ISSN 2706-6827 Vol. 3, Issue 18: 55-60, DOI: 10.25236/IJFS.2021.031808

Carbon Emission Assessment of Port Integrated Logistics in Low-carbon Environment

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Abstract: *To realize the low-carbon development of the regional economy, it is inseparable from the support of low-carbon logistics. The logistics industry will play an important role in the development of the regional low-carbon economy. The purpose of this article is to study the carbon emission assessment of integrated port logistics based on the low-carbon environment. First, it summarizes the domestic and foreign related low-carbon emission reduction research; secondly, it analyzes the factors that affect the port low-carbon emission reduction efficiency; then summarizes the port low-carbon emission reduction efficiency evaluation indicators and the port integrated logistics carbon in a low-carbon environment. Construction of emission assessment system. Finally, taking M Port as an example, the data envelopment method and principal component analysis method are used to realize the evaluation of the low-carbon emission reduction efficiency of Dalian Port. The experimental results show that in terms of service types, the emissions of logistics services account for the vast majority, basically reaching 80%, so reducing the carbon emissions of logistics services will be the top priority.*

Keywords: *Low-carbon environment, Integrated logistics, Port logistics, Carbon emission assessment*

1. Introduction

While the logistics industry develops rapidly and promotes economic development to a higher level, it also brings adverse effects such as resource loss, noise pollution, greenhouse gas emissions, and increased carbon dioxide emissions [1]. These negative effects are showing an increasing trend, increasing the burden on the environment [2]. When the environment is out of balance, the loss to economic and social development will be very serious. The logistics industry's "high energy consumption, high investment, high emissions, and low output" operating conditions have caused many problems such as energy waste and environmental pollution [3]. The carbon emission problem of the logistics industry has become an important issue that restricts the willingness of the logistics industry to take a new path [4].

China's logistics industry has developed rapidly in recent years, but it also faces problems such as high cost, low efficiency, and excessive carbon emissions, which have caused a heavy burden on the environment [5]. Deng F developed a comprehensive evaluation index system to evaluate China's logistics performance. Apply Principal Component Analysis (PCA) to reduce indicator dimensions, and then use Slacks-based measurement-data envelopment analysis (SBM-DEA) to measure and evaluate the logistics performance of 30 provinces / cities under carbon emission constraints and no carbon emission constraints. Analysis of the overall level and spatial characteristics of China's logistics industry efficiency [J]. Then use the Tobit model to perform regression analysis to determine the driving factors. The results show that there are large regional differences in my country's logistics efficiency, showing a gradual decline from east to west [6]. Yang J tried to analyze the carbon emission performance of the logistics industry from the city level by investigating 16 cities in Yunnan Province. In particular, the data envelopment analysis (DEA) model and Malmquist index are explored from both static and dynamic perspectives. In order to further capture the driving factors of logistics carbon emission performance, the Tobit model is used for regression analysis. Although six cities have improved, the average performance of dynamic logistics carbon emissions in all cities from 2011 to 2015 decreased by about 5.9% [7]. Studying the carbon emission assessment of integrated port logistics in a low-carbon environment has very important practical significance for environmental protection and economic development.

The innovation of this article: So far, many scholars at home and abroad have started from the

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overall economy or the regional economic system when talking about carbon emissions. Such research is not deep enough. There are relatively few studies on carbon emissions in the logistics industry, and there is also a lack of research on the factors affecting changes in the local carbon emissions industry. This article introduces the methodology and methodology of the factor index system that affects the implementation of comprehensive low-carbon statistics, and combines factor analysis with M port as an empirical analysis.

2. Research on Carbon Emission Assessment of Port Integrated Logistics in Low-carbon Environment

2.1. Integrated Port Logistics

The essence of the so-called integrated logistics station is to develop a multi-functional and multi-functional logistics system. Port cities use comprehensive location characteristics to develop ports in combination with waterway, railway, and land transportation routes [8]. Local logistics activities spread the local economy related to the land. With the support of information technology, the establishment of port companies, make full use of port resources, and participate in logistics services with the characteristics of the logistics company chain [9]. Port logistics is an important and irreplaceable field in the logistics industry, and it is also a pillar that promotes the development of port logistics enterprises and related industries.

