A Review of Urban Low-carbon Traffic Assessment

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Abstract. Transportation not only promote social and economic development, but also improve people's living standards, but its high energy consumption and high pollution brought a series of energy and environmental problems. In order to reduce the impact on the environment, countries are developing low-carbon transport as part of the socio-economic development mentioned on the agenda. On the basis of understanding the background and connotation of low-carbon transportation, this paper reviews and collates the evaluation index system and evaluation method of urban low-carbon transportation, which is used to provide reference for urban low-carbon transportation research.

1. Introduction

Greenhouse gas is mainly from three major industries, namely, the transportation industry, construction industry and industrial sectors. The State Council has made it clear that it should focus on the transportation and industries and raise the development of urban low-carbon transportation as a strategic plan for national economic development. Carbon emissions are rising rapidly, and energy-saving emission reduction indicators have been incorporated into the social development and long-term planning of the national economy, this development model is low pollution, low emissions and low consumption. So domestic and foreign experts and scholars on the development of urban low-carbon transport has given great attention.

2. Analysis on the Background and Connotation of Urban Low-carbon Transportation

2.1. Urban low-carbon transport development background

After reviewing the literature on low-carbon transport at home and abroad, the background is no more than the following: Firstly, a response to climate change. Global warming is a major feature of climate change, which is already a matter of concern to the world. In order to alleviate this problem, countries are strengthening their cooperation and taking effective measures to curb their further deterioration. Secondly, to prevent energy security issue. In fact, global climate change is not just an environmental issue, but also brings energy security issues, the world economy depends heavily on coal, oil and other fossil energy. Thirdly, transformation of economic development. Global warming brings not only environmental problems, but also be identified as a resource problem from the development point of view. The traditional economic development model is characterized by high carbon and extensive, and now the development model is low carbon, low pollution and low emission[1][2].

2.2. Urban transport low-carbon development connotation

At present, the global basically reached a consensus on traffic: low-carbon development. The development of low-carbon transport is a long-term plan and the process is gradual, which is to seek balance point between economic development and low-carbon transport development. It can be said that the development of low-carbon transport make human civilization in a better direction, and truly reflect the harmonious development of man and nature in the field of transport goals[3].

The connotation of low-carbon transportation can be understood as: (1) it belongs to the category of low-carbon economic development; (2) it is the extension of low-carbon urban construction in the field of transportation; (3) the need to take effective measures to reduce greenhouse gas emissions and resource consumption in order to achieve the sustainable development of all aspects of the city concept. The core of low-carbon transport development is: (1) to improve energy efficiency; (2) to improve the efficiency of transport tools; (3) to optimize the structure of the transportation system to reduce the impact of the transportation industry on the urban ecological environment and travel environment, and realize the sustainable development of transportation, environment and resources[4].

3. Summary of low-carbon traffic evaluation indexes at home and abroad

3.1. Research on Evaluation Indexes of Low-carbon Transportation in Foreign Cities

Foreign traffic development time is much earlier than the domestic, and research content and methods are relatively mature, especially in the low-carbon transport sustainable development evaluation indicators.

Luderna, M.W in his study[5], a set of traffic system evaluation criteria was established. The evaluation criteria include five factors: safety, environmental pollution, accessibility, transportation costs and congestion levels. The evaluation index analyzes the traffic system from three aspects: the government, the environmental angle and the urban residents' perspective, which provides the corresponding policy support. Finally it is applied to the city's traffic system to assess the status of the operation of indicators and assist policy makers to make decisions. Bougromenko, V. In his study[6], an expert evaluation system for urban traffic is established based on the concept of MTS (Minimal Transportation System). After an empirical study of the development of different countries in different stages of development, the author established the expert evaluation system, which covers social, economic, ecological and geography.

Mackett, Roger, Edwards and Marion in their study[7], an expert evaluation system has been established for the new public transport system, which includes five key indicators: (1) whether it can improve the urban traffic congestion; (2) whether it can promote the development of all aspects of the city; (3) whether it can provide better services for the city center; (4) whether it can improve the urban travel environment and ecological environment; (5) whether it can provide better services for public transport that the system is suitable for the development of new public transport traffic city. Todd Goldman[8] mainly had given four innovative evaluation indicators for low-carbon transport sustainable development, namely: 1) Emerging travel mode. Such as in order to facilitate the traffic traveler, summarize the various modes of transport information. 2) City logistics. Freight in sustainable city must be increased in the urban area of the full load rate, reduce the empty transport and optimize the means of scheduling. 3) Intelligent system management. The combination of bus and traffic congestion management improves the efficiency of the operation of the vehicle. 4) Livability. City traffic is for people to travel more conveniently, so now the city is developing low-carbon traffic, cycling and other green traffic.

3.2. Evaluation of low carbon transport in domestic cities

The domestic traffic development time is a few decades, especially it is still in the initial stage in the low-carbon traffic evaluation index. It is necessary to sort out the current domestic evaluation for the better development of low-carbon transportation in Index system.

Research on low-carbon transportation planning evaluation index: In order to develop green traffic, Tianjin build the first domestic evaluation index system[9]. Based on the principles and methods of the

environmental impact assessment index, Li Zhi has selected the traffic planning indicators which can closely link the human and the environment system, and established traffic planning environmental impact assessment index set[10]; Wang Zhenzhen mainly select the low-carbon traffic evaluation index from four aspects, namely social harmony, resource conservation, environment-friendly, traffic function, and then integrate the weighted average and improve the fuzzy analysis to complete the evaluation system[11].

