

Analyze the development trend of green building in China

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Abstract. The development of green buildings has emerged as an unavoidable trend in the construction industry in response to the public's demand for a gradual increase in the environmental standards for home building during the emergence of the epidemic. The author collected the number of green building initiatives and green building development policies over the years to analyze the development tendency of green buildings in China. The findings indicate that green construction has a bright future in China. China places a great priority on the construction of green structures and has made it a cornerstone of its national strategy.

Keywords: Green Building; Development Tendency; Development Policy.

1. Introduction

According to China's national standard "Green Building Evaluation Standard" (GB/T 50378-2006), a "green building" conserves resources (energy, land, water, and materials), protects the environment, and reduces pollution to the barest minimum over the course of the building's entire life cycle. They are constructions that offer individuals useful, healthful spaces they may utilize in conjunction with the environment [1].

Since the 21st century, energy saving, environmental protection, low carbon, and sustainable development have become the main development tendency in the world. At the same time, information technology is also developing rapidly. In this era, many kinds of information technology, such as artificial intelligence, the Internet of things, and other new-generation information technology are now promoting the transformation and upgrading of the global construction industry. The integration of architecture, nature, and information technology has become the mainstream of the construction industry's development, and green buildings, intelligent buildings, and ecological buildings have become the main development tendency. After the outbreak of COVID-19, as an important part of the epidemic prevention work, construction has had a significant impact on China's epidemic prevention work. At the same time, people have less time to go out and spend more time indoors, which leads to the gradual improvement of people's requirements for the house building environment. Green building has become the inevitable choice for the future development of architecture with their higher health attributes and living quality [2].

From the standpoint of development, after entering the information age, the progression of green buildings is based on the two concepts of energy saving and returning to nature. It combined with different types of information technology in recent years, from a single green energy-saving to information, intelligent and birthed a new concept of "green smart building." In order to enable people to use green buildings more effectively and conveniently, to achieve effective management and control of buildings, further reduce energy consumption, and realize the sustainable development of buildings as well as the entire city, green smart buildings integrate information technology such as the big data, BIM, and Internet of Things. The significance of green and intelligent buildings is now recognized by all nations. They have strengthened key green and smart building assessment standards, and progressively enacted rules that are helpful for the development of green and smart buildings. They also made the process of creating green and smart buildings more professional and standardized and gave them more authority [3].

2. Method

2.1 Trend research method

Trend research refers to the research on the law governing the construction of green buildings in the time dimension, which is a kind of longitudinal research. The purpose is to summarize the cross-sectional studies of the research objects in different periods to find the law of their occurrence over time. The author will compile pertinent information on China's green construction initiatives throughout time and count the number of projects. After creating the forms, the author will study the green building number change research development trend and convey the results.

2.2 The determination of the number of network layers

Classification research means the author will collect statistics on the relevant policies of China's central government and various local governments regarding the development of green buildings. Then the author will classify the policies into three categories according to whether they are conducive to the construction of the green building.

(1) Positive policies: the development policies formulated in this region are conducive to the construction of green buildings

(2) Neutrality policies: The creation of green buildings is significantly impacted by the development policies created in this region.

(3) Negative policies: the development policies formulated in this region inhibit the construction of green buildings

3. Result

3.1 3.1 The result of trend research methods

As evidenced by the data published by the Ministry of Housing of China over the years, China officially launched the green building evaluation and identification work in 2008. At that time, there were only 10 projects that received green building evaluation marks and the building zone is 1,412,200 square meters. However, with the continuous construction of green building identification and evaluation across China, the number of green building projects has significantly expanded. Especially after the Green Building Action Plan issued by the Ministry of Housing in 2013, Chinese local governments have begun to enact policies to help green building development. As a result, the volume of green construction projects has quickly expanded as shown in Figure 1 [4].

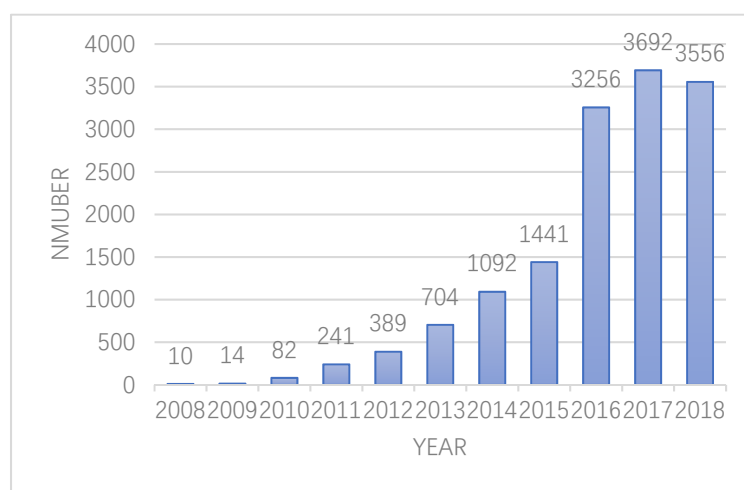


Figure 1. Annual growth of green building projects [4]