Port logistics occupies an important position in the global logistics chain, is the foundation of the entire global logistics chain, and promotes the development of the national economy. It is also affected and restricted by relevant national policies, and is closely related to the accumulation and distribution system and the hinterland economy [10].

Port integrated logistics services generally have three basic components: fluid, carrier and flow direction [11].

Fluid refers to cargo passing through the port. The purpose of port logistics is to determine the flow of goods from the supplier to the recipient. In the process of determining this flow direction, some goods need to be stored in the port warehouse [12]. All products transshipped through the port must go through the process of loading, unloading and processing to determine the spatial movement to ensure a steady flow of port cargo.

The carrier is the material and equipment through which the fluid passes. Vehicles are divided into two categories. The first category refers to infrastructure such as waterways, ports, port roads and seaports. The location of port logistics, especially the location of logistics infrastructure, directly determines the quality, efficiency and benefit of port logistics.

The flow direction is the direction in which the fluid in the port flows from the starting point to the end point. There are four kinds of natural selection flow direction and secondary selection flow direction.

2.2. Construction of a Carbon Emission Assessment Index System for Integrated Port Logistics

The scoring index is the basis of evaluation. The first is to evaluate the efficiency of energy conservation and emission reduction in Port M in recent years, and use standardized methods and models to compare the evaluation results to reflect the comparison of the evaluation results. Then, through the comparison of the results, decisions can be drawn, which will provide scientific decision-making basis for the sustainable and effective development of future port capacity saving and export reduction.

2.2.1. The Principle of Objectivity

The decision-making of the station reduction index system must be systematic, and the process must be combined with drills to objectively explain emergencies. Strive to understand the essence through superficial surprises, understand the most important, representative, and most prominent features and importance of port competition, combine the specific conditions of each port with the future development culture, and explain in clear, concise and realistic language The concept and meaning of each indicator.

2.2.2. Search Process

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The data used to design the indicators should be flexible, and the concepts of the selected indicators should be clear, easy to understand and easy to organize. At the same time, the selected indicators should match the current general indicators as much as possible to facilitate the collection of required reference data.

2.2.3. Process

There are also many factors that affect port power saving and emission reduction. Multi-angle and multi-factor factors reflect that port competition is a complex system, and the influence of each part of the system must be one aspect. All links of port power saving and consumption reduction should systematically and comprehensively display the physical connection between the assessment results and the index system, and organically link the evaluation target results with the index system to obtain a clear and systematic whole.

The integrated logistics carbon emission assessment index system of Port M introduced in this article is the following three indicators: input indicators, pollution indicators, production indicators and other three secondary indicators, including environmental safety investment, investment port fees, the number of employees in transportation units at the end of the year, and one time There are a total of 12 three-level indicators such as tanker ballast, carbon dioxide emissions, sulfur dioxide emissions, nitrogen emissions, vehicle emissions, cargo transportation, packaging, and commercial vehicles used, recycled and manufactured.

In order to further evaluate the carbon emission assessment index system and energy efficiency and emission reduction of M Port's integrated logistics, based on the basis of energy efficiency indexing, combined with data availability issues, the M Port energy conservation and emission reduction evaluation index system was constructed. That is to say, on the basis of the comprehensive logistics carbon emission assessment index system of Port M, a secondary port city economy and green index is included, including port city GDP, the proportion of urban tertiary industry in port GDP, import and export volume, and social The total retail sales of consumer goods, the average salary of water transport employees, and the average green area per capita.

3. Investigation and Research on Carbon Emission Assessment of Port Integrated Logistics in Low-carbon Environment

3.1. Research Objects

Port M is one of the economic hubs of China and foreign trade ports. It is the most convenient port for cargo transportation in Europe, North America, South Asia, and the Far East. M Coast not only has many harbours, but also has a very advantageous natural location. Most of the ships are very wide, with deep sea water, short and straight water channels, large paved area, not easy to freeze, and not easy to accumulate sand, which are very suitable for transporting ships. At present, more than 123 countries and regions have economic and commercial connections with Port M, and more than 250 ports. According to research statistics, the spatial potential for the construction of the coastline in City M is still large. According to preliminary statistics, the city's public areas are suitable for port construction, with a total length of about 50 kilometers.

