The Vision of Urban Spatial Planning Based on the Concept of Low-Carbon City

Tao Liang

1. Low-carbon economy and low-carbon city

Along with continuous global growth of population and economic scale, extensive energy utilization causes large amounts of discharge of carbon dioxide and other green-house gases so that the international society is under strict challenge of green-house effect. Irrefutable facts are global warming climate, decreasing glacier and snow, rising sea level and even threatening disappearance of Maldives and other island countries. For the purpose of achieving balance between economic development and resources environment protection, low-carbon economy based on low energy consumption and low pollution is becoming an internationally hot spot and another new tendency after industrial revolution and information revolution that will probably exert major influence upon global economy.

The concept of low-carbon economy was first proposed officially in British “White paper on energy sources” of 2003, and once put forward, it attracted wide attention over the whole world. The concept of low-carbon society proposed in Japan in 2007 was to reduce discharge of green-house gases through low-carbon technology and system to be realized by means of change of consumption ideas and ways of life. Shortly thereafter, more and more countries and cities started to explore the means for practicing low-carbon economy.

In China, low-carbon economy is now starting to receive extensive concern and recognition. In the macroscopic background of state strategic regulation focusing on “scientific approach of development” and “building up ecological civilization”, development of low-carbon economy will become our inevitable choice for alleviating climate warming-up and realizing sustainable development. Along with the calling of Copenhagen Climate Meeting by end of 2009, the issue of climatic change is one of the key topics in the current international political struggle. Discharge reduction in large developing countries like China will be put under more international supervision, so that development of low-carbon economy may take up a certain urgency and necessity in China.

As the center of human life and production, the city plays an essential part in the development of low-carbon economy. It is a fundamental material carrier in the social economic development, while low-carbon city constitutes an important support for energy saving, discharge reduction and development of low-carbon economy. As the only way for realizing sustainable development, low-carbon city will be a new tendency for future urban construction. More than 20 cities in China have started to plan the low-carbon ecological cities or satellite towns. Zhuhai, Hangzhou, Guiyang, Jilin, Nanchang and Wuxi have proposed the vision of building up low-carbon cities. At the beginning of 2009, Shanghai and Baoding were both chosen as the first lot of experimental cities of the “Program of development of low-carbon cities in China” by the World Wide Fund for Nature (WWF), whereby Baoding has taken the lead in unveiling its low-carbon city plan, and Shanghai has set the target of

low-carbon business district for its key project in the Detailed Planning of Hongqiao CBD.

The low-carbon concept is just at an initial state in its application to our city planning, and is under exploration in the cities. No complete theoretical system or planning approach has been established, but, the initial trial of low-carbon city planning has positive meaning in the respect of breaking through traditional city planning system, enriching theories and practices concerning city planning, and stimulating the process of low-carbonizing cities.

2. Analysis on the concept of low-carbon city

Many scholars in China have made elaborations on the concept of low-carbon city. In the opinion of Fu Yun and Wang Yunlin, the concept of low-carbon city is "to minimize discharge of green-house gas in the cities and get rid of past socio-economic operating mode of large production, consumption and discarding by developing low-carbon economy and innovating low-carbon technology in the cities, so as to form an energy-saving and highly effective economic system of optimized structure and cyclic utilization, introduce a healthy, saving and low-carbon way of life and consumption mode, and finally achieve a clean, highly effective and sustainable low-carbon development of cities". Liu Zhilin holds that the concept of low-carbon city is "to realize an urban construction mode and social development form beneficial to reduction of carbon discharge under the prerequisite of guaranteeing and improving living standard by changing economic development mode, consumption concept and ways of life". As proposed by Dai Yexin, a low-carbon city should "take low-carbon economy as its development pattern and target, its residences should take low-carbon life as their vision and behavior characteristics, and government management should take low-carbon society as its construction blueprint". According to this point of view, low-carbon city development is neither a simple market action, nor a government action completely. Therefore, the government, enterprise and residence should all be integrated into the common administration system.

To sum up, the above viewpoints have following in common: first, low-carbon city is oriented toward development of low-carbon economy and aims at sustainable development; second, low-carbon city relies on the transformation and regulation of the mode of economic operations, mode of social development and mode of life and consumption, on the extent of progress and extension of low-carbon technology, and on common propulsion from the government, enterprises and residences as multiple principals.

