Economic Development Advantages of Low-Carbon Economy under Waterway Transportation

Mei Jing¹, Weigang Zheng²,³*

¹ School of Energy and Power Engineering, Wuhan University of Technology, Wuhan, Hubei, 30063, China
² School of Mechanical and Electronic Engineering, Wuhan University of Technology, Wuhan, Hubei, 430070, China
³ Engineering Training Center, Wuhan University of Technology, Wuhan, Hubei, 430063, China
*Corresponding author’s e-mail: zfeidiao@126.com

Abstract. With the continuous deepening of economic development, ecological hidden hazards such as environmental pollution are gradually emerging. Global warming, over-exploitation of energy, land desertification, and other problems are emerging. It is urgent to grasp the direction of national environmental protection policy support, and take the advantages and disadvantages of low-carbon economy development as the primary merit index for industry development.

Firstly, this paper expounds the internal relationship between water transport and low-carbon economy. Then it objectively examines and analyzes the difficulties and reasons of the development of waterway transportation economy in low-carbon economy. Next, it is pointed out that the water transport system under the background of low-carbon economy is an inevitable choice. Finally, the paper summarizes the advantages of the economic development of waterway transportation, and puts forward the corresponding optimization countermeasures according to the actual situation, which provides an effective guarantee for deepening the low-carbon behavior of transportation.

1. Introduction
The concept of “low-carbon economy” was first seen in the State Council Executive Meeting in 2009 [1]. For the first time, the participants deeply realized the hidden dangers caused by the increasing annual emissions of transport vehicles and took the low-carbon transportation system construction of the energy-intensive transportation industry as the main development object in the context of constructing low-carbon economy [2-3].

As we all know, transportation is a key path that deeply connects the cultural, economic and other factors of various regions [4]. Its unique operating methods and development characteristics are important links that promote the development of various industries [5]. And waterway transportation has an irreplaceable key position in the entire transportation development process, and it is also one of the important modes of transportation subject to the environmental requirements of the low-carbon economy [6-7].

Therefore, China’s waterway transportation system urgently needs to improve its own transportation management mechanism as soon as possible in the context of the low-carbon economy, establish a green...
waterway transportation development system, and pay full attention to the advantages of waterway transportation to promote its continuous social benefits and economic value [8].

2. Analysis of the significance of economic development of waterway transport in a low-carbon economy

In the new economic situation, low-carbon economy has become one of the important goals of the country’s struggle in the development of modernization. Industries with low energy consumption and environmental pollution have become the objects that are strongly supported by the government [9].

The transportation industry is an important foundation for domestic economic and social development, and it has become an important optimization object concerned by the nation in the context of a low-carbon economy. Waterway transportation is a major green and cheap mode of transportation. With its multiple advantages such as low carbon, environmental protection, low cost, energy saving and consumption reduction, it plays a positive role in attracting industries, optimizing port construction, and driving regional economic development along the river. The technical and economic characteristics and distinctive industrial characteristics make it an important part of the domestic integrated transportation system.

According to statistics, 90% of the volume of international trade in China are completed by waterway transportation. Therefore, it is of great practical significance to deeply analyze the development advantages and improvement strategies of Economy of waterway transportation based on the low-carbon economy environmental requirements. The improvement of the quality of waterway transportation has become an inevitable requirement for the development of the transportation industry [10].

3. Analysis and refinement of sustainable development advantages of low-carbon waterway transportation

Since the founding of the People’s Republic of China, the infrastructure construction of domestic transportation industry has accelerated, and the comprehensive transportation network with internal and external links has been gradually improved. In recent years, China has vigorously promoted the transformation and upgrading of waterway transportation system, and the freight turnover of waterway transportation nationwide has increased year by year (as shown in the figure), and the unique advantages of water transportation in the transportation of bulk materials have gradually emerged.

![National Waterway Cargo Turnover](data:image/png;base64,iVBORw0KGgoAAAANSUhEUgAABAAQAAAECAAMAAAwWAAAA...)

Figure 1. National waterway transportation freight turnover (data source: National Bureau of Statistics).

