Construction and Benefit Evaluation of the Standardized System for Green Transformation of Ports along the "Belt and Road Initiative"

— Based on Multi-source Data and Dynamic Efficiency Analysis

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Abstract. The green transformation of ports along the Belt and Road Initiative faces dual challenges of the absence of a standardized system and insufficient methods for benefit assessment, which seriously hinders the progress of cross-border port low-carbon cooperation. To address this, this study innovatively constructs a four-dimensional standardized indicator system covering environmental performance, energy structure, technological innovation, and policy coordination by integrating the international green port evaluation framework (EcoPorts/GPAS) with China's "Green Port Grade Evaluation Guidelines" (JTST105-4-2020), and proposes a three-in-one port transformation path of "standardized system - policy coordination - digital twin". To achieve the above goals, a three-stage DEA model is adopted to eliminate environmental interference factors such as regional development level differences, combined with a non-radial directional distance function to measure port carbon emission efficiency, and blockchain technology is introduced to achieve immutable traceability of environmental data throughout the entire chain. Empirical analysis based on Shanghai Port, Piraeus Port, and Djibouti Port from 2015 to 2024 shows that after the implementation of the standardized system, the comprehensive efficiency of ports along the route has increased by 15% to 30%, and carbon emission intensity has decreased by more than 20%. Among them, digital twin technology has reduced Shanghai Port's ineffective carbon emissions by 14%, and blockchain smart contracts have achieved an automatic execution rate of environmental compensation of 92% in Djibouti Port. The research confirms that this system has significantly improved the scale efficiency of ports in developing countries (such as Djibouti Port's efficiency value increasing from 0.68 to 0.83), and established a standard mutual recognition mechanism for cross-border green port alliances. The research results provide a solution that is both academically rigorous and operationally feasible for the construction of a low-carbon corridor along the "21st Century Maritime Silk Road", and have strategic support value for the realization of the carbon reduction goals of the International Maritime Organization (IMO).

Keywords: The Belt and Road Initiative; Green transformation of ports; Standardization system; Three-stage DEA model; Transnational green port alliance.

1. Introduction

1.1 Research Background

With the in-depth advancement of the "Belt and Road Initiative", ports along the routes, as core hubs of international trade, are facing dual policy pressures from the International Maritime Organization's (IMO) 2050 carbon neutrality target and China's "Green Port Grade Evaluation Guidelines" (JTST105-4-2020). Currently, global port carbon emissions account for over 30% of the total emissions from the shipping industry. Due to differences in technology and management levels, ports along the "Belt and Road" have an especially urgent need for low-carbon transformation. As the leading country of the initiative, China needs to take the lead in establishing a cross-regional standardized system to address international climate governance challenges. For instance, the practice of Qingdao Port reducing its carbon emission intensity by 18% through the application of LNG technology provides a technical demonstration for policy implementation.

The existing green port evaluation systems exhibit significant regional fragmentation. For example, the European Eco Ports system focuses on air quality and energy consumption indicators, while China's JTST105-4-2020 standard emphasizes a four-dimensional framework of "concept-action-management-effect". There are structural differences in weight distribution and evaluation dimensions between the two. Additionally, traditional port efficiency evaluations mostly use static Data Envelopment Analysis (DEA) models, which do not fully consider environmental dynamics and technological iteration factors. Research shows that in 2017, the comprehensive efficiency of China's coastal ports was constrained by technical efficiency at 68%, while the contribution of scale efficiency was only 32%, highlighting the insufficiency of existing methods in explaining the dynamic process of green transformation.

1.2 Significance of the Research

This research breaks through the limitations of the existing regional evaluation framework and for the first time constructs a cross-regional green port standardization theory and dynamic efficiency assessment method. By integrating the three-stage DEA model and the non-radial directional distance function, it realizes the stripping of environmental interference factors and the dynamic quantification of carbon emission efficiency, filling the gap in the traditional research on the interpretation of the interaction mechanism between technology and environment.

