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A Study on International Cooperation Model of Shenzhen International Low Carbon City

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Abstract: As the climate problem is worsening, low-carbon cities are becoming more popular worldwide. The low carbon city development in China started later than developed countries and thus there is room and need for international collaboration. Shenzhen International Low Carbon City is a flagship project of Sino-EU Partnership on Low Carbon and Sustainable Urban Development, which aims at fostering the international cooperation in the field of low carbon city development. After reviewing relevant theories and analyzing the cases of low carbon cities in China and abroad, this research designs an international cooperation model for Shenzhen International Low Carbon City, which is suitable for its own.

Keywords: Shenzhen International Low Carbon City; International Cooperation Model; Low carbon city development;

1. Introduction

In recent years, international cooperation in low carbon city is gaining more and more instance, the first batch of cities that are confirmed for China-US low carbon pilot cities include Hefei in Anhui province, Weifang and Rizhao in Shandong province, Langfang in Hebei province, Hebi and Jiyuan in Henan province. In addition, China-UK Low Carbon City Development (LCCD) dialogue since 2009 has also established a collaborative framework among government, industries, and university for research and application. The first batch of pilot low carbon cities in the LCCD includes Nanyang in Henan province, Guangzhou in Guangdong province, and Shanghai. Furthermore, Europe-China Eco Cities Link (EC-LINK), a key project in the Sino-European partnership for urbanization, has officially started during the EU-China Urbanization Forum in Beijing on Nov. 21, 2013. The EC-LINK project is funded by EU and aims to provide technical assistance to Chinese cities in their endeavor to meet the targets set in the 12th Five Year Plan. Twelve European and Chinese cities signed cooperation agreements on urban sustainable development, under the high patron of China Premier Li, President Barroso of the European Commission, and President Van Rompuy of the European Commission.

At the same time, the international cooperation and development in low carbon eco parks also turn ideas into practice. More and more countries collaboratively develop low carbon eco parks, especially in developing

countries. Developed countries are able to provide advanced technologies and guiding ideas while developing are able to provide low cost factors such as land and labor. Currently, the main eco parks in China developed through international cooperation include Suzhou Industrial Park, Tijin International Eco City, China-Sweden Caofeidian International Eco City, Qingdao China-Germany Eco Park, China-Finland Digital Eco City, etc. The development of eco parks involves governments and firms in both countries and the effective management of eco parks affects the healthy development of low carbon cities in the long run. However, little research thus far focuses on the model for international collaborative development of eco parks. This research is an attempt to explore international cooperative model in Shenzhen International Low Carbon City (SZILCC).

SZILCC is located in Pengdi Street in Longgang District with a planned area of fifty-three square kilometers. As a flagship project of China-EU cooperation for sustainable urbanization, SZILCC aims to build an open platform for international collaboration. Drawing on the experience of other countries and regions such as EU, US, and Japan in the application of low carbon technology, the development of low carbon economy, and the construction of low carbon city, SZILCC is an audacious and innovative attempt to promote green and low carbon development in Shenzhen city and strengthen energy and technological cooperation. This research will provide a theoretical analysis of existing low carbon eco parks and study typical cases for cross-country and cross-region cooperation in this regard. Based on the practices and lessons from other countries and the situation and needs of SZILCC, the research will discuss and suggest a suitable international cooperation model and roadmaps with established principles for SZILCC.

2. Theoretical Analysis

The theoretical foundation for low carbon eco cities mainly comes from industrial ecology and recycling economics. Industrial ecology ecological theories and methods to study industrial production and views industrial production as a closed system similar to natural ecological system. In a circular economyÿmaterial flows can be designed either reenter the biosphere safely (biological nutrients) or circulate at high quality without entering the biosphere (like technical nutrients). The primary purpose of eco parks is to reach an all-win situation economically, environmentally, and socially through resource management. The development of eco parks combines with the development of local region would enable the adequate utilization of resources such as information, materials, energy, and infrastructure for better economic and social returns[1]. Some scholars researched on eco-industrial parks at a global level and suggest that an international institution should be built for coordination and consultation and a natural ecosystem should be built worldwide to absorb waste[2].