According to the People’s Daily, the cumulative freight volume of waterways nationwide in 2018 was 6.991 billion tons, with year-on-year increase of 4.7%. Combined with the above analysis of waterway transportation advantages, the economic benefits of waterway transportation are obvious. The diversified advantages of waterway transportation in the context of the low-carbon economy have gradually become prominent. The development advantages are mainly concentrated in the following areas:
3.1. Low-carbon environmental protection advantages
Under the background of efficient social development, the energy consumption and its produced waste residue, waste gas, and waste water in the transportation field have surged. The significant competitive advantage of waterway transportation in the context of low-carbon economy has gradually become clearer at this time because waterway transportation has the advantages of both land and rail transportation. Compared with air transportation, it is more suitable for the development of low-carbon economy. It is one of the transportation modes with the lowest carbon dioxide emission among existing transportation modes.

From the data, China’s waterway transportation system has completed 1/2 of the global freight volume of container ship under the premise that the CO₂ emissions accounted for only 1/4 of the sea freight, and compared with the international railway transportation standard, the hydrocarbons produced by the domestic waterway transportation only account for 20% of the amount produced by railway transportation method under the same international trade conditions with the unit energy consumption ratio as 9:11, which can fully meet the new ideas of low-carbon economy development under the premise of making full use of water transportation efficiency, and helps to promote the development of new environmental protection concepts such as low-carbon and environmental protection in the development of Economy of waterway transportation, as well as deepens its development towards green, smart, and energy-saving direction, to achieve low-carbon goals such as protecting the environment during economic development.

3.2. Advantages of reducing energy consumption
The development advantage of waterway transportation also comes from its low consumption advantages that are not accessible by land and air transportation. It can ensure the profit of waterway transportation on the basis of avoiding environmental pollution as much as possible; at the same time, it can effectively reduce the transportation cost, furthermore, waterway transportation uses rivers, lakes, seas and other “natural waterways” and natural resources for transportation. It not only has excellent navigability, but rarely has traffic jams, which meets the requirements of low-carbon economy concept.

The data can explain everything. According to statistics, the unit weight and mileage transportation cost of waterway transportation are much lower than the value of railway transportation. Taking a general cargo vehicle with a fuel consumption of 0.05mg/t as an example, the fuel consumption only accounts for 12.5% of the cargo vehicle. Under the same transportation distance for transporting the cargo of 1 ton, the energy consumption of waterway transportation (especially by sea) is the lowest among all transportation modes. That is to say, no matter from the perspective of cost-effectiveness, carrying capacity and other indicators, waterway transportation can greatly reduce energy consumption, and effectively control cost reduction while improving energy efficiency. It has a good energy-saving effect and meets China’s low carbon, environmental protection, energy saving and other requirements.

3.3. Unique economic advantage
Limited by the non-renewability of energy and the uncontrollability of energy technologies such as solar energy and wind energy, no new energy substances that can replace the consumption energy such as gasoline have been found in China in the short term. Based on this demand background, countries attach great importance to marine transportation increasingly. Waterway transportation is still recognized as the most economical mode of transportation. It bears the important responsibility of bulk cargo transportation in bulk. The advantages of large volume, long distance and large tonnage determine the unique position of waterway transportation in international trade, and the advantages of low carbon and low consumption and government support.

With the deepening of the marine industry, the port construction has also begun to show a professional development trend. The application of various advanced loading and unloading equipment and process research and development technology has significantly reduced the cost of waterway transportation, enabling it to be docked, linked, and connected more quickly with other modes of transportation, having gradually strengthened the port’s larger evacuation capacity.
4. The Development dilemma encountered by the waterway transportation economy in low-carbon economy

Compared with other modes of transportation, the development trend of waterway transportation in the low-carbon economy is generally better (as shown in the figure).

| Mode of transportation | Economical efficiency | Low carbon | Development trend     |
|------------------------|-----------------------|------------|----------------------|
| Air                    | Bad                   | Bad        | Transition           |
| Highway                | General               | General    | Transition           |
| Railway                | Good                  | Good       | Priority in consideration |
| Waterway transportation| Good                  | Good       | Preferred            |

Table 1. Comparison of various transportation modes in the context of low-carbon economy.

