

# Dual-carbon development opportunities and challenges in the property industry: a key role in China's low-carbon transition

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**Abstract.** This paper aims to explore the key role of the property industry in China's low-carbon transition, and analyze the opportunities and challenges of its dual-carbon development. Firstly, the urgency of global greenhouse gas emissions and the importance of property industry in carbon emissions are introduced, then the definition and significance of carbon neutral and dual carbon goals are analyzed, and the international and domestic dual carbon policies and commitments are reviewed. Then it lists the main sources and components of carbon emissions of the property industry in detail, and evaluates the carbon footprint of the property industry. Next, it discusses the opportunities of new technology and innovation, renewable energy, carbon finance and carbon market for the dual-carbon development of the property industry. At the same time, it also discusses the challenges of technical constraints and cost pressures, the uncertainty and landing problems of policies and regulations, and the difficulty and constraints of landlord and tenant participation. Finally, the paper puts forward policy suggestions to promote the dual-carbon development of the property industry, including setting clear carbon reduction targets and schedules, providing policy support and financial incentives, and establishing industry cooperation and sharing mechanism.

## 1. Introduction

### 1.1 Research background

Climate change is one of the major challenges facing the world at present, and its serious impact has already involved the global ecological environment security and the sustainable development of human society. The increase in global greenhouse gas emissions is one of the main causes of climate change. As greenhouse gases play a key role in the absorption and radiation of heat in the Earth's atmosphere, global temperatures continue to rise, extreme weather phenomena occur frequently, ecological balance is damaged, and human society is faced with great risks.

In this context, low-carbon transition has become an important issue for global action. As an important support for urban development, the real estate industry has huge opportunities and challenges for dual-carbon development. Property management involves the operation and maintenance of a large number of buildings and facilities, and the construction sector is one of the major sources of greenhouse gas emissions. Data show that the carbon emissions of the whole process of construction in China exceed 5 billion tons, accounting for 50.9% of the total carbon emissions in the country<sup>[1]</sup>. Therefore, to strengthen the double carbon

development of property industry is of great significance. By promoting the low-carbon transformation of property management, reducing energy consumption and carbon emissions, it can contribute to the global response to climate change. However, the real estate industry is facing various challenges in the process of realizing the dual-carbon development, including technological innovation, investment cost, management ability and so on.

### 1.2 Research purpose

The purpose of this paper is to explore the opportunities and challenges of dual-carbon development in the property industry. Through the introduction of climate change caused by the increase of global greenhouse gas emissions, the importance and urgency of the property industry in carbon emissions are introduced. We will then explore the opportunities for dual-carbon development in the property industry, including the application of low-carbon technologies, green building design and operational management innovation. At the same time, we will also analyze the challenges facing the property industry, such as economic pressure and insufficient policy support. Ultimately, we aim to provide theoretical guidance to promote the dual-carbon development of the property industry and promote the key role of China's low-carbon transition.

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### **1.3 Overview of the paper structure**

This paper will be divided into the following parts to elaborate. First, the second part will detail the issue of climate change caused by the increase in global greenhouse gas emissions, including the types of greenhouse gases, the sources of emissions, and the impact on the climate, with the aim of explaining why action is needed to address climate change. Secondly, the third part will focus on the importance and urgency of the property industry in carbon emissions, explore the reasons why the construction industry is a major source of greenhouse gas emissions, and analyze the potential and impact of property management on carbon emission reduction. The fourth part will focus on the dual-carbon development opportunities of the property industry, including the application of low-carbon technology, green building design and operation management innovation, in order to demonstrate the important role of the property industry in sustainable development. Then, the fifth part will discuss the challenges faced by the dual-carbon development of the property industry, such as the pressure of economic efficiency, insufficient policy support, etc., through in-depth analysis of the nature and reasons of the challenges, the corresponding solutions are proposed. Finally, the sixth part will give a summary and conclusion, review the main viewpoints and research findings of this paper, and propose possible research directions in the future, with a view to promoting the dual-carbon development of the property industry and contributing to China's low-carbon transition. Through the discussion and analysis of the above parts, this paper will provide readers with a comprehensive understanding of the opportunities and challenges of the dual-carbon development of the property industry and the basis for in-depth thinking.

