



## New green theories of urban development in China



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### ABSTRACT

China's rapid urbanisation has already led to the development of more large-scale cities than ever before. One result is that China is now the largest carbon emitter in the world. Meanwhile, China is facing enormous challenges in respect to environmental degradation, and limiting the use of natural resources in urban areas when it comes to balancing rapid economic development and environmental protection. To address this issue, China has to explore a new approach to urban development, namely green urban development.

Various green urban theories are in the process of being formulated in China due to the difference in the responsibility of the central government and the gradual changes in national policies. The lack of a clear vision and target is a common barrier to green urban development in China. This paper reviews three new concepts and approaches to green urban development in China, and analyses how these concepts and approaches have been adopted, defined and developed within the Chinese context. Three typical projects are then selected to illustrate green city development in order to develop a better understanding of the application of the green theories of urban development in China. Finally, methods of future green urban development in China are proposed.

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### 1. Introduction

China has experienced especially high rates of urbanisation in recent years; the floor space of completed buildings in 2013 was almost double that of 2007 (Fig. 1) (National Bureau of Statistics of China, 2014). By the end of 2011, China's urbanisation rate had reached 51.3% and is currently projected to climb to 75% by 2050 (Li & Yu 2011). As a result, more urban infrastructure and services, such as residential buildings, will be needed to satisfy the demands of city dwellers, resulting in higher energy consumption and associated carbon emissions. According to a report released by the Asian Development Bank, less than 1% of the 500 largest cities in China meet the air quality standards recommended by the World Health Organisation, and of the 10 most polluted cities in the world, 7 are in China (Zhang and Crooks, 2012).

Two of the most urgent issues with which China must deal, regarding its urban development, are improving the efficiency of energy use and reducing the intensity of carbon emissions. Many studies have revealed a complex relationship between urbanisation and energy consumption, and most scholars have confirmed

that compact urban form, and mixed land use, can reduce urban energy consumption (Wang et al., 2014; Dhakal, 2010; Steemers, 2003). Furthermore, more recent research shows that differences in income levels, locations, time, policies, etc. can all lead to different results of energy consumption and associated carbon emissions in cities (Anderson et al., 1996; Dhakal, 2009; Giuliano & Narayan 2003).

The complexity of the issue of urban development, and the uncertainties regarding the future urban development, suggest that there is an urgent need to implement "green" city development due to the problems of environmental pollution, climate change, and the scarcity of resources. New approaches to urbanisation in China now have to be adopted to cope with these issues. In this context, the promotion of green urban development, i.e. developing eco-cities, low-carbon cities, and low-carbon eco-cities, has been increasingly promoted by the central government in China.

This paper mainly reviews these three new concepts and approaches to green urban development in China, and analyses how these concepts and methods have been utilised, defined, and developed within the Chinese context. Three typical projects are then selected to illustrate green city development in order to develop a better understanding of the green theories of the urban development in China. Finally, methods of future green urban development in China are proposed.

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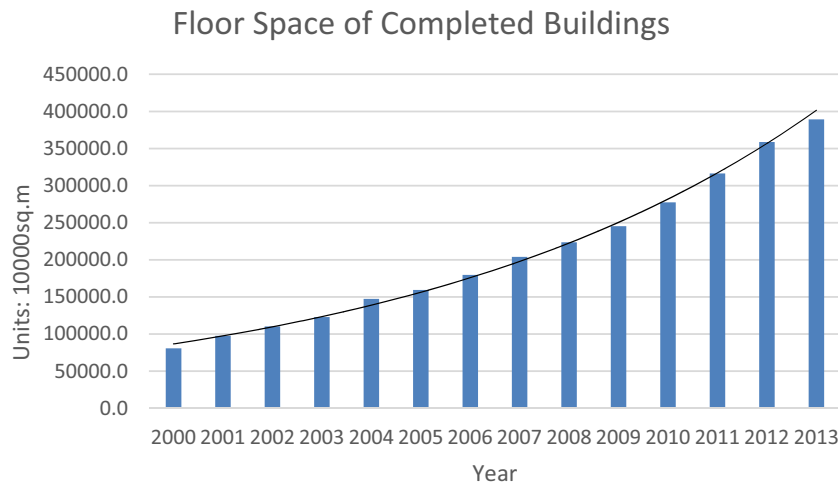


Fig. 1. Floor Space of Completed Buildings.

