technological innovation on the carbon emission efficiency of the logistics industry using this new model; (2) Conducting winsorization; in this paper, 1% and 5% winsorization treatments are selected; (3) Shortening the time span; originally, the time period selected in this paper is from 2013 to 2022, which is now shortened to from 2014 to 2022. The results of the robustness tests are as follows. As indicated by the robustness test results, the level of technological innovation significantly affects the carbon emission efficiency of the logistics industry, with a positive regression coefficient, demonstrating the reliability of the benchmark regression results in this paper.

Table 4. Results of Robustness Analysis

Variable	(1)	(2)	(3)
LnCee	Tobit	winsor	Delete year
lnT	0.383***	0.507***	0.659***
	(5.361)	(4.444)	(4.692)
LnIncome	-0.198*	-1.892***	-3.283***
	(-1.867)	(-4.553)	(-6.055)
LnGov	1.242***	-1.868***	-1.324***
	(2.749)	(-4.879)	(-3.069)
LnErg	-0.203***	0.787***	0.804*
	(-4.285)	(2.671)	(1.705)
LnUrb	-0.524***	0.355	-0.128
	(-3.315)	(1.062)	(-0.351)
cons	6.483***	10.957**	25.392***
	(3.992)	(2.151)	(3.475)
r2		0.241	0.285
N	300.000	300.000	270.000

4. Conclusion and Recommendations

4.1. Research Conclusion

Based on provincial panel data from 30 provinces in China spanning from 2012 to 2022, this paper employs panel regression models and mediation effect models to analyze the impact and mechanism of technological innovation on the carbon emission efficiency of China's logistics industry, yielding the following conclusions: (1) Enhancing the level of technological innovation can promote the improvement of carbon emission efficiency in the logistics industry. Technological innovation exerts a significant positive promotional effect on the carbon emission efficiency of the logistics industry, indicating that technological innovation should be a key focus. (2) The results of the mediation mechanism test show that the level of technological innovation can influence the carbon emission efficiency of the logistics industry through logistics industry agglomeration. On one hand, technological innovation optimizes resource allocation in the logistics industry through agglomeration, improving resource utilization efficiency within agglomerated regions, attracting more logistics enterprises to settle in, and promoting the development of logistics industry agglomeration, thereby reducing carbon emissions in the logistics industry. On the other hand, technological innovation drives enterprises within logistics industry agglomeration zones to adopt green and low-carbon technologies and production methods, reducing energy consumption and environmental pollution. This green and low-carbon development not only enhances the social image and market competitiveness of enterprises but also promotes sustainable development in logistics industry agglomeration zones. (3) The level of technological innovation can influence the carbon emission efficiency of the logistics industry through the upgrading of the logistics industry structure. On one hand, technological innovation can improve logistics models through the upgrading of the logistics industry structure, reducing the number of logistics turnovers and transportation distances while optimizing transportation combinations and collaborative operations, thereby improving utilization rates and enhancing carbon emission efficiency in the logistics industry. On the other hand, by introducing advanced information technologies and management systems, logistics enterprises can achieve real-time monitoring and intelligent decision-making in logistics processes. This digital management not only improves the operational efficiency and service quality of logistics enterprises but also optimizes resource allocation through precise data analysis and forecasting. Additionally, by introducing green supply chain management concepts and tools, logistics enterprises can drive the entire supply chain towards green and low-carbon development. This includes measures such as selecting green suppliers, promoting green packaging, and recycling packaging materials to reduce energy consumption and carbon emissions in the supply chain process.

4.2. Policy Recommendations

Based on the aforementioned conclusions, the following policy recommendations are proposed:

(1) Given that the level of technological innovation can significantly and positively promote carbon emission efficiency in the logistics industry, and to better implement the "Implementation Plan for Science and Technology Supporting Carbon Peak and Carbon Neutrality (2022-2030)" jointly released by the Ministry of Science and Technology and eight other departments in August 2022, the following measures are recommended from a macro perspective. From the government's standpoint, the recommended measures include: Firstly, promoting the utilization of new energy sources, such as the development of novel energy supply models like offshore wind power, distributed photovoltaic power generation, and onshore wind power, and continuously advancing large-scale wind and photovoltaic projects in eastern and western regions. Secondly, encouraging logistics

enterprises to adopt new energy vehicles in the final delivery stage and providing preferential policies such as tax reductions for eligible new energy delivery vehicles. At the micro level, low-carbon, environmentally friendly, and low-energy-consumption technologies need to be comprehensively introduced. For logistics enterprises, the following actions should be taken: Firstly, gradually phasing out traditional fuel vehicles with high energy consumption and carbon emissions and reducing overall carbon emissions by improving transportation methods. Secondly, enhancing resource utilization efficiency in non-transportation links such as warehouse management, delivery services, and packaging handling to reduce carbon emissions in other areas. Logistics enterprises should also proactively take a series of positive measures, such as prioritizing the replacement of existing high-energy-consuming and high-emission traditional fuel vehicles with more environmentally friendly models, which can significantly reduce carbon emissions during transportation. Simultaneously, continuous optimization of operational processes in non-transportation links such as warehousing, delivery, and packaging is necessary to further reduce carbon emissions in these processes. Through these comprehensive measures, national goals for carbon peak and carbon neutrality can be effectively supported while promoting sustainable development in the logistics industry.

(2) Since the level of technological innovation can indirectly promote carbon emission efficiency in the logistics industry through logistics industry agglomeration, regional governments should reasonably optimize the layout of logistics enterprises to fully leverage the agglomeration effect. Physical industry agglomeration, on one hand, can fully exploit economies of scale and provide a platform for efficient resource integration. This facilitates logistics enterprises in achieving reasonable allocation and efficient utilization of resources through shared infrastructure, optimized transportation routes, and collaborative warehousing management, thereby effectively reducing carbon emissions and promoting the development of green logistics. This resource integration not only helps reduce operational costs for individual enterprises but also enhances the sustainability of the entire logistics industry. On the other hand, the agglomeration of the logistics industry can also generate significant spillover effects, strengthening economic ties and cooperation with surrounding regions. As logistics activities become more frequent and efficient, the speed of commodity circulation in surrounding areas accelerates, and market scope expands, thereby promoting regional economic prosperity and development. Furthermore, these positive effects brought about by logistics industry agglomeration can also indirectly contribute to the achievement of carbon neutrality goals. As logistics efficiency improves and service quality enhances, the overall energy consumption and emissions of the logistics industry will be effectively controlled, laying a solid foundation for achieving carbon neutrality goals. Simultaneously, the agglomeration of the logistics industry can also promote the research and application of low-carbon technologies, driving the logistics industry towards a greener and more environmentally friendly direction and contributing more to the achievement of global climate governance goals.

(3) Promote the optimization and upgrading of industrial structures to achieve coordinated development among industries. The government should guide the rational layout of various industries, promoting the transformation and upgrading from low-end to high-end industries to optimize resource allocation and address the issue of resource misallocation. Additionally, implementing an innovation-driven development strategy, promoting carbon reduction in the logistics industry through industrial structure upgrading, encouraging enterprises to actively engage in independent research and development and innovation, and driving the widespread application of green technologies to inject new impetus into China's emission reduction efforts.

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