

Index System of Low-carbon Driving Factors of Construction Industry in Hebei Province

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Abstract: Under the background of "double carbon" goal, the low-carbon development of construction industry in Hebei Province has become an important part of achieving the carbon peak in 2030 and carbon neutrality in 2060. The construction industry is one of the main sources of carbon emission in Hebei Province, and how to promote its low-carbon development is an urgent issue to be solved. Based on the five aspects of technology, energy, society, economy and industry, this paper constructs the low-carbon driving factor index system of the construction industry. The research shows that technological innovation, energy structure optimization and economic structure adjustment are the key factors to promote the low-carbon construction industry. In addition, by analyzing the current situation and future trend of carbon emissions of the construction industry, this paper puts forward corresponding policy suggestions, which provides theoretical support for the government to formulate countermeasures for the low-carbon development of the construction industry. The conclusion points out that the research and development and application of low-carbon technology, the optimization of energy structure and the green transformation of industrial structure will be the core path to realize the low-carbon development of the construction industry.

Keywords: Low Carbonization; Driving Factors; Construction Industry.

1. Introduction

As an important pillar industry of China's national economy, the carbon emissions of the construction industry account for more than 50% of the total emissions in Hebei, so promoting the low-carbon development of the construction industry is an inevitable choice to achieve the national carbon emission reduction target. The low-carbon development of the construction industry is faced with challenges such as high energy consumption, large carbon emissions and slow technological update. How to promote the transformation of the construction industry to the green and low-carbon direction through effective policies and technical means has become a common concern of the government and academia. This paper aims to identify the key factors affecting the low-carbon development of the construction industry in Hebei province by constructing the low-carbon driving factor index system, and puts forward corresponding countermeasures and suggestions, in order to provide theoretical basis and practical guidance for the green transformation of the construction industry.

2. The Composition of Low-Carbon Driving Factors of Construction Industry in Hebei Province

2.1. Technology Driving Factors

Scientific and technological progress is an important force to promote the low-carbon development of the construction industry. In the construction industry, the development and application of low-carbon technologies is a key way to reduce carbon emissions. The technology drive mainly includes the investment of R&D (research and development) funds, the number of patents and the technical level of construction equipment. These factors together affect the technological innovation capacity of the construction industry and the popularization of low-carbon technologies.

Firstly, the investment of R&D funds reflects the

importance of the government and enterprises to the research and development of low-carbon technologies. In recent years, as the country attaches great importance to the development of green economy, the R&D investment in the construction industry has increased year by year, providing financial support for the innovation of low-carbon technologies. In addition, the growth in the number of patents also reflects the achievements in the application of low-carbon technologies in the construction industry. More and more innovative technologies, such as energy-saving building materials and intelligent building systems, are being widely used in[8] building construction.

On the other hand, the technical level of construction equipment is also one of the important manifestations of science and technology drive. The upgrading of construction machinery and equipment, the improvement of automation and the use of energy-saving equipment can significantly reduce energy consumption and carbon emissions in the construction process. Therefore, to promote the low-carbon construction industry needs to increase the research and development and application of green building technology, improve the technical level of equipment, so as to achieve the goal of energy saving and emission reduction.

2.2. Energy Drivers

Energy is one of the main sources of carbon emissions in the construction industry. Optimizing energy structure and improving energy efficiency are the core measures to promote the low-carbon development of the construction industry. The energy driving factors mainly include the optimization of energy intensity and energy structure.

Energy intensity refers to the amount of energy consumed per unit of GDP, which reflects the efficiency of energy utilization. A reduction in energy intensity means that less energy is consumed for the same amount of economic output, and therefore less carbon is emitted. As an energy-intensive industry, construction accounts for a very high proportion of energy consumption. By improving energy efficiency and

promoting green energy technologies, such as renewable energy such as solar and wind power, the carbon emissions of

the construction industry can be effectively reduced.

