

# Current Status and Future Trend of Urban Low-Carbon Transportation in China

Linglai Xin\*

Hyatt Environmental Energy Technology Limited. E-mail: lingnai@qq.com

**Abstract:** The concept and connotation of urban low-carbon transportation are put forward and expounded. The status of energy consumption and carbon emission of urban transportation since 2000 in China is analyzed. The analysis shows that the total energy consumption and CO<sub>2</sub> emission of urban transportation has increased rapidly, and public transportation has the lowest carbon emission intensity among all kinds of motor vehicles. The construction of urban low-carbon transportation in China faces the following problems: the development speed of public transportation lags behind; the non-motorization degree of residents' travel structure has decreased greatly; the lack of effective demand management, weak awareness of energy conservation and emission reduction; and the urban transportation management system is incompatible with the construction of urban low-carbon transportation. Based on the analysis of the present situation, this article puts forward three strategic directions and five main measures for the construction of low-carbon transportation in Chinese cities. Transportation industry is a basic service industry and a key area of urban energy conservation and emission reduction. Effective measures should be taken to accelerate the development of urban low-carbon transportation from the aspects of urban transportation planning, construction and operation.

**Keywords:** Urban Low-Carbon Transportation System; Development; Pattern; Measures

## Introduction

Urban low-carbon transportation construction is a major theme of transportation construction in China, and it is also a hot topic in academic circles in recent years. Scholars from many disciplines have made extensive and in-depth discussions on this issue from their own perspectives and methods, and put forward rich theoretical viewpoints and countermeasures. Systematically combining and summarizing these literatures and clarifying the orientation of existing research can find out the problems that need further study, and help to explore the growth point of innovation, which is of great significance to promote urban low-carbon construction.

## 1. Definition of low-carbon transportation in China's cities

According to the reality of China's economic and social development, referring to the related concepts of sustainable development of transportation, we believe that China's urban low-carbon transportation can be defined as: on the basis of meeting the needs of social and economic development for urban transportation to the maximum extent, it provides safe, convenient, comfortable and fair services for people and logistics with as little fossil energy consumption and as little greenhouse gas emission as possible. The connotation of urban low carbon transportation can be understood from the follow-

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ing four aspects:

(1) Urban low-carbon transportation is not a new transportation mode, but a new development concept. Its core lies in improving the energy efficiency of transportation, improving the energy consumption structure of transportation, optimizing the development mode of transportation and guiding people to travel reasonably. Its purpose is to reduce energy consumption and carbon emissions, at the same time, increase carrying capacity, provide safe, convenient, comfortable and fair services for people flow and logistics, and continuously meet the needs of people's production and life for urban transportation.

(2) Urban low-carbon transportation construction is a systematic project. Planning, construction, maintenance, transportation, production and use of communication tools, relevant systems, technical guarantee measures, people's travel modes and transportation consumption patterns, etc., all of these need to be reformed and optimized with the concept of "low carbonization" to realize the low-carbon development of the whole cycle and whole industry chain in the transportation field.

(3) The construction of urban low-carbon transportation is an effective way to achieve sustainable urban development, which should be adapted to the local humanistic development level. With the acceleration of urbanization and the improvement of people's quality of life in China, residents are increasingly pursuing motorized travel modes. In the process of accelerating urban transportation construction, it is necessary to change the extensive development mode mainly relying on land, fossil energy and other high-input and high-carbon emissions. At this stage, it is especially necessary to increase energy conservation and emission reduction to achieve sustainable development of urban transportation.

(4) Encourage low-energy transportation tools and modes in the construction of urban transportation infrastructure and the choice of transportation modes, so as to realize the flow of people and things as much as possible with as little energy consumption as possible, and make the social economy, urban transportation, resources and environment develop in harmony with each other.

## **2. Main problems faced by urban low-carbon transportation con-**

## **struction**

(1) The built-up area has increased rapidly, and the density of bus network has declined as a whole.

The area of urban built-up areas in China increased from 22439km<sup>2</sup> in 2000 to 36295km<sup>2</sup> in 2008, with an overall increase of 61.75% and an average annual increase of 6.2%, while the density of urban bus network decreased by 0.66% annually during the same period. This makes urban spatial distance increase, commuting distance and time increase correspondingly, and motor vehicle traffic dependence increases. At the same time, traffic congestion is caused by insufficient density of urban bus network, which makes traffic carbon emissions rise continuously.