It can be intuitively seen from Figure 1 that China's green building project work was depressed only in the early stage of the work from 2008 to 2009. After 2010, it began to increase steadily year

by year, and in 2016, it got a jumping growth. From 1441 in 2015 to 3256 in 2016, a growth rate of 225%. By the end of 2019, there were 20,000 green building projects in China. Currently, China has created more than 5 billion square meters of green buildings. Compared with 2008 when the green building work was just carried out, it is undoubtedly a qualitative leap, which benefits from the Chinese government’s strong support for the construction of green buildings [5].

3.2 Analysis of experimental results

3.2.1 The attitude of the Chinese government

Since the concept of green building was introduced into China, the Chinese government has been supporting the construction of green buildings. The Chinese government formulates development policies on a five-year cycle, the pertinent regulations for the creation of green building projects date back to the “Guiding Opinions of the Ministry of Construction on Promoting the Development of Energy-saving and Land-saving Buildings” issued in 2005. It put forward the development of green buildings, work goals, basic ideas, and approaches. In 2006, the Evaluation Standards for Green Buildings were released by the Ministry of Construction and stipulated the corresponding evaluation and classification of green buildings. From then on, the green building officially developed in China. Subsequently, through the “12th Five-Year Plan” development policy period, the progression of green buildings was formally included in the national development policy, which has become an important part of China's development. The fundamental objective of the “12th Five-Year Plan” is to promote green progression in society. The purpose is to let people know the importance of green development, and future initiatives to promote and create green buildings will benefit from it. Through the “12th Five-Year Plan period”, the number of green building projects increased year by year and developed stably, all the original targets have been exceeded as shown in Table 1. It has established a strong foundation for the growth of green structures in China over the “13th Five-Year Plan” period [3].

Table 1. The main development indicators for constructing energy-saving and green buildings during the “12th Five-Year Plan” period

Indicators	In 2010 cardinal number	Planning goal		implementation	
		In 2015	Average annual growth rate [cumulative]	In 2015	Average annual growth rate [cumulative]
The implementation rate of energy-saving standards for new urban buildings (%)	95.4	100	[4.6]	100	[4.6]
Area of urban residential buildings upgraded to energy-efficient construction in cold and cold regions (100 million square meters)	1.8	8.8	[7]	11.7	[9.9]
Urban residential buildings in hot summer and cold winter areas improved for energy conservation (100 million square meters)	-	0.5	[0.5]	0.7	[0.7]
Energy efficiency improvement of public buildings (100 million square meters)	-	0.6	[0.6]	1.1	[1.1]
Number of projects with green building evaluation and identification (each)	112	-		4071	[3959]
Urban shallow ground area (100 million square meters)	2.3		-	5	[2.7]
Urban solar thermal application area (100 million square meters)	14.8	-	-	30	[15.2]
Tips: 1) the indicators highlighted in black are those that were suggested in the Major City Work Conference, the National New Urbanization Development Plan (2014-2020), and the Comprehensive Work Plan for energy conservation and emission reduction. 2) In [] is the cumulative value of 5 years.					

Since the coronavirus epidemic, China's construction sector has been severely impacted. Local governments have implemented stringent management measures to confine the motion of people to contain the spread of the disease. The majority of the real operators in the construction sector are highly mobile migrant workers, and the flow of construction workers is constrained as a result of the pandemic. One of the key factors contributing to the construction industry's decline is a shortage of personnel. Several building projects have had to be delayed or put on hold as a result of the necessity to transfer various construction materials owing to the work being done to avert epidemics [6]. However, the epidemic also altered peoples' perceptions of architecture in the past, and they started to place more value on a building's ability to promote health. Because of their comfortable, healthy interiors and focus on people, green buildings stand out among all other types of construction and have taken the central stage in Chinese government campaigns. Even in 2020, when the epidemic broke out, China's green building development was still in full swing. By the end of 2020, China had completed its “13th Five-Year Plan” in terms of green buildings. In metropolitan areas, new green buildings totaled more than 6.6 billion square meters. Over 23.8 billion square meters of energy-efficient structures have been constructed, making up more than 63% of the entire area of urban residential structures [7].