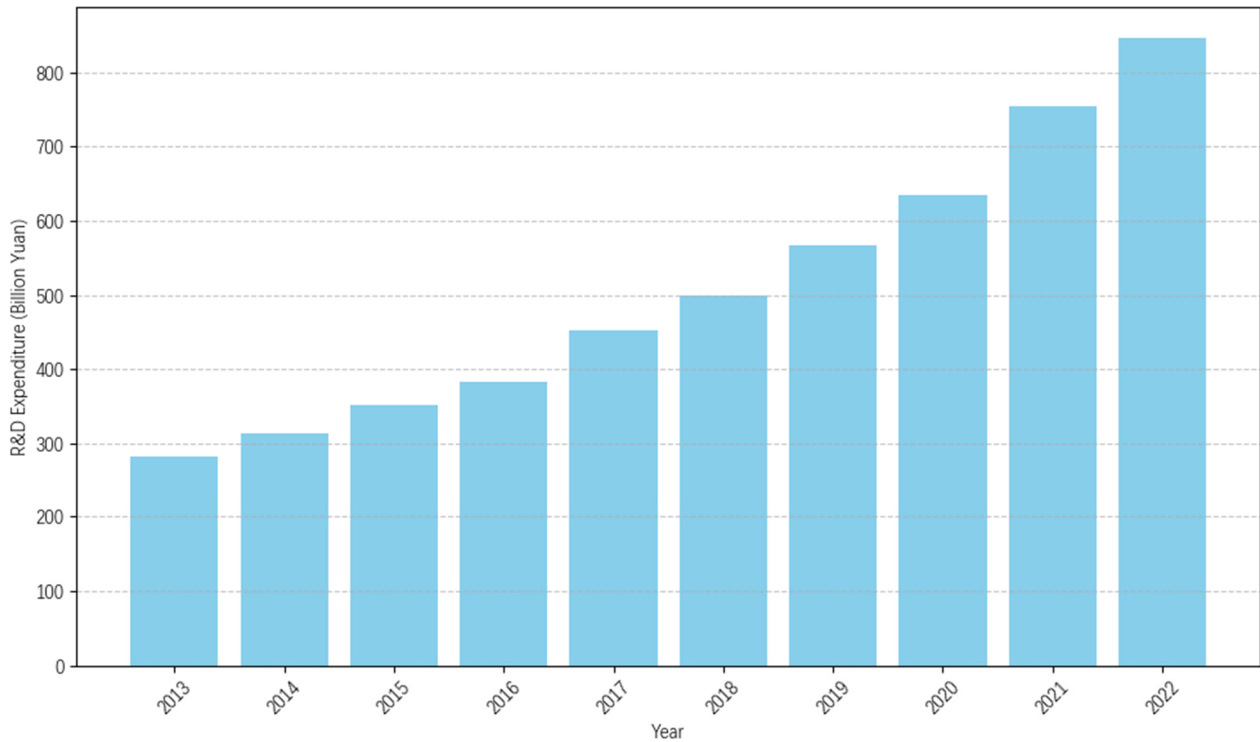


Figure 1. R&D expenditure of Hebei Province from 2013 to 2022

At the same time, the optimization of energy structure is also an important way to promote the low-carbon construction industry. The use of high-carbon energy such as coal is one of the main reasons for the high carbon emissions of the construction industry. In recent years, Hebei has made some progress in reducing coal use and promoting clean energy alternatives. However, the construction industry is still highly

dependent on coal, and adjusting the energy structure and increasing the proportion of renewable energy use will be an inevitable choice to achieve a low-carbon construction industry in the future.