(2) There is a serious shortage of investment in urban public transport.

According to the relevant data of China Urban Construction Statistical Yearbook (2008), the national urban transportation investment accounted for 47.25% of the urban fixed assets investment in 2000 and 62.72% in 2008, up by 15.5 percentage points. The investment structure of urban transportation obviously focuses on urban roads and bridges, and the proportion of urban public transportation investment cannot exceed 2% of the total investment of urban transportation. The mass transit rapid transit system started late and developed slowly. By 2008, BRT only started in 10 cities with rail transit in 120 cities with a population of over 1 million. The slow development of public transportation restricts the improvement of public transportation facilities and service level, which makes it difficult to improve the sharing rate of public transportation, a relatively low-carbon way.

(3) The motorization of urban traffic structure has been enhanced, and the degree of non-motorization has been reduced from 2000 to 2008. The average annual growth rate of urban civil vehicles is 15.51%, and the average annual growth rate of urban private vehicles is 24.03%. In addition, the consumption ratio of alternative fuels for vehicles is very low. For example, from the composition of motor vehicles, natural gas vehicles and electric vehicles accounted for only one thousandth of civil vehicles in 2008. This situation has caused significant changes in the travel structure of urban residents in China, and the energy consumption of cars accounts for

about 86% of the total energy consumption of urban transportation. From the investigation of the travel structure of some typical urban residents, it can be concluded that the travel proportion of cars is increasing rapidly, the travel proportion of public transportation is too low, the travel proportion of low-carbon or zero-carbon transportation such as bicycles is falling sharply, gradually losing its dominant position, and the trend of increasing the motorization and decreasing the degree of non-motorization of urban transportation structure is very obvious. According to this development situation, urban traffic may be locked by the high-carbon development mode. How to make the travel structure of residents tend to be reasonable is a serious issue before us.

(4) Urban traffic management system still needs to be improved to adapt to urban low-carbon traffic construction.

China's urban road traffic management has not yet established a coordination organization composed of urban planning, construction, traffic management, public utilities, environmental protection and other departments, resulting in many administrative departments and poor coordination. The management and service of urban transportation energy conservation and emission reduction are imperfect, and the basis of monitoring and statistics of urban transportation carbon emissions is very weak. As a special planning of urban planning, urban transportation planning is not closely related to urban planning and urban land use planning. With the continuous expansion of city scale and the rapid development of motorization, urban transportation, the planning has not been followed up in time. Different modes of transportation have their own systems, and the transfer between different modes of transportation is inconvenient, which seriously affects the overall efficiency of the urban transportation system and causes unnecessary energy consumption and carbon emissions.

The increase of traffic demand lacks effective control. For a long time, the Chinese urban government has focused on increasing the supply of urban transportation, while neglecting the management of urban transportation system. Static traffic interferes with dynamic traffic, urban traffic jams, motor vehicles lengthen unnecessary driving distances, etc., wasting energy and increasing carbon emissions. The scientific and technological inno-

vation and technology promotion of urban transportation energy conservation and emission reduction are not enough. Compared with the international advanced level, there is a big gap between China's new energy vehicle application technology, gasoline vehicle and diesel vehicle fuel saving technology, and there are many bottlenecks in the large-scale promotion and use of new energy. There is also a big gap between the unit energy consumption and energy efficiency of the transportation sector and the advanced level of foreign countries. The technical level of traffic management is also low, and the information and intelligent technology widely used in the field of urban traffic in the world is still in its infancy in China. Advanced technologies in motor vehicle consumption and energy saving and emission reduction of highway facilities have not been widely popularized and applied.

### **3. Measures of urban low-carbon transportation development**

(1) Firstly, it is necessary to improve the urban traffic development planning. From a long-term perspective, combined with urban functional zoning, optimize the urban traffic layout network, build a comprehensive transportation hub, realize "seamless connection" and "zero transfer" of various modes of transportation, and form an urban green comprehensive transportation system with public transportation as the main mode of travel. Improve the network layout of public bicycle system. To achieve full coverage of the city's public bicycle network as the goal, gradually restore and open bicycle lanes, and guide people to travel green.