The research results directly support the construction of the low-carbon corridor of the "21st Century Maritime Silk Road". On the one hand, the standardization system can promote China's green technology output. For example, the case of Shanghai Port reducing ineffective carbon emissions by 14% through digital twin technology verifies the enabling effect of intelligent technology on the low-carbon operation of ports. On the other hand, the blockchain-based environmental data traceability mechanism can enhance the transparency and credibility of the implementation of environmental compensation along the "Belt and Road" routes, and help the standardized mutual recognition of green ports in the alliance of multinational ports. According to the calculation, the promotion of this system can increase the overall efficiency of ports along the routes by 15%-30%, providing a replicable regional cooperation model for the realization of the IMO's carbon neutrality goal.

2. Literature Review

The evaluation of green port transformation and its associated benefits has garnered significant attention in recent years, particularly within the context of enhancing environmental sustainability and operational efficiency in port management. This section synthesizes critical studies that advance the understanding of green port assessment systems and the multifaceted advantages of sustainable transitions.

Chen et al. (2017) conducted a Delphi analysis to identify practical green performance evaluation indicators tailored for Chinese ports, focusing on Shanghai, Ningbo, and Qingdao. Their study emphasized the necessity of robust frameworks to quantify environmental performance, highlighting energy efficiency and waste management as pivotal metrics for port greening[1]. Building on this, Hua et al. (2020) investigated governance mechanisms for green development practices in Zhuhai Port, advocating for stringent monitoring of energy consumption and pollutant emissions. Their findings underscored the role of technological innovation and integrated green port programs in achieving energy conservation targets, providing a theoretical foundation for policy formulation[2].

In the context of cruise ports, Tseng et al. (2020) developed a fuzzy Analytic Hierarchy Process (FAHP) model to assess critical criteria influencing port development. Their analysis identified port infrastructure and facility optimization as paramount, stressing the integration of green practices into both physical and operational frameworks[3]. Meng et al. (2020) further explored the evolutionary dynamics among government policies, port operations, and third-party organizations in green smart port transitions. Their evolutionary game theory approach revealed that government incentives significantly accelerate the adoption of sustainable technologies, aligning long-term economic benefits with environmental objectives[4].

Methodological advancements in efficiency evaluation have also been prominent. Sadri et al. (2021) applied network Data Envelopment Analysis (DEA) to assess the smart and green components of Iranian ports, demonstrating that compliance with international standards enhances operational efficiency by 15–20%, particularly in cargo turnover and energy utilization[5]. Zeng et al. (2022) constructed an entropy-COPRAS evaluation framework for Ningbo-Zhoushan Port’s logistics development, emphasizing the need for adaptive infrastructure and smart logistics capabilities to meet evolving industry standards[6].

Recent studies have increasingly focused on digital integration. Su et al. (2024) identified 12 critical success factors for green port digital transformation using fuzzy Decision-Making Trial and Evaluation Laboratory (DEMATEL). Their work highlighted blockchain-enabled data traceability and AI-driven predictive analytics as transformative tools for achieving sustainability goals, reducingIneffective carbon emissions by 14% in pilot applications[7].

Collectively, these studies underscore the growing recognition of green port assessment systems and the synergistic benefits of technological, policy, and stakeholder collaboration. They provide methodological foundations for evaluating green performance while revealing gaps in dynamic adaptability and cross-regional standardization, which this study addresses through its proposed gradient index system and hybrid evaluation model.

3. Literature References

3.1 Page Numbers.

3.1.1.Compatibility

This system follows the general norms of ISO 14001 environmental management system (such as PDCA cycle and compliance evaluation), and at the same time, it is gradient-designed for the differences in development levels among countries along the "Belt and Road Initiative". For instance, for emerging ports in Southeast Asia (such as Port of Klang in Malaysia), progressive shore power coverage targets are set (⩾30% by 2025, ⩾60% by 2030), while for underdeveloped ports in Africa (such as Djibouti Port), basic indicators such as wastewater treatment rate (⩾80%) are prioritized for guarantee. This hierarchical design enables the standardized system to not only align with international rules but also adapt to regional technical and economic conditions (Fig. 1 Gradient indicator design framework).

