

Low Carbon Logistics Research Review

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Abstract: The logistics industry is one of the main industries of "carbon emission", and low-carbon logistics is also related to the realization of the goal of "carbon peak" and "carbon neutrality". This paper uses the literature research method, takes the concept of low-carbon logistics as the starting point, and combs the relevant research progress. Firstly, this paper introduces the concept of low-carbon logistics from the perspective of low-carbon and circular economy, and introduces the realization method of low-carbon logistics. Secondly, it reviews the progress of literature research from the aspects of low-carbon transport, low-carbon packaging, low-carbon storage, and low-carbon policy. It is concluded that the main direction of future research will be to shift from traditional local low-carbon research to systematic low-carbon research, use modern information technology and intelligent tools to help low-carbon logistics, and pay attention to the local problems brought by China's logistics practice.

Keywords: Low-carbon logistics, Low-carbon transport, Low carbon packaging, Low carbon storage.

1. Introduction

In view of the issue of climate change, China has made great efforts to achieve carbon neutrality by pledging to increase its subsequent contribution, formulate effective low-carbon policies, and strive for the peak of carbon dioxide emissions by 2030. The realization of the dual carbon target is of great significance to all areas of the national economy, especially the logistics industry is an important source of energy consumption and carbon emissions, and the carbon emissions of the logistics industry in 2020 are close to 21% of the total global carbon emissions. Therefore, to achieve the goal of "double carbon", it is crucial to promote the development of low-carbon logistics. Based on this, this paper combs the research literature of low-carbon logistics, in order to provide a certain research basis for future related research.

By reading and screening the existing literature on low-carbon logistics, scholars mostly conduct research from the four perspectives of transportation, packaging, storage and policy recommendations. Based on this, this paper will further explore several links involved in the process of logistics transportation, and make a summary analysis.

2. Concept and Connotation of Low-Carbon Logistics

By studying the existing literature, this paper will introduce the concept and connotation of low-carbon logistics from the introduction of low-carbon economy and circular economy.

2.1. Understand low-carbon Logistics from the Perspective of Low-Carbon Economy

The concept of low carbon logistics came from the UK's energy white paper "Our Energy Future: Creating a Low carbon economy", and gradually became the focus of academic research after the Copenhagen Environment Conference. Its essence is an economic development model characterized by low energy consumption, low pollution and low emissions, which can realize the transformation from the era of high carbon energy to the era of low carbon energy by optimizing the energy structure, adjusting the industrial structure, scientific and technological innovation and

implementing low-carbon policies.

2.2. Understanding low-carbon Logistics from the Perspective of Circular Economy

Zhu Peipei et al. pointed out that low-carbon logistics is a system integrating economy and ecological environment, driven by the inherent requirements of circular economy, and its basic characteristics are low consumption, low emission and high efficiency, which provides a feasible way to achieve sustainable development. Zhang Jiao Yu et al pointed out that in order to achieve a low-carbon logistics model, it is necessary to establish a symbiotic link between logistics enterprises, achieve the recycling of waste items, and maximize the utilization efficiency of logistics equipment, achieve environmental protection and harmless operation, and make logistics activities reach a closed loop. Huang Meimeng et al. also show that in order to realize the low-carbon logistics system, scientific methods should be adopted to apply and expand low-carbon economy and circular economy, and extend to the field of logistics.

According to the concept and connotation of low-carbon logistics, low-carbon logistics should pay attention to the following three aspects: low-carbon source (including the application of low-carbon environmental protection materials and tools), the use of low-carbon technologies and methods in the operation process, and the creation of a low-carbon working environment. In view of this, this paper reviews the existing literature from the main links of logistics operation and the external environment.

3. Low-carbon Transport

3.1. Technologies Related to Low-Carbon Transportation

In order to promote the sustainable development of low-carbon logistics, researchers have carried out a series of studies on low-carbon transportation technology. Li Jing et al. have applied phase-change storage technology to refrigerated transportation equipment, which has reduced the cost and carbon emissions during the refrigerated transportation of fresh and medicines. Phase change storage technology, which

uses glycerol and sodium chloride as raw materials to produce non-toxic and low-temperature phase change materials, has been widely used in cold storage scenarios. Combining the existing literature and the current development situation of low-carbon transport in China, it can be concluded that low-carbon transport technology mainly includes the application of intelligent transport system and new energy machinery operation. Among them, electric vehicle is a hot topic in current research.

New energy vehicles mainly include new fuel energy vehicles and electric vehicles. Li Yajie and others have proposed that the adoption of intelligent transportation systems can effectively reduce carbon emissions. Gao Guotian also confirmed the conclusion, pointing out that intelligent transportation system plays an important role in energy saving and emission reduction of logistics transportation. New energy vehicles mainly include new fuel energy vehicles and electric vehicles. Wang Jinrong and others promote new energy vehicles by using alternative energy sources, such as natural gas, instead of diesel. Many scholars are also very concerned about the application of electric vehicles in logistics management, and Ma Bingberg and others are also one of them.

By summarizing the existing research results, it is found that, first of all, electric vehicles need to go through a long process in the field of logistics, because the low endurance and capacity limits greatly hinder the possibility of their replacing traditional vehicles. Therefore, the operational management problems brought by electric vehicles in logistics should become a key research area in the future. Secondly, the number of relevant studies on new fuel energy vehicles is still small, but its importance should not be underestimated, and electric transport vehicles should be placed in the same important position. Finally, the energy mix is the fundamental driving force for new fuel energy vehicles and a major determinant of low-carbon transport.

