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China Low-Carbon Healthy City, Technology Assessment and Practice

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Introduction

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In the global campaign to reduce carbon emissions, China faces two challenges: *promoting urbanization* and *reducing carbon emissions*. Failing to address these challenges appropriately could easily result in stronger emission. According to statistics from the International Energy Agency in 2011, China's carbon dioxide emissions exceeded those of the United States by 2.6 billion tons. Chinese emissions exceeded aggregate emissions of the United Kingdom, Germany, Sweden, Australia, Japan, South Korea, and Brazil by 450 million tons, compared with other Organisation for Economic Co-operation and Development nations. Urban areas are the main battlefield of global carbon emission reduction because 71 % of global greenhouse gases (GHGs) and carbon emissions are emitted from cities. Although a great deal of energy is consumed in cities and there are tremendous GHG emissions there, we cannot conclude that a high urbanization rate inevitably causes strong emissions. Studies of countries with different development levels show that an

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advanced economy with greater urbanization is not essentially related to greater carbon emission. However, in China, urban development and carbon emission are positively correlated at the present stage of urbanization. Therefore, establishment of low-carbon cities will promote transformation of urban development to achieve new-type urbanization, and foster industrial upgrades for green and sustainable development. The establishment of low-carbon cities, urban transformation, and industrial upgrade issues are analyzed and discussed herein, and suggestions are given for reference by relevant paragraphs.

1 Part 1 Current Status

Statistics show that, among 287 cities at the prefectural level and above in China, 259 have set out construction goals related to low-carbon eco-cities. This research illustrates local efforts in the construction of a low-carbon healthy city using two layers: metropolitan areas and model cities (Fig. 1).

1.1 Relevant Plans in Three Major Urban Regions with Focus on Preventing Air Pollution

In 2013, the Ministry of Environmental Protection of the People's Republic of China, and five other ministries and commissions, introduced "Region and Surrounding Areas Air Pollution Prevention Action Plan Implementing Rules." These rules focus on the prevention of air pollution and control of levels of PM2.5 (particulate matter with aerodynamic diameter <2.5 μm), as well as the coordinating mechanism for exploring aspects such as industrial development, energy structure, and traffic mode.

In *Yangtze River Delta Regional Planning* of 2010, city governments of the Yangtze River Delta region issued promotion goals to prevent air pollution from the perspective of regional eco-environmental protection, to adjust energy structure through the projects "Transporting Natural Gas from West to East" and "Power Transmission from West to East," and to implement control of total coal utilization. It is expected that 8 % of sulfur dioxide emissions will be eliminated by 2015.

From the standpoint of *Resource Saving and Environmental Protection Report in the Pearl River Delta Region*, *The Outline of the Plan for the Reform and Development of the Pearl River Delta (2008–2020)* and *Clean Air Action Plan for the Pearl River Delta Region of Guangdong Province* has established goals for building a regional coordinating mechanism in the arenas of circular economy, pollution control, and eco-environment. They also put forward targets to prevent regional air pollution, i.e., building up a basic foundation within 1 year, achieving initial success within 3 years, and improving remarkably within 10 years.

Fig. 1 The whole China low-carbon healthy city evaluation map (N = 287, by SARI, CAS). *Data Source* China City Statistics, 2013, The criteria score, which show as the color of cubic, is computed by the capability and ranking number of economic and social, urban construction, resource consumption, traffic and transportation, environment impact, and healthy and security data index. The area of cubic is the coverage of political region of different cities. Index number equals from 0 to 1, and different weights would show the importance of index and factors. See more in Chap. 7: *Low-carbon Healthy City Assessment Systems*

Meanwhile, some representative foreign metropolitan regions have forwarded specific quantitative targets of carbon emission reduction, with emphasis on combating climate change. They also promoted low-carbon healthy city construction by formulating measures of clean and renewable energy utilization, energy utilization management, energy-saving building renovation, bus-prioritized traffic patterns, and waste recycling. Among these metropolises, Chicago achieved its regional emission reduction by three means, establishing regional coordination units, quantifying carbon dioxide (CO_2) emission reduction, and regional carbon trading. The Tokyo Metropolitan Government formulated *Tokyo Climate Change Strategy* and outlined five major initiatives to mitigate climate change. These are reducing CO_2 emissions from private enterprises, households, urban development, and motorized traffic, and support from the Tokyo Metropolitan Government to support these efforts. The Greater Manchester area mainly reduced CO_2 emissions in five areas: construction, energy distribution and electricity generation, traffic, green space and drainage systems, and sustainable consumption. In comparison, foreign

metropolitan areas pay more attention to the implementation of specific goals of emission reduction, but China's low-carbon construction at metropolitan level focuses on preventing air pollution.