It can be seen that in the context of the low-carbon economy, among various modes of transportation, the disadvantages of traditional modes of transportation are constantly being exposed, and the problems existing in the development of waterway transportation need to be examined positively, including the following:

4.1. Ecological problem

In the context of the new economy, the first problem that China’s waterway transportation has to deal with is serious environmental pollution. This is because waterway transportation fuel may cause pollution to the marine environment and inland river environment, which is not in line with the concept of sustainable development.

4.2. Ship problem

At present, many domestic ships have prominent problems such as chaotic transport models, weak ship material structure, and insufficient shipping expertise, which have hindered the development of waterway transportation. It is necessary to ensure the rationality of the ship’s capacity structure framework.

4.3. Technology problem

Compared with the world’s largest public ports, the domestic port construction is seriously lagging behind. During the design and application of inland waterway, some ports fail to carry out high-standard water conservancy waterway construction, and the navigation capacity is difficult to meet national application standards, resulting in a decline in waterway transportation advantages.

It can be seen that although waterway transportation has many advantages, many objective problems have become constraints to the economic development. It is urgent to further develop the advantages and potential of waterway transportation and increase the construction of waterway transportation to achieve the organic connection between waterway and other methods, to better promote the sustainable development of the low-carbon economy.

5. Measures to promote the economic development advantages of waterway transportation in low-carbon economy

In the context of the new low-carbon economy, economic development of waterway transportation has become an inevitable choice for the development of China’s transportation industry. The main improvement strategies are as follows to actively take advantage of waterway transportation:

5.1. Guarantee the protection of waterway transportation environment

In order to improve the quality of low-carbon transportation, the basic environment of transportation should be low-carbonized construction and management, such as transportation energy consumption
control, transportation channel greening and other methods, which are all effective means of waterway transportation for environmental protection. Therefore, related staff of waterway transportation must adhere to scientific assessment and review on low-carbon environmental protection indicators of infrastructure projects, attach importance to structural optimization at various stages, and rely on new technologies to extend the service life of the transit facilities of waterway transportation (such as shore power technology is the technology used by land power, and it can effectively reduce the emission of toxic and harmful gases), and ensure that the major ports and supporting facilities on the coastline have a higher carrying capacity (such as LED energy-saving lamps are better than the previous lighting technology in terms of light efficiency and average life) in order to make the natural environment in the transportation process be more effectively controlled and protected, and the energy efficiency of water transportation ports is effectively improved, making waterway transportation gradually become the main transportation mode in the future development of the low-carbon economy.

5.2. Attach importance to the inland waterway transportation

Compared with other international shipping centers, the construction of inland waterways in China is relatively backward, and most of the inland water transportation network construction has not even reached the conditions to promote the development of the “water and water transport” cause. Therefore, the first priority for domestic inland navigation construction projects is the construction and improvement of the inland waterway transportation system. By strengthening the construction of inland waterways, attaching importance to the widening of the backbone channel, increasing the investment amount for inland waterway maintenance costs, and high-quality inland waterway transportation system will be constructed gradually.

On the one hand, the construction of professional and large-scale modern port will be focused on, and the low-carbon environmental awareness and quality control awareness of water conservancy construction staff in inland waterways should be cultivated and established. They shall be urged to be guided by low-carbon environmental protection concept, to guarantee enhancing the work quality of waterway maintenance management on the basis of good waterway construction inspection and ensure the ecological development of waterway transportation. On the other hand, it effectively guarantees the enhancement of the quality of waterway maintenance and management, and ensures the ecological development of waterway transportation. On the other hand, in accordance with the requirements of the inland waterway planning and layout, the core waterway is constructed, the waterway coverage is expanded, and the network waterway development of trunk and tributary water multimodal transport of river-sea multimodal transport are promoted, to play a supporting role in the economic development of the industrial hinterland in the construction of inland waterways.

