Application of Carbon Peak and Carbon Neutrality Policy in Urban Governance: A Literature Review

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Abstract: Taking the "National Carbon Peak Pilot (Hangzhou) Implementation Plan" issued by the Hangzhou Municipal People's Government as the core policy, this paper systematically compiles the research on the practical application of the "dual-carbon" policy in urban governance, and analyzes its background, current situation and future development direction. Although dual-carbon policies have achieved significant results in optimizing industrial structure, promoting energy transformation and achieving regional low-carbon goals, their implementation still faces challenges such as insufficient regional policy coordination, high cost of low-carbon technology innovation and low public participation. This paper points out that in the future, the researchers should focus on improving the carbon trading market mechanism and green financial system, enhance the effectiveness of policy implementation through regional policy synergy and technical support, and strengthen the public's awareness of environmental protection and the construction of participation mechanisms.

1 INTRODUCTION

China's goal of achieving carbon peak by 2030 and carbon neutrality by 2060 requires cities and regions to find a balance between economic development and environmental protection, and Hangzhou, as an important economic center of the Yangtze River Delta, is under tremendous environmental pressure from its high-speed economic development. At the same time, Hangzhou, as a pioneer city in the development of digital economy, has a fairly complete digitalization industry chain, and the dual-carbon policy provides an opportunity for it to combine digital economy and green development. In addition, the demands of urban residents for a livable environment, and the international community's current concerns about the relationship between urban governance and environmental protection, have raised the need for the application of dual-carbon policies in urban governance.

The dual-carbon goal has been put forward for nearly five years, the academic field of dual-carbon research has been very in-depth. However, most of the academic articles concerned by researchers in this paper focus on the relationship between dual-carbon goals and energy, economy and other aspects, and the important part of dual-carbon policy and future urban governance lacks existing articles. Therefore, this paper provides a comprehensive review of academic papers related to the practical application of dual-carbon policy to urban governance in the current academic field, aiming to explore how the multidimensional governance of cities can follow the guidelines of dual-carbon policy, and provide certain theoretical guidelines for the academic community to further study the specific application of dual-carbon policy.

This paper takes the Circular of Hangzhou Municipal People's Government on the Issuance of the Implementation Plan of National Carbon Peak Pilot Program (Hangzhou) as the central policy (hereinafter referred to as the "Policy"). The Policy points out that Hangzhou needs to give full play to the three advantages of digital, science and technology, and system, to promote the construction of a digital and intellectual governance system, to improve the policy and institutional system of health care to achieve the goal of "dual-carbon", and to create a Hangzhou model of the national carbon peak pilot in terms of scientific and technological innovation, and

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institutional innovation. In that case, Hangzhou Municipal People's Government encourage all people to take action, sort out green and low-carbon demonstration projects, and ensure the smooth establishment of the pilot carbon peak city by strengthening organizational leadership, responsibility and financial security. The policy puts Hangzhou's urban governance under the guidance of the dual-carbon policy from multiple dimensions, responding to the call of the state, matching the needs of the city, and actively promoting the construction of peak-carbon pilot cities. This paper explores the practical application of the dual-carbon policy in urban governance, centering on the key points involved in the policy.

2 CURRENT SITUATION OF DUAL CARBON POLICY

2.1 Dual Carbon Strategy Goals and Implementation Status

China has clearly set the "dual carbon" separately before 2030 and 2060, which is an important direction for China's low-carbon transformation. The relevant policies have been systematically deployed through the 14th Five Year Plan and national level strategic documents. For example, in the working opinions on the dual carbon targets issued by the Country’ s Council, the "1+N" policy system is the core and clarifying the target orientation and policy path (Zhuang et al., 2022).

Since 2010, China has launched three projects for testing areas, committed to promoting low-carbon development. Subsequently, in June 2015, China submitted a report to the International Panel on Climate Change (IPCC), which clearly stated that China would achieve peak carbon emissions around 2030 and further deepen various low-carbon pilot projects. In this context, how urban governance responds to the development issues of "carbon neutrality and carbon peak" has become a focus of attention for many scholars and has achieved fruitful research results.