In the ongoing “14th Five-Year Plan”, based on the progression achievements of the “13th Five-Year Plan”, the Chinese government has further formulated and implemented relevant expected targets in order to set a direction for green building development as shown in Table 2. It is expected that by 2025, new buildings in cities and towns will be fully green buildings. To attain a carbon peak by 2030, China will establish a green, low-carbon, and circular construction and development mode and provide a strong foundation for urban and rural growth [8].

Table 2. Specific indicators of building energy conservation and green building development were developed during the “14th Five-Year Plan period”

Main indicators	2025
Energy efficiency improvement of existing buildings (100 million square meters)	3.5
Building area with ultra-low energy consumption and near zero energy consumption (100 million square meters)	0.5
The proportion of prefabricated buildings in new urban buildings	30%
New installed building solar photovoltaic capacity (gigawatts)	0.5
Increased geothermal energy building application area (100 million square meters)	1.0
The renewable energy replacement rate for urban buildings	8%
The proportion of electricity consumption in building energy consumption	55%

(Tips: Indicators in the table are all expected indicators)

The Chinese government expects to achieve specific goals by 2025, including completing the construction of low energy consumption, nearly zero energy buildings covering 350 million square meters, prefabricated buildings accounting for 30% of new buildings in cities and towns, and new buildings with photovoltaic solar power installed capacity of at least 0.5 million km. Buildings will use more than 100 million square meters of geothermal energy, 8% of urban buildings will switch to renewable energy, and more than 55% of building energy will be derived from electricity use.

Furthermore, the Chinese government is focusing on both increasing the number and calibre of green structures. Before the “14th Five-Year Plan”, most of China's green construction projects were one- or two-star endeavors, with three-star endeavors being relatively scarce. At the end of 2018, there were 4,137 one-star and 4,092 two-star green building projects in 27 provinces, municipalities, and autonomous regions, respectively, accounting for 45.02% and 44.53% of the total green building which accounted for 89.55%. While there were only 961 three-star projects, or 10.45% of the total, in the same 27 provinces, municipalities, and autonomous regions. This demonstrates that more than ten years into the growth of green buildings in China, it has mostly remained in the stage of quantity development, while the number of high-star of high-star green buildings grows slowly. The Chinese

government has taken note of the situation and the “14th Five-Year Plan” was presented to strengthen the construction of high-quality green buildings, promote star green buildings, and adopt the "compulsory + voluntary" marketing model. It also increases government investment in public buildings, particularly large public buildings, and the construction of key function district star green buildings in new buildings. The Chinese government hopes that this policy will encourage the growth of highly starred green buildings and transform the progression of green buildings in China from a quantitative change to a qualitative change. This policy will serve as a guide for local governments as they develop policies like green finance, floor area ratio award, and priority evaluation award, and support the development of star-rated green buildings [9].

However, there are certain flaws in China's development of green buildings as well, which are hampered by the uneven economic growth across the country. There are significant disparities in space and an imbalance in the development of green buildings across different locations. Green buildings are more prevalent in the eastern coastline regions of China because there is a stronger economic and policy climate there than in the middle and western regions. At the end of 2018, 6,199 projects in eastern China had been awarded green marks, making up 67.5% of all green buildings in the nation. 1755 buildings in central China obtained green ratings, making up 19.1% of all the structures in the country. 1,236 projects, or 13.4% of all green buildings in China, were located in western China and displayed green building signs. [10] The author believes that if China wants to make more significant advancements in the field of green building, it cannot limit the development of green buildings to the eastern region. Instead, there should be a policy tilt toward the central and western regions that are more conducive to green building, so that the progression of the central and western regions' green building can quickly catch up to that of the eastern region. In order to ensure that everyone in the country can experience the benefits of green building and that the idea of low-carbon, green, and environmental protection becomes more deeply ingrained in people's minds, it is essential to vigorously develop the green building in both the less developed economies of the central and western regions as well as in the less developed economies of the country as a whole.

3.2.2 The attitude of Chinese local governments

With the central government's policy encouraging the development of green buildings, it has been prioritized by the local governments of China in local construction. The author made statistics of 34 provincial-level administrative regions in China, collected and analyzed the green building policies of local governments, and summarized and analyzed the table in Figure 2.

