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Port Development Model based on Low-carbon Economy

Xiaozhe Zhang

School of Shanghai Maritime University, Shanghai 201306, China.

Abstract

In order to further strengthen the construction of port low-carbon green, promote the development of ports in China green low carbon process, this article embarks from the analysis of research status at home and abroad, and then find the driving factors to promote low-carbon port construction, summarize the content above put forward the current domestic ports without relevant low-carbon green planning, lack of local about low carbon green port, port between the lack of corresponding laws and regulations system integration, lack of corresponding exchange between port and social, understanding of the concept of low carbon green port construction is not enough in place and so on a series of problems, from each of these aspects to study the corresponding measures, Suggestions are put forward for better construction of low-carbon and green ports to accelerate the construction of low-carbon and green ports in China.

Keywords

Low carbon economy; Port development; Development countermeasure.

1. Introduction

The "Twelfth Five-Year Development Plan for Transportation" set up a special chapter on green transportation, and clearly stated that the transportation industry should focus on energy conservation and emission reduction, establish a low-carbon transportation development model, improve resource utilization efficiency, and strengthen ecological protection And pollution control, build a green transportation system, and take a resource-saving and environment-friendly development path. Accelerating the construction of green, circular and low-carbon ports is of great practical significance for optimizing the port industry structure, planning the industrial layout, ensuring the sustainable development of the port, and realizing the "four transportations". Therefore, in the process of accelerating the transformation of transportation methods, building a low-carbon transportation system, and building a "two-oriented society", building ports based on low-carbon and green concepts has become the top priority of all tasks.

Ports are of great significance to shipping construction and foreign trade. However, in recent years, China's port cities have been shrouded in fog over a large area and for a long time, which not only affects economic development and environmental ecology, but also affects people's normal life and health. Every year, China's direct economic losses caused by environmental pollution exceed tens of billions. Obviously, the serious ecological environmental damage has exceeded the ability of nature. Faced with the increasingly serious environmental pollution problem, many countries have formulated low-carbon environmental protection development plans. China wants to strengthen its strength. To solve the port pollution problem, we must actively face environmental problems and take the port's low-carbon environmental protection development route.

The connotation of the low-carbon ecological port area is to integrate low-carbon goals and ecological concepts, rely on technological innovation and policy measures, and transform economic development methods to reduce resource consumption, reduce carbon emissions, alleviate

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environmental impacts, and coordinate the harmony of the port and city. "Human, port area, natural environment", a harmonious and co-existing complex port ecosystem. Low-carbon ecological port area is the specific application of low-carbon ecological economy in port area planning, construction, production and operation, and it is a new model that pursues the harmonious development of port and city.

2. Review of relevant research at home and abroad

2.1 The connotation of low-carbon economy

Low-carbon economy means that under the guidance of the concept of sustainable development, through various means such as technological innovation, institutional innovation, industrial transformation, new energy development, etc., the consumption of high-carbon energy such as coal and petroleum is reduced as much as possible, and greenhouse gas emissions are reduced to achieve A form of economic development that is a win-win situation for economic and social development and ecological environmental protection.

2.2 Overview of research on low-carbon ports

In terms of low-carbon green ports, foreign developed countries started earlier and have achieved more mature theoretical research results. Domestic ports started late in low-carbon and green construction. In terms of related theoretical research, Guo Baochun and others learned from the efforts made by the New York-New Jersey port in the construction of "green ports" to carry out sustainable green construction for China’s ports make a suggestion. Lu Yong and others introduced the practical activities of the Sydney Port in Australia for the construction of green ports in seven aspects, including water quality and air quality, and put forward countermeasures and suggestions for the construction of green ports in my country's ports. At present, most of the research is still based on the overall research of the port, and there is a lack of independent research on various environmental factors. At the same time, most of my country's ports are under high pressure on the water environment, so planning and countermeasures for the prevention and control of port water environment pollution based on the green and low-carbon model are becoming increasingly urgent, which is also the key content of my country's green and low-carbon port construction.