There isn't much research on international cooperation on low carbon cities. Some scholars discussed this issue from the perspective of game theory. Ou Xunmin et al used the analytical tool of the game theory to study environmentally-friendly low carbon technology transfer and established a double-level static game model with non-cooperation and complete information[3]. This model examined the micro game of firms and the macro game of countries and yielded the following findings. Direct influencing factors in the model mainly include return on investment in a firm's project, a country's taxation level, project regulation or level of subsidies, and level of supportive funding from the international community to coping with the climate change. The level of citizens' awareness of environmental protection in both countries becomes an important and indirect influencing factor in the model.

He Jiankun et al believe that there will be fierce competition in the areas of technology, commerce and trade and there will be opportunities and challenges in coping with the global climate change. Low carbon technology transfer and technical cooperation internationally would help create an atmosphere for countries to introduce advanced low carbon technology, promote technological innovation and transfer, and as a result establish an international cooperation mechanism that is long lasting and flexible and invites all countries and all circles to participate[4]. Although enterprises are the main body of conducing low carbon technology transfer, countries play a key role. According to He et al, international transfer of low carbon technologies shouldn't be considered as a simply commercial activity. Instead, it should be more of "country driven" and both developed and developing countries have ample room for policy moves[5].

The process of international cooperation involves multiple stakeholder groups of various countries, and the mechanism design theory is applicable in this case. According to the notion of incentive compatibility introduced first by Leonid Hurwiczÿindividual participants in the market would act for self-interest. If there is an institutional arrangement that can make individual self-interest consistent with the firm or group's goal of collective value maximization, and make the incentives that motivate individuals consistent with following the group rules, incentive compatibility occurs and desired outcomes are achieved[6]. However, in many cases, the government authority often imposes direct price regulation on the firms that provides public goods, which results in lack of incentives for public utility firms to increase productivity and at the same time makes government effort of controlling and monitoring cost fruitless. Due to the goal conflict between firms and government for their respective interest, the incentive compatibility becomes a key issue when designing the price regulation mechanism for public goods. Therefore, there is an urgent need to change mentality toward market entry, improve information disclosure system and asymmetric regulation, strengthen the regulatory rules, and institutionalize the principal-agent relationship[7].

International cooperation in low carbon eco-park development is different from traditional regional public management. Traditionally, regional public management is divided into three types-regional public management among countries, sub-regional public management, and local public management[8]. Examples of the governing body of public management among countries are European Union, Association of Southeast Asian Nations (ASEAN), Mercosur, and watershed management in the Danube. Sub-regional public management examples are the Lantsang-Greater Megong river, and the Greater Pearl River Delta of Guangdong, Hong Kong, and Australian. The governing body of local public management can be central government, local government, trans-district local government consortium, or non-profit organizations. The Greater Changjiang River is an example of trans-district public management. Successful cases for international and regional development cooperation in China and abroad include the Dutch-Swedish cross-border Oresund Region[9], Suzhou Industrial Park[10], Tianjin Eco-City[11], and Guangzhou Knowledge City[12].

3. International Cooperation Model of Shenzhen Int'l Low Carbon City

Shenzhen International Low Carbon City (SZILCC) intends to become a world-class low carbon comprehensive demonstration zone and future new city that advocates low carbon city construction, low carbon development, and low carbon life. Due to the vast scope and complex nature of the planning on SZILCC, it would be difficult for Shenzhen alone or even for China alone to accomplish the goal given their limited experience in low carbon development. Therefore, cross-border collaboration would become an important regional cooperation model and reflect the resource diversityÿforeignness, and complexity in SZILCC.

SZILCC is devoted itself to becoming an important vehicle for international cooperation in low carbon field in China, exploring new paths for China's copying with the climate change, and building international low carbon demonstration zone. Therefore, SZILCC is an cooperation model of one verse several partners, aiming to build collaborative relationships with multiple countries and promote low carbon technological advance and industrial system formation in low carbon city.