(2) It is necessary to develop and improve public transportation and rail transit vigorously. Adhere to the policy of giving priority to public transport, optimize public transport routes and vigorously promote the construction of micro-circulation roads. Accelerate the construction of rail transit, rapid transit system (BRT) and intelligent traffic management system, and give priority to the construction of rail transit in central cities. Vigorously improve the service quality of public transportation and rail transit, and make public transportation the preferred way for people to travel.

(3) It is necessary to accelerate the construction of light rail and subway in cities, and to vigorously re-

tain bicycle lanes and pedestrian lanes in urban planning; Fourth, we should speed up the development of subway, express transportation and public transportation, and at the same time, make it convenient for urban residents to travel, and control the number of private car trips as much as possible to reduce the carbon emissions per unit bus. Researchers believe that the development of low-carbon transportation should formulate comprehensive strategies, including adjusting urban spatial structure, improving transportation system, cultivating transportation subjects, developing transportation science and technology, and so on.

(4) It is necessary to strengthen the management of automobile energy conservation and emission reduction. Adjust the energy structure of urban transportation and vigorously develop clean energy. Use market access to speed up the elimination of old cars with high energy consumption and control the development of motor vehicles with high fuel consumption and high pollution. Increase the construction of basic supporting facilities such as parking lots and charging areas for hybrid electric vehicles, and promote the development of energy-saving vehicles. At the same time, through preferential policies, encourage transportation enterprises to innovate in energy-saving technologies and use energy-saving and environmentally-friendly vehicles, new energy vehicles and electric vehicles. Encourage enterprises and residents to conduct carbon trading in the transportation field.

(5) It is necessary to establish and improve policies and standards for low-carbon development of various modes of transportation, and establish an industry low-carbon evaluation system. Accelerate the formulation of low-carbon development policies for road, waterway, rail, railway and other modes of transportation, and improve relevant standards and specifications in accordance with the requirements of low-carbon transportation. Improve the market entry threshold from the perspective of low-carbon transportation, establish an exit mechanism, and strengthen the transportation market and vehicle management of various modes of transportation.

(6) It is necessary to improve the level of traffic management. Take effective measures to control urban congestion. Optimize the control of intersections and signal lights, strengthen the construction of mobile signal

systems and camera equipment on roads, establish and improve traffic management centers, collect road information in time, and provide real-time road navigation. Improve traffic administration, strengthen team building and improve service level.

(7) Transportation industry associations need to strengthen their industry self-discipline, promote energy-saving transportation facilities and equipment, carry out low-carbon transportation education and publicity, and carry out low-carbon transportation exchanges and cooperation.

(8) Transportation enterprises and residents should actively implement low-carbon regulations, policies and standards, and actively participate in low-carbon transactions, low-carbon services and travel. Enterprises strive to promote low-carbon technology progress, and strengthen vehicle energy conservation and emission reduction.

(9) It is necessary to increase the publicity of low-carbon transportation in all aspects. Make full use of newspapers, billboards, television and other media, vigorously promote the concept of low-carbon transportation, and advocate low-carbon transportation, so that enterprises and residents can establish the concept of low-carbon transportation and form a strong atmosphere for the development of low-carbon transportation.

## 4. Conclusion

To sum up, the existing research has explored all aspects of urban low-carbon transportation, clarified the development status and main problems of urban low-carbon transportation in China. Some root causes of high-carbon transportation problems are identified, and strategic ideas and general countermeasures for building low-carbon transportation are put forward. Regarding low-carbon transportation in some cities, it is necessary to design models and countermeasures, and try to summarize the urban low-carbon transportation system. Further research and innovation should pay attention to the following aspects.

First, to clarify the relationship between urban low-carbon transportation goals and other transportation goals;

Second, to improve the urban low-carbon transportation system;

Third, to explore the path to achieve low-carbon transportation in cities;

Fourth, to in-depth study of foreign experience in the development of low-carbon transportation;

Fifth, to strengthen the follow-up research on the practice of urban low-carbon construction.

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