Research on the sustainability of low-carbon traffic: Fan Jianlin and Sun Zhang proposed the concept of level about sustainable development, development ability and coordination ability for the first time[12]; Liu Xiajia mainly focuses on the coordination ability of sustainable development. From the four aspects, environmental impact, social economy, resource shortage and traffic policy, 15 coordination ability evaluation indexes are formulated, and the Delphi method, information entropy and the gray relational degree analysis method is used to establish the evaluation model. The sustainable development coordination ability of six cities is evaluated synthetically, which results show that the model is operable and scientific[13].

Research on the comprehensive evaluation of low-carbon traffic: In order to achieve social and economic maximization, Lu Huifen[14] made the city of low-carbon passenger transport as the main object of study to develop six aspects of evaluation indicators, namely: convenient, the smooth, level of service, the level of information technology and the safety standards. The energy saving and low carbonization of the traffic assessment system proposed by Guo Jie is composed of four indicators, namely: the transport infrastructure conditions, transport equipments' low carbonization, urban transports' public and transport organization and management level[15].

4. Summary of low-carbon transportation evaluation methods at home and abroad

4.1. Research on Evaluation Method of Low-carbon Transportation in Foreign Cities

The research on the evaluation index system of urban low-carbon traffic abroad is relatively comprehensive and mature, and a variety of evaluation methods are used to analyze the contents of these evaluation indexes.

Anjali[16] mainly analyzed the application of fuzzy TOPSIS method and introduced some evaluation methods of sustainable traffic development which are different and more applicable. The more commonly used method is the cost-benefit analysis method from the monetary point. Optimization model method and linear programming model are the most commonly used; Evaluation index model method is roughly divided into three categories. Wang Ya-jun[17]evaluated the safety of urban traffic, which is an important prerequisite for low-carbon transport planning process. The safety of traffic system is not only affected by the total length of vehicles and the number of vehicles, but also influenced by many uncertainties and subjective factors. Therefore, the fuzzy comprehensive evaluation method was applied to the evaluation index in order to obtain accurate results about the traffic system.

In Hu qi-zhou's research[18], the material element analysis theory is analyzed, and the evaluation model of urban ecological transportation is constructed. The article uses the matter-element matrix to standardize the uncertainty and incompatible evaluation index, and also construct the corresponding membership function. In Lunhui Xu's research[19], the main content is the comprehensive evaluation of the operation status of urban traffic using AHP. The author takes the traffic average travel time, the intersection time, the average speed and the intersection delay as the four main indexes of the evaluation. In addition, Ghaderih and Izadbakhs use the analytic hierarchy process and data envelopment analysis to establish the simulation model of the transportation system[20]. Vuchie[21] first analyzes the characteristics of urban traffic system. On this basis, the weight of each evaluation index is determined by analytic hierarchy process (AHP). Finally, the fuzzy comprehensive evaluation method is applied to evaluate the urban traffic system.

4.2. Research on Low-carbon Transportation Evaluation Method in Domestic Cities

The development time of low-carbon transportation in China is relatively short, and the evaluation method is simple and diversified. Research on low-carbon traffic strategy: Zhao Hui and others[22] make traffic simulation technology into the field of traffic strategy evaluation research. From the aspects of the source of energy saving and emission reduction, the vehicle pollutant discharge and greenhouse gas emissions are specified as the main evaluation index.

Research on the sustainability evaluation of low-carbon traffic: In order to be able to comprehensively evaluate the sustainable development level of a city traffic, the application of factor analysis in statistics can be used to group the factors that influence each other, so as to obtain the basic data structure[23]. Zhang Jun[24], Wang Xiuliang[25] and Dai Yi[26] roughly have the same ideas on low-carbon transport sustainable development evaluation. Firstly, the evaluation index is selected according to certain principles. Then, the evaluation model is established by using data envelopment analysis method combined with attribute mathematics.

In the evaluation of eco-environmental impact of low-carbon traffic, He Ruhai[27] has studied the ecology of traffic, level and evaluation system. Finally, a model for evaluating the quality of traffic ecological environment was established. Wang Zhao[28] put forward the concept of comprehensive evaluation interval and the interval estimation method of comprehensive evaluation value. And the case study was carried out by using the extension element analysis method and establishing the corresponding evaluation model.

5. Conclusion

Low-carbon traffic assessment for a city development has a huge role on promoting. At present, there is great progress in low-carbon traffic evaluation. Low-carbon traffic assessment indicators are: (1) More evaluation indicators, it is not only involved in all aspects of transport, but also related to the transport closely linked to the ecological, economic, environmental and other aspects. (2) The research object is different, there are transportation infrastructure, related traffic policy, traffic management and the impact of mutual mechanism. The evaluation methods of urban low-carbon transportation are as follows: (1) There are various methods, including analytic hierarchy process, data envelopment analysis method, fuzzy evaluation method, gray relational degree method, value function method and so on. (2) a wide range of content on the evaluation, involving low-carbon transport strategy, sustainable development, the impact on the ecological environment and comprehensive evaluation and other aspects.

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