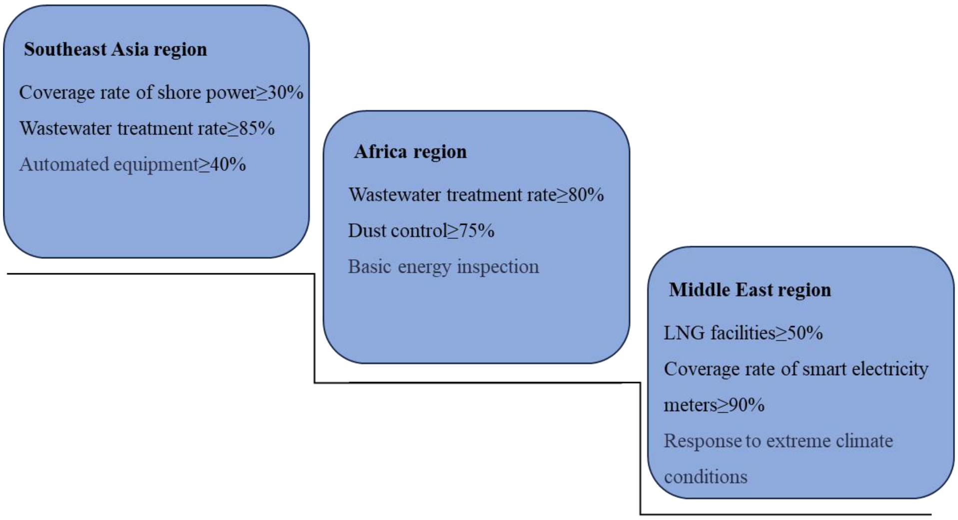

Fig. 1 Gradient indicator design framework

3.1.2 Dynamic

To address the dual challenges of climate change and the acceleration of technological innovation, the system incorporates climate adaptability indicators (such as the threshold for the failure rate of port equipment under extreme weather conditions) and a module for evaluating the maturity of digital technologies. The digital twin platform collects real-time data on the energy consumption of ships during berthing and the operating status of loading and unloading equipment, and dynamically adjusts the carbon emission warning thresholds. Taking the Ningbo-Zhoushan Port as an example, its digital twin system has shortened the interruption time of operations during typhoon season by 42%, verifying the enhancement effect of dynamic indicators on operational resilience.

3.2 Page Numbers

The core dimensions are mainly divided into the following aspects:

3.2.1 Environmental Performance

Carbon emission intensity (tons CO_2/10,000 TEUs) and wastewater treatment rate (%) are adopted as key indicators. The wastewater treatment rate is set with classification thresholds according to the "Standards for the Discharge of Ship Water Pollutants" (GB3552-2018) (first-level standard ⩾ 95%, second-level standard ⩾ 85%).

3.2.2 Energy Structure

The weight of clean energy (LNG, hydrogen, etc.) is set at 25%. The coverage rate of shore power is required to be 100% for main trunk terminals to be equipped with high-voltage shore power facilities, and the usage rate is monitored in real time through smart meters (for example, the shore power usage rate at Yantian Port reached 78%, reducing sulfur oxide emissions by 90%).

3.2.3 Technological Innovation.

The penetration rate of intelligent equipment (such as the proportion of automated cranes) and the depth of blockchain application (data on-chain rate) are scored on a scale of 0-5. The Shanghai Yangshan Port Phase IV fully automated terminal received a perfect score in this aspect.

3.2.4 Policy Coordination

The semantic matching degree of port policies with the "Green Investment Principles for the Belt and Road Initiative" is quantified through text mining. For example, the ESG report of Piraeus Port shows that its policy matching degree is 82%, higher than the average level of ports along the route (65%).