2.3 Corresponding research on domestic cases

2.3.1 Shanghai Port

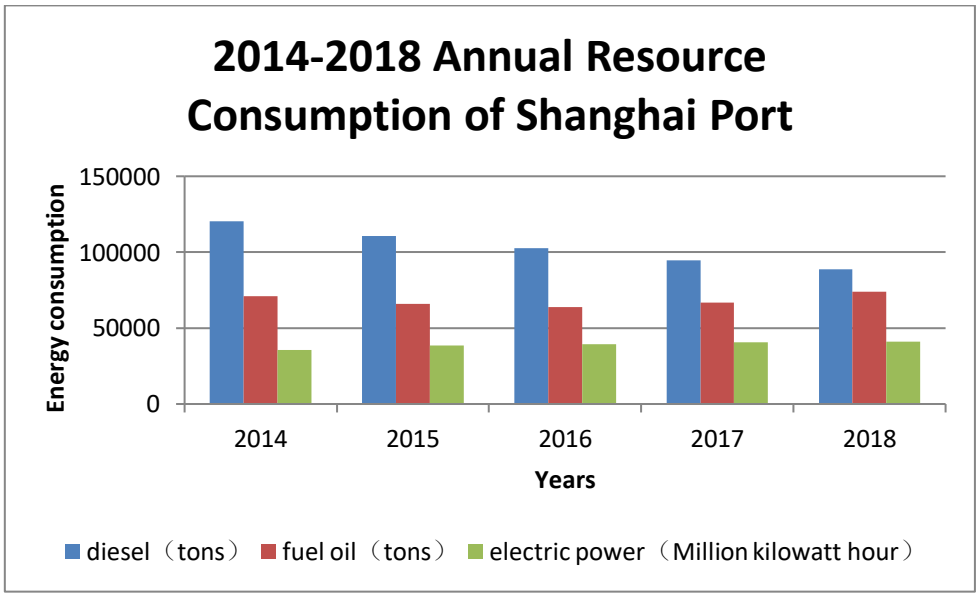

Figure 2.1 Annual resource consumption of Shanghai Port from 2014 to 2018

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In order to change the port development mode and alleviate the contradiction between environmental protection and port development, Shanghai Port formally proposed the "Shanghai Green Port Three-Year Action Plan (2015-2017)" in July 2015. By the end of 2017, the port production The comprehensive energy consumption per unit throughput decreased by 7% compared with 2010, the carbon emissions per unit throughput of port production operations decreased by 9% compared with 2010, and the annual average concentration of fine particulate matter (PM2.5) in major port areas decreased by 20% compared with 2013. As shown in Figure 2.1, it is the annual resource consumption of Shanghai Port from 2014 to 2018. In order to achieve the above goals, Shanghai Port has formulated a number of specific measures in three aspects: ship management, port area management, and port capacity building. For example, in order to reduce PM2.5 emissions, half of Shanghai Port's terminals will use shore power systems in 2020; Shanghai Port plans to establish a joint law enforcement mechanism between the national maritime affairs, environmental protection and quality supervision departments to check the quality of marine oil and supervise them. Ship oil pollution is discharged, and the inspection results are regularly announced; in the water source protection area, Shanghai Port will implement "zero discharge" measures of ship sewage and domestic garbage to protect citizens' drinking water safety. Numerous measures will ensure the smooth completion of Shanghai Port's green port.