5.3. Promote the professional development of shipping

In accordance with the requirements of low-carbon economy, rational adjustment of the fleet structure is also a key point in the economic development of Waterway transportation. Based on the concept of low-carbon economy, aiming at China’s low-carbon economy policy and the development requirements of Economy of waterway transportation, and combining the actual construction, shipping companies shall be guided to rationally adjust the fleet structure scientifically. On the basis of actively introducing modern and high-tech ships, backward ships are eliminated as a whole. Liquid gas ships, container ships and other vessels can be considered as development objects. Material specifications are guaranteed to ensure its comprehensive waterway transportation capacity; the fleet structure can also be optimized in terms of ship structure, capacity structure, and personnel structure to ensure the systematic improvement of the ship carrying capacity and transportation capacity.

At the same time, the construction of professional large-scale marine shipping system shall be attached with more importance. The capable technical departments are encouraged to develop modern and specialized standard ships, intelligently reducing the energy consumption and pollution of waterway transportation, and making ships be more professional, intelligent, energy-saving and have more excellent environmental protection and economy property, thus further improve the benefits of low-
carbon economy in the rationalization of costs, and promote to realize benefits of both the marine ecology and regional economy.

5.4. Promote the professional development of shipping
In the context of the low-carbon economy, the country has always emphasized the inherent connection and coordination of functions between different modes of transportation, with a view to complementing the advantages of various modes of transportation to deepen the entire transportation system.

Waterways and railways are currently the most frequently used transportation modes, and their reasonable connection is imperative. It should be considered to actively deepen the construction of various infrastructures in the sea-rail transportation, constructing a feasible sea-rail transportation network system, and dynamically monitoring the sea-rail transportation process, with real-time feedback to clarify hidden risks, and deepen the sea-rail transportation based on scientific methods to meet the diverse transportation needs in regional construction and development, and promote the deepening of Economy of waterway transportation.

At the same time, it can also take advantage of the diversified advantages of waterway transportation to gradually replace high-energy, high-pollution transportation methods, promote the implementation of low-carbon, environmental protection, and energy saving concepts in the transportation industry, and gradually increase the proportion of waterway transportation, as well as promote the further development of low-carbon economy in the efficient operation of ecological environment system.

6. Conclusion
Waterway transportation is one of the important transportation modes under the environmental protection requirements of low-carbon economy. Therefore, the domestic waterway transportation system must improve its own transportation management mechanism as soon as possible, establish a green waterway transportation development system, pay full attention to the advantages of waterway transportation, and ensure that the role and value of waterway transportation can be fully exerted.

Acknowledgments
Thank you, Mr. Zheng, for your guidance on this paper.

References
[1] Zhang, Q. (2019). Talking about the economic development advantages of the low-carbon economy under water transportation. J. Economic Research Guide, 27: 185-186.
[2] Yang, Z. H. (2019). Discussion on the economic development advantages of low-carbon economy under water transportation. J. Modern Economic Information, 16: 365.
[3] Wang, Q. (2019). Analysis of the advantages of low-carbon economy in the economic development of water transportation. J. Chinese and foreign entrepreneurs, 09: 37-38.
[4] Yuan, Z. B. (2019). Exploring the economic development advantages of low-carbon economy under water transportation. J. Zhujiang Water Transport, 01: 102-103.
[5] Yang, Y. (2018). Discussion on the advantages of low-carbon economy in the development of water transportation economy. J. Zhujiang Water Transport, 15: 87-88.
[6] Xu, J. H. (2018). Analysis of the economic development advantages of low-carbon economy under water transportation. J. Modern Business, 08: 11-12.
[7] Zheng, Y. (2017). Economic development advantages of low-carbon economy under water transportation. J. Economic and Trade Practice, 17: 57.
[8] Wang, Z. (2017). Economic development advantages of low-carbon economy under water transportation. J. Chinese and foreign entrepreneurs, 05: 20.
[9] Wang, T. (2017). Analysis on the development countermeasures of the low-carbon economy sewage transportation industry. J. Technology and Market. 07.
[10] Yang, C. Y. (2016). Analysis of the advantages of water transportation under the background of low-carbon economy. J. Technology and Market. 06.