2.3. Social Drivers

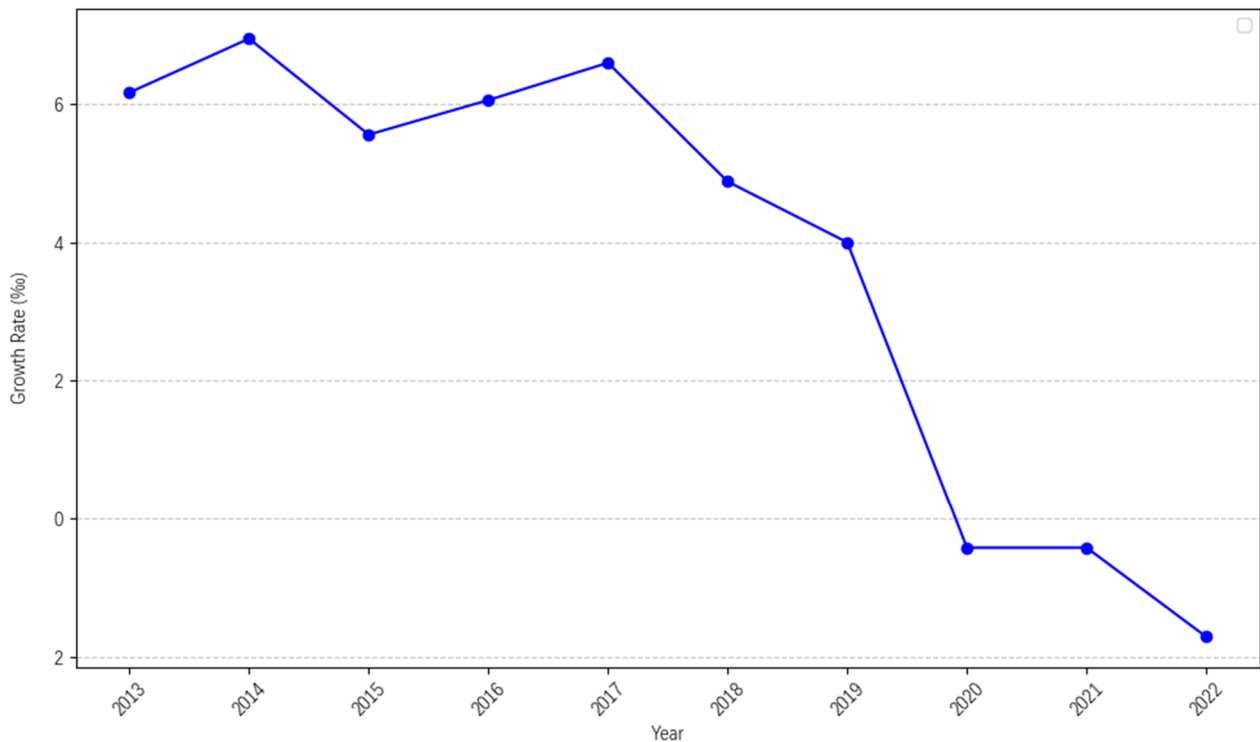


Figure 2. Natural population growth rate in Hebei Province from 2013 to 2022

The decarbonization of the construction industry not only depends on the improvement of technology and energy, but also is closely related to many factors of social development. The social driving factors mainly include population growth, urbanization level and social demand for green buildings.^[4]

First of all, population growth and urbanization process directly affect the scale of building demand. As the population increases and the level of urbanization increases, the construction volume of the construction industry continues to rise, and the carbon emissions increase accordingly. Therefore, in the process of promoting the low-carbon construction industry in Hebei Province, it is necessary to comprehensively consider the dynamic changes of population and urbanization, rationally plan the building layout and construction scale, and avoid the waste of resources and the increase of carbon emissions caused by over construction.

Secondly, the social demand for green buildings is gradually increasing. With the enhancement of environmental awareness, more and more consumers and enterprises begin to pay attention to the environmental performance of buildings, and green buildings have gradually become a new trend in the market. Green building is not only more environmentally friendly in the choice of materials, but also significantly lower in energy consumption and carbon

emissions in the construction process than traditional buildings. Therefore, promoting the popularization and application of green building technology is an important means to realize the low-carbon construction industry in Hebei.

2.4. Economic and Industrial Drivers

Economic and industrial factors are the basis for promoting the low-carbon development of Hebei's construction industry. The low-carbon transformation of the construction industry must be coordinated with the adjustment of economic growth and industrial structure.

