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## Development of low-carbon city in China: Where will it go?

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### Abstract

It is undoubted that low-carbon city has become a vital development trend for Chinese cities in the new century. Many Chinese cities have been devoted to the upsurge of low-carbon city construction in recent years. Focusing on these problems - What measures has been adopted to construct low-carbon city in China? How is the effect of low-carbon city construction? Are there some issues needing attention in the future - this paper summarizes the situation of low-carbon city development in China and clarifies a few viewpoints that need be paid attention to in the subsequent development. It is expected that the discussion in this paper can help promote the construction of low-carbon city in China.

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*Keywords:* low carbon economy; construction of low-carbon city; energy consumption; reducing carbon emission

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### 1. Introduction

The climate change is real, no matter what caused. Although what caused is disputable, what will be caused by climate change is indisputable, i.e., the societal development and economic growth in all countries will be negatively affected while the poorer countries will suffer earlier and more. It is estimated in “Stern Review: The Economics of Climate Change” that the overall costs and risks of climate change will be equivalent to losing at least 5% of global GDP each year, and could rise to 20% of global GDP or more if a wider range of risks and impacts is taken into account [1]. It is urgent that each country should

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take effective actions to mitigate the huge risk of climate change, amongst which reducing carbon emission is the acknowledged feasible way and objective.

Facing the increasingly serious challenge of environmental change (levels of carbon dioxide in the atmosphere have risen by more than a third since the industrial revolution and are now rising faster than ever before) and decline of the indigenous energy supplies (by 2020 the country could be dependent on imported energy for three quarters of its total primary energy needs), the UK government proposed a future scenario named “low carbon economy” in the energy white paper “Our Energy Future-Creating a Low Carbon Economy” issued by the Department of Trade and Industry in 2003 [2]. Many countries have made efforts to reduce carbon emission by framing development planning and taking measures from aspects of energy, transportation, industrial structure, etc.

With an annual GDP growth in excess of 10% in recent years, China has become one of the largest energy consumers and carbon emitters in the world [3]. The crisis of energy and resources shortage is approaching. The huge cost of environmental change needs to be concerned. Meanwhile, more and more attention around the world has been paid to issues of Chinese energy consumption, environmental change and efforts of coping with climate change. It is admitted that China is facing great pressure both inside and outside international climate negotiations to exhibit greater ambition in combating global climate change [4]. A new development pattern with more productivity but less energy consumption is urgently required in China.

As the centre of social economy and human activity, cities gather more than one half of the world people and produce about three quarters of the global carbon emission [1]. Undoubtedly, low carbon development in cities is significant for achieving the overall goal of low carbon economy, especially in China with rapid urbanization. In January 2008, the demonstration project of low-carbon city was jointly launched by the Ministry of Housing and Urban-Rural Development and World Wildlife Fund, when selecting Baoding in Hebei province and Shanghai as the pilot areas. It indicated the construction of low-carbon city was formally started in China [5]. In August 2010, the pilot work of low-carbon province and low-carbon city was started by the National Development and Reform Commission, while five provinces including Guangdong, Liaoning, Hubei, Shanxi, and Yunnan as well as eight cities including Tianjin, Chongqing, Xiamen, Shenzhen, Hangzhou, Nanchang, Guiyang, and Baoding were selected as the cases [6]. Until now, over one hundred Chinese cities have been devoted to the construction of low-carbon city that will contribute to the sustainability goals.

What measures of low-carbon city construction have been taken in China? How is the effect? What needs to be paid attention to in the future development? These problems are what this paper attempt to discuss.

## **2. Concept of low-carbon city**

As mentioned above, the phrase of low carbon economy was first proposed in the UK’s energy white paper “Our Energy Future-Creating a Low Carbon Economy”, where it was described as “higher resource productivity-producing more with fewer natural resources and less pollution-will contribute to higher living standards and a better quality of life” and “the opportunity to develop, apply and export leading-edge technologies, creating new businesses and jobs” [2]. It is a totally new concept, let alone the concept of low-carbon city. Without any international reference, Chinese scholars present their understandings of low-carbon city from different viewpoints along with its practical construction, which can be classified into following three points.

