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City Development: A Comparative Study of Eco-City Planning in China and the West

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Abstract. Low-carbon urban planning is proposed in the context of global warming, extremely polluted air, and a serious impact on human health. The core of low-carbon urban planning is to optimize the urban structure, promote green energy use, develop public transportation, and encourage low-carbon lifestyles. This research essay uses case studies and comparative research methods to compare China and Western low-carbon urban planning from the perspective of population, people's lifestyle, national development status, and government implementation mode. As China is a developing country, the population of China is extremely large, urban density is gigantic, and some infrastructure has not been perfected, so the goal of low-carbon urban planning needs to be carried out through low-carbon planning for cities without affecting the stability of economic development within the country. However, most Western countries are developed countries, and the main goal is to correct and transform on the basis of "high energy consumption, high emissions, and high pollution" in the past. This study finds that there is a significant difference between China and Western countries in the implementation of low-carbon plans, with the West adopting encouraged implementation and China's planning mostly promoted and determined by the government departments.

Keywords: Low carbon, urban density, lifestyle, economic development, sustainable development

1. Introduction

This study focuses on the context of global climate change and sustainable development cities, and ecological and low-carbon urban planning has become an extremely important strategy and approach for countries around the world to cope; this research is meaningful for improving the quality of life of residents, the diversity of ecosystems, slowing down the rate of global warming, and promoting sustainable human development; the advantage of this method is that it can clearly analyze the concepts, methods, and economic development of low-carbon urban planning in China and the West, which is benefit to the conduct of research. The ultimate goal of this study is to compare low-carbon environmental protection planning and measures in Chinese and Western eco-cities. Firstly, it analyzes the development and distinct features of low-carbon city planning in China. Secondly, it examines the theoretical background and planning methods of eco-city planning

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in the West. Finally, through comparative research, it proposes the key points of future research goals and the planning characteristics of low-carbon city construction in China and the West.

2. Characteristics and examples of low-carbon city planning and construction in China

The development of low-carbon cities plays an important role in the sustainable development of a country, especially for emerging economies like China today. China's large population, being a major emitter of greenhouse gases and an important carrier among developing countries, has made low-carbon development a major challenge for China [1]. According to the data, China became the world's largest carbon emitter in 2007, and it was previously expected that this status would not be achieved until 2030 [2]. However, it is precisely because of the huge population and large greenhouse gas emissions that promoting low-carbon goals is the key for China to succeed "dual carbon" goal. China's requirements for the transformation and design of key areas to provide low-carbon and environmentally friendly emissions, and provide a green, high-quality, and low-carbon living environment for every single city. China's low-carbon development was initially driven by international influences.

2.1. Improve and increase green transportation energy

Green transportation energy refers to providing green power for transportation vehicles, which is an important measure to resist "high energy consumption and high greenhouse gas emissions", and is the core of achieving the "low carbon" goal. Green transportation through the use of solar, wind, electricity, etc. In the "Eleventh Five-Year Plan", China proposed to achieve a 20% reduction in energy consumption (energy intensity) per unit of GDP by 2010 compared to 2005, and now it has proposed a target of reducing carbon emissions per unit of GDP (carbon intensity) by 40%~45% by 2020 compared to 2005 [3]. These two low-carbon targets are not mere numbers, but embody China's aspiration to achieve low-carbon development and reflect the evolution in its development philosophy and governance logic—from “setting targets” to “climate governance.” This has allowed China to implement measures to reduce carbon emissions as much as possible from all areas of transportation.

In the traditional manual toll channel, vehicles need to complete the process of "slow down, stop, billing, start, and accelerate", on average, each time takes about 30-60 seconds, during which time the car engine is still idling. It's easy to imagine how much carbon dioxide is produced during this process. Assuming each vehicle emits an average of 0.1 liters while waiting, 1,000 vehicles would generate 100 liters of carbon dioxide. It only takes 3-5 seconds to pass through the ETC channel; there is almost no waiting time, and most vehicles can pass by maintaining average speed, which not only reduces the problem of traffic congestion but also shortens the idling time by more than 90%, even 100%. In terms of the number of ETC users in China, "by the end of 2015, the number of ETC users in Hebei Province exceeded 2 million, accounting for nearly one-tenth of the total number of ETC users in the country (25 million)" [4]. If each vehicle reduces idle time by 30 seconds through ETC, it can significantly cut carbon dioxide emissions daily. This plan can definitely reduce the burden on the planet.