The content of cooperation in SZILCC will certainly be grounded in low carbon and everything sets off from low carbon, including introduction, research and development, and industrial application of low carbon technology, introduction of low carbon project and talent, low carbon forum, summit or expo, as well as other collaborative forms. All center around and serve low carbon in order to achieve low carbon targets in production, life, and entertainment in SZILCC.

3.1. Cooperation Principles

Based on the successful cases on regional cooperation in China and abroad as well as Shenzhen's reality in city construction, the following cooperation principles for SZILLC are proposed.

3.1.1. Principle of Equality and Mutual Benefit

All parties to the cooperation shall observe the principle of equality and mutual benefit in the construction and development of low carbon city. Learning from advanced ideas and the successful experience of European and American countries about ecology and environmental protection, SZILLC can introduce superior resources in biotechnology, finance, and education, actively attract domestic and foreign investments, mobilize the initiative of the cooperative partners – firms, governments, and research institutions, and build long-term and stable collaborative relationship.

3.1.2. Principle of Openness and Progressiveness

Based on the cooperation with the Netherlands in the pre-phase, SZILCC can attract a wide range of experts, firms, and institutions all over the world to get involved and integrate low carbon technologies and standards around the world. The first-phase project in SZILCC involves Pingdi Street only. In the future, it may naturally extend into Dongguan city and Huizhou city through the market mechanism and then further expand into the entire area through commissioned development and BOT, which can become an exemplary project of regional cooperation

3.1.3. Principle of Serving the National Overall Interest

SZILCC is a piolet area for Shenzhen to search for control of the total amount of carbon emission and push it forward. In the light of the country's overall strategy for coping with climate change and for low carbon international cooperation, Shenzhen will prudently move forward under the leadership of National Development and Reform Commission. Following the principles of subordinating itself to and serving the national general interest, Shenzhen can research and propose a coordinative mechanism for the SZILCC development model and time sequence and bring it into the national strategic level.

3.1.4. Principle of Sustainable Development

Sustainable development is a fundamental way to solve the problems in city development and would bring about long term benefits for SZILCC's low carbon and ecological development. SZILCC can expand its cooperation and reasonably develop resources. Sustainable development in low carbon city would promote sustainable development in bilateral cooperation.

3.2. Cooperation Positioning

Leveraging the radiant power of Shenzhen Special Economic Zone as a center city and the geographical advantage of adjacent to Hong Kong, SZILCC can build international cooperative mechanisms at multiple levels and play a role as a demonstration window. Also, it can introduce low carbon technologies, funds, projects, and talent through multiple channels and in multiple ways

and build an international and open platform for networking and for low carbon development. First of all, SZILCC would actively cooperate with advanced low carbon cities in developed countries such as in Europe and America and investigate diverse forms of cooperative models between governments and firms. Using governmental cooperation to pushes forward the transfer, promotion, and application of technology and knowledge in the low carbon field. Secondly, SZILCC needs to strengthen the exchange and collaboration with Hong Kong, Macau, and Taiwan in low carbon area and coping with the climate. Finally, SZILCC would also pay attention to cooperation with emerging economies and developing countries and promote Chinese low carbon products, technologies, knowledge, and services to go abroad.

Shenzhen can integrate itself into international system of scientific and technological cooperation through introduction, digestion, and absorption of foreign advanced technology and through technological alliance, collaborative research and development, and participatory patent, SZILCC would support companies and research institutions for bilateral or multilateral joint research projects targeting at key technology and bottleneck technologies, and improve the conversion efficiency of technological results through learning foreign advanced ideas and methods in technological transfer. SZILCC would also encourage foreign universities, scientific research institutes, and multinational corporations to establish R&D institutions, build collaborative research platform, and attract global low carbon talent to create business ventures here.

3.3. Cooperative Framework

Cooperative framework carries a lot of weight in the entire cooperation model. A clear cooperative framework can clarify the rights and responsibilities of each stakeholder and provide smooth communication channels for all parties in the cooperation process. Under the guidance of the National Development and Reform Commission and featured with international cooperation, the International Low Carbon City intends to establish diverse and wide range of international cooperation, increase international influence, and introduce strongest technologies, projects, R&D institutions, and talent in low carbon development from various countries. Based on the cooperation models of Sino-Singapore Tianjin Eco-city (SSTEC), Sino-Singapore Guangzhou Knowledge City, Suzhou Industrial Park, and Sino-Sweden Caofeidian Eco-City, SZILCC designs an organizational cooperative framework with consideration of its own characteristics (see Figure 1 below).