First of all, economic growth has a significant impact on the carbon emissions of the construction industry. The rapid development of the construction industry is often accompanied by high energy consumption and high emissions. Therefore, how to achieve the low-carbon transformation of the construction industry while maintaining economic growth is an important challenge. The research in this paper shows that by developing green economy and promoting the innovative application of low-carbon building technology, carbon emissions can be reduced without sacrificing economic growth.

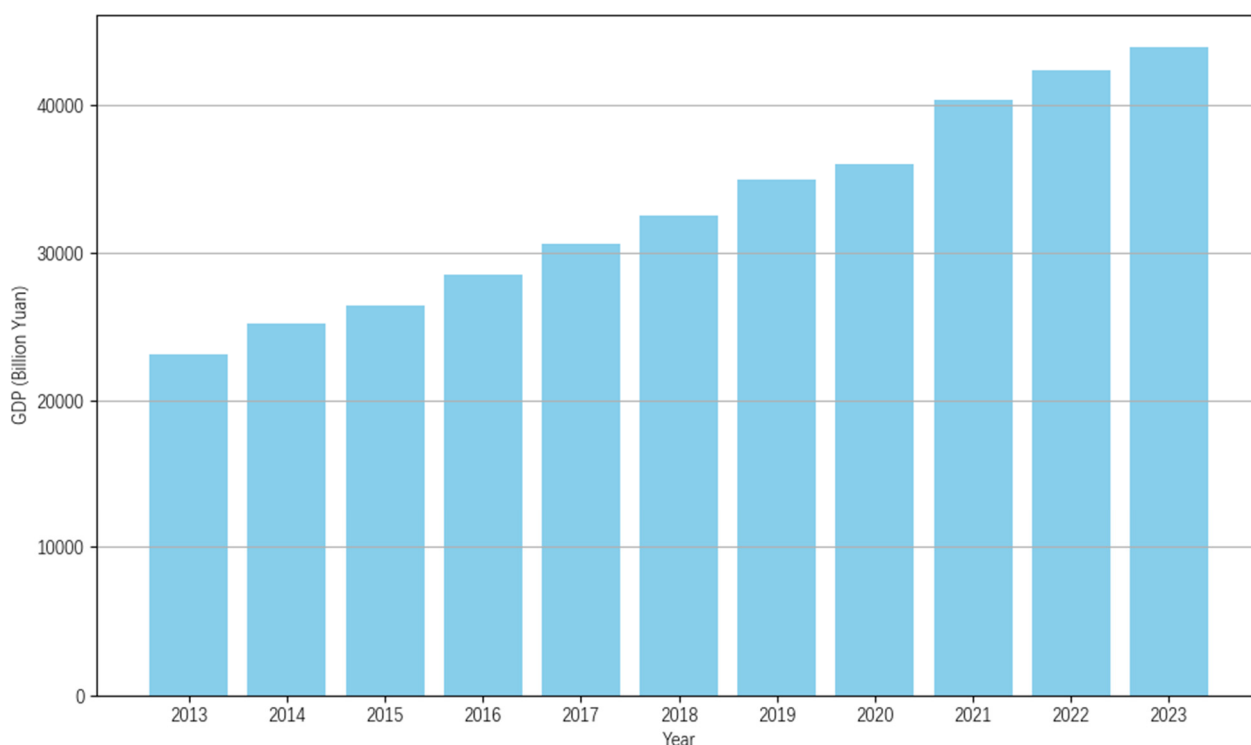


Figure 3. GDP of Hebei Province, 2013-2023

Secondly, the adjustment of industrial structure is also a key factor in realizing the decarbonization of the construction industry. The traditional construction industry relies on a production mode with high energy consumption and high pollution, while the green building industry pays more attention to the application of energy-saving and environmental protection technologies. By promoting the optimization and upgrading of the industrial structure and promoting the transformation of the construction industry to a green and low-carbon direction, the carbon emissions of the construction industry can be significantly reduced. At the same time, the government can encourage enterprises to adopt

