



Study on the Construction of Hainan Free Trade Port Based on Green and Low-Carbon Transformation

Yongzhi Jiang¹, Yanquan Cui², Xiaochuan Jia³

¹Hainan University of Science and Technology, Haikou 570100, Hainan, China

²China Academy of Building Research, Beijing 100000, China

³China Construction Design and Research Institute Co., Ltd., Beijing 100000, China

Abstract: Against the backdrop of China's "dual carbon" strategy (carbon peaking and carbon neutrality), Hainan Free Trade Port faces the dual challenges of economic growth and ecological protection. Based on a systematic analysis of the necessity of green and low-carbon transformation in Hainan Free Trade Port, this study proposes an industrial system upgrade, low-carbon transformation of infrastructure, and a mechanism for realizing the value of ecosystem services, and formulates supporting measures to provide support for the green development of the free trade port.

Keywords: Hainan free trade port; low-carbon transformation; green development; industrial reform

1. Introduction

With the acceleration of global climate governance, the green and low-carbon transformation and development model has become a core competitive dimension in the field of international economy and trade. Hainan Free Trade Port is China's important gateway for opening up to the Pacific and Indian Oceans, undertaking major national strategic missions, and urgently needs to explore a path for in-depth integration of high-quality economic growth and long-term sustainability. Yao Xuange (2025) took the legal guarantee for the high-quality development of the low-altitude economy as an entry point, suggesting that Hainan should connect the technological needs of tropical islands with open scenarios, balance safety and development with digital technology, and build new drivers for the development of the free trade port[1]. Lin Yuya and Gao Chengyin (2025) proposed the construction of green financial product innovation and market paths for Hainan Free Trade Port based on the "dual carbon" goals[2]. Luo Jincheng (2023) pointed out that free trade ports are high-level platforms for opening up, shouldering the historical responsibility of high-quality "bringing in" and high-level "going out"[3].

2. Necessity of Green and Low-Carbon Transformation in Hainan Free Trade Port

2.1 Synergistic Demand for Ecological Civilization Construction and Economic Development

As a global biodiversity hotspot, Hainan Island has significant contradictions between the fragility of its ecosystem and the urgency of economic development. The traditional extensive development model has led to problems such as mangrove degradation and offshore pollution, and the constraints of ecological thresholds have forced the innovation of development models. Through the construction of a mechanism for realizing the value of ecological products, green and low-carbon transformation can promote the innovation of natural resource capitalization paths. For example, the application of policy tools such as the ecological compensation mechanism for tropical rainforest national parks and blue carbon trading pilots can achieve a positive cycle of ecological protection and green industry development[4].

2.2 Internal Logic of Institutional Opening-Up and Alignment with Low-Carbon Rules

The special supervision model of the free trade port — "opening up at the first line and controlling at the second line" — provides an institutional carrier for the internalization of international green standards. By exploring institutional breakthroughs such as cross-border carbon market connection and green financial tool innovation, Hainan can become a hub for the allocation of international low-carbon factors. Institutional innovation not only reduces the compliance costs of enterprises but also enhances China's discourse power on rules in global climate governance.

2.3 Dual Drivers of Energy Structure Optimization and Industrial Reform

Currently, Hainan has a high degree of external dependence on energy, and the structural problem of excessive reliance on fossil energy restricts its sustainable development[5]. The construction of a clean energy system such as offshore wind power and solar hydrogen production can not only ensure energy security but also reshape the regional industrial competitiveness. For instance, the cultivation of a green hydrogen industry chain can link the coordinated development of high-end

equipment manufacturing, port logistics, and other industries, forming a positive interaction between technology, capital, and the market, and promoting the free trade port to leap from a traditional factor-driven development model to an innovation-driven one.

3. Design of Implementation Paths for Green and Low-Carbon Transformation

3.1 Reconstruction and Upgrade Strategy of the Industrial System

Implement an “industrial carbon budget” management mechanism and establish a dynamic adjustment system for the negative list of industry access. Conduct full-life-cycle carbon emission accounting for the tourism industry, and promote eco-tourism certification and the development of low-carbon tourism products. In the field of high-tech industries, focus on the layout of cutting-edge technology research and development such as carbon capture materials and smart microgrids, and build a source of green technology innovation. In terms of modern service industries, develop professional services such as carbon asset management and ESG consulting, and build an ecosystem of green producer services.

3.2 Path for Low-Carbon Transformation of Infrastructure

Promote the “electrification-intelligentization-sharing” trinity transformation in the transportation field, and build a multi-modal transportation network with intercity rapid railways as the backbone. In terms of port operations, promote the full coverage of shore power systems and the application of LNG-powered ships, and build an intelligent energy management platform. In the construction field, strictly implement green building standards, promote the large-scale development of ultra-low-energy buildings, and pilot the commercial application of building-integrated photovoltaics (BIPV) technology. In terms of digital infrastructure, establish a carbon data traceability system based on blockchain technology to improve carbon emission monitoring capabilities.