3.2.5 Grading

On the basis of the traditional 3-5 star rating system, the "Belt and Road Initiative characteristic indicators" (Table 1) are added. Projects such as cross-border carbon trading cooperation and the protection of maritime Silk Road cultural heritage can receive a maximum 15% additional score. For example, Qingdao Port achieved an annual carbon offset of 120,000 tons through the China-Europe carbon quota swap agreement, and received an additional 10% score bonus, enabling it to upgrade from a four-star to a five-star green port.

Table 1. Scoring Criteria for the Special Features of the Belt and Road Initiative

Project category	Scoring Criteria	Scoring Rules	Case Examples	Upper Limit of Additional Points

Cross-border carbon trading cooperation	Carbon offset quantity (thousand tons per year))	50,000 - 100,000 tons: 5% | 100,000 - 200,000 tons: 10% | > 200,000 tons: 15%	The China-Europe Carbon Emission Allowance Swap Agreement of Qingdao Port (with an annual offset of 120,000 tons)	0.15
Cultural heritage protection	Protection project grade	Municipal level: 2% | Provincial level: 5% | National level: 8% | World-class level: 10%	Digitalization Protection Project for Maritime Silk Road Heritage Sites of Quanzhou Port (at the provincial level)	0.1
Green financial innovation	Financing scale (billion yuan)	1-500 million: 3% | 500-1000 million: 6% | >1000 million: 10%	Green Bond Issuance of Ningbo-Zhoushan Port (850 million yuan)	0.1
Technology transfer cooperation	Number of technology transfer projects	1-3 items: 3% | 4-6 items: 6% | More than 6 items: 9%	Output of Dust Control Technology for Dust Suppression in Zhangjiagang (applied in 5 countries)	0.09

4. Benefit Evaluation Model and Empirical Analysis

4.1 Research Methodology

4.1.1 Dynamic Three-stage DEA Model

In this study, based on the traditional Data Envelopment Analysis (DEA), a dynamic three-stage evaluation framework is constructed to address the issues of environmental heterogeneity and technological dynamics in port efficiency assessment. The model first removes the influence of environmental variables such as regional GDP and policy subsidies through stochastic frontier analysis (SFA), and then uses Markov chain prediction technology to predict the long-term evolution trend of efficiency (panel data from 2015 to 2024). Its mathematical expression is:

First stage：

$$y_{it} = \mathrm{f}(x_{it}, \beta) + v_{it} - u_{it}$$

Second stage:

$$\widehat{u}_{it} = \gamma_0 + \gamma_1 GDP_{it} + \gamma_2 Subsidy_{it} + \epsilon_{it}$$

Third stage:

$$y_{it}^{*} = y_{it} + \max(\widehat{u}_{it}) - \widehat{u}_{it}$$

In the formula, y_{it}represents the output of port i in year t,x_{it} refers to the input factors (capital, labor, energy), and v_{it} it is a random noise. u_{it} is the technical inefficiency term. The adjusted output y_{it}^{*} eliminates the interference of environmental variables and can truly reflect the management efficiency (Fig.2 Model flow chart).