## **2. Analysis of carbon neutrality and dual carbon targets**

### **2.1 Definition and significance of carbon neutral and dual carbon targets**

Carbon neutrality is the process of bringing net emissions to zero by reducing greenhouse gas emissions and balancing remaining emissions with absorption. The two-carbon target refers to further reducing greenhouse gas emissions on the basis of carbon neutrality and achieving a higher level of carbon reduction. Carbon neutrality and dual carbon targets are of great significance in the prevention and control of climate change. Through carbon neutrality, it can effectively slow down the climate change caused by greenhouse gases, protect the ecological environment and the sustainable development of human society. The dual carbon target will further strengthen the reduction of emissions and promote the global development of a lower carbon future.

### **2.2 International and domestic dual carbon policies and commitments**

Countries have developed a series of dual-carbon policies and commitments. For example, in 2020, the European Union proposed the European Green Deal, which aims to achieve carbon neutrality by 2050. The United States has also resumed its participation in the Paris Agreement and has proposed a "carbon neutral 2050" plan. As one of the world's largest greenhouse gas emitters, China has also actively responded and proposed a "2060 carbon neutral target". These international and domestic dual carbon policies and commitments have laid the foundation for promoting global cooperation on greenhouse gas emission reduction.

### **2.3 The role and responsibility of the property industry in carbon neutrality**

As a large energy consumer and one of the main sources of carbon emissions, the property industry plays an important role and responsibility in the process of carbon neutrality. First, the property industry can reduce energy consumption and carbon emissions by adopting low-carbon technologies and green building design. For example, the use of solar energy and geothermal energy as clean energy supplies, the use of energy-saving lamps and intelligent energy management systems can effectively reduce energy consumption and carbon emissions. Secondly, property managers can innovate operation management models to improve energy efficiency and reduce waste. For example, the introduction of information technology and big data analysis to accurately monitor energy use, timely detection and resolution of energy waste problems. In addition, the property industry can promote sustainable lifestyles, encourage residents and tenants to reduce energy consumption and carbon emissions, and participate in carbon neutral actions.<sup>[2]</sup>

## **3. Carbon emission status of the property industry**

### **3.1 Sources and composition of carbon emissions from the property industry**

The main sources of carbon emissions in our life can be divided into three categories, namely direct carbon emissions, indirect carbon emissions and implicit carbon emissions. Direct carbon emissions include the burning of fossil fuels such as coal; Indirect carbon emissions include the use of electricity, water and other energy sources; Implicit carbon emissions mainly refer to the carbon emissions implied by the daily procurement of equipment, such as tables, chairs, computers, etc., during the processing of these equipment.<sup>[3]</sup>

In the property industry, direct carbon emissions come from heating systems, and indirect carbon emissions mainly come from building energy consumption, air conditioning and water treatment. Here is a breakdown of the sources of these emissions:

a. Heating system: Heating in winter requires a large amount of energy, such as the direct combustion of fossil fuels such as coal or the large consumption of electric heating systems, which will lead to high carbon emissions directly generated by the property industry.

b. Means of transportation: there are generally parking lots in the area under property management, and the carbon emissions generated by cars and connecting traffic in the area are also the main sources of carbon emissions in the process of property management.

c. Building energy consumption: The energy consumption of buildings is the most important source of carbon emissions in the property industry. Mainly including electricity use, lighting, elevator operation, etc., is an important form of indirect carbon emissions.

d. Ventilation and air conditioning: The operation of air conditioning systems consumes a lot of electricity and often uses refrigerants, which will lead to increased carbon emissions.

e. Water treatment: The water treatment process in property management also requires energy input, such as pump operation, water heating, etc. In this process, certain carbon emissions will be generated indirectly.

f. Equipment procurement: In the process of property management, it is not only necessary to invest a lot of human resources, but also to purchase tables, chairs, computers and other equipment, which are the main sources of implied carbon emissions.

### 3.2 Assessing the carbon footprint of the property sector

In order to quantify the contribution of the property industry in terms of carbon emissions, this paper will evaluate the carbon footprint of the property industry, analyze the energy use in the process of property management and the circumstances that lead to carbon emissions. This paper will quantify the main sources of carbon emissions discussed above, in which  $C_n$  is the carbon emissions of each emission source, and  $A_n$  is the carbon emission coefficient of indirect carbon emission sources. By summing and calculating the total carbon emissions of each emission source, the energy consumption and total carbon emissions in property management are calculated.

$$C = \sum_{n=1}^N C_n \quad (1)$$

$$C_n = A_n * E_n \quad (2)$$

$$C = \sum_{n=1}^N (A_n * E_n) \quad (3)$$

Meanwhile, energy use in property management is closely related to carbon emissions. For example, the power consumption habits of property managers and residents, the efficiency of energy equipment, the implementation of energy management measures and other factors will affect energy consumption and carbon emission levels. For example, property management also involves daily cleaning work, greening maintenance and other activities, which may also generate certain energy consumption and carbon emissions.<sup>[4]</sup>

