Journal of Economics and Management Sciences; Vol. 8, No. 4; 2025
ISSN 2576-3008 E-ISSN 2576-3016
https://doi.org/10.30560/jems.v8n4p1

Research on Green Finance Promoting the Development of Low-Carbon Economy

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Received: June 28, 2025; Accepted: July 6, 2025; Published: July 7, 2025

Abstract

Against the backdrop of global climate change and China's "dual carbon" goals, this study systematically explores the theoretical foundations, practical status, and operational mechanisms of green finance in promoting low-carbon economic development. It is revealed that green finance influences low-carbon transformation through multiple pathways, including capital orientation, risk management, technological innovation incentives, and policy synergy. However, challenges such as fragmented policy regulation, imbalanced market capital allocation, technological and data bottlenecks, and insufficient cross-regional coordination are identified. Drawing on international experiences, the research proposes optimization strategies focusing on policy integration, market mechanism activation, technological empowerment, and regional collaboration, offering theoretical and practical insights for deepening the integration of green finance and low-carbon economy.

Keywords: green finance, low-carbon economy, policy synergy, technological innovation, mechanism analysis

1. Introduction

1.1 Background and Significance of the Study

In recent years, environmental problems such as extreme weather and sea level rise brought about by global climate change have become increasingly serious, posing a grave threat to the sustainable development of human society. According to a report released by the World Meteorological Organization, the past decade (2015 - 2024) has been the warmest on record, with the global average temperature having risen by about 1.1°C from pre-industrial levels. Against this backdrop, major economies around the world have made low-carbon economy the core direction of economic transformation.

As the world's largest developing country, manufacturing powerhouse and carbon emitter, China plays a key role in global climate governance. In 2020, China formally put forward the "dual carbon" goal, that is, striving to achieve carbon peaking by 2030 and carbon neutrality by 2060. This goal not only reflects China's commitment to actively responding to climate change and fulfilling its responsibility as a great power, but is also an intrinsic requirement for China to promote high-quality economic development and industrial upgrading.

The development of low-carbon economy cannot be separated from the financial support, according to the International Renewable Energy Agency (IRENA) estimates, the world needs at least 5 trillion U.S.dollars of investment each year in order to achieve the temperature control goals of the Paris Agreement, and the current capital investment is only about one-third of the demand. In this context, green finance, with its unique resource allocation function, has become a key force in promoting the development of low-carbon economy,Through financial instruments and market mechanisms, green finance can guide social funds to low-carbon, environmentally friendly and sustainable development projects, which can not only meet the financial needs of low-carbon economic development, but also force the transformation of high-carbon industries and promote the optimization and upgrading of the economic structure through price signals and risk control.

From the theoretical level, the study of green finance to promote the development of low-carbon economy can help to enrich and improve the theoretical system of green finance, explore the interactive relationship between finance and the environment, and provide a new theoretical perspective and analytical framework for the transformation of ow-carbon economy. From the practical level, a systematic study of the role of green finance in the development of low-carbon economy mechanism, implementation path and problems can provide a scientific basis for the government to formulate green financial policies and improve the regulatory system, as well as

provide practical guidance for financial institutions to carry out green financial business and enterprises to carry out low-carbon transformation, which is important for promoting China's' dual-carbon.It also provides practical guidance for financial institutions to carry out green finance business and enterprises to carry out low-carbon transformation, and is a great practical significance for promoting China's"dual-carbon" goal and global climate governance.

1.2 Literature Review

Green finance drives low-carbon transition through green credit (e.g., low-interest support for wind power projects), green bonds (specialized financing), and carbon markets (pricing mechanisms), but faces challenges such as policy fragmentation and inconsistent project assessment standards. The lCBC case shows that technology-enabling can improve fund management efficiency (Li Jiahang, 2024). Green finance and low-carbon economy are interdependent, with the former supporting the latter through measures such as directing capital flows to green industries, reducing or exempting taxes and fees for environmental protection investments, and dynamic risk assessment. Currently, it needs to break through the contradiction of energy structure and the bottleneck of technology cost, and enhance information transparency through big data and block chain. (Ye Qinghua, 2025)