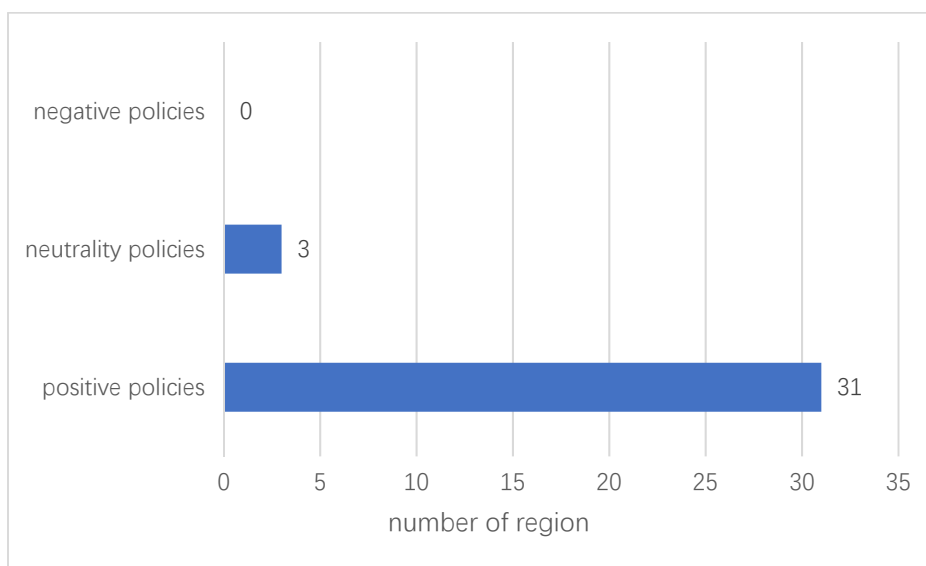


Figure 2. Classified statistics of local government policies related to green building development

In Figure 2, among the 34 provincial-level administrative regions in China, 31 have formulated policies conducive to the development of green buildings. With plans for new green buildings in other

regions of the province accounting for more than 70% of all new construction, by 2025 all new structures will be green buildings thanks to the legislation that these local governments have established. Guangdong, Shanghai, Hebei, Chongqing, and Jiangsu are some of these provinces. The active implementation of the national government's green building strategy by these local governments has aided in the quick growth of green construction in China. Three provincial-level administrative jurisdictions have specifically chosen not to include green buildings in their development guidelines: Taiwan Province, Hong Kong Special Administrative Region, and Macao Special Administrative Region. The author speculated that it was mainly influenced by China's national conditions that these three local governments did not respond well to the policy put forward by the central government. But these three local governments have put forward the concept of green and sustainable development. The author predicts that shortly, these three local governments will also clearly take the development of green buildings as a major development policy because this is in line with the conception of green and circular development.

4. Conclusions

From the results of the earlier research techniques, it is evident that adopting the idea of green building was formally advised in China, the Chinese government attached accomplished importance to the ecological and economic benefits brought by green building and rapidly developed relevant standards for green building assessment and incorporated the progression of green buildings into the national development policy. Local governments have also responded positively to national policies and become an important reason for the rapid development of green buildings. Since its development in 2006, green building projects in China have grown from scratch to bloom everywhere. In just ten years, it has achieved a qualitative leap and satisfactory results. 2022 is the second year of the implementation of China's "14th Five-Year Plan". It is also an important year for China to lay the foundation for a carbon peak in urban and rural development by 2030. Combined with the past achievements and experience, the author believes that China will exceed the goals set in the "14th Five-Year Plan" this time, and in the future green building will be widely popularized and modernized in China.

References

- [1] Ministry of Housing of China. The Green Building Assessing Standard (GB/T50378-2006), 2006.
- [2] Wang Qingqin, Li Guozhu, Meng Chong, et al. Effects of Assessment Standard for Green Building (GB/T50378--2019) and Consideration of Epidemic Prevention and Control in Buildings Facing the COVID-19, 2020.
- [3] Gou Shaoqing. Development Status and New Technology of Green Intelligent Building. Shanghai Yanhua Smartech Co, 2020.
- [4] Information on <https://www.qianzhan.com/analyst/detail/220/200410-83e03daa.html>.
- [5] Ministry of Housing of China. "12th Five-Year Plan" Building energy conservation and green building development plan, 2010.
- [6] Chang Pei, Zhang Qi. Analysis of the current situation of China's construction industry under the impact of COVID-19, 2021.
- [7] Ministry of Housing of China. "13th Five-Year Plan" Building energy conservation and green building development plan, 2015.
- [8] Ministry of Housing of China. "14th Five-Year Plan" Building energy conservation and green building development plan, 2020.
- [9] Xing Yudong. Current status and characteristics of green building development in China, 2021.
- [10] Ministry of Housing of China. The Green Building Assessing Standard (GB/T50378—2019), 2019.