Source: National Bureau of Statistics of China (2014).

## 2. Aims and methods

The main objectives of this paper are to:

- Discuss why and how these Chinese green urban development concepts have been proposed and implemented within the Chinese context.
- Compare and analyse these concepts and present examples to help better understanding of the green urban development in China.
- Identify the barriers to green urban development in China and propose suitable approaches to such development.

The primary method adopted for this research is to review of the existing literature. Supporting data are taken from research publications, government statistics and other information available on the Internet.

## 3. Historical green urban development in China

As early as in the 1990s, the principle of limiting the scale of large cities and promoting small cities and towns was adopted as the primary strategy for urbanisation in China (Li, 2011). During these periods, many concepts of city development were proposed by different governments. These include the Green city, Garden city and National Environmental Protection Model City (Liu et al., 2014). Through these principles, the total number of cities in China grew rapidly. By contrast, urbanisation in most developed countries takes the form of the expansion of existing cities through migration from the countryside (Anderson & Ge, 2005). However, the Chinese government reversed this principle of limiting large cities in the late 20th century, and since then there have been few changes in the overall number of Chinese cities (Liu et al., 2014).

Following entry into the 21st century, China's urban development has been under pressure to move towards a more self-sufficient, energy efficient and environmentally-friendly model. By recognising the limited resources, and environmental challenges associated with its existing development patterns, Chinese leaders have made ambitious commitments to reduce the amount of carbon emissions and have proposed different concepts and approaches to urban development at various stages based on the Chinese context. Through central government policy guidance, local implementation, and cooperation with international partners, China has proposed more comprehensive green city concepts, and

the growth of city initiatives in the post-2000 era. Examples include the concept of the eco-city, low-carbon city, and low-carbon eco-city (Peng, 2010).

### 3.1. Eco-city

The term “eco-city” was first coined by Richard Register in 1987, who provided inspirational guidance for making cities ecological in a visionary book entitled *Eco-city Berkeley* (Register, 1987). In China, the concept of Eco-cities was proposed by the MEP (Ministry of Environmental Protection) in 2003 under the “Eco-City Construction Plan”, with a revised version of the standards being issued in 2007 (Baeumler et al., 2009). It stressed the eco-environment of the city. Recent new eco-city projects that have received international attention include Sino-Singapore Tianjin Eco-city, Tangshan Bay Eco-city, and Shenzhen Guangming New District (Yu, 2014). These projects, which are led by the central, provincial, and municipal governments, are often high-profile, and thus attract considerable attention and publicity.

### 3.2. Low-carbon city

Chinese scholars introduced the concept of the Low Carbon City based on the research such as the 2003 energy white paper “Low Carbon Economy” (DTI, Department of Trade and Industry, 2003) in the UK, and “Low Carbon Society” in Japan (Ashina et al., 2012). This concept represent a key turning point in the future development of Chinese cities (Liu et al., 2009), and can be seen as a reaction to the problems posed by China's carbon emissions. In fact, the Low-carbon City is a newer concept than the Eco-city, and is more widely used at the international level, with the goal being to tackle the problem of global climatic change, by reducing the intensity of carbon emissions. There have been many attempts to define the concept and develop evaluation methodologies worldwide, but because there exists no comparable benchmark for all countries, so this has to be done locally (Li et al., 2012; Price et al., 2013).

The low-carbon city provides a new approach to sustainable development in China. In 2010, the NDRC (National Development and Reform Commission) selected five provinces and eight cities as the first pilot projects (Zhou, 2014). More than 40 cities have since announced that they are planning turn themselves into low-carbon cities, with even more to come.

**Table 1**  
Characteristics of different green concepts in China. Adapted and reorganized from Liu et al. (2014).

Concept	Proposed Date	Proposing Organisations	Indicator area				
			Carbon efficient economy	Environmental protection	Energy efficiency	Economic growth	Social aspects
Eco-city	2003	MEP		✓		✓	✓
Low-carbon City	2008	NDRC	✓		✓	✓	
Low-carbon Eco-city	2010	MoHURD	✓	✓	✓	✓	✓

### 3.3. Low-carbon eco-city

In 2007, the 17th National Congress of the Chinese Communist Party focused on the idea of eco-civilisation. In fact, this idea is not new in China, as it started and was used by the government in the mid-1990s, but it was for the first time in 2007 that environmental issues were included in the party's political report in China (MEP, 2007).