green building materials and technologies through policy guidance and market incentives to enhance the sustainable development level of the construction industry. The low-carbon development of Hebei's construction industry is a complex and arduous systematic project, which requires the government, enterprises and the public to work together and make joint efforts. It is believed that with the joint efforts of all parties, the construction industry in Hebei Province will be able to successfully realize the low-carbon transformation, and make greater contributions to building a beautiful China and promoting the sustainable development of the global construction industry. The low-carbon development of the

construction industry in Hebei Province is a key link to achieve the national "double carbon" goal. By analyzing the driving factors of the low-carbon construction industry in Hebei Province, this paper constructs an index system covering science and technology, energy, society, economy and industry, and reveals the core factors affecting the carbon emission of the construction industry. The research shows that the research and development and application of low-carbon technology, the optimization of energy structure and the green transformation of industrial structure will be the core path to promote the low-carbon construction industry.

In future policy making, the government should continue to increase its support for the research and development of low-carbon technologies, optimize the energy structure and promote the development of the green building industry. Meanwhile, all sectors of society should also raise their awareness of environmental protection and promote the popularization and application of green buildings. Through technological innovation, policy guidance and market incentives, the low-carbon transformation of the construction industry will make an important contribution to achieving Hebei's carbon reduction target.

3. Analysis

The analysis of the drivers of decarbonization in the construction industry is based on a large body of literature exploring different dimensions of carbon emissions. The framework presented in this paper draws on multiple studies that analyze how technological innovation, energy efficiency and economic growth interact to affect carbon emissions from the construction industry.

For example, studies have shown that investments in green technologies and research and development significantly reduce energy consumption over the long term. In addition, the literature shows that optimizing the energy mix and phasing out high-carbon fuels such as coal are crucial to decarbonizing the construction industry. The role of urbanisation and population dynamics in shaping building demand is also a widely explored area, with many studies highlighting the importance of sustainable urban planning.

By integrating these insights, a comprehensive framework has been proposed for understanding and addressing the key drivers of low-carbon development in Hebei's construction industry. The proposed indicator system provides policymakers and industry stakeholders with a powerful tool to measure progress and implement targeted interventions to reduce carbon emissions.

4. Conclusion

The low-carbon development of construction industry in Hebei Province is a complex and arduous systematic project, which requires the government, enterprises and the public to work together and make joint efforts. It is believed that with the joint efforts of all parties, the construction industry of Hebei Province will be able to successfully realize the low-carbon transformation, and make greater contributions to building a beautiful China and promoting the sustainable development of the global construction industry. The low-carbon development of the construction industry in Hebei Province is a key link to achieve the national "double carbon"

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References

- [1] National Bureau of Statistics, People's Republic of China. China Statistical Yearbook -2011-2021[M]. Beijing: China Statistics Press, 2011-2021.
- [2] National Bureau of Statistics of the People's Republic of China. China Construction Industry Statistical Yearbook 2011-2021[M]. Beijing: China Statistics Press, 2011-2021.
- [3] National Bureau of Statistics of the People's Republic of China. China Energy Statistical Yearbook -- 2011-2021[M]. Beijing: China Statistics Press, 2011-2021.
- [4] Li R, Jiang R. Moving low-carbon construction industry in Jiangsu province: evidence from decomposition and decoupling models[J]. Sustainability, 2017, 9(6): 1013.
- [5] Shan Y, Guan D, Zheng H, et al. China CO2 emission accounts 1997–2015[J]. Scientific data, 2018, 5(1): 1-14.
- [6] Scientific and Technological Development Plan for Housing and Urban and Rural Construction in the 14th Five-Year Plan [J]. Installation,2022(04):1-7.
- [7] Zhang S, Li Z, Ning X, et al. Gauging the impacts of urbanization on CO2 emissions from the construction industry: Evidence from China[J]. Journal of Environmental Management, 2021, 288: 112440. Hassan K, Salim R. Population ageing, income growth and CO2 emission: Empirical evidence from high income OECD countries[J]. Journal of Economic Studies, 2015.
- [8] MOU Gaohui, Gao Hong. Research on Driving Factors and Countermeasures of low-carbon construction industry under dual-carbon background [J]. Journal of Hebei University of Civil Engineering and Architecture,2023,41(1):213-219.