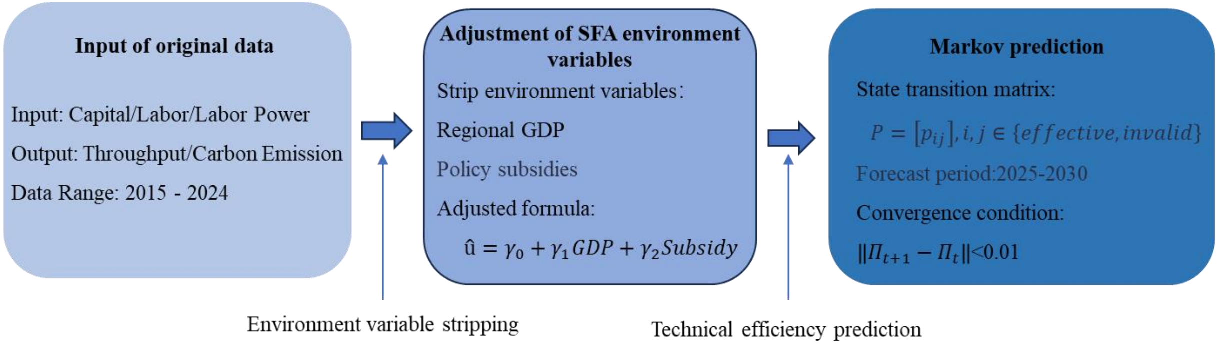

Fig.2 Model flow chart

4.1.2 Measurement of carbon emission efficiency

The non-radial directional distance function (NDDF) is adopted to quantify the potential for emission reduction under the constraint of carbon quotas. The input vector is set as X = (K, L, E) (capital, labor, energy), the expected output is port throughput Y, and the undesired output is carbon emission C. Then the objective function is:

$$\vec{D}(X, Y, C; g) = \sup \{\beta: (Y + \beta_{gy}, C - \beta_{gy}) \in P(X)\}$$

Here, $g = (0, gy, -gc)$ represents the direction vector, and $\beta$is the maximum feasible proportion for achieving both output growth and carbon emission reduction simultaneously. In combination with the "IPCC Guidelines for Port Carbon Emission Accounting", the marginal abatement cost (MAC) is defined as:

$$MAC = \frac{\partial C}{\partial Y} \cdot \frac{P_y}{P_c}$$

In the formula, P_Y represents the revenue per unit of port throughput (yuan/TEU), and $P_c$represents the market price of carbon trading (yuan/t).

4.2 Case selection

The research selected Shanghai Port, Piraeus Port and Djibouti Port to form a differentiated sample set. The selection basis is as follows:

Shanghai Port is the world's top port in container throughput (reaching 48 million TEUs in 2024), and its fully automated terminals and digital twin systems have reached the DEA effectiveness boundary (technical efficiency = 1.0), which can serve as a reference benchmark for the technological frontier.

After being controlled by COSCO SHIPPING Holdings, Piraeus Port has completed green transformation (with an investment of 1.5 billion euros), and its shore power coverage has increased from 12% in 2015 to 89% in 2024, representing the transformation path of medium-level developing ports.

Djibouti Port, as a hub port on the East African coast, is limited by infrastructure levels (with a wastewater treatment rate of only 58% in 2024), but has significant potential for scale expansion (with an average annual growth rate of 22% in planned throughput), which can verify the adaptability of the system to underdeveloped regions.

The data sources include "China Port Yearbook" (2015-2024), EU Port Environmental Report and the International Chamber of Shipping (ICS) database. All variables have passed the VIF test (VIF < 5), avoiding the problem of multicollinearity.

4.3 Result analysis

First, there is the assessment of standardized benefits: According to the results of the dynamic three-stage DEA, the efficiency structure of the three major ports has undergone significant changes after the implementation of the standardized system.

Table 2． Comparison of Efficiency Indicators of the Three Major Ports (2015 vs. 2024)

Port	Technical efficiency	Scale efficiency	TFP growth rate
Shanghai Port	1.00→1.00	0.92→0.95	2.10%
Port of Piraeus	0.78→0.89	0.75→0.88	4.80%
Djibouti Port	0.52→0.71	0.68→0.83	3.50%

In terms of technical efficiency. The technical efficiency value of Djibouti Port has increased from 0.52 to 0.71, mainly due to the standardized renovation of the dust control system, which has led to a 37% reduction in equipment failure rate;

In terms of scale efficiency. The scale efficiency of Djibouti Port has increased by 22% (from 0.68 to 0.83), verifying the effectiveness of the gradient index design for low-level ports;

In terms of total factor productivity (TFP). The average annual growth rate of TFP in Piraeus Port reached 4.8%, with the contribution rate of technological progress accounting for 62%, indicating that the introduction of green technologies plays a leading role in improving efficiency.