Since then, the concept of low-carbon eco-city campaign has been launched in China, with widespread discussions at different levels of government, academia and public life on how the idea should be implemented (Qiu, 2009; Liu, 2010). In 2009, the Low-carbon Eco-city was formally promoted by MoHURD (Ministry of Housing and Urban-Rural Development) as an approach to “eco-civilisation”. This is literally a combination of the existing concepts of a Low-carbon City and Eco-city, and highlights the two core issues of energy efficiency, and environmental protection. The concept has substantial support from a senior level of Chinese officials, and is regarded as the future direction for China's economy and urban development.

### 3.4. Discuss and compare the difference of these three concepts

The reasons why those three concepts were independently initiated by Chinese central government are that the organisations of MEP, MoHURD, and NDRC have different responsibilities in their respective sectors. More specifically, the MEP has the responsibility of formulating and implementing the national environmental protection policies, and planning and drafting laws and regulations (MEP, 2008). One of the main tasks for the MoHURD is to do research and formulate policies of urban planning and construction, and to guide the implementation (MoHURD, 2008). Although they are quite similar in their formulation and implementation of all these programmes, they essentially control a sector through issuing various guidelines and there seems to be no strict control of concept development from a higher political level. Additionally, these concepts differ in focus, but environmental protection has always been a paramount aspect. Apart from the environmental aspect, economic growth is important in most of these concepts and energy efficiency is attracting increasing attention. Finally, many cities are involved in such programmes, and this creates a community of cities under the name of eco-city, low-carbon city, or low carbon eco-city. This can be helpful improving the attraction towards investment for the cities.

On the other hand, there are also some differences between these three concepts. For example, the eco-city concerns the natural and living environment. Conversely, climate change is the core focus of the low-carbon city. As a result, the content of concerning an eco-city is much broader and comprehensive, while a low-carbon city emphasises the reduction of carbon emissions and an increase in carbon sequestration (Liu et al., 2014). To some extent, the low-carbon city is a subset of the eco-city. Therefore, the low-carbon eco-city proposed in China is a combination of the two. The following table compares the characteristics of these three green concepts in China (Table 1).

## 4. Case studies

The development of different green city concepts shows that the Eco-city, Low-carbon city and Low-carbon Eco-city are more comprehensively and extensively used in China. Therefore the case studies, selected and presented below, relate to these three concepts. However, they are not intended to give a comprehensive picture. In this paper the Tangshan Bay Eco-city, Baoding low-carbon city, and Shenzhen low-carbon eco-city are briefly analysed as examples.

### 4.1. Tangshan Bay Eco-city

A new ecological Tangshan Bay Eco-city supported by both the Chinese and Swedish government was proposed in 2007. It is an example of a new, large-scale eco-city and occupies 74 km<sup>2</sup> (Caofeidian New Area Tangshan Bay Eco-city Administrative Committee, 2012).

The city adopts the strategic land-use and green transportation integration and advocates the city of short distance (Ma, 2009). To achieve these goals, the Tangshan Bay Eco-city was planned to adopt a mixed land-use plan, which ensured the city would be more compact. In addition, the city was designed to be a transit-oriented development (TOD). For example, the city centre and sub-centre are linked by a light rail system and BRT (bus rapid transit). With these approaches, the city's population will heavily rely on public transportation, and thus automobile trip distances will be reduced. Therefore, the city will have lower fuel consumption.

However, it should be noted that the Tangshan Bay eco-city is struggling to survive (Liu, 2013). Problems have occurred at the implementation stage, which seem to be connected to a failure to attract investment from the market, and instead an over-reliance on local government investment. This has led to a situation where the investment stopped during the implementation of the project, and an unclear development strategy, which is also linked to the failure of investment (Yu, 2014).

### 4.2. Baoding low carbon city

Baoding, one of the largest cities in Hebei Province, is situated in 140 km south of Beijing. The Baoding Government announced its intention to become a City of Solar Energy as a short-term aim. Due to this initiative, this city was selected by the WWF (World Wide Fund for Nature) as one of the pilot projects for exploring the development of low-carbon cities.