2.2. Ecological practices in China's low-carbon city planning

Zhuhai City in Guangdong Province, China, is one of the nation's national-level ecological cities. Zhuhai City, situated on the western shore of the Pearl River Estuary—Guangdong's mother river—

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is a coastal city that seamlessly blends modern vibrancy with ecological harmony. The city has been honored with titles such as National Sanitary City, Forest City, and one of the Top Ten Livable Cities. The city's ecological emblem predominantly features dolphins, which hold a crucial connection to its development philosophy. Zhuhai's municipal development philosophy centers on science and technology-driven urban development, low-carbon environmental protection, urban civilization, and coastal beauty, all of which serve as guiding principles for urban planning and other initiatives. Entering Zhuhai City, the coastal boulevards and sculptures immediately greet visitors, leaving an indelible impression of a seaside metropolis. Upon entering the city, the tree-lined, clean, and orderly streets further highlight the charm radiating from this eco-city. Modern, high-tech factory buildings are everywhere, yet there is absolutely no sign of the old factory problems like black smoke, noise, or fumes. This is because every enterprise follows urban planning requirements and prioritizes environmental protection in construction, the economy has been revitalized, the environment safeguarded, and residents' incomes raised—thus transforming it into a livable city. This city, with its low-carbon planning and charm, has attracted numerous tourists, thereby driving economic development.

2.3. China's low-carbon city planning - construction planning and economic development of high-speed railways

In the realm of high-speed rail, China's high-speed rail construction stands as a global model for low-carbon transportation. The transition from coal-powered trains to electrified high-speed rail represents a monumental achievement in China's core contribution to low-carbon, environmentally friendly urban development. The construction of high-speed rail effectively reduces travel time for people and enhances transportation efficiency while significantly lowering carbon emissions. Compared to airplanes, trains, gasoline-powered cars, and coal-fired vehicles, high-speed rail can effectively reduce the carbon footprint of transportation both between cities and within urban areas. Taking the route of high-speed rail from Beijing to Shijiazhuang as an example, the environmental footprint of China's high-speed rail transportation was calculated. Greenhouse gas emissions per passenger-kilometer from origin to destination ranged from 54 to 178 grams of carbon dioxide equivalent, representing reductions of 10% to 60% compared to road vehicle transportation and 45% to 73% compared to air transportation [5]. These astonishing numbers demonstrate high-speed rail's triumph in the transportation sector. Beyond significantly reducing carbon dioxide's severe damage to nature, the construction of high-speed rail has propelled China's economy toward tremendous growth and advancement. The newly constructed high-speed rail station has emerged as the city's new hub, driving the concentration and development of commercial, residential, and industrial activities while also reducing commuting distances for urban residents. This has significantly reduced overall carbon emissions and energy consumption, improved people's quality of life, and driven economic growth in China.

3. Characteristics and examples of low-carbon urban planning in the West

Since the Industrial Revolution, Western cities have long relied on a lifestyle and development model characterized by “high energy consumption, high emissions, and high pollution.” This means that most are developed and industrialized nations, with the majority of cities having completed industrialization and no longer requiring new infrastructure development or industrial expansion. This has rapidly driven economic development, and it has also accumulated numerous urban problems, such as traffic congestion, massive carbon dioxide emissions, and air pollution. Unlike

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China, the West needs to reform and transform its past practices to address high carbon emissions and achieve the goals of "low energy consumption and low emissions."

3.1. Transformation and adjustment of urban residents' travel modes

Western countries have developed a lifestyle and mode of transportation centered around automobiles due to the long-term influence of their living habits. Unlike China, Western countries with smaller populations and modern low-carbon urban planning primarily focus on overhauling high-carbon models to enhance the overall quality of cities. In May 2018, London Mayor Sadiq Khan launched the London Environment Strategy, covering air quality, green infrastructure, climate change mitigation and energy, waste, adaptation, noise, and the low-carbon circular economy. The strategy included a chart (Figure 1) detailing the percentage of greenhouse gas emissions across London's various sectors, pledging to transform London into a zero-carbon city by 2050 [6]. In terms of specific measures, London has enhanced energy efficiency and expanded the development of clean energy sources such as wind power, electricity, and solar energy, while promoting sustainable transportation models. For instance, in the realm of green transportation, citizens are encouraged to use shared transport powered by clean energy sources—such as subways, trams, and bicycles — thereby reducing London's carbon emissions and correcting past high-carbon lifestyles. These renovations and improvements effectively enhance local air quality, boosting the city's livability and residents' quality of life.

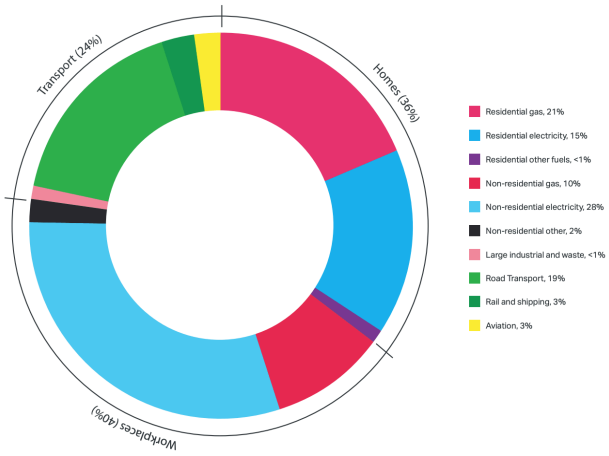

Figure 1. London's greenhouse gas emissions by sector (2018) [6]