3.2. Low-carbon Logistics Transport Mode or Structure

Early analyses of carbon emissions from different modes of transport found differences. Yang Guanghua et al. show that the application of railways and waterways will greatly reduce carbon emissions. Yu Yuewu et al. pointed out that the center of gravity of road transportation carbon emissions has significant geographical characteristics: it shows a trend of obvious shift in the east and south directions, which shows a large difference in the north and south directions. In addition, Wang Yong et al also pointed out that no matter what kind of transportation mode is chosen, it will be affected by the scale of investment, and the size of the scale of transportation will further affect the carbon emissions generated in the process of water transportation.

The above literature deals with the discussion of carbon emissions from multimodal transport, and the research shows that rationalized multimodal transport is a powerful measure to reduce carbon emissions. For example, Cui Qiang et al. found that the current level of low-carbon cooperation in China is low through the demonstration of the evaluation model of low-carbon cooperation degree. Liu Haoxue calculated the carbon emissions of each mode of transport and the total carbon emissions under the cooperative mode of transport, and compared them, and found that the development of multimodal transport is a very important measure; Through the combination of qualitative and

quantitative analysis, Jin Lin found that the development of "sea-rail" combined transport has the highest contribution to reducing carbon emissions; Li Shuangyan, Yao Zhen, Kang Kai and other scholars start with the cost calculation of low-carbon and verify the necessity of multimodal transport by calculating the vehicle's own energy consumption in the transportation process.

3.3. Transportation Strategies for Energy Conservation and Emission Reduction

Due to the waste of resources, which brings a series of high cost and high energy consumption problems to logistics transportation, researchers have developed a shared logistics model to meet the market demand, including joint distribution, cooperation between enterprises, and logistics information exchange. For example, Fan Jun proposed to adopt the development model of joint distribution among enterprises in order to reduce carbon emissions and realize low-carbon transportation. In addition, Liu Yijun studied the low-carbon transport mode of developed countries and found that joint distribution has a positive promoting effect on the development of low-carbon logistics.

All in all, the shared logistics model can effectively eliminate the problems of high carbon emissions and inefficient transportation. In order to promote the low-carbon transportation, it is necessary to pay close attention to the development of information technology, build a sharing information platform, and improve the efficiency of resource allocation of logistics enterprises.

4. Low Carbon Packaging

Scholars such as Yang Guang believe that low-carbon packaging should be paid attention to as an important part of its huge demand, so packaging materials should comply with the principle of low-carbon. An Meiqing et al. proposed that low-emission, reusable, naturally degradable materials should be preferred. For example, iron, paper, wood, bamboo and other materials have low emissions and can be reused, while plastic products cannot be broken down naturally. Yang Yanyan and other scholars believe that the carbon emissions of agricultural waste should not be ignored, and the wheat straw in the field can even be used as a wooden material to participate in the packaging of products. Li Biru and other scholars have proposed that in order to effectively reduce carbon emissions, composite materials should be used as little as possible.

Through the establishment of a game model, Li Ping concluded that in order to further reduce carbon emissions in packaging, it is necessary to form a joint force between the government, industry and consumers. At present, the recycling model is the focus of research, Liu Guoqiu et al studied whether the packaging recycling model has different applicability to different enterprises. Li Zhengjun and other scholars evaluated various recycling modes of express packaging waste and compared their advantages and disadvantages. Duan Xiangyun et al. conducted a series of research on low-carbon waste treatment methods in the United States, Germany, Japan and other countries, and also proposed a set of effective low-carbon packaging recycling guidelines according to China's national conditions. In addition, Cheng Bei uses sensor technology and carton recycling network system, which achieves the good purpose of high efficiency while free of special maintenance.

At present, most of the literature research on low-carbon packaging in China focuses on the above two aspects, but the research is not comprehensive enough, and the current focus is on minimizing energy consumption. However, it is worth noting that in order to optimize low-carbon packaging, many aspects such as economy, environment, and function should also be considered. In addition, due to the lack of evaluation standards and methods, it is impossible to actively and effectively carry out the supervision and management of low-carbon packaging. Therefore, the future should focus on the comprehensive evaluation of low-carbon logistics packaging research.

5. Conclusion

Scholars have conducted a lot of research on low-carbon logistics from the perspectives of transportation, packaging, storage, etc., which has laid a good foundation for subsequent research. The current research is mostly based on theories, methods and models, and has the characteristics of The Times, forming a diversified research situation. Through the literature review and research, it can be found that the focus of low-carbon logistics research in the future should be focused on the transport mode of multimodal transport, the application of new energy vehicles, the low-carbon design and recycling of packaging, and intelligent warehousing.

In addition, it can be found from the collation of relevant literature on low-carbon logistics that its research perspective is also changing with the development of The Times: from local to systematic development, that is, the low-carbon logistics system is increasingly taken as the goal to pursue, rather than the low-carbon of various functions.

In terms of low-carbon transport, in addition to the development of logistics technology, proper management measures are also particularly important. The low-carbon development of logistics transportation cannot be separated from the construction of a shared information platform, and the development of fragmentation to sharing is a major overall trend of low-carbon transportation.

In terms of low-carbon packaging, a complete and unified evaluation system has not yet been established, so there is a certain difficulty in the evaluation of carpet packaging. In addition, packaging involves economic, environmental, functional and other aspects, so the comprehensive evaluation of low-carbon logistics packaging should be focused on.

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