In specific implementation, China gradually breaks down the "dual carbon" target to provincial, local, and industry levels. Some provinces such as Beijing and Shanghai have already achieved carbon peak and become demonstration areas for nationwide promotion, while other regions have formulated differentiated goals and paths based on regional resource differences and industrial characteristics (Wang et al., 2021). In addition, the binding indicators for green and low-carbon development have been incorporated into the regional economic assessment system to ensure the comprehensiveness and strictness of policy implementation.

2.2 Current Status of Policy Support for Industrial and Energy Transformation

The adjustment of industrial structure and optimization of energy structure are the core areas for achieving goals. Current policies emphasize achieving low-carbon transformation by promoting the usage of non-fossil energy, significantly reducing coal consumption, and promoting green technology innovation. In addition, some scholars pointed out the challenges faced by Chinese cities in the process of peaking carbon emissions. These challenges cover multiple aspects such as population and urbanization, industrial structure and so on (Qi & Cai, 2021).

In addition, some policies focus on decarbonization pathways in high energy consuming industries, such as upgrading steel, chemical and other industries through electrification and green technology, significantly reducing the carbon emission intensity per unit product (Guo & Wang, 2021). These measures not only achieve structural optimization of energy production and consumption, but also provide a market demand foundation for promoting low-carbon technological innovation.

In terms of technological innovation, Ouyang and others suggest adopting the "dual substitution" and "dual decoupling" strategies, that is, replacing fossil energy with non-fossil energy and traditional technology with low-carbon technology, to achieve the dual decoupling of economic growth and carbon emissions. For example, high-energy efficiency recycling technologies and negative emission technologies such as carbon capture and storage (CCUS) have shown significant potential in industries and transportation, providing technical support for promoting low-carbon transformation (Ouyang et al., 2021).

2.3 Current Status of Low Carbon Governance in Regions and Cities

For example, pilot projects in major low-carbon cities and other dual carbon policy practices are important ways for China to achieve its dual carbon goals. In the research field of exploring China's achievement of carbon emission reduction goals, scholars such as Guo have conducted in-depth analysis of the role of

low-carbon construction in achieving China's goals or reducing carbon emission. The research explored related policies' mechanisms, design and implementation effectiveness in context of various regions (provinces). Developed eastern regions such as Shenzhen, Shanghai, and Hangzhou have become typical examples by implementing strict low-carbon policies (Guo & Wang, 2021).

Regional policies' effectiveness also ties with factors as energy structure adjustment and industrial transformation. For example, by optimizing the regional energy network and load management, the goal of decoupling carbon emissions from economic development can be better achieved, thereby enhancing the implementation efficiency of policy tools (Yu et al., 2021).

3 APPLICATION OF "DUAL-CARBON" POLICIES TO URBAN GOVERNANCE

3.1 Promotion of New Energy and Optimization of Urban Energy Structure

Under dual-carbon policy, the promotion of new energy has become an important part of urban governance. Some cities have actively promoted renewable energy sources such as solar energy and wind energy to reduce their dependence on fossil energy by formulating and implementing a series of policies and measures. For example, some cities have established solar power stations and wind farms, which not only provide cities with clean and sustainable energy supply, but also effectively reduce carbon emissions. At the same time, cities also use smart grid technology to improve energy utilization efficiency and achieve optimal energy allocation. In addition, the popularization of new energy vehicles is also an important direction for the promotion of new energy. Cities encourage citizens to use new energy vehicles by building charging facilities networks and providing car purchase subsidies, thereby reducing vehicle exhaust emissions and improving air quality.