(1) City is regarded as the executive location of low carbon economy [7-9]. Based on developing low carbon economy, the traditional economic development pattern characterized by huge energy

consumption and environmental cost will be transformed into a new one characterized by less energy consumption, less carbon emission but more socio-economic benefit in the low-carbon city.

(2) The final objective of reducing carbon emission is emphasized [10, 11]. On the premise of economic growth and social progress, the energy consumption and carbon emission must be maintained at a low level in the low-carbon city.

(3) Low-carbon city is a new development pattern as well as a development idea [12, 13]. The low carbon idea should be penetrated into all fields of the urban development including the production and industry, consumption and living, system and management.

Although the emphases of above ideas are different from each other, two common points still can be found out. For one thing, low-carbon city pursues to reduce carbon emission, but it is based on the economic growth. For another, systemic consideration of the whole city is necessary in that low-carbon city involves many aspects, e.g., economy, society, and culture, production pattern and consumption model, technology, product, and idea.

### **3. Practice of low-carbon city in China**

Many Chinese cities have made their efforts to construct low-carbon city in recent years. Some typical cases are collected in Table 1, in which the main characteristics of each city's practice in low-carbon development are also summarized.

As indicated in Table 1, different cities with different conditions put the low-carbon city construction into practice from different aspects, among which some establish the overall development planning, some emphasize the construction of demonstrative area, some pay attention to specific fields such as energy, industry, transportation, and some regard research and international cooperation as important platform. Although different measures were taken, the final objective of low-carbon city practice is same, i.e., achieving more economic productivity with less energy consumption and carbon emission, improving human living standard, and amending the environment.

### **4. Effect of low-carbon city construction and its enlightenment on the future development**

#### *4.1. How are the low-carbon development levels of Chinese cities?*

After taking so many actions to construct low-carbon city, how are the actual low-carbon development levels of Chinese cities? Choosing Jilin city - the first demonstrative city of low carbon economy selected by the National Development and Reform Commission - as an example, its situation is still far away from the low-carbon standard issued by Chinese Academy of Social Sciences [18]. A comparative study amongst different cities indicates that Shanghai - one pilot area of the low-carbon city demonstration project started by the Ministry of Housing and Urban-Rural Development and World Wildlife Fund - performs weak in energy consumption for living and per capita greenbelt area although performs well in economic development level and industrial structure [9].

It means there is a long way to go before achieving the low-carbon objective for Chinese cities. Besides practicing low-carbon city construction, we also need to sit down and review what items should be paid attention to in the future.

Table 1 Adopted approaches of low-carbon city construction in China

City	Ways of low-carbon city construction	Main characteristics of low-carbon city construction
Baoding	Put forward the plan of “Electricity Valley of China”. Six industrial systems including optic-electricity, wind power, electricity saving, electricity storage, trans-electricity, and power automation have been formed in recent years [5]. It was confirmed that the low-carbon city will be constructed from six key projects, i.e., Electricity Valley of China, Solar Energy City, improvement of urban environment, low-carbon office building, low-carbon community, and low-carbon transportation system [14].	Focusing on the energy exploitation and utilization, the concept of “Electricity Valley of China” is first put forward.
Shanghai	Taking the Shanghai Expo as an opportunity, solar energy technology was largely employed and new energy car was developed greatly [5]. The Chongming Dongtan Eco-city was designed from urban planning, ecological development, sustainable energy, waste management, green building, and transportation planning. It is likely to become the first carbon-neutral area in the world, where an ecosystem characterized by low carbon, water saving and energy saving will be generated [8].	Developing the demonstrative area, i.e., the Chongming Dongtan Eco-city.
Jilin	Industrial structure regulation for heavy industrial city was the key issue. Exploitation of new energy was confirmed as a long-term strategy [15]. It was predicted that energy consumption per unit GDP and carbon emission per unit GDP in 2020 will reduced about one half when taking that in 2005 as the baseline, and zero-carbon energy consumption will equal to one fifth of the total energy consumption, and the proportion of energy saving building will reach four fifths [5].	Regulating the industrial structure and developing new energy.
Hangzhou	Fifty low-carbon policies were drawn up. Low-carbon economy, low-carbon building, low-carbon transportation, low-carbon living, low-carbon environment, and low-carbon society were confirmed as six inseparable ways of constructing low-carbon city [5]. The slogan of green commuting was first called out, the public transportation will be developed with priority, and the big public transportation system composed of subway, bus, taxi, public bicycle, water bus will be constructed [5, 15].	Establishing comprehensive policy and emphasizing construction of transportation system.
Tianjin	China-US low-carbon finance research centre, carbon finance pilot area of national central bank, and UN centre of low-carbon economy were all located at Tianjin. Meanwhile, it will also become the demonstrative area of low-carbon economy cooperated by Chinese and Japanese cities [14]. Green building, green transportation, and exploitation of new energy will be mainly developed to construct the low-carbon city [16].	Setting up research institution and concerning with international cooperation.
Wuxi	The planning of low-carbon city development strategy for Wuxi city was the first low-carbon city planning acknowledged by experts in China. The green building was largely promoted by a series of support policy, energy saving technologies, and demonstration projects [15]. It has become the biggest production and export base of photovoltaic industry in China, where many manufacturers and related industry groups are gathered. It is planned that Wuxi will grow into an important base in 2012 that leads domestic production and application of green energy [17].	Establishing overall planning of urban development strategy and constructing photovoltaic base.