3.3.1. SZILCC Steering Committee

The Steering Committee of SZILCC consists of leaders of the National Development and Reform Commission (NDRC)and other relevant ministries, and main leaders of Shenzhen municipal government, of which the NDRC is a director unit. The main responsibilities of the Steering Committee are as follow:

A. Guiding the development and construction of SZILCC and formulating relevant policies according to the national major strategic measures for coping with the climate change and low carbon development.
B. Research on the pilot policies in favor of low carbon city to investigate low carbon development model.
C. Guiding and coordinating governmental international cooperation between countries about major low carbon projects.
D. Recommending low carbon projects and technologies at home and abroad to land in the International Low Carbon City.
E. In charge of negotiation, cooperation, and signing agreements between countries and governments in the SZILCC.
F. Other tasks necessary in the view of the Committee.

3.3.2. SZILCC Leading Group and Office

The leading group of SZILCC makes decision on important matters about low carbon city planning, development, construction, and operation and as well

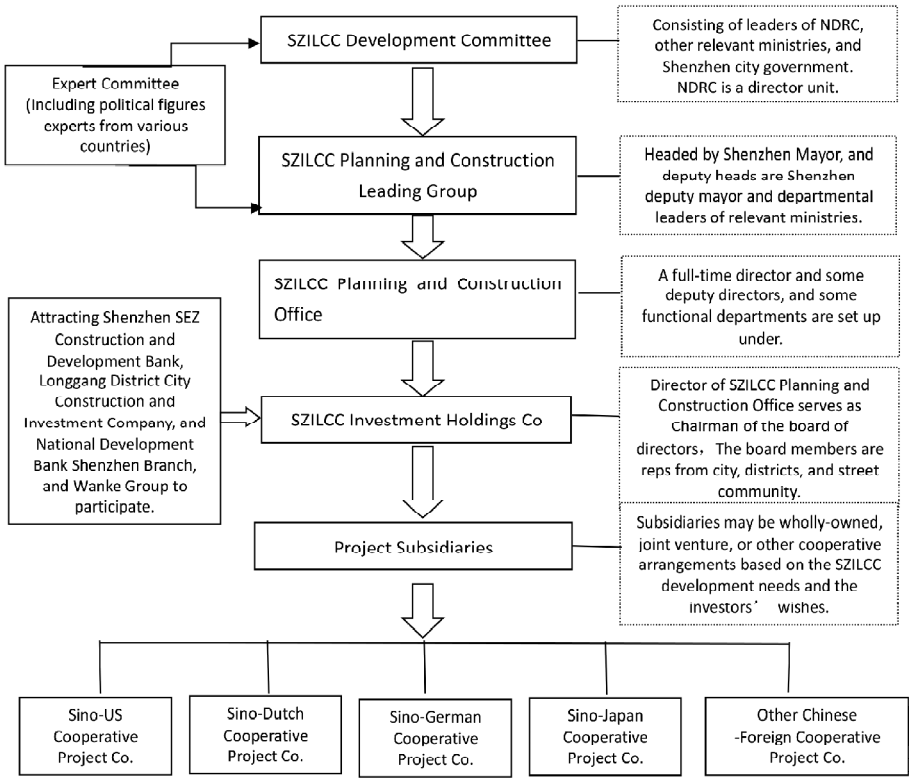

Figure 1: Organizational Framework for SZILCC Management

as formulate relevant development policies. An office is set up under the leading group and responsible for the SZILCC work, including administration, coordination, planning, development, construction, investment promotion, and financing, etc. Social administration and public services in SZILCC is still the responsibility of Longgang District Government and Pingdi Street Office.