3.3 Mechanism for Realizing the Value of Ecosystem Services

Innovate the GEP (Gross Ecosystem Product) accounting methodology and establish a value evaluation system covering ecosystems such as forests, oceans, and wetlands. Launch blue carbon trading pilots and explore methodologies for carbon sink development in mangrove restoration projects. Set up ecological bank pilots to activate ecological assets through property rights segmentation and market-oriented circulation. Introduce a water rights trading mechanism in basin ecological compensation to realize the shared burden of ecological protection costs by the whole society.

4. Construction of a Support System for Transformation Implementation

4.1 Innovative Design of Market Incentive Mechanisms

It is recommended to establish a green development fund and guide social capital to invest in low-carbon projects through a risk compensation mechanism. Promote green financial products such as “environmental protection loans” and explore a carbon emission rights pledge financing model. Implement energy use rights trading in key industries and establish a coordinated operation mechanism with the carbon market. Implement an additional deduction policy for low-carbon technology research and development, and improve the tax preference system for green technology innovation.

4.2 Strengthening of the Scientific and Technological Innovation Support System

It is suggested to establish a green technology research institute and build a collaborative innovation platform integrating “government, industry, academia, research, and application”. Layout a carbon neutrality technology laboratory in the Deep-Sea Science and Technology City to tackle key technologies for marine negative emissions. Build a digital twin city system to realize intelligent regulation in fields such as energy and transportation. Establish an international green technology transfer center and set up a mechanism for rapid patent examination and cross-border transactions.

4.3 Path for Promoting the Modernization of Governance Capacity

Build an inter-departmental collaborative supervision platform for carbon emissions, integrating multi-source data such as environmental monitoring and energy statistics. Establish an audit system for leading cadres’ natural resource assets when leaving office, and incorporate carbon intensity indicators into the performance evaluation system. Cultivate environmental protection social organizations and build a multi-participation supervision and evaluation mechanism. Launch a national low-carbon literacy improvement campaign and establish a personal carbon account incentive system.

5. Conclusions and Prospects

This study systematically demonstrates the strategic necessity of green and low-carbon transformation in Hainan Free

Trade Port and reveals the implementation logic of the collaborative drive of institutional innovation and technological innovation. The study points out that the special policy advantages of the free trade port provide a testbed for breaking institutional barriers in traditional transformation. By building a “policy-market-technology” trinity support system, a development model with demonstration value can be formed. Looking forward, it is necessary to focus on cutting-edge issues such as carbon tariff response strategies and the construction of cross-border green supply chains, and deepen research on interaction with the international rule system. With the advancement of the transformation process, Hainan is expected to become a practical example of global ecological civilization construction and provide a Chinese solution for developing countries to explore green growth paths.

Acknowledgments

This paper was supported by the following fund projects: Planning Project of Philosophy and Social Sciences in Haikou: “Study on the Paths and Methods of Innovative Investment and Financing Modes for Key Projects in Urban Comprehensive Improvement Work” (2024-ZCKT-67); Planning Project of Philosophy and Social Sciences in Haikou: “Study on Urban Renewal under the Background of Territorial Spatial Planning” (Project No.: 2025-ZCKT-115).

References

- [1] Yao Xuange. On the Legal Guarantee for the High-Quality Development of the Low-Altitude Economy — A Case Study of Hainan Free Trade Port [J]. *Journal of Financial and Economic Theory*, (2025): 10.13894/j.cnki.jfet.20251027.001.
- [2] Lin Yuya, Gao Chengyin. Innovation of Green Financial Products and Market Paths in Hainan Free Trade Port under the “Dual Carbon” Goals [J]. *Business Economy*, 2025 (10): 180-183.
- [3] Luo Jincheng, Huang Xun, Pang Shu. Thoughts on Accelerating the Green and Low-Carbon Development of China’s Pilot Free Trade Zones — A Case Study of Hunan Pilot Free Trade Zone [J]. *World Environment*, 2023 (04): 53-56.
- [4] Guo Kai, Chen Hao, Duan Lianwen, Xu Fage, Huang Fengxue. “Infrastructure Materials Bank” in Jinan Free Trade Zone Opens a New Path for Green, Low-Carbon and High-Quality Development [J]. *World Environment*, 2023 (04): 60-61.
- [5] Liu Changsong. Accelerating the Construction of Green and Low-Carbon Free Trade Parks [J]. *China Development Observation*, 2017 (14): 18-21+24.