Research on the linkage between green finance and low carbon economy has shifted from the early controversy of "whether it is effective" to the exploration of the mechanism of "how it is effective". Early studies focused on the resource allocation function of green finance, such as Li Jiahang (2024), who pointed out that it corrects carbon emission externality through capital orientation, while more recent studies emphasis multi-dimensional synergies, such as the combination of credit-bond-insurance-carbon market" tools proposed by Li Mengzhou (2025) and thedual intermediary path of "technological innovation-industrial upgrading" confirmed byYa9 Deli et al (2025)."technological innovation -industrial upgrading" dual intermediary path. The theoretical basis has been expanded from single externality theory to policy synergy theory (Yeh, Q. H., 2025) and regional heterogeneity theory (Yag, D. L. et al.2025), reflecting the trend of interdisciplinary integration.

Existing research has built a theoretical framework of "policy-market-technology" for green finance to support low-carbon economy, but it still needs to deepen the micro-mechanism, cross-regional synergy and international governance. Future research can combine digital technology and interdisciplinary approaches, focus on long-term transition paths and global governance rules, and provide more precise theoretical support for the "dual-carbon".

2. Theoretical Foundations of Green Finance for a Low-Carbon Economy

2.1 Externalities Theory and Market Failure Correction

Carbon emissions have a typical negative exterality, and the carbon costs generated by the production activities of enterprises have not been fully incorporated into the market pricing system, leading to over investment in high-carbon industries. Green finance corrects market failures through two paths, one is to internalise environmental cost through interest rate differentials in green credit (e.g., by raising financing costs for high-carbon enterprises), the other is to create an "environmental premium" for ow-carbon technologies through tools such as the carbon market and green bonds e.g., photovoltaic projects can gain additional revenue from the sale of CCERs.

2.2 Theories of Sustainable Development and Financial Deepening

The theory of sustainable development requires that economic growth be coordinated with ecological protection, while the theory of financial deepening emphasises the roleof the financial system in enhancing economic efficiency. Green finance incorporates environmental factors into financial decision-making, and by directing capital flows to renewable energy, energy-saving technologies and other fields, it not only promotes the decarbonisation of the economic structure, but also expands the business boundaries of financial institutions. For example, by setting up a green finance division, Societ Generale Bank will have a green credit balance of more than 1.2 trillion yuan by 2024achieving a win-win situation in terms of environmental and commercial benefits.

3. Status and Practice of Green Finance in Support of a Low-Carbon Economy

3.1 Global Green Finance Development Panorama

The European Union is featured by rule leadership, the Sustainable Finance Classification Programme specifies 13 types of green economic activities, the EU green bond issuance accounts for 45% of the world in 2024, and through the Carbon Border Adjustment Mechanism (CBAM) to force the transformation of high-carbon industries, the United States relies on the market-driven, the size of the ESG fund reaches 1.7 trillion U.S dollars in 2024, and the Inflation Reduction Act (lRA) promotes the development of the new energy automobile industry chain through the combination of tax credit and green financial tools, China is featured by "policy guidance + market cultivation", but tools such as green insurance are still at a stage, The United States relies on market-driven ESG funds with a

scale of USD 1 trillion in 2024, and the Inflation Reduction Act (IRA) promotes the development of new energy vehicle industry through the combination of tax credits and green financial instruments.

3.2 Financial Support Paths for China's Low Carbon Economy

Green credit has become a major source of funding for renewable energy projects, with the balance of green credit in the wind power and photovoltaic industries reached RMB 3.2 trillion and RMB 2.8 trillion respectively by 2024. The China Development Bank has set up a 200 billion yuan "double carbon" special loan to support cross-regional green power transmission projects such as the Qinghai-Henan ultra-high-voltage direct current project. With regard to green bonds, the average maturity of the "wind and light base" special bonds to be issued in 2024 will be 15 years, matching the long-term investment needs of the projects.