3.2. Switch to and rectify the use of high-energy-consumption energy sources employed in the past

Solar energy is a clean energy source that requires no fuel, meaning it cannot release carbon dioxide into the atmosphere. This makes it an environmentally friendly choice that does not contribute to global warming, acid rain, or pollution, while protecting human health, wildlife, and ecosystems... A fundamental principle of direct solar energy utilization involves solar panels converting sunlight into electrical energy through photovoltaic cells, thereby minimizing pollution. Specifically, Photovoltaic in a solar panel turns sunlight into direct current electricity (DC). Then, an inverter converts the DC electricity into alternating current electricity (AC), and once this process has taken place, the electricity is used, fed into the grid, or stored in a battery [7]. For example, Tesla's "Solar Roof" project in the United States. Tesla's solar roof utilizes solar panels, photovoltaic tiles, and non-

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photovoltaic tiles to directly convert sunlight into electricity without burning any fossil fuels. Research indicates that installing Tesla solar roofs not only effectively reduces carbon emissions and the environmental impact of energy use but also increases home resale value [8]. Switching to solar energy will help improve air quality and reduce health risks. It also mitigates climate change and extreme weather events, which can support animal health and growth while preserving ecological biodiversity. Overall, solar energy not only protects the health of humans and animals but also improves air quality. The widespread adoption of solar energy is of great importance, representing a highly impactful invention. Because solar energy offers numerous advantages in reducing carbon emissions, federal governments across the United States provide tax incentive certificates to encourage the use of solar power for electricity generation [9]. From 2022 to 2031, the tax incentive rate is 30%. In 2033, the rate is 26%, and in 2034, it is 22% [10]. This approach of reducing taxes to encourage the use of low-carbon energy can effectively replace and correct the past reliance on fossil fuels and coal-fired power generation.

4. Comparison of ecological city planning in China and the West

China and the West exhibit significant differences in lifestyle habits, cultural perspectives, and developmental foundations regarding low-carbon urban planning. First, Western cities differ from China's high-density, high-population development model, exhibiting characteristics of low density and smaller populations. Second, unlike the West's heavy reliance on automobiles, China possesses an exceptionally robust and diverse array of green transportation options, including subways, high-speed rail, electric buses, and maglev trains. Third, as mentioned in the example, China is currently in a stage of development where infrastructure in some regions has yet to be fully developed. Therefore, China emphasizes establishing and implementing plans for low-carbon eco-cities while ensuring stable economic growth. However, in the West, where most countries have already completed their development, the goal is to transform and rectify the existing “high-carbon, high-emission, high-pollution” model. Fourth, unlike the Western approach, China's approach is government-led and driven, with strict enforcement through legal provisions, policy requirements, and standards. Western governments also establish relevant policies but employ incentive measures, such as the example mentioned, where installing solar panels allows citizens to enjoy tax benefits to encourage public participation. The above presents a comparison of ecological low-carbon urban planning characteristics between China and the West (Table 1). During the research process, it was discovered that as a developing country with a large population, China has overlooked some more remote cities in the process of developing low-carbon urban planning. Some towns and rural cities still lack measures to reduce carbon emissions. Some towns and rural areas still lack measures to reduce carbon emissions. Compared with developed cities, rural economic income is relatively backward, which leads to a contradiction between the survival need of "not having enough food to eat" and the planning requirements of "low carbon emissions". These regions often rely on energy-intensive and highly polluting industries to sustain their livelihoods, which exacerbates the living conditions of residents and fails to improve low-carbon planning. It is hoped that China can lead rural areas to develop together with developed cities to achieve low-carbon, low-energy-consuming, and low-pollution urban planning at an early date.

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Table 1. Comparison of characteristics in ecological low-carbon urban planning between China and the West

China	The West
The population is large, and the density is high	Small population and low density
Ensure the stability of economic growth and carry out low-carbon planning and development	Optimize and correct on the existing basis
developing country	Developed countries (the vast majority)
An abundance of green public transportation systems (more on foot)	Highly dependent on cars (rarely walking)
The government departments directly implement it	Incentive method (reducing taxes)

5. Conclusion

The results and findings of this study indicate that due to differences in population, lifestyle habits, governmental management approaches, and varying levels of national economic development between China and the West, this further leads to the conclusion that China pursue low-carbon urban planning and development while ensuring the stability of economic growth within the country, whereas the West should focus on optimizing and refining its existing approaches; this study provides valuable insights for future research in this field. This has impacted international cooperation between China and the West. Both sides can learn from each other's advanced technologies and planning concepts to jointly accelerate the pace of global low-carbon city planning and achieve the goal of zero-carbon cities. Future research should focus more on in-depth exploration in the areas of smart low-carbon cities, energy-efficient buildings, and big data.

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