2.3.2 Qingdao Port

Qingdao Port is actively engaged in environmental protection construction of the port centering on the two green and low-carbon development concepts of "low energy consumption, low pollution, low emissions" and "high efficiency, high efficiency, and high benefit". From 2007 to 2012, Qingdao Port invested 1.5 billion yuan to purchase and construct environmental protection equipment. In 2013, Qingdao Port invested 2.2 billion yuan to implement 27 key engineering projects in five areas, including infrastructure construction, transportation equipment energy-saving technology application, terminal loading and unloading process system transformation, port intelligent information technology application, and environmental protection. Measures such as using clean energy, strengthening technological reforms, and reducing energy consumption, actively promote the harmonious development of ports and the environment. Under the strategic advocacy of "rejuvenating the city by port", Qingdao Port will pay more attention to the coordinated development of itself and the environment, make every effort to build a green port, and fully develop the blue economic belt of the peninsula. As shown in Table 2.1, from 2016 to 2018, the use of recycled water has increased, direct energy consumption has decreased year by year, and indirect energy consumption has increased year by year, which indicates that Qingdao Port has made certain changes in the use of resources.

Table 2.1 Energy consumption statistics of natural resources in Qingdao Port

Number	Resource type	Unit	2016	2017	2018
1	Water	Thousand cubic meters	3130	3590	3862
2	Circulating water	Thousand cubic meters	750	920	1172
3	Gasoline and diesel	One thousand tons of	52.58	48.7	45.8
4	Direct energy consumption	Thousand tons of standard coal	85	77	70.8
5	Indirect energy consumption	Thousand tons of standard coal	169	179	194
6	Comprehensive energy consumption	Thousand tons of standard coal	254	256	265

2.3.3 Dalian Port

Dalian Port has started the construction of the port's "ecological model", promoting green and low-carbon development of the port in various ways. For example, the establishment of wind-proof and dust suppression walls in the port area can effectively suppress dust pollution and noise pollution; the use of biotechnology to treat polluted wastes to avoid secondary pollution, high efficiency and energy saving and emission reduction; implementation of "oil-to-electricity" and sea-source heat pumps in the port area , Solar energy lighting and other energy-saving renovations, reduce energy consumption

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through resource reduction and reuse; the green area of 520,000 square meters in the port area accounts for more than 90% of the green area. With the implementation of environmental protection measures one by one, the green transformation of Dalian Port has achieved initial results.

2.3.4 Yantian Port

The green development of the entire industrial chain of the port logistics industry, the integration of the development of ports, industries, and cities, the combination of green development of the port and the construction of ecological civilization have become in-depth and systemic issues facing the green development of Yantian Port. In this regard, the Yantian District Government attaches great importance to it. In the district reform project in 2015, it put forward the “Research on the System and Mechanism of the Low-Carbon Ecological Harbor Area in Yantian District” and entrusted the Institute of Water Transport Sciences of the Ministry of Transport to carry out research work. At present, the project has successfully passed the expert review. Through the project research work, breakthroughs have been made in theory and filled the gaps in the research field of low-carbon ecological harbor areas. The main results are as follows:

(1) Interpretation of the connotation of low-carbon ecological port area, which is to integrate low-carbon goals with ecological concepts, rely on technological innovation and policy measures, and transform economic development methods to reduce resource consumption, reduce carbon emissions, alleviate environmental impacts, and coordinate ports The city is harmonious, and a complex harbor ecosystem of “people, port area and natural environment” is built in harmony and symbiosis.

(2) Based on the principle of analytic hierarchy process, a low-carbon ecological port area evaluation index system was constructed. The constructed low-carbon ecological port area indicator system includes three levels: target level, path level, and index level. Among them, the identified target levels include four dimensions to achieve low-carbon ecological development: saving and low-carbon, environmental protection, ecological culture, and demonstration and innovation. Determine the path to achieve 4 dimensions, covering 8 aspects including resource conservation, low carbon, environmental quality, environmental management, publicity and education, social participation, demonstration applications, and technological innovation. Determine the evaluation index level of the path level, including 30 evaluation indexes.