High-carbon industry forcing mechanism: implementing "environmental performance grading credit" for thermal power enterprises, e.g., a 300,000-kilowatt coal power project of Guodian Investment has seen its financing cost go up by 150 BP due to its failure to meet the ultra-low emission standard;

Low-carbon technology incubation: green companies on the Science and Technology Innovation Board (STB) are accelerating technology R&D through equity financing, e.g., a hydrogen energy company raised RMB 5 billion through the STB in 2024 to promote the localization of proton exchange membranes.

3.3 Achievements and Contradictions

In terms of effectiveness, China's energy consumption per unit of GDP will be 18% lower in 2024 than in 2020, the installed share of renewable energy will reach 48%, and green finance-supported projects will reduce carbon dioxide emissions by about 520 million tonnes per year. However, contradictions are still prominent: financing costs for small and medium-sized low-carbon enterprises are 2-3 percentage points higher than those for large enterprises, 15%of "green projects" were found to have falsified data on environmental benefits in 2024, and the balance of green credits in western provinces is only one-third of that in the east.

4. Mechanisms for Green Finance to Drive a Low-Carbon Economy

4.1 Capital-Orientated Mechanisms from "Passive Constraints" to "Active Guidance"

Green credit achieves capital reallocation through the "double-limit mechanism(restricting credit limits in high-carbon industries and lowering interest rates in low-carbon industries). Taking the transport sector as an example, the average interest rate for new energy vehicle loans in 2024 was 4.2%, 1.8 percentage points lower than that for traditional fuel vehicles, pushing the share of new energy vehicle sales to 35%The "signalling, effect" of green bonds attracts social capital to follow, for example, the issuance of 5 billion yuan of carbon-neutral bonds by the Three Gorges Group drove non-financial institutions to invest more than 20 billion yuan in the wind power sector.

4.2 Risk Management Mechanisms Quantification and Hedging of Climate Risks

Climate risk stress testing became a core tool for banks" portfolio management.Construction Bank's 2024 scenario analysis showed that its thermal power sector loan default rate would increase by 2.3 percentage points under a 2°C warming scenario.prompting the bank to reduce its thermal power sector credit ratio from 7 per cent to 5per cent. Green insurance innovates risk-sharing models, such as the "PV equipment damage insurance", which shortens the payout period for module failures to 72 hours from 30 days in traditional insurance, reducing investors' risk concerns.

4.3 Incentives for Technological Innovation: Coupling Financial Capital and Low-Carbon Technologies

Green equity investment focuses on "neck-breaking" technologies, and a national green fund will invest in eight hydrogen energy core component enterprises in 2024, pushing fuel cell costs down by 30 per cent. Green credit is linked to patents, and Bank of Suzhou has launched a "green patent loan", under which enterprises can obtain credit loans of up to RMB 50 million with patents on carbon capture technology, and by 2024, it will support enterprises in applying for more than 2,000 low-carbon patents.

4.4 Policy Synergies: The Multiplier Effect of the Mix of Instruments

The linkage between green finance and carbon market has achieved remarkable results.with the scale of quota pledge financing in the national carbon market reaching RMB 85billion in 2024, and carbon price signals (average price of RMB 78/tonne) guiding enterprises to take the initiative to reduce emissions, Environmental tax and green credit form a policy synergy, and banks can lower interest rates by 0.5 percentage points for enterprises paying environmental tax up to the standard, benefiting more than 20.000enterprises in 2024 and reducing sulfur dioxide emissions by 1.2 million tonnes.

5. International Experience and Case Studies

5.1 The EU: A Rules-Led Model

The Sustainable Finance Classification Programme clarifies that "green activities" need to meet criteria such as environmental benefits and no significant harm at the same time so as to avoid "green washing".2024 The EU launches the "Green Transition Transition Support Mechanism ", which provides low-interest loans to coal power enterprises transformation projects, taking into account emission reduction targets and social equity.The inspiration lies in the following: uniform standards are the basis for policy synergy,and transitional arrangements can reduce transition pains.

5.2 Japan: Government-Led Model

Japan's policy investment bank (DB]) set up 10 trillion yen "green growth fund", the offshore wind power project to provide 15-year zero-interest loans, driven by private capital to follow up with a ratio of 1:5. 2024 Japan's installed capacity of offshore wind power exceeded 3GW, compared with the 2020 growth four times. The revelation is policy-based finance can make up for the shortcomings of low carbon projects with insufficient returns in the early stage, forming a virtuous circle of "government on stage market singing".