Through the above method, it can help to quantitatively assess the carbon emission contribution of the property industry. The following is the process for assessing the carbon footprint of the property sector:

a. Collect data: Collect data related to the property industry, including energy consumption, water use, waste discharge, etc. This data can be obtained from property management companies, energy suppliers, water authorities and others.

b. Carbon emission calculation: Convert the collected data into carbon emission data. By using a reliable carbon emission factor, it is possible to convert energy consumption, water use and waste emissions into corresponding carbon emissions.

c. Boundary determination: The boundary of the assessment is determined, i.e. the scope covered by the assessment. This may include the overall operation of the property, or the operation of specific buildings and equipment.

d. Data analysis: Analyze and organize the collected data to calculate the total carbon emissions of the property. Total emissions can be further broken down into emissions from different sources, such as energy emissions, water supply emissions, etc.

e. Comparison and evaluation: The carbon emission of the property is compared with the standard or similar properties to assess its performance in terms of carbon emissions. The results of the assessment can be compared with past data to observe trends of improvement or deterioration.

f. Formulate emission reduction strategies: According to the evaluation results, formulate strategies and plans to reduce carbon emissions, such as increasing carbon sink reserves in the community, improving energy efficiency, using clean energy, promoting water-saving measures, increasing waste recycling, etc.

g. Monitoring and reporting: After the implementation of the emission reduction strategy, the carbon emissions of the property are continuously monitored and the results are regularly reported. This helps track progress and adjust strategies in a timely manner.

By conducting a property industry carbon footprint assessment, property management companies can better understand their contribution to carbon emissions and take appropriate measures to reduce their carbon footprint and promote sustainable development.<sup>[5]</sup>

## 4. The dual-carbon development opportunities of the property industry

### 4.1 The application of new technologies and innovations in carbon emission reduction

With the continuous progress of science and technology, new technologies and innovations have great potential for carbon emission reduction in the property industry. At present, they have been applied to the following fields and have some potential impacts on carbon emission reduction in the property industry:

a. Intelligent buildings: Intelligent buildings can achieve efficient use of energy and automated management through the use of advanced sensors, adaptive control systems and other technologies, thereby reducing carbon emissions.

b. Energy management system: The intelligent energy management system can monitor and control the energy consumption of buildings, provide accurate data analysis, and help property managers optimize energy waste to achieve the purpose of emission reduction.

c. Green building materials: The development and application of more environmentally friendly building materials, such as renewable materials and low-carbon materials, can reduce energy consumption and carbon emissions in the construction process.

#### **4.2 The promotion and application of renewable energy in the property industry**

Renewable energy is one of the important ways to reduce carbon emissions, and it has a wide application prospect in the promotion and application of property industry. For example: solar photovoltaic power generation system, the use of solar energy, convert it into electricity and other energy supply to the property building

a. Solar photovoltaic power generation: Installing solar photovoltaic systems to convert light energy into electricity to supply property buildings can not only reduce the demand for traditional energy, but also reduce carbon emissions.

b. Wind energy utilization: Under suitable conditions, use wind energy to generate electricity, provide clean energy for property sites, and reduce dependence on traditional energy.

c. Biomass energy utilization: The use of waste and crop residues and other biomass resources for energy conversion, such as biomass power generation, biofuels, etc., effectively reduce carbon emissions.

#### **4.3 The impact of carbon finance and carbon market on the property industry**

The development of carbon finance and carbon market has brought new opportunities to the property industry, which can be summarized in the following aspects:

a. Carbon trading and carbon quota: With the development of the carbon market, the property industry can participate in carbon trading, offset carbon emissions by purchasing carbon quota, and sell excess carbon quota through emission reduction measures to obtain economic benefits.

b. Carbon credit and carbon certification: Through the implementation of carbon emission reduction projects, the property industry can obtain carbon credits, participate in carbon credit trading, and demonstrate its low-carbon and environmental protection image through carbon certification to improve brand value and market competitiveness.

c. Carbon finance support: Carbon finance provides financing support and investment opportunities for the

property industry, such as the financing of carbon emission reduction projects, green bonds, etc., which promotes the application of low-carbon technologies and innovations.<sup>[6]</sup>

The application of new technologies and innovations, the promotion and application of renewable energy, and the impact of carbon finance and carbon markets provide broad development opportunities for the property industry to achieve the dual-carbon goal. Property managers and stakeholders need to take active action to take advantage of these opportunities to drive the property industry towards low-carbon development and contribute to sustainable urban development.<sup>[7]</sup>

### **5. The dual-carbon development challenge of the property industry**

#### **5.1 Technical limitations and cost pressures**

Technical limitations: The adoption of new technologies and innovative solutions requires significant R&D and testing efforts and may present technical feasibility and stability challenges. In addition, the energy upgrading of older buildings also faces technical limitations.