(3) Created a theoretical model for the development of low-carbon ecological port areas. Under the guidance of theoretical research, combined with the current status of Yantian Port Area, port and industrial development planning, the construction of low-carbon ecological port area in Yantian District has been further deepened in terms of scope and indicators, and the concept of global low-carbon ecological port area has been proposed for the first time. The port and the rear land area are considered as a whole, exploring the integration of the concept of ecological civilization into the development of the global port area, and creating a theoretical model for the development of a low-carbon ecological port area. At the same time, demonstration innovation indicators such as the annual average concentration of PM2.5 in the port area, the implementation rate of energy-saving evaluation of logistics projects, the carbon trading compliance rate of logistics enterprises, the proportion of green logistics enterprises in logistics enterprises above designated size, and the utilization rate of distributed photovoltaic power generation on warehouse roofs are proposed. , To achieve the goal of industry model through the first trial.

2.4 Corresponding research on foreign cases

2.4.1 Port of Houston, USA

The Port of Houston in the United States took the initiative to learn environmental protection design knowledge and update facilities. The Port of Houston has taken the lead in passing ISO international environmental quality standards, becoming the first "low-carbon" port in the United States and the world. In addition, it has also carried out sediment control projects, introduced the most advanced technology to reduce gas volatilization, and comprehensively controlled rainstorms and reduced noise to achieve low-carbon ports. The following table 2.3 shows the amount of solid waste that was

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recycled in the port from 2014 to 2018. It can be seen that the Port of Houston in the United States has made certain efforts in waste recycling.

Table 2.2 The amount of solid waste recycled and reused in ports from 2014 to 2018

Species	2018	2017	2016	2015	2014
Aluminum	0.9	0.88	0.16	0.13	0.81
The cardboard	20	20	22	3	15
Electronic products	6.6	6.4	5.21	-	-
Office paper	62	77	31	36	38
Plastic	1.6	1.53	2.11	0.23	0.16
Scrap metal	824	299	248	512	60
Broken tire	73	77	78	117	140
Wood packing	1,162	544	4,707	3,902	5,206
The used oil (gallons)	8,525	13,520	12,354	883	11,589

2.4.2 New York Port of New Jersey

The Port of New York and New Jersey has taken a series of measures to establish a low-carbon port, such as establishing a port environmental management system (EMS), adopting ISO14001 specifications as a guiding standard, electrifying loading and unloading equipment, improving port gates and introducing new equipment for storage yards. Reduce road congestion and harmful gas emissions; discharge ballast water regularly to ensure that species of external waters do not enter the freshwater waters of the port; modify the main engine of ships to reduce emissions; control the speed of ships entering and leaving the port, slowing down to 12kn, comprehensive cost The rate of decrease is 45%-48%; the expansion of high-speed railways reduces congestion, and the original 13% of the amount of goods transported out of the port by train is increased to 30%; the port logistics system is improved, and the self-loading and unloading barges with low pollution and high efficiency are used to directly transport inland Port dredging application of cargo and railway transportation system.

2.4.3 Port of Tokyo

The Port of Tokyo divides the construction of a low-carbon port into three phases, namely: (1) The planning and design phase of the port area: sufficient land is reserved for the greening and landscape of the port area. Gardens, grasses, and numbers are shown as a whole The layout of dots, lines and surfaces is full of vitality everywhere; (2) The construction and operation stage of the port area: the construction of new materials with environmental protection and low pollution is adopted, and each link of the operation process is always practicing the concept of environmental protection and green. Achieve a full range of energy conservation and emission reduction; (3) The late expansion stage of the port: reclamation and land reclamation, focusing on the protection of coastal landscape and sea area ecology, which truly reflects the coordinated development of man and nature, economic development and environmental protection.