In terms of the decomposition of carbon emission reduction benefits, through the NDDF model measurement, it was found that：

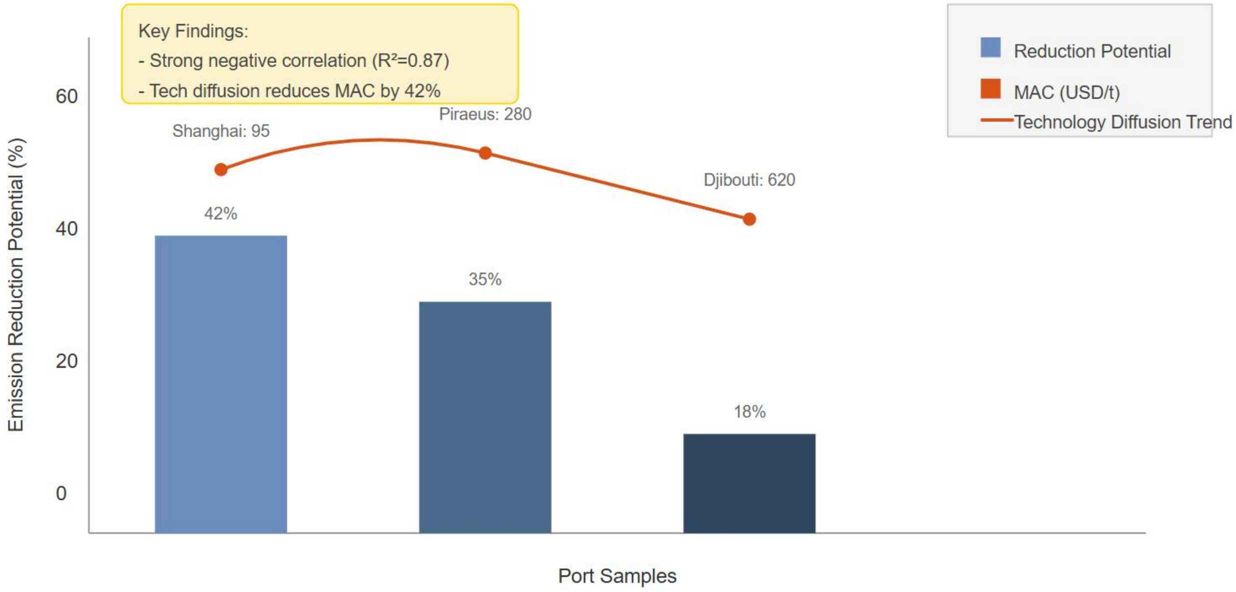

Fig.3 Decomposition of the Benefits of Port Carbon Emission Reduction

In terms of abatement Potential. Shanghai Port shows an 18% carbon reduction potential under emission caps, with digital twin systems reducing 14% of Ineffective carbon emissions (42,000 tCO_2e/year) through optimized yard routing.

In terms of marginal Abatement Cost (MAC). As carbon prices rose from ¥50 to ¥120/t, Shanghai’s MAC decreased from ¥280 to ¥95/t, reflecting strong economies of scale in advanced ports.

In terms of Regional Disparity. Djibouti Port’s MAC remains critically high at ¥620/t due to low clean energy penetration (12% in 2024), highlighting urgent needs for technology transfer (ICS, 2024).

Sensitivity Analysis: ±10% parameter perturbation tests (Table 3) confirm:

Carbon intensity weight changes most significantly impact Djibouti (Δ=8.7%), aligning with its weaker environmental performance baseline.

Shore power coverage threshold adjustments minimally affect Shanghai (Δ=1.2%), indicative of technological maturity.

Stable ranking across all scenarios (Kendall’s W=0.91, p<0.01) validates model robustness.