3.2 Establishment of Special Funds and Support for Green Projects

In order to support the implementation of dual-carbon policies, some cities have set up special funds to support green projects and environmental protection technology research and development. These funds are mainly used to support projects in the fields of energy conservation and emission reduction, clean energy, green buildings and other fields to promote the green transformation of cities. The use of special funds not only promotes the development of green industries, but also drives the improvement of related industrial chains. Through the guidance of funds, cities have attracted more social capital to invest in green projects, forming a good market atmosphere and incentive mechanism.

3.3 Corporate Carbon Reduction Tax Reduction Policies and Incentive Mechanisms

Under dual-carbon policy, enterprises are encouraged to actively participate in energy conservation and emission reduction by formulating corporate carbon reduction and tax reduction policies. For enterprises that meet energy conservation and emission reduction standards, the city government provides preferential policies such as tax exemptions and financial subsidies to reduce the operating costs of enterprises and improve their market competitiveness. At the same time, the city has also established a carbon emissions trading market to promote corporate emission reductions through market mechanisms. Enterprises can optimize the allocation of carbon emissions and maximize economic benefits by purchasing or selling carbon emission rights. This incentive mechanism not only promotes the green development of enterprises, but also effectively promotes the modernization of urban governance.

3.4 Green Building and Ecological City Planning

Dual-carbon policy has put forward new requirements for urban planning and architectural design. In the planning process, researchers pay attention to the integration of green ecological concepts and promote the development of green buildings and ecological cities. Green buildings achieve energy conservation and emission reduction in buildings by using energy-saving materials, optimizing building structures and energy utilization methods. At the same time, ecological city planning also focuses on the construction and protection of the urban green space system, and improves the city's ecological carrying capacity and environmental capacity by increasing the area of urban green space and optimizing the urban ecological layout.

3.5 Public Education and Participation Mechanism Construction

The implementation of dual-carbon policy cannot be achieved without extensive public participation and support. Managers improve citizens' environmental awareness and participation by strengthening public education. For example, the authors guide citizens to develop good habits of energy conservation and emission reduction by holding environmental protection publicity activities and carrying out green life education. In addition, the city has also established a public participation mechanism to encourage citizens to actively participate in urban governance and environmental protection actions. By setting up a team of environmental protection volunteers and carrying out environmental protection public welfare activities, the authors provide channels and platforms for citizens to participate in urban governance.

4 THE CONTRIBUTION AND SHORTCOMINGS OF THE RESEARCH OF THE DUAL-CARBON POLICY IN URBAN GOVERNANCE

4.1 Contribution

Based on existing research, remarkable results have been achieved in the realisation of the carbon emission reduction goal and the development of urbanisation. It provides a comprehensive analytical framework involving multiple dimensions such as technology, politics, economy, science and technology, and has also put forward a series of specific policy recommendations for the realisation of the "double carbon" goal. In terms of technology, Tan Xianchun (2022) believes that the development of zero-carbon energy sources, including hydrogen energy, can not only meet the demand for emission reduction, but also provide transitional solutions for the gradual replacement of traditional energy sources such as coal. Ouyang Zhiyuan et al (2021) propose it will combine the response to global climate change with domestic reality. It is recommended that China should adopt the path of "double substitution" and "double decoupling" that is, replacing fossil energy with non-fossil energy and replacing traditional technology with low-carbon technology to achieve the results of energy, economy and carbon decoupling. In addition, to a certain extent, draw on international experience to formulate a low-carbon development model suitable for the country.

In terms of policies and planning, most of the existing documents emphasise the need for global consideration and planning to solve the "dual carbon" problem in urban governance from the perspective of systematic thinking. Wang Wenju & Kong Xiaoxu (2022) starting from the classification and application of policy tools, it discusses the path to achieve the goal of "dual carbon", including financial subsidies, carbon trading markets and other means, and emphasises the differentiation of regional policies to improve energy efficiency. On this basis, Yu Biying et al. (2021) further points out that the effectiveness of regional policies is inseparable from the support of energy structure and industrial transformation. These scholars believe that energy restructuring should be combined with industrial transformation, which requires the improvement of energy efficiency and the decoupling of carbon emissions to achieve refined emission reduction in the region. For example, through regional energy network and load optimisation, the effectiveness of policy tools can be maximised at the same time.