#### 4.2. What needs to be concerned in the future?

##### (1) Low-carbon city is a long-term objective

It should be realized that construction of low-carbon city is a time-consuming project. It can not be reached in a short period. As stated in the UK’s energy white paper “because energy requires very long-term investment, we look ahead to 2050 to set the overall context” [2], low-carbon economy is a long-

term development objective by 2050. A large number of foreign metropolises have set up their own low-carbon goals and plans targeting in 2020, 2030 or 2050 [19]. Therefore, it is necessary to understand the concept of low-carbon city first, after that the long-term planning can be established when taking the possible changes during the long-term development process into account.

(2) Construction of low-carbon city is a systemic project

City is a complex system in which many components react with each other. Construction of low-carbon city needs to consider such correlated factors as economy, industrial structure, energy structure, energy utilization technology, transportation system, social consumption, carbon sink, rule, etc. [9] Thus, a systemic perspective is essential to guide the complex project in a holistic way. If investment is only partial to single or a few fields, i.e., new energy, transportation, building, or industry, the integrated goal of low-carbon city is unavailable. In fact, experts in various planning and management fields like economy, environment, urban planning, management, garden, transportation and engineering are required to meet and cooperate to draw up a feasible development blueprint of low-carbon city.

(3) Different cities should have different development patterns of low-carbon city

Ways of low-carbon construction for cities in developed and developing countries are different. With respect to Chinese cities, the development patterns of low-carbon city are also different in that each city has its own condition of natural endowment, economic development level, industrial structure, social culture, and urban development orientation. Every city should investigate its own foundation and make reasonable and distinctive construction measures. For example, cities with plentiful sunshine can develop solar energy largely, which is unsuitable for those cities without abundant sunshine. Cities with high economic development level and energy usage efficiency may make efforts to cultivate people's low-carbon consumption behavior, while others have to take actions to regulate the industrial structure and increase the efficiency of energy usage.

(4) Evaluation system is required

Facing this long-term systemic project, an evaluation system is necessary to check the executive effect of low-carbon city construction. According to the evaluation results, suitable modification can be conducted to make sure the construction is on the right way. During the long process, the evaluation system may need to be regulated according to the situation changes in time. It means an evaluation system should be updated over time and the evaluation of low-carbon city construction also needs to be updated.

## 5. Conclusions

In order to mitigate the huge cost and risk of climate change, the new pattern of low-carbon development is urgent. Facing great pressure both inside and outside, this low-carbon pattern with more productivity but less energy consumption and carbon emission is required in China.

City is an important platform of low-carbon development. Many Chinese cities have made their efforts to construct low-carbon city in recent years, among which some establish the overall low-carbon city strategy planning, some construct demonstrative area, some pay attention to specific fields such as energy, industry, transportation, and some emphasize the scientific research and international cooperation.

There is still a long way to go before achieving the low-carbon development objective. Certain items need to be concerned in the future, e.g., a comprehensive understanding of low-carbon city is necessary and a systemic perspective is required to guide the low-carbon city construction in a holistic way, each city should investigate its own foundation and set up distinctive construction scheme, and an evaluation system is necessary to be established and updated to check the effect of low-carbon city construction which can make sure the construction is always in the right direction.

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