3.2. Carbon Emission Evaluation Index of Integrated Port Logistics

Since this article studies the carbon emissions of the entire port integrated logistics system, including information and business services, the traditional carbon emissions per unit volume of logistics can no longer be used to evaluate the carbon emissions of the port integrated logistics system. Therefore, this paper proposes The concept of carbon emissions per unit of output refers to the amount of carbon emissions generated by the port's integrated logistics system for every unit of economic contribution produced.

The indicator calculation method is shown in formula 1:

$$EPO = E / GDP \tag{1}$$

Or as shown in formula 2:

$$EPO = E / EC \tag{2}$$

Among them: E is the carbon emissions of the port's integrated logistics system, in units of t; EPO is the carbon emissions of the port's integrated logistics system per unit of GDP or unit economic contribution, in t/US Dollar; EC is the port's direct economic contribution, in units of US Dollar.

4. Investigation and Analysis of Carbon Emission Assessment of Port Integrated Logistics in Low-carbon Environment

4.1. Current Carbon Emissions of Port M based on Integrated Logistics

In 2019, the total carbon emissions of Port M were 378,397.34 tons, the most important of which was the carbon emissions of transportation vehicles, accounting for 51% of the total emissions, reaching 190,000 tons. In the calculation of the carbon emissions of transportation vehicles, ships docked at the docks. The highest emissions at the time, reaching 55% of the general emissions, are the types of carbon emissions that need to be reduced; the second is heavy equipment for loading, unloading, handling and packaging operations at the docks and yards. The distribution of carbon emissions reaches 26%, exceeding 90,000 tons; for material consumption, for statistical reasons, this object only measures 47836.49t of carbon emissions brought by the cabinet. This is because there is no statistics for non-circulation such as rework or reprocessing. Carbon emissions caused by materials consumed by processing services. However, it can be predicted that the actual carbon emissions in this section should exceed 70,000 tons. By 2020, the contribution of most emissions will remain unchanged. Compared with the carbon emission contribution brought by material energy consumption in 2019, the carbon emission contribution has slightly decreased, and the contribution of heavy equipment has increased, as shown in Figure 1.

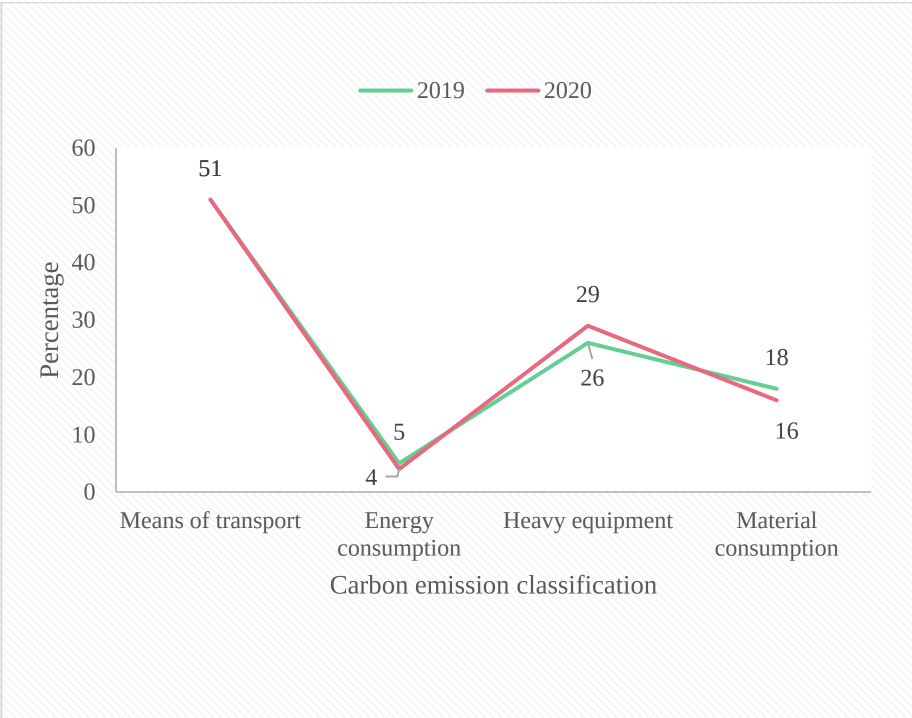

Figure 1: Comparison of various types of carbon emissions in Port M

4.2. Carbon Emission Assessment of Logistics Services of Units in Port Areas

The degree of involvement of different carbon emissions in different port areas is not very different, but the degree of involvement of different types of emissions in each port area is slightly different due to their trade and material characteristics. Take a port area as an example, a port area is a newly built port area, and its facilities are the best in terms of environmental protection and safety. The total carbon emissions of different port areas are different, but it is basically proportional to the throughput of the port area.