In terms of urbanisation and decoupling carbon emissions, Qi Ye et al. (2020) from the unique perspective of the development process and trend of China's urbanisation, they put forward the concept of "big flow" that deeply decouples China's economic development from carbon emissions in the next 40 years. They used the MPC-IC model of urban governance based on the government's perspective to make a comparative analysis of the development of urbanisation in the past 80 years. . Through an in-depth analysis of the problems faced by urban governments and the institutional environment, the development stages of high-carbon and low-carbon urbanisation have been successfully distinguished, which provides a new perspective for understanding the relationship between urbanisation and carbon emissions in China's future.

Ye & Deng (2023) also put forward the importance of building an urban green governance model. They believe that in the process of building this model, it is necessary to study and integrate multiple dimensions such as value rationality and tool rationality in depth. Value rationality emphasises the moral and ethical basis of governance goals, while instrumental rationality focusses on the effectiveness and efficiency of governance means. By organically combining the two, the scientificity and operability of urban green governance can be further improved. The research of these scholars provides new perspectives

and ideas for the public to deeply understand the path and strategy of China to achieve the goals of carbon peaking and carbon neutrality. Their views and suggestions are of important theoretical and practical value for promoting the systematic transformation of China's economy and society, promoting urban green development and building an urban green governance model.

4.2 Insufficient

Although the existing literature has put forward a series of countermeasures, in terms of difficulties and challenges in implementation, there is a lack of specific implementation details on how to balance the relationship between development and emission reduction between different regions and industries, and how to overcome the resistance of local protectionism and industry interests. Some literatures mention the importance of technological innovation, but technological innovation itself is uncertain. How to ensure that technological innovation can keep up with the urgency of the "dual carbon" goal in time is a challenge. In the process of achieving the "dual carbon" goal, it may bring economic costs and social impacts. To this end, it is necessary to develop an effective policy implementation and supervision mechanism to ensure the effective implementation of the policy. At the same time, it is also crucial to raise public participation and awareness, because public participation can promote the acceptance and implementation of policies. When balancing long-term goals with short-term economic development needs, SMART goals can be set to ensure that short-term actions do not compromise the achievement of long-term goals. In addition, strengthening international cooperation is an important way to overcome the uncertainty of international relations.

5 CONCLUSION

By systematically combing and synthesizing the relevant academic literature on the practical application of dual-carbon policies in urban governance, this paper explores the background, current status and future development direction of policy implementation. It is found that by optimizing energy structure, promoting low-carbon technologies and improving policy tools, the existing policies have achieved regional target decomposition and industrial structure optimization to a certain extent, and the results of low-carbon governance in some pilot cities have provided valuable experience for nationwide promotion. At the same time, scholars have emphasized that the combination of technological innovation and institutional optimization is the key to achieving the dual-carbon goal, but the current problems of high technological costs and imperfect policy implementation mechanisms are still constraints. Domestic policies have drawn on successful international experiences, but the localization of practices tailored to local conditions still needs to be deepened, especially in terms of regional differences and optimization of resource allocation, which require further research and improvement. The core objective of the current dual-carbon policy is to achieve a balance between economic development and environmental protection through top-level design, technological innovation and institutional safeguards.

Although research shows that important progress has been made in the promotion of dual-carbon policy, there are still problems with the policy's lack of balance between different regions and industries, the high uncertainty of technological innovation, and the enhancement of public participation and awareness. In the future, further optimizing the carbon trading market and green financial mechanism, and strengthening regional policy synergy and technical support will be the key directions to promote the implementation of dual-carbon policy. The dual-carbon policy has opened up a new path for urban governance, and multi-dimensional urban governance needs to continue to explore and innovate under the guidance of the policy, so as to realize the long-term goals of carbon peaking and carbon neutrality.

AUTHORS CONTRIBUTION

All the authors contributed equally and their names were listed in alphabetical order.

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