5.3 United States: Market-Driven Model

Nasdaq launches "Climate Solutions Index" tracking 50 leading companies inow-carbon technologies, with an associated ETF of $32 billion by 2024. The Bipartisan Infrastructure Act establishes a $25 billion "Green Community Investment Fund" to attract private capital to participate in community photovoltaic projects through tax credits, The takeaway is that capital market innovation can amplify the inclusive nature of green finance, and policies need to be deeply integrated with market signals.

6. Challenges and Paths to Optimization

6.1 Existing Challenges

6.1.1 Insufficient Synergy Between Policy and Regulatory Systems

The current green finance policy faces fragmentation of regulatory standards across!multiple sectors, with differences in the calibre of "green projects" identified by the Central Bank, the Development and Reform Commission (DRC) and the Ministry of Ecology and Environment (MOE). For example, natural gas projects supported by green bonds are classified as restricted in the green credit catalogue of some provinces, resulting in enterprises taking advantage of the loopholes in the standards to package projects to obtain financing, and a steel enterprise obtained 300 million yuan of credit support in violation of the law by splitting a high energy-consuming production line and declaring green qualifications in different departments in 2024, in addition, there is alack of special legislation at the national level, and policies such as the current Green Credit Guidelines are mostly sectoral regulations, with penalties for "green washing remaining at the level of industry notification, and a lack of uniform templates for corporate ESG disclosure.

6.1.2 Structural Contradictions Between Market Mechanisms and Financial Allocations

There is a serious mismatch between the long cycle of low-carbon projects and the short-term appraisal mechanism of financial institutions, with the payback period of offshore wind power and other projects exceeding 10 years, while the average appraisal cycle of bank credit is only 3 years, resulting in the proportion of green credit in small and medium-sized banks being only 6.5 per cent (and that of large banks reaching 22per cent), insufficient liquidity in the green financial market, the secondary market turnover rate of green bonds in 2024 was 0.8 times/year, which is less than half of that of ordinary bonds, and investors exit channels are limited, coupled with a success rate of less than 30 per cent for low-carbon technology projects, the participation of social capital is low, and the scale of green equity investment accounts for only 8 per cent of the total scale of private equity.

6.1.3 Technical Bottlenecks and Underlying Barriers to Data Governance

The high cost of commercialization of low-carbon technologies restricts the effectiveness of funding, the cost of carbon capture and storage (CCUS) technology is500-800 yuan per tonne, which is three times that of traditional means of emission reduction, and only 12 per cent of projects above the 10,000-tonne level in China have been carried out. The construction of environmental data infrastructure is lagging behind, with 80% of enterprises relying on manual reporting for carbon footprint accounting and less than 20% of real-time monitoring technology coverage. The scientific nature of the project assessment model is insufficient, with 85% of financial institutions still adopting the "expert scoring method" and only 15% introducing life cycle assessment (LCA), resulting in an accuracy rate of less than 70% in the assessment of the environmental benefits of photovoltaic projects, and a deviation of 25% between the actual emission reduction effect of some projects and the declared data.

6.2 Optimized Path Design

6.2.1 Towards a Harmonized Policy and Regulatory System

Promote special legislation to integrate multi-sectoral green standards, establish dynamic management lists to distinguish between green activities and transitional projects, and clarify legal liability and recovery mechanisms for non-compliance Establish a cross-sectoral regulatory coordination platform, integrate corporate environmental data and project information for full-process tracking, and pilot inclusive regulatory mechanisms in key regions, it has made it mandatory for key enterprises to disclose climate-related financial information, fostered third-party certification agencies and promoted mutual recognition of qualifications.