2.4.4 Port of Rotterdam, Netherlands

The coal blending center gets rid of the traditional open-air operation method, uses a closed belt conveyor to automatically output and stack, effectively control the coal blending process, and realize the clean utilization of coal. Precise coal blending technology has saved the Netherlands about 100 million euros; since 2005, the carbon dioxide emissions of the refinery have been reduced by no less than 20% (2.1 million tons), the output increased by 4% in the same period, and more low-sulfur products are being produced . Figure 2.2 shows the pollutant emissions of the Port of Rotterdam from

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2016 to 2018. In 2018, the pollutant emissions of coal power plants were significantly reduced compared with 2016, and the pollutant emissions of refineries were also reduced to a certain extent compared with 2016, while the pollutants of natural gas plants There is a certain increase in emissions compared to 2016, which shows that the operating mode of the Port of Rotterdam in the Netherlands is changing.

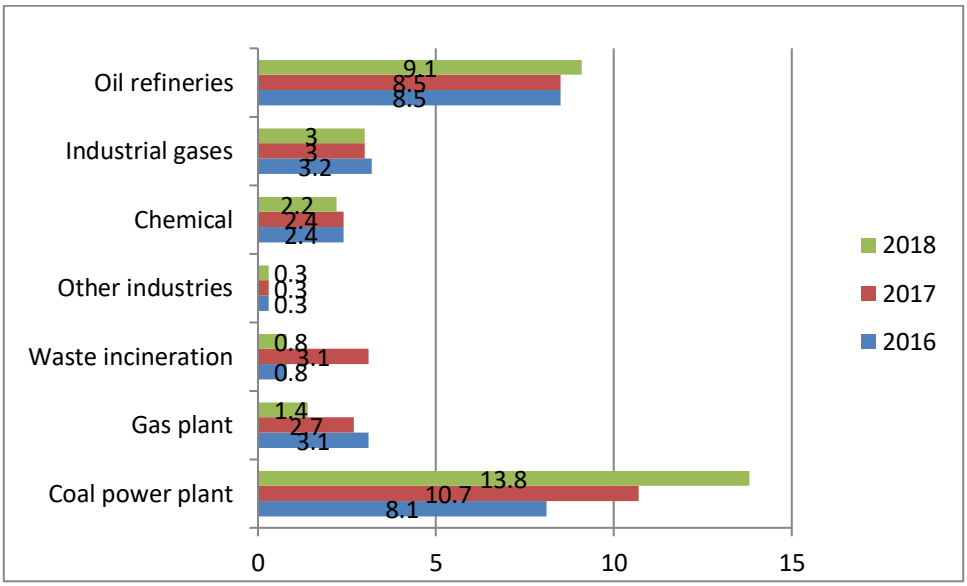

Figure 2.2 Pollutant emissions from the Port of Rotterdam from 2016 to 2018

3. Driving factors

According to data from the Organization for Economic Cooperation and Development (OECD), the emissions from ships of the 25 largest ports in the world account for 50% of the emissions from ships in the world. For example, in Hong Kong, more than 50% of sulphur dioxide emissions come from the shipping industry; in Los Angeles, about 85% of trucks on highways are related to port operations. These ports play a pivotal role in the development of global trade, but at the same time they also severely affect the port ecological environment.

The factors that promote the construction of green and low-carbon ports mainly include three aspects: policies and regulations, incentive mechanisms and technological innovation. In addition, other factors are related to these three aspects at different levels (regional or global) and promote the construction of green ports to varying degrees.

In addition, after a detailed discussion on the three driving factors of policies, regulations, incentives, and technological innovation, it is found that the current driving factors for the development of ports based on the green economy are the result of some ports in the current countries paying attention to the green economy. The efforts made are not the policy of the national government, but the result of the port's own evolution through upgrading.

3.1 Policies and regulations

As the construction of green ports has attracted more and more attention, ports in various countries have introduced policies related to port energy saving and emission reduction, especially those related to transportation.

For example, the Port of Los Angeles in the United States has implemented a truck scrapping plan since 2006, so exhaust emissions have been reduced by as much as 90%; the New York-New Jersey Port stipulates that when ships approach the port, they must slow down to 12 knots at a distance of 20 nautical miles from the breakwater. Otherwise, The port refused to send staff to navigate, berth,

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etc., and gave certain economic rewards to ships consciously complying with the regulations; the Port of Long Beach in the United States levied a green surcharge on all trailers entering and leaving the terminal. The implementation of these policies not only effectively reduces waste gas emissions, but also effectively promotes the construction of green ports.