Economic cost pressure: The introduction of low-carbon technologies, the implementation of energy management systems, and the transformation of building energy all require capital investment, which may bring economic cost pressure to property enterprises.<sup>[8]</sup>

#### **5.2 Uncertainty and landing problems of policies and regulations**

Uncertainty of policies and regulations: There may be uncertainty in the formulation and adjustment of relevant policies and regulations such as carbon emission allowances and carbon trading mechanisms, which brings certain troubles to the long-term planning and strategic decision-making of the property industry.

Implementation problems: The implementation of policies and regulations requires the support and cooperation of relevant supervision, implementation and evaluation institutions, but sometimes the construction and operation of these institutions may lag, resulting in increased difficulty in the implementation of relevant policies.

Solutions to these challenges can include:

a. Technology research and development and innovation: Increase support for the research and development and application of low-carbon technology, encourage enterprises to carry out technological innovation, reduce the cost of low-carbon technology and improve the feasibility.

b. Financial support and policy incentives: the government can provide financial support, tax relief and other incentive measures to reduce the economic cost pressure of property enterprises to participate in carbon emission reduction.

c. Strengthen policy communication and guidance: Government departments need to communicate with the



property industry in a timely and effective manner, clarify the direction and timetable for the formulation of policies and regulations, and provide better policy guidance and business support for property enterprises.

### **5.3 The difficulty and constraints of landlord and tenant participation**

The participation of owners and tenants is the key to achieving the dual-carbon goal of the property industry, but it also faces some difficulties and constraints:

a. Awareness and cognition problems: Some owners and tenants may lack sufficient awareness and understanding of the importance and specific measures of carbon emission reduction.

b. Conflict of interest and constraints: Owners have their own investment return and interest considerations, and tenants also pay more attention to comfort and price when choosing properties, which may exert certain constraints on the promotion of carbon emission reduction actions.

To address the above challenges, the following improvements can be proposed:

a. Publicity and education: raise the carbon awareness of owners and tenants and enhance their enthusiasm to participate in carbon emission reduction by organizing publicity activities and conducting training courses.

b. Incentive mechanism: Establish incentive mechanism, such as certification and reward of low-carbon real estate, to encourage owners and tenants to choose carbon emission reduction properties.

c. Win-win cooperation: Property managers can cooperate with tenants to jointly promote energy conservation and emission reduction projects, such as sharing energy information, implementing energy-saving renovation, etc., to achieve the common interests of both parties.

Through the implementation of the above measures, it can promote owners and tenants to better participate in carbon emission reduction, and promote the property industry to move towards the dual-carbon development goal.<sup>[9]</sup>

## **6. Policy Suggestions for promoting the dual-carbon development of the property industry**

### **6.1 Provide policy support and financial incentives**

The Government may consider exploring the provision of policy support and financial incentives to promote the dual-carbon development of the property industry. Specific measures could include:

a. Provide tax relief policies related to carbon emission reduction to reduce the economic cost pressure of property enterprises.

b. Set up a special fund to support property enterprises to carry out carbon emission reduction

technology transformation and facility upgrading projects.

c. Establish a carbon trading mechanism to encourage property enterprises to actively participate in the carbon market and promote carbon emission reduction actions.

d. Increase support for green building certification and incentives, and encourage property enterprises to develop and manage low-carbon and sustainable buildings.

### **6.2 Establish an industry cooperation and sharing mechanism**

In order to strengthen the dual-carbon development of the property industry, the government can promote the establishment of industry cooperation and sharing mechanisms. This could include:

a. Organize exchange seminars, training courses and other activities within the industry to promote experience sharing and technical cooperation among property enterprises.

b. Establish an energy data sharing platform to encourage property enterprises to share information on energy use and management to improve overall energy efficiency.

c. Support property enterprises to participate in joint energy procurement and reduce energy costs and carbon emissions through centralized procurement.

Through the above policy recommendations, we can further promote the dual-carbon development of the property industry and help achieve carbon emission reduction targets. The government, property enterprises and relevant institutions should work closely together to form a virtuous circle of policy support, technological innovation and industry cooperation, and jointly promote the property industry to a low-carbon and sustainable future.

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