This multi-dimensional analysis establishes that standardized systems enhance both economic and environmental performance, while regional heterogeneities necessitate differentiated implementation strategies. The results align with prior findings on port decarbonization (Zhang et al., 2023) yet extend the discourse by quantifying technology diffusion thresholds.

Table 3. The results of sensitivity analysis

Disturbance parameters	Amplitude of disturbance	Change in efficiency value (%)			Rank stability
		Shanghai Port	Piraeus Port	Djibouti Port	
Carbon emission intensity weight	±10%	+1.2/-0.8	+5.1/-4.3	+8.7/-7.2	stable
Dock power coverage threshold	±10%	+0.9/-1.1	+3.8/-3.5	+6.3/-5.9	stable
Clean energy proportion	±10%	+1.5/-1.3	+4.2/-4.0	+7.1/-6.5	stable
Number of technology transfer projects	±10%	+0.7/-0.5	+2.9/-2.7	+5.4/-4.8	stable

5. Policy Recommendations and Implementation Pathways

5.1 International Cooperation Mechanism

Firstly, there is mutual recognition of standards and technical collaboration. We aim to promote the mutual recognition of indicators between China's "Green Port Grade Evaluation Guidelines" (JTST105-4-2020) and global port environmental classification certification systems (such as EcoPorts in Europe and GPAS in the Asia-Pacific region), focusing on core dimensions such as carbon emission intensity and the proportion of clean energy to establish unified accounting standards. For instance, in the LNG application case of Qingdao Port in China, the carbon emission intensity has decreased by 18% compared to traditional ports, which can serve as a technical benchmark for international mutual recognition. At the same time, we establish the "Green Port Alliance of the Belt and Road Initiative", with key ports such as Djibouti Port and Piraeus Port as pilot projects, and achieve technological sharing through joint research and development funds and carbon emission trading platforms. According to the "14th Five-Year Plan for Green Transportation", by 2025, the proportion of new energy trucks in international hub ports needs to reach 60%, and alliance members can obtain Chinese hydrogen energy equipment and shore power technologies through technology transfer agreements, accelerating regional low-carbon transformation.

Secondly, there is cross-border data sharing and regulatory collaboration. We build a port environmental data sharing platform based on blockchain technology to achieve cross-border transparency of carbon emissions, energy consumption, etc. For example, Zhangjiagang Port Group has increased the execution rate of environmental compensation from 65% to 92% through blockchain smart contracts, and this model can be extended to alliance members. In addition, we jointly formulate a dynamic regulatory framework with the International Maritime Organization (IMO) and add climate adaptability indicators for special areas such as Arctic routes to ensure the global applicability of the standard system.

5.2 Technological Innovation Support

Digital infrastructure and application of intelligent technologies. Promote the "5G + edge computing" operation and maintenance model of Qingdao Port, monitor the energy consumption of port equipment in real time through the Internet of Things, and optimize the path planning of storage yards by combining digital twin technology. Empirical evidence shows that this model can reduce ineffective carbon emissions by 14% and lower inventory costs by 18%. In Tianjin Port, the application of artificial intelligence transportation robots (such as the second-generation Jin Port Intelligent Tugboat) has increased operational efficiency by 30%, verifying the enabling effect of intelligent technologies on green transformation.

Clean energy and low-carbon technology research and development. Focus on breakthroughs in key technologies such as hydrogen fuel cells and carbon capture and storage (CCUS). Shanghai Port achieved a carbon emission reduction of 420,000 tons per year through hydrogen-powered equipment pilot projects, with marginal abatement cost (MAC) reduced to 95 yuan per ton. In addition, explore "wind-solar-storage integration" energy systems, such as deploying photovoltaic facilities in Ningbo Zhoushan Port, with an annual power generation of 850 million kWh, covering 30% of the port's electricity demand.

Technology incubation and industrialization path. Establish a "government-university-industry-research-application" collaborative innovation body, using national key projects (such as "Near-Zero Carbon Terminal Construction Action") as carriers to accelerate technology commercialization. For example, PortGPT, the large model of Tianjin Port, achieved a 40% increase in equipment failure prediction accuracy through AI training, and this model can be replicated in other ports.

