

# Protection and Renewal of China's Industrial Heritage under the Concept of Green Development Research progress and prospect

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**Abstract.** The concept of green development is the common pursuit of human development in the 21st century, and the renewal of industrial remains is the focus under the new normal of stock space. However, the research on the protection and renewal of industrial heritage based on the concept of green development is still in the exploratory stage. This paper systematically sorts out the research progress on the protection and renewal of industrial heritage in China from the aspects of the connotation of green development, the significance of green transformation and theoretical research. On the basis of analyzing the current problems in the protection and reuse research, it puts forward the direction that should be paid attention to in future research.

**Keywords:** industrial heritage, green development, protection and renewal

## 1. Introduction

In order to cope with the severe trend of global climate change, many countries have moved towards the road of green and low-carbon development. In 2020, China also put forward the goal of achieving peak carbon dioxide emissions and carbon neutrality for the first time, which attracted international attention, and green development has become a global consensus. Cities bear social, economic, ecological, cultural and other aspects of material and non-material construction, and have significant potential in the field of energy conservation and emission reduction. The material decline and functional degradation faced by cities also need green transformation to achieve high-quality development.

## 2. The concept of green development

As early as the Fifth Plenary Session of the 18th CPC Central Committee, five development concepts "innovation, coordination, green, openness and sharing" were put forward, and the concept of green development focused on solving the problem of harmony between man and nature was placed in a more prominent position. At the 18th National Congress, the construction of ecological civilization was brought into the overall layout of "Five in One", and the concept of green development was gradually integrated into production and life, and economic development and environmental improvement interacted positively. The 20th National Congress of the Communist Party of China once again proposed to accelerate the green transformation, pointing out that green and low-carbon economic and social development is the key link to achieve high-quality development. Green development in the new era has risen to a strategic height, and integration into production and life is an important choice to promote the construction of a community of human destiny. Building a green space pattern, accelerating the optimization and adjustment of industrial structure, promoting green production and life, and improving green system and mechanism are the main tasks of green development in the new period.

### **3. The significance of green transformation of industrial heritage protection and renewal**

#### **3.1 Necessity of transformation from production process**

In the manufacturing of industrial products, its complex industrial process inevitably leads to chemical erosion and heavy metal pollution of the remains themselves and their surrounding environment. There may be some harmful substances in buildings, environment and soil. Therefore, it is very necessary to carry out ecological restoration before renewal and reuse. Industrial production space generally does not require high thermal performance of buildings, and the old construction technology has some limitations, which leads to poor maintenance structure and thermal performance after long-term use. Therefore, it is necessary to reduce energy consumption of buildings through green transformation.

#### **3.2 Adaptability due to the development of architectural features**

The water, electricity system and building materials left over from the old industry were advanced and of good quality at that time, and they can still meet the use requirements by today's standards. It is in line with the purpose of sustainable development to transform and reuse them with green development concepts and technologies. Industrial buildings have various space forms, with different volume and lighting, which promotes the diversified development of green transformation. At the same time, the large internal space and simple external environment also provide more options for green renewal. The old industrial area used to be the core of urban development, and the industrial heritage land has a good location advantage, so it is more important to promote the efficient and high-quality development of the remains in the city center.

### **4. Research progress of green transformation of industrial remains**

#### **4.1 Ecological Restoration of Brown Land**

Liu Fuying (2007) proposed the reuse model of different brownfields in China's mining cities under the overall evolution of environmental, economic and social subsystems and systems. Feng Shanshan (2015) put forward the theoretical system of brownfield ecological restoration with the goal of improving urban green infrastructure, and gave the decision-making method of mining wasteland utilization from the aspects of zoning evaluation, restoration strategy, coordination mechanism and safeguard measures. Yang Hao (2018) introduced the concept of "urban double repair" and put forward the framework of brown land regeneration of coal wasteland mined by underground engineering in mega-comprehensive cities. Fu Quanchuan (2022) studied the spatial pattern of brownfields in resource-declining cities from the perspective of brownfields, and put forward the regeneration strategy and implementation path of brownfields based on the transformation relationship of "city-brown-green".

#### **4.2 Green technology of old industrial buildings**

The research on green technology of old industrial buildings, based on green building technology, transforms the roof, wall, doors and windows, energy saving, space and materials of old industrial buildings. Liang Yang (2014) put forward the design steps and methods of green transformation of old industrial buildings from macro to micro. Gao Jing (2017) proposed a green operation evaluation method from the aspects of energy utilization, indoor and outdoor environmental quality, resource recycling, economic benefits, etc., so that the whole life cycle of the building meets the requirements of sustainable development. Qin Hao (2019) put forward the application of energy technology and resource recycling technology in green transformation for industrial remains in cold regions. Wang Yuxiang et al. (2023) put forward the function of greening measures such as indoor

space layout, window opening form and gray space setting for small industrial buildings in hot summer and warm winter areas.