However, environmental protection is not the only goal in the plan. It includes retrofitting buildings as low-carbon demonstration projects, which incorporate technologies such as solar-driven lighting systems, and building management systems (Li et al., 2012). The plan also requires all public buildings in the city to be retrofitted before 2020. Additionally, the integration of technology into building designs achieves better building energy efficiency.

However, the plan does place more emphasis on environmental aspects. CO<sub>2</sub> emissions are considered only by quantitative methods, but no further detailed indicators are put in place to achieve

low-carbon goals. In addition, since most of the action plans are qualitative, they will be difficult to evaluate in the future.

#### 4.3. Shenzhen low-carbon eco-city

Shenzhen, located in the south of China, was one of the first of four Special Economic Zones. However, the intensive urbanisation process has caused environmental problems. For example, the scarcity of land and rising population is putting increasing pressure on the city's development.

Based on this context, the local and the central government signed a framework to transform Shenzhen city into China's first low-carbon eco-pilot city in 2010. According to the plan, the focus will be on exploring the conversion of the city development model and on planning Low-carbon Eco-city development under local climate conditions. It also states that the construction of the Shenzhen Low-carbon Eco-city should be replicable to other districts or cities in China (Cales, 2014).

The comprehensive target is to become a Low-carbon Eco-City Pilot that is economically sustainable, socially harmonious, and environmentally friendly, thus acting as an important role-model in China. The aims are to establish an intensive and compact city development model, so as to improve the ecological environment significantly, to increase resource efficiency and to maintain a low level of carbon dioxide emissions (Shenzhen Government, 2011).

The development of the low-carbon eco-city in Shenzhen has so far been unsuccessful, however, because Shenzhen city places more emphasis on the construction of infrastructure related to traffic, green belt, and waste management, but indicators concerning energy use and carbon emissions are not included. Furthermore, the construction of the Shenzhen low-carbon eco-city should not only be concerned on technologies but also social harmony, e.g., equal opportunities for all and reducing disparity (Yu, 2014).

#### 4.4. Analysis of existing Chinese urban development based on the above three cases

Green urban development has become a mainstream direction in Chinese urbanisation. Due to the inappropriate understanding of the concept and unclear targets at each stage, however, the concept has yet to be fully realised in practice. There are three main problems in this process that can be identified.

##### 4.4.1. Lack of clear definition, standards and targets

In the process of each stage of green urban development, comprehensive knowledge is needed. In China, the barriers are partly due to the lack of concrete definitions and standards relating to the different concepts used for this sustainable development. Although there are different concepts in China, they are not concretely defined with standards and regulations. In practice, this kind of knowledge shortage has resulted in a conventional spatial plan and design concepts for the low-carbon eco-city. The case of the low-carbon eco-city in Shenzhen showed that the low-carbon concept is still seen as an extension of economic development goals. Although Shenzhen has ambitions to reduce its carbon emissions, there also lies the goal to increase its economic growth. Therefore, the low-carbon plan remains the same, namely the economic growth. Planners lack understanding of the nature of the concept when it comes to putting real projects into practice. This knowledge shortage has resulted in poor environmental awareness in China.

##### 4.4.2. Over emphasising technologies and economic development

Green urban development requires innovation in technologies, typically technologies of renewable energy application to promote an ecological economy. The application of green and ecological technologies can help to reduce the consumption of fossil-fuels, and

thus reduce carbon emissions. However, green urban development is not only to minimise the use of energy and natural resources, it should emphasize both social development and environmental protection as well so that the city serves as an environment that supports a high quality of life. For example, the existing low-carbon eco-city development, such as the Shenzhen low-carbon eco-city, has placed great emphasis on technology and economic development, but it has ignored social equality, in terms of various aspects such as equal opportunities for all, and reducing disparity (Yu, 2014). This situation may increase the risk of losing sight of the general objectives of a low-carbon eco-city.