3.2 Incentive mechanism

On a global scale, in order to reduce the tremendous pressure on the environment caused by ports, governments and relevant departments of various countries have adopted various incentive measures to encourage shipping companies and port enterprises to actively carry out green port construction. In 2010, some large ports around the world jointly developed the Environmental Ship Index (ESI) under the World Ports Climate Initiative (World Ports Climate Initiative) of the International Ports Association. This project is an international clean air plan, The ocean shipping company belonging to the latest clean ship at the Port of Los Angeles will be rewarded.

ESI not only brings environmental protection benefits to ports, but also brings significant economic benefits to shipping companies. According to the ESI project content, as long as the shipping company promotes engine, fuel and other emission reduction technology upgrades to make the ship's carbon emissions lower than the regulations of the International Maritime Organization, the shipping company can receive port fee reductions or bonuses.

3.3 Technological innovation

Technological innovation mainly includes two aspects, namely, the port actively introduces new equipment and the port actively carries out technological innovation, develops energy-saving loading and unloading machinery, improves loading and unloading quality and operation efficiency, and reduces energy consumption. At present, my country's Shanghai Port, Qingdao Port, etc. have all realized this level one after another, and have taken measures in line with the development of their own ports. This is a major innovation.

4. My country's low-carbon port development related problems and their solutions

4.1 Obstacles to the development of low-carbon ports in my country

4.1.1 The port lacks a green development plan

My country's economic development started relatively late. In the early stage of port construction, both the government and the overall environment of the society were relatively weak in environmental protection awareness. Therefore, my country generally followed the road of "development before governance". The port did not incorporate the concept of green and low carbon into the "pre-feasibility study" and "industrial feasibility study" in its development planning process. At present, both the government and the port themselves attach great importance to green and low-carbon development, but the measures they take are difficult to fundamentally solve the existing pollution problems. In the planning process of the new port, it is necessary to formulate relevant development plans for the green port to help the port solve the problem from the source.

4.1.2 Lack of local laws, regulations and evaluation systems for green and low-carbon port construction

In the process of port green and low-carbon development, although the state has issued relevant regulations and policy measures to support it, for each local government, each terminal faces different situations and the corresponding measures to be taken are also different, relying only on the state The rules and regulations introduced are not enough to enable the port to develop comprehensively. Only by establishing the corresponding legal system and evaluation system according to each port's own situation, and formulating the corresponding development plan, is the correct way suitable for the development of different ports.

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4.1.3 Lack of communication and cooperation between ports

Although all ports are consciously carrying out the next step of low-carbon port construction in accordance with their own development, communication between ports is still very lacking. Many ports are roughly similar in function and very close geographically, but they have not cooperated with each other, nor have they integrated resource advantages to form port clusters. In fact, ports with close functional structures can learn from each other's good development measures and make improvements to them in order to achieve success in their own development. Only by coordinating and cooperating between ports, avoiding blind competition, and realizing resource sharing, can they achieve maximum economic benefits and promote sustainable development and effective environmental protection.

4.1.4 Lack of collaboration between ports and society

The green and low-carbon development of a port requires not only its own efforts, but also the support and cooperation of the government and society of the city where the port is located. From the current point of view, although there is more cooperation between the port and the government, the cooperation between the port and the society is not close. The public is still very lack of understanding of the green and low-carbon development status of the port, and the relevant construction of the port is also Can not give effective support.