Among these types of services, logistics services account for the vast majority of emissions, with a base of up to 80%. Therefore, reducing the carbon emissions of logistics services will be a focus. Carbon emissions from ships at berths account for a very large proportion of logistics activities, and emissions reduction needs to be significant.

If the carbon emissions of a single logistics station of an integrated carbon logistics station are calculated for each station area according to the above reference indicators, as shown in Table 1, it can be seen that although the overall emissions of station b are the largest, it is in the carbon emissions per unit of logistics service. However, the port area is much larger; as shown in Figure 2, the largest emission volume of a single port area logistics project is due to the higher unit carbon emissions. This also shows once again that reducing carbon emissions from ports and ships is the key to reducing carbon emissions from comprehensive port statistics.

Table 1: Comparison of carbon emissions of logistics services per unit in main port areas of port M

	A port area	B port area	C port area	D port area
2019	284.21	300.32	246.74	253.33
2020	295.34	321.23	266.43	261.21

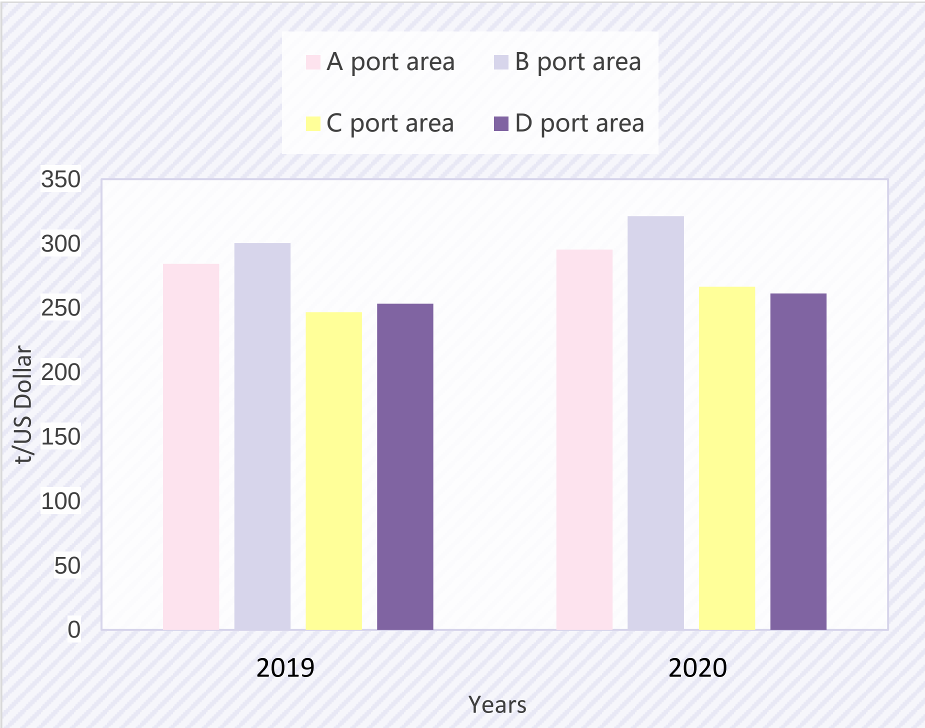

Figure 2: Comparison of carbon emissions of logistics services in major port areas of M Port

5. Conclusions

The main cause of global warming is excessive carbon dioxide emissions. Economic growth must be energy. Energy consumption will increase carbon emissions. How to strike a balance between the two has become a major issue. Based on solving the carbon emission problem of logistics industry development in M area, this paper measures the carbon emission of logistics industry, and uses mathematics and methodological methods to investigate the relationship between carbon emission of logistics industry in M area and economic development. Decompose the driving factors of the carbon emission intensity of the logistics industry in the M area, explore the direct and indirect effects of applying the carbon emissions of the logistics industry in the M area, and analyze the changes in the direct and indirect carbon emission system in the logistics industry in the M area.

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ISSN 2706-6827 Vol. 3, Issue 18: 55-60, DOI: 10.25236/IJFS.2021.031808

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