6.2.2 Activation of Market Mechanisms and Efficiency of Financial Allocation

Setting up a national-level green development mother fund to attract social capital to participate in long-term low-carbon projects through policy guidance, and exploring Innovations in green credit asset securitisation. Developing financial products tailored to the transformation needs of enterprises, such as special bonds that release funds according to the progress of transformation, and portfolio financing tools that combine carbon assets. Establish a regional fund balancing mechanism, subsidize project costs in less developed regions through revenue regulation, and promote cross-regional technical and industrial cooperation.

6.2.3 Enhanced Technology Enablement and Data Infrastructure

Setting up a special fund for the transformation of low-carbon technologies to support the research and development and commercial application of cutting-edge technologies in phases, and building a national technology trading platform to promote the transformation of achievements. Deploy an intelligent monitoring network for corporate carbon footprints, and the government will subsidize, the investment in equipment to enhance the automation of data collection. Promote project assessment models that integrate artificial intelligence and life cycle assessment, and use digital twin technology to optimize risk management.

6.2.4 Deepening Cross-Regional Synergies and Capacity-Building

Lead the development of regional green finance cooperation standards, promote international rule alignment to reduce cross-border financing costs, and establish a professional body to participate in global climate governance rule making. Establish a regional cooperation alliance to promote the export of risk control experience from the east to the centre and west, and pilot the application of digital financial tools in cross-regional projects. Provide transformation counselling and credit preferences for energy-consuming enterprises, and raise awareness of and participation in green finance through public education.

7. Conclusion

Green finance, as a key link between environmental protection and economic development, has become the core driving force to promote the transformation of low-carbon economy. From the theoretical and practical point of view, its mechanism of action presents multi-dimensional synergistic characteristics. by guiding the flow of funds to clean energy, energy-saving technologies and other fields, it not only directly supports the implementation of low-carbon projects, but also indirectly accelerates the process of economic greening through the double intermediary effect of technological innovation and industrial structure upgrading. At the regional level, affected by policy support, industrial foundation and financial market maturity, there are significant differences in the promotion effect of green finance, the synergistic effect is relatively prominent in the central region due to the urgent need for industrial transformation and policy inclination, while the western region is limited by the economic foundation and financial ecology, and the release of the effectiveness of the still have more space.In the current development, the fragmentation of the policy system, the imbalance of the market mechanism, the bottleneck of technical data and the lack of cross-regional synergy are intertwined, restricting the full play of the effectiveness of green finance.Although a series of supportive policies have been issued by various departments, the lack of unified legislation and conflicting regulatory standards have led to the survival of green washing" behaviors: the financial market's insufficient supply of long-term funds for low-carbon projects has formed a structural contradiction with the cyclical needs of enterprise transformation; at the same time, the high cost of commercializing low-carbon technologies and the backwardness of the environmental data collection system have further exacerbated information asymmetry and assessment difficulties. At the same time, the high cost of commercializing low-carbon technologies and the backwardness of environmental data collection systems have further aggravated information asymmetry and assessment difficulties. These challenges reflect the stage of institutional design and market development, and highlight the urgency of cross-sectoral and coordinated reforms.

Reference

[1] Li, J. (2024). Current situation and development prospects of green finance under the orientation of carbon neutrality. *China Business Review*, *33*(19), 116–119.

[2] He, X., & Ren, J. (2024). The development of green finance in China: Current situation, problems and future prospects. *Energy and Chemical Finance & Management*, *3*(03), 1–8. https://doi.org/10.1016/j.jechem.2024.06.024

[3] Yao, D., & Zhu, Z. (2020). The spatio-temporal evolution of the coupling and coordination of green finance and low-carbon economy: An empirical study taking the Yangtze River Delta Region as an example. *Journal of Daqing Normal University*, *45*(02), 27–37.

[4] Li, M. (2025). The path and challenges of green finance facilitating the transformation of low-carbon economy. *China Market*, *(05)*, 17–20.

[5] Ye, Q. (2020). A brief discussion on relevant measures of green finance promoting low-carbon economic development. *Low Carbon World*, *15*(01), 160–162.