3.3.3. SZILCC Holding Company

SZILCC Holding Company is held by Shenzhen city and invites Shenzhen Special Economic Zone Construction and Development Group, Longgang District City Construction and Investment Company, and National Development Bank to join the holding company. The main responsibilities of the holding company is to carry out the specific tasks for the development, construction, operational management, and financing and investment management.

3.3.4. SZILCC Project Subsidiaries

According to the needs of project development and the willingness of investors, subsidiaries can be established as a wholly owned entity, joint venture, or cooperative enterprise. Forming subsidiaries for international cooperation through signing project contracts between firms is encouraged. If it is considered necessary for cooperation at government level, the contracts can be signed by relevant national ministries and commissions and by Shenzhen municipal government respectively. Such project subsidiaries are mainly responsible for undertaking the job of the development, construction, and operation through cooperation between Shenzhen and companies at home and abroad.

3.3.5. International Low Carbon Summit

International Low Carbon Summit will be held periodically to conduct international academic and technological exchange and collaboration in the low carbon area and promote international transaction and industrialization of low carbon technology. Currently, countries such as the Netherlands, Germany, UK, Denmark, U.S., Japan, Singapore, and Australia have expressed their willingness to cooperate under the promotion of the National Development and Reform Commission. EU Directorate-General for Climate Action has also clearly indicated its interest to join the collaboration and its willingness to ask for opinions of its member states.

3.4. Cooperation Platform

International Low Carbon City Industrial and Technological Alliance is the main platform for SZILCC international cooperation. With SZILCC as a carrier, the Alliance is a non-profit service-oriented consortium with professional, academic, and mutual-beneficial characteristics. The Alliance was initiated by

enterprises, R&D institutions, universities, industry organizations, and financial and investment institutions at home and abroad. The Alliance is established as an international collaborative consortium mainly by Shenzhen SEZ Construction & Development Group, Shenzhen Energy Group Company, Shenzhen Gas Corporation, Shenzhen Graduate School of Tsinghua University, Shenzhen Institute of Building Research Company, Shenzhen Research Institute of International Low Carbon Development. Those founding enterprises and institutions are industries, academia, research institutes, and investment firms in Shenzhen that are centered around low carbon development and in collaboration with the counterparts at home and abroad such as Philips Company, Delft University of Technology, the Netherlands Organization for Applied Scientific Research, University of Westminster, and etc.

Built on the basis of SZILCC's planning, construction, and operation, the Alliance widely disseminates low carbon ideas, promote green projects, integrate appropriate low carbon technologies, and breed emerging low carbon industry. The Alliance also encourages to set relevant standards and make regulations, and promotes a sustainable development model for a new type low carbon eco-city. The Alliance actively assists its members to make contributions in copying with and adapting to the climate change with their technologies, standards, products, and services heading toward the national and world markets from Shenzhen.

In shortÿthe International Low Carbon City Industrial and Technological Alliance is an international and open exchange platform for networking and collaboration in the low carbon field and actively drive for the cooperation among industries, academia and research institutes, including inviting investments, financing low carbon technology, and collaborating on CDM projects among firms, making depth exchange among research institutions, and promoting cooperative dialogues among countries and governments. The Alliance intends to forge an effective tool to promote and disseminate low carbon ideas in society.

3.5. Cooperative Projects

The cooperative content defines the boundary and methods of the cooperation. The broad coverage of the cooperative content provides multiple ways to achieve the goal of low carbon city positioning, such as technological R&D, project introduction, and international forum, etc.

(1) Low carbon development foundation projects. Shenzhen Low Carbon Development Foundation has been established in collaboration with EU, US, and Japan, and other developed countries. It supports Shenzhen to join the Rotterdam-Amsterdam Clinton Climate Initiative.

(2) Opening Innovation Campus projects. A lot of about 1 to 2 square kilometers near to Gaoqiao Industrial Park in Pingdi Street is planned for construction of an open and international university campus, which

shares service facilities with surrounding industrial clusters, sparks new ideas, and produce new technologies and promotes its application.