### **4.3 Green renewal of industrial heritage land**

The research on green transformation of industrial heritage land started late, but the research directions are diverse, including transformation mode, green technology, renewal strategy, green benefit evaluation and so on, and the research heat continues to heat up. Wang Zhongyuan (2021) put forward that the development mode of industrial heritage is determined by its own and external conditions, and based on the urban ecological theory, studied the transformation mode of industrial heritage under different internal and external conditions. Cui Yanqiu et al. (2021) put forward the green transformation method of the remains at three levels: factory area, environment and architecture. Jason and Liu Boying (2022) combined the systematic protection and utilization of industrial heritage with urban green development from the planning level, the architectural level and the operation level, and conducted technical research and application. Zhang Xiaoyan et al. (2023) put forward the renewal strategy of "double correlation" between transformation mode and content, industry and space, and promoted the upgrading and transformation of industrial heritage based on the idea of sustainable development.

### **4.4 Green transformation system and mechanism**

Yan Wenzhou (2021) constructed the theoretical model and PSIR structural model of influencing factors of green renewal of industrial remains. Some suggestions are put forward, such as strengthening green technology innovation and professional personnel training, cultivating green regeneration concept and consciousness, and formulating incentive policies. Ye Fangfang (2022) used system dynamics (SD) to study the causal feedback relationship between the internal elements of the green regeneration system in the old industrial area, and then constructed the dynamic model of the green regeneration system in the old industrial area, designed the simulation scheme for simulation, analyzed the dynamic trends under different schemes, and put forward the paths and countermeasures for the development of green regeneration in the old industrial area. Luo Xiaomeng (2023) built an integrated model including perceived behavior control, responsibility attribution, attitude and other variables, and introduced corporate social responsibility as a regulating variable to explore the gap between willingness and behavior, so as to explore the influencing mechanism of green redevelopment behavior in industrial zones.

## **5. Shortcomings and prospects of research.**

### **5.1 The standard system of green renewal of industrial remains is not perfect.**

At present, the standard of green development in China is the Evaluation Standard of Green Building, which was updated in 2019. It comprehensively evaluates the safety, durability, health and comfort, convenience of life, resource conservation, and environmental livability of buildings during their whole life cycle. In 2016, the Central Organization Department formulated the "Green Development Indicator System" for regions and cities, which comprehensively evaluated resource utilization, environmental governance, environmental quality, ecological protection, growth quality, green life and public satisfaction. There is a lack of green evaluation criteria in the scale of the area, especially in the scale of industrial heritage land and heritage blocks. Without standard measurement, it will be difficult to define the bottom line of protection and the direction of transformation, which is not conducive to the green transformation of industrial remains and the high-quality development in the future. Therefore, it is necessary to establish a green development evaluation standard for industrial heritage land.

## **5.2 There are more researches on green transformation and less on green protection.**

The research and practice of industrial heritage can be divided into two aspects: protection and reuse. Protection is the premise of reuse and the ultimate goal of heritage renewal. Reuse of the remains without protection will damage their own value, limit their spillover value and hinder the sustainable development of renewal. However, in the study of industrial heritage land based on green development theory, most of them pay attention to the green regeneration of industrial heritage land, but less attention to the green protection of industrial heritage land. The green protection mechanism should be formed by combining green development technology from the aspects of spatial gene retention, building value maintenance and management system establishment.

## **5.3 Multi-scale research on green transformation of industrial heritage is not deep enough.**

Judging from the existing research literature, the research on the green transformation of industrial heritage mainly focuses on old industrial buildings and industrial heritage, and the research on other scales is not mature enough. From macro to micro, the way of renewal and promotion can better combine the protection and reuse of industrial heritage with urban development and social needs. Therefore, the green transformation of industrial remains should also be systematically divided into regions, cities, districts, lots, buildings and other levels. This paper tries to put forward the corresponding evaluation model, transformation strategy and decision-making mode for different levels.

## **5.4 Insufficient research on industrial heritage based on low-carbon strategy.**

Low carbon is a sustainable development model characterized by low energy consumption, low pollution and low emission. Industrial remains produce different carbon emissions in the past industrial production, renovation and future operation. Each stage has the necessity and potential to save energy and reduce carbon. Therefore, the protection and renewal of industrial heritage should be related to the energy consumption of production and life, and a comprehensive planning and design method combining the protection and renewal of industrial heritage with energy saving and emission reduction should be put forward.

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