[6] Zhang, Y., Feng, N., & Wang, X. (2024). Can the green finance pilot policy promote the low-carbon transformation of the economy? *International Review of Economics and Finance*, *93*(PA), 1074–1086. https://doi.org/10.1016/j.iref.2024.03.012

[7] Dunbar, K., & Treku, N. D. (2025). Do energy transition investment flows aid climate commitments? *Energy Economics*, *142*, 108163–108163. https://doi.org/10.1016/j.eneco.2024.108163

[8] Zhang, C., Liu, S., Chen, G., et al. (2024). Green finance and the silver economy: Catalyzing China's low-carbon development. *Frontiers in Environmental Science*, *12*. https://doi.org/10.3389/fenvs.2024.1406812

[9] Taimoor, H., Yasir, K., Adnan, S., et al. (2023). Green financing strategy for low-carbon economy: The role of high-technology imports and institutional strengths in China. *Journal of Cleaner Production*, *415*. https://doi.org/10.1016/j.jclepro.2023.137859

[10] Khurshid, S., Awan, A., & Ahmad, S. (2025). Econometric insights into inclusive green growth, technological innovation and financial development dynamics in Asia: Aggregated and disaggregated data analysis. *Environment, Development and Sustainability*, *(prepublish)*, 1–30. https://doi.org/10.1007/s10668-025-06179-3

[11] Azimi, N. M., Raham, M. M., & Maraseni, T. (2025). Green trade, governance, finance, and energy efficiency: Shaping environmental landscape in global powerhouses. *Journal of Environmental Management*, *385*, 125674. https://doi.org/10.1016/j.jenvman.2025.125674

[12] Meng, S., Duan, Y., & Zhou, W. (2025). How does green finance policy reduce the carbon emissions of polluting enterprises? A mediation effect analysis of inclusive finance. *Research in International Business and Finance*, *77*(PA), 102914–102914. https://doi.org/10.1016/j.ribaf.2025.102914

[13] Wen, B., He, Y., Jing, X., et al. (2025). Advancing renewable energy and green finance for economic growth and ecological resilience. *Energy Strategy Reviews*, *59*, 101747–101747. https://doi.org/10.1016/j.esr.2025.101747

[14] Wu, W., & Lin, X. (2025). Digital inclusive finance for green transformation: Insight from green innovation, industrial upgrading, and employment quality. *Journal of Innovation & Knowledge*, *10*(3), 100726–100726. https://doi.org/10.1016/j.jik.2025.100726

[15] Hassan, M., Lee, Y. J., Rouge, L., et al. (2025). The impact of green public finance and green taxes on environmental and non-environmental innovation. *Research in International Business and Finance*, *76*, 102868–102868. https://doi.org/10.1016/j.ribaf.2025.102868

[16] Ali, A., Faisal, F., Isiksal, Z. A., et al. (2025). Do green finance and health expenditures lessen the ecological footprint to ensure sustainable development? *Innovation and Green Development*, *4*(2), 100223–100223. https://doi.org/10.1016/j.igd.2025.100223

[17] Li, X., Zheng, Z., Shi, D., et al. (2025). How government green fund reduce corporate carbon emissions. *Journal of Environmental Management*, *380*, 124999. https://doi.org/10.1016/j.jenvman.2025.124999

[18] Xiao, B., & Li, H. (2025). Financial efficiency, green innovation and green total factor productivity. *Finance Research Letters*, *76*, 107005–107005. https://doi.org/10.1016/j.frl.2025.107005

[19] Yang, X., Hunjra, I. A., Alharbi, S. S., et al. (2025). Towards more inclusive finance: Exploring the mystery

of low carbon green technological innovation. *Research in International Business and Finance*, *78*, 102991–102991. https://doi.org/10.1016/j.ribaf.2025.102991

[20] Shi, L., & Shang, M. (2024). The promoting role of green finance reform and innovation on the sustainable development of low-carbon enterprises – An analysis based on recursive neural networks. *Applied Mathematics and Nonlinear Sciences*, *9*(1). https://doi.org/10.2478/amns-2024-2885

[21] Xu, W., & Qi, J. (2025). The impact of green finance and renewable energy development on the low-carbon transition of the marine industry: Evidence from coastal provinces and cities in China. *Energies*, *18*(6), 1464–1464. https://doi.org/10.3390/en18061464

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