(3) Bicycle transportation demonstration area projects. Shenzhen cooperates with EU, US, and Japan and others in the construction of suitable living environment and bicycle transportation system and also conducts application study. Shenzhen also strengthens its cooperation with the Netherlands in the planning, design, and management of the bicycle transportation system in order to collaboratively build a demonstration area in Shenzhen

(4) New energy automobiles projects. The Netherlands partner is committed to publicize and promote Shenzhen's technologies, products, and operational models in new energy automobile in the Holland to help introduce Shenzhen's product technologies into the European market.

(5) Low carbon exhibition center projects. Shenzhen plans to work with the participating institutions from various countries and builds a low carbon exhibition center in Pingdi. The center would show international cutting-edge low carbon technologies and energy-saving innovations in order to strongly increase the public awareness of low carbon development and drive local residents to actively get involved in the construction of low carbon city.

(6) Green space reconstruction projects. Shenzhen would invite low carbon experts from various countries conduct comprehensive investigation and research about Pengdi and then select a small area and buildings for pilot green, low carbon planning, design, and reconstruction.

3.6. Technological Cooperation

There are four main areas for international technological cooperation in SZILCC.

First cooperation area is the energy field, which includes current technology integration, demonstration and application, such as renewable energy application (e.g. solar energy and wind energy), resourceful utilization of waste, and utilization of distributed energy (e.g. triple co-generation of cooling, heating, and power). Also, the energy field cooperation includes further study and demonstration of integration of electrical cars and smart grid, and high density energy storage technologies (e.g. low-temperature superconductors). Furthermore, the energy cooperation includes studying and setting international standards in the fields of new energy and renewable energy and promotes internationalization of relevant standards in low carbon city.

Second area of international technological cooperation is in the field of knowledge infrastructure, which is to establish a developmental framework for effective knowledge infrastructure and execution based on the actual

situation in Pingdi. In collaboration with other institutions such as Delft University of Technology in the Netherlands, Shenzhen establishes a R&D center to work on lower carbon dioxide emission technology and the use of multiple means including market mechanism including the emission trading scheme.

Third area of international cooperation is in the green building area. Working with participating experts from various countries, Shenzhen is exploring the definition and standards of green buildings in Pingdi, considers the (excessive) cost of green building in Pingdi, and establishes a database to collect information about existing standards. In the Sino-Dutch pilot project, Shenzhen works collaboratively with local residents and inhabitants to investigate the possibility and feasibility of the renovation of current houses.

The last area of international cooperation is in the urban planning area. Many foreign authorities select appropriate existing groups of buildings within a low carbon city and propose solutions to the green and low carbon renovation of buildings that attracts local residents to get involved. Through sharing foreign experience and exchanging ideas, Shenzhen can raise public awareness and work together to embark on projects of best practice, such as establishment of attractive demonstration and information center.

4. Conclusions

SZILCC attempts to become a world class low carbon comprehensive demonstration area and a new city in the future that advocates low carbon city building, low carbon development, and low carbon life worldwide. Due to the complexity and richness of the planning, it would be difficult to accomplish such a goal by Shenzhen alone or even China along given limited experience cumulated. Therefore, cross-country cooperation becomes a very important regional cooperative model. Building Shenzhen International Low Carbon City through international cooperation could become the focus of attention as well as an international role model for international low carbon cooperation between China and other countries and for other countries. Cross-border cooperation manifest the diversity, exoticness, and complexity of resource for the SZILCC development. A scientific, mature, and effective cross-country cooperation model serves as an important foundation for successful SZILCC.

In summary, this research reaches the following conclusions about the selection of international cooperative model for low carbon city.

First, the main principles for low carbon city building through multiple country participation include equality and mutual benefits, openness and progressiveness, serving the national overall interest, and sustainable development. All cooperative activities cannot violate those principles.

Second, a scientific organizational framework in SZILCC is an organizational guarantee to ensure the smooth construction and operation of

low carbon city. Therefore, it is an important step to construct and enrich relevant organizational framework at appropriate time during the preparation for low carbon city construction.

Finally, priority on cooperative projects should be placed on green building and renovation, low carbon energy application, research and development and industrialization of new generation of energy technology, and low carbon knowledge infrastructure.

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