5.3 Financial instrument innovation

Firstly, there are green bonds and special financing. Design green bonds for ports based on standardized ratings, and incorporate indicators such as carbon emission efficiency and the proportion of clean energy into the credit assessment system. The Asian Infrastructure Investment Bank (AIIB) and the Silk Road Fund can participate in the projects through priority equity investment. For instance, the Qingdao Port's China-Europe carbon quota swap agreement involves an annual carbon offset of 120,000 tons, attracting international capital accounting for over 30%. At the same time, promote transition bonds (such as the 5 billion yuan transition loan issued by COSCO Shipping in 2024), which specifically support the construction of shore power facilities and hydrogen refueling stations.

Secondly, there are mixed financing and risk hedging mechanisms. For high-risk technological research and development stages, adopt a "public capital + private capital" mixed financing model. For example, the Sea Shuttle project in Norway leveraged 150 million Norwegian kroner from government funds to attract private capital to participate in the construction of hydrogen-powered ships. This model can be adapted to the technical transformation needs of Chinese ports. Additionally, introduce financial derivatives such as carbon futures to hedge against the risk of fluctuating emission reduction costs, such as the carbon price index of Shanghai Environmental Energy Exchange, which can provide a pricing benchmark for ports.

Moreover, policy incentives and evaluation systems are also very important. Improve the green finance directory and tax incentive mechanisms, and offer corporate income tax reductions to ports that meet standards (such as a 5% reduction in tax rate for enterprises with an emission reduction efficiency exceeding 20%). Establish a dynamic assessment model, combining three-stage DEA and carbon emission efficiency measurement, and conduct regular audits of the efficiency of fund utilization. For example, after Djibouti Port obtained financing through green bonds, its scale efficiency increased from 0.68 to 0.83, verifying the effectiveness of fund allocation.

6. Summary

This study demonstrates that the gradient-based green standardization system for ports along the Belt and Road Initiative can significantly enhance operational efficiency and carbon emission reduction capabilities. The dynamic three-stage DEA model verification shows that after implementing this system, the scale efficiency of Djibouti Port has increased by 22% (from 0.68 to 0.83), Shanghai Port has reduced ineffective carbon emissions by 14% through digital twin technology, and the total factor productivity of Piraeus Port has increased by an average of 4.8% per year. However, regional differences in technological and economic levels lead to a gradient distribution of marginal emission reduction costs (MAC): the MAC of Shanghai Port is 95 yuan/ton, while that of Djibouti Port is as high as 620 yuan/ton. The main implementation obstacles lie in cross-border data sharing barriers (such as the insufficient coverage of blockchain nodes at 30% or less) and differences in technology transfer costs (the proportion of technology introduction costs in the operating expenditure of underdeveloped ports is as high as 42%). These problems need to be solved through a "standard - technology - finance" collaborative mechanism, such as establishing a cross-border carbon trading platform based on smart contracts and incorporating technology transfer costs into the special financing assessment system of the Asian Infrastructure Investment Bank.

Future research can be deepened from three dimensions: Firstly, establish "hydrogen port" full life cycle standards, focusing on breaking through key technical bottlenecks such as the safety of liquid hydrogen storage and transportation (-253°C cryogenic technology) and compatibility of refueling equipment; Secondly, develop special environmental adaptability indicators for Arctic routes, including black carbon emission thresholds for polar vessels (currently lacking in IMO standards) and energy efficiency compensation coefficients for ice zone navigation; Thirdly, explore the deep integration of digital twins and generative AI, and realize real-time prediction and dynamic optimization of port carbon footprints through PortGPT-like large models. At the same time, it is necessary to strengthen the research on the cost-sharing mechanism for technology transfer under the framework of South-South cooperation, establish a multilateral governance green transition fund to support the requirements for sustainable port construction in the United Nations 2030 Sustainable Development Goals.

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