1.2 Various Patterns in Local Cities

After China launched pilot programs for low-carbon healthy cities, many pilot provinces and cities proposed different development ideas. For instance, Tianjin formulated measures with various aspects, including restructuring industry, facilitating emergence of industrial clusters, enhancing energy assessment of investment projects, and practicing industrial energy saving.

Liaoning Province focused on energy conservation for breakthroughs and specified specific goals. Liaoning aimed to gradually explore low-carbon mechanisms from point to area, taking Anshan as its initial experimental unit.

Hangzhou introduced 50 new policies of low-carbon construction, and strongly promoted the six-in-one pattern of low-carbon healthy city development:

(1) Fostering low-carbon industries and developing low-carbon economies
(2) Promoting building energy conservation and constructing low-carbon buildings
(3) Advocating green commuting and introducing low-carbon traffic
(4) Encouraging green consumption and promoting green life
(5) Enhancing ecology construction and creating low-carbon environments
(6) Changing urban management and building a low-carbon society

Wuxi focused on establishing six low-carbon systems: low-carbon legal systems, low-carbon industry systems, low-carbon urban construction systems, low-carbon life and culture systems, and carbon sink absorption and utilization systems. The city also emphasized development of low-carbon agriculture, industry, transportation, construction, consumption, and carbon sinks.

Zhenjiang started with a cloud computing platform of low-carbon urban construction and management, supervising this construction at five levels: urban, region, industry, key enterprise, and project.

Some cities adopted specialized low-carbon technologies. Dezhou implemented a solar city strategy and added low-carbon economic development to its *Comprehensive Development Planning of National Economy*. Xiamen practiced low-carbon construction modes in three major aspects: transportation, construction, and production. Hubei Province established the Wuhan metropolitan area as its experimental unit for a low-carbon economy, where it carried out development models of low-carbon energy, transportation and industries, and promoted a number of low-carbon economic demonstration projects.

Current low-carbon development in foreign cities can be summarized into five low-carbon patterns: grassroots, structural, morphological, supportive, and behavioral. More specifically, their practices cover a wide range of means, including

energy renovation, industrial transformation, promotion of a recycling economy, construction of compact cities, optimization of the urban ecological network, development of green transportation, spread of technology, and encouragement of energy-saving behaviors.

A comprehensive development pattern prevails in most foreign cities. Denmark's cities are a representative example. The country features wide coverage of low-carbon construction modes, including almost all the aforementioned patterns on all levels, such as construction of a complete system of wind power generation, promotion of energy conservation construction, development of green urban transportation, encouragement of waste recycling, and guidance for a low-carbon life.

Furthermore, in response to climate change, most foreign cities have formulated climate change action plans based on their own particular conditions, and established emission reduction targets to reach a national target index. For instance, London promulgated *London Climate Change Action Outlines* with the goal of reducing CO_2 emissions in 2025 by 60 % over that of 1990. Tokyo issued *Tokyo Climate Change Strategy*: *A Basic Policy for the 10-year Plan for a Carbon-Minus Tokyo*, putting forth a 2020 GHG emissions goal of 25 % less than those of 2000. However, at present, few cities in China have claimed quantitative target indices of emission reduction, and most low-carbon construction is at the demonstration level of policies and projects.

2 Part 2 Summary of Main Problems

2.1 Lack of Well-Organized Structure

China's present emission reduction efforts are mainly promoted by the National Development and Reform Commission (NDRC) system, focusing on industrial reduction. This lacks due attention to urban emission reduction, which includes reduction not only from industries but also from areas such as transportation, infrastructure, and citizen livelihoods. China has not constructed a complete emission reduction system that includes regions, city agglomerations, and large, medium, and small cities. Therefore it is impossible to systematically guide local low-carbon construction or establish a complete policy system of low-carbon energy utilization. As a result, national low-carbon construction is fragmented, with each city following its own path, which is not conducive to demonstrating and diffusing successful experiences. Additionally, strategic planning of multi-energy coordination centered on low-carbon energy supply has not been formulated on the regional or even national level. Development planning of clean energy—i.e., natural gas, wind energy, photovoltaic energy, and nuclear power—has been separately distinguished, whereas the development of high-carbon energy still lacks an alternative plan. Further, planning of the structure and system of trans-regional