4.1.5 The concept of low-carbon green development still has limitations

China's research on the connotation of the construction of green ports and low-carbon development is not complete enough. The development efforts are more focused on how to reduce pollutant emissions, how to increase economic benefits, and how to increase energy utilization. How to maintain biodiversity, how to formulate more reasonable development plans, and what positive feedback the environment has on the development of the port is still not comprehensive enough, and it has not fundamentally solved the problem of green development of the port. In addition, the interpretation of the concept of energy saving and emission reduction only starts from a certain link in the production and transportation operation process or a certain operation department of a port enterprise, and lacks a complete energy saving and emission reduction operating system. These deep-seated reasons all make the port green and low-carbon development effect unsatisfactory. In addition to environmental-related content, green and low-carbon development is also extremely important in terms of efficiency improvement and simplification of procedures.

4.2 Related solutions

From the perspective of low-carbon development, it is necessary to improve the competitiveness of ports in the port cluster. A strong ability to handle environmental issues in the port area, complete port infrastructure and good port ecosystem integrity can enhance the comprehensive competitiveness of the port. Therefore, it is believed that the construction of low-carbon ports can be improved and strengthened from the following aspects.

(1) The environmental problems caused by the construction of the port area mainly include: destruction of the ecological environment, reduction of sea area tidal reception, increase of traffic noise and pollution accidents. It is therefore suggested that in the planning and construction of the port area, the principle of “protection priority” should be adhered to, the scale of port development should be demonstrated from the perspective of environmental protection, routes should be optimized, shoreline resources to be protected should be determined, and ship garbage in the port area should be protected. , Domestic garbage and wastewater in the port area shall be effectively treated, a sound oil spill and chemical leakage treatment plan shall be established, and land transportation in the port area shall be optimized.

(2) Improve the port infrastructure construction, carry out the main construction and equipment configuration for the main handling cargo of the port, improve the production efficiency of the port, obtain a larger output with a smaller investment and lower carbon consumption, and improve the competitiveness of the port.

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(3) Ecosystem integrity is an important concept in resource management and environmental protection. It mainly reflects the degree to which the ecosystem maintains its natural state, stability and self-organization ability under external disturbances. To maintain the integrity of the port's ecosystem, it is necessary to first establish a scientific and detailed evaluation index for the integrity of the ecosystem according to the actual situation of the port, and then continuously monitor, evaluate and rectify during the construction and development process to maintain the port's ecological restoration capabilities.

5. Research conclusions and prospects

5.1 Main research conclusions

The impact of port ecological environment is the most important criterion for port competitiveness under low-carbon development. This shows that port ecological environment has the greatest impact on port competitiveness. If ports want to gain advantages in low-carbon development, improving port ecological environment is one of the effective measures. One. In terms of specific indicators, the top three weights are the construction of the port area's environmental problem handling capacity, port infrastructure and the integrity of the port area's ecosystem.

Constructing a scientific and reasonable low-carbon port evaluation index system is the basis for port green and low-carbon evaluation and for promoting the port's green and low-carbon development.

The comprehensive evaluation index system on the one hand can provide specific theoretical and practical guidance for the construction and development of green low-carbon ports, and urge port enterprises to improve the efficiency of energy and resource development and utilization while vigorously developing, and reduce port carbon emissions and others.

The emission of pollutants reduces pollution to the port and surrounding environment, maintains the ecological balance of the port, and enhances the comprehensive competitiveness of the port.

On the other hand, it can also provide a basis for the management of the port management department, so that it can conduct a comprehensive green and low-carbon evaluation of the relevant ports, which is conducive to the realization of scientific management.

This paper uses the fuzzy analytic hierarchy process to establish a port competitiveness evaluation index system based on low-carbon development, and calculates the weight of each index. The result analysis shows that the port area's environmental problem handling capacity construction, port infrastructure and port ecosystem Integrity is a key factor in enhancing the competitiveness of ports under low-carbon development.

5.2 Research Outlook

Green and low-carbon ports, as an important trend in port development, can be completed in a day's work. Through the research on the green and low-carbon development of domestic ports, we can understand the weakness of the construction and put forward corresponding countermeasures. All port managers should seize the corresponding development opportunities to help ports develop better.

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