##### 4.4.3. Unsuitable government performance assessment mechanism

The problem of over emphasising economic growth is the consequence of the unsuitable local government performance assessment mechanism. There have always been debates regarding the balance between economic development and environmental protection, in terms sustainable development (Haughton, 1999). As a developing country, China has adopted the policy of economic development as an absolute objective since the 1980s. The existing government's performance assessment mechanism, which was formed since then, is inadequate to promote green urban development, and to encourage a transformation of the present development model. Economic growth has always been the key criterion for assessing the performance of local government and local senior leaders. In addition, the existing tax system is another factor that tends to misdirect green urban development. The revenue of local government mainly depends on land leasing owing to the existing tax systems (Liu, 2011). Economic development as an absolute principle has been an excuse for local governments to promote development at the cost of environmental protection, and arable land occupation. This is because the revenue of Chinese local government from land leasing contributes significantly to the overall income of Chinese local governments. A considerable amount of investment on the part of local governments relies on leasing more land (Yu, 2014).

## 5. The approach to planning green urban development

Energy consumption and carbon emissions mainly come from the transportation, and building sectors in cities (Liu et al., 2009; Dai, 2009). Due to the Chinese context of rapid urbanisation, the green urban development in China should consider its real situation, high carbon emissions in both building and transportation aspects. The major four approaches to planning green urban development in China, based on tackling the above barriers presented, are set out below.

### 5.1. Clear definitions, targets, indicators and methodologies

There is a need to provide explicit definitions, targets, indicators, and methodologies for green urban development from an official level in China. From the analysis of the above three case studies, a large degree of divergence among the low-carbon plans in terms of concepts, focus, and target was evident. Clear definitions, targets, indicators and methodologies would help to provide a much-needed comprehensive framework and scope for sustainable development for local governments, particularly for those that are relatively lacking in this kind of field-specific knowledge.

### 5.2. Implement low-carbon and ecological concepts into practice

Implementing the green urban planning concept is an effective strategy to guide low-carbon urban development. More specifically, Eco-cities reflect the green urban development that



should follow the harmonious development between humanity and nature. The city, acting as a complex ecosystem, serves to guide the development of the conceptual and technical requirements of urban conservation and intensive development, to reduce energy consumption and ecological impacts. At the same time, the promotion of “low carbon” and “ecological” concepts, their implementation into urban construction, and employment of new urban construction models are determined according to the local situations.

### 5.3. More market-oriented, rather than administrative

The system of urban planning in China is hierarchical, with local governments performing tasks that are supervised by a higher-level government. This system has been proven to be effective in achieving national economic growth, but lacks coordination between different institutions (Khakee, 1996). This drawback has blocked the implementation of green urban development plans. The Tangshan Bay Eco-city is an apt examples of the failure to attract investment from the market, which leads to a reliance on investment from the local government (Yu, 2014).

### 5.4. Learning from both sides during international cooperation

The Tangshan Bay project in China, which was carried out in collaboration with Sweden, integrated knowledge of eco-cycles in the urban system, and applied technology to waste collection systems and renewable energy (Joss & Molella, 2013; Joss, 2010). This project demonstrated how to combine ecological knowledge and related technologies in urban planning. However, most urban planners in China lack this kind of knowledge. One important reason for this is that most urban planning education in China is rooted in architecture. The focus is on the skills of detailed urban design, while ignoring other types of knowledge for urban development (Zhao & Zhao, 2009; Zhao & Zhang, 2013). The shortcomings of the education system have resulted in current urban plans, such as Master Plans, being based on a conventional approach to deciding the location, layout, and other design issues (Khakee, 1996). For green urban development, this will have to change. Urban planning will have to integrate knowledge from other disciplines such as environmental technology, policy, and transportation planning.

## 6. Conclusions

Chinese urban development, generally had a strong focus on economic growth before the 21st century, and since the turn of the century there has been a shift away from this sole focus. Many different green urban concepts have been proposed and adopted since then, because of the different responsibilities of different central government departments and these concepts should be updated regularly to adapt sustainable urban development.

This paper analyses the development and use of new green concepts and approaches concerning green urban development in China. It shows that the number of concepts used is partly due to institutional factors, and partly due to gradual changes in national policies. Common barriers include a lack of clear definitions, visions, and targets for sustainable development. Additionally, more holistic approaches are needed to initiate effective urban planning, and combat the associated challenges. Urban development needs to support planners in developing more sustainable and resource-efficient urban pathways rather than creating a series of innovative pilot projects. Although numerous problems have been found in China's green urban development, such as unclear definitions and targets, over-emphasis on economic development, and unsuitable government performance assessment, the low-carbon

eco-city development provides a new approach to green urban development in China.

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