3. Idea of spatial city planning based on the concept of low-carbon city

In the current city planning, the concept of low-carbon city is largely seen in the formulation of planning target. As it is quite simple, namely, achieving reduction of total carbon discharge in a city through various planning means, some cities have even formulated their concrete quantified index for reduction of carbon discharge. Low-carbon target may cover various material levels ranging from macroscopic urban spatial layout and meso community design to microscopic handling of energy-saving construction; it also involves such non-material levels as urban economy, mode of residents' social behavior as well as common administration. Following are some planning ideas on the match between low-carbon target

and spatial level, as a modest spur to introduce valuable contributions from others.

Spatial planning based on the concept of low-carbon city is, in the spaces of different scales, by utilizing various means of city planning such as application of organizations for optimizing urban functions, upgrading of operational mode of urban industries, increase of ecological green spaces of different scales and promotion of low-carbon behavior mode among the residents, to reduce energy consumption and optimize general energy structure in cities, so as to attain the target of reducing total carbon discharge and increasing carbon collection in the cities.

This article tries to analyze the understanding of spatial planning of low-carbon city from four scales: region, city, community and site.

3.1 Scale of region

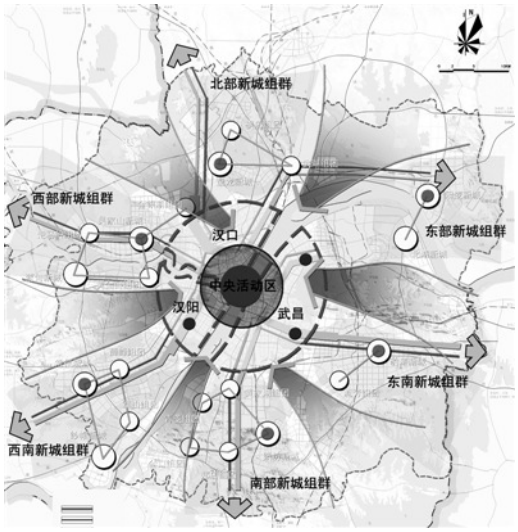
The scale of region refers to planning of metropolitan districts (rings) or town groups related to densely populated urban regions. Starting from the concept of low-carbon city, it is to establish a metropolitan spatial structure of multiple centers of a “compact city” by using the “flowing space” of expressways, high-speed railways and telecommunication cables, to ensure effective communication and operation between cities by means of information and modern communication, to intensify coordination and resource sharing between urban groups or metropolitan rings, and to minimize repeated construction, thus helping attainment of low-carbon target.

3.2 Scale of city

The scale of city refers to the level of urban master planning. Attainment of low-carbon city target mainly includes two aspects: measures for reduction of carbon discharge and improvement of the effect of natural carbon fixation in urban regions. A general consideration of the following four respects should be taken: urban pattern, mode of land utilization, mode of comprehensive transportation system, and construction of infrastructures.

3.2.1 Urban pattern

With respect to planning of urban pattern, a rational structure is the most important energy saving through low carbon. Low-carbon city pattern may be optimized through establishment of a rational layout between functional regions, natural sceneries and ecological green lands of the city, whereby extension of ecological green lands and ecological corridors and strict maintaining of a pattern of green ecological safety are all effective means. Take as an example the “Master plan of Wuhan”, which won the prize of



The urban pattern in
<The Master Plan of Wuhan >

global “Outstanding contribution” in August of 2009 from the International Society of Planners for Cities and Regions, with its six ecological corridors interwoven with land space reserved for urban development, the urban pattern is shifted from “ring type” to “axial type”, thus forming a spatial pattern that most suits its characteristics of inundated area. Large amounts of lakes and hills are just distributed in the six major ecological wedges. Future ecological corridors will evenly reduce temperature in Summer and shorten operation time of air conditioning, thus creating a low-carbon life.

As another example, the basic ecological control line defined in Shenzhen is determined on the principle of equilibrium between carbon and oxygen. It is so planned that after nearly half of the city area is defined as the scope of the basic ecological control line, illegal construction actions that harm the ecological control line will be under stringent control to guarantee the effect of natural carbon fixation, thus laying a good foundation for attaining the low-carbon target there.

The basic ecological control line of Shenzhen

3.2.2 Mode of land utilization

With respect to mode of land utilization, we should encourage effective mix of land to obtain balance between residence and employment, avoid huge districts of a uniform function, and reduce long-distance trips of cars. In the meanwhile, we will promote industrial upgrading by adjusting industrial layouts in cities, thus effectively reducing CO^2 discharge. For example, taking advantage of the Expo as an opportunity, Shanghai is upgrading urban functions and optimizing their combinational structure and enhancing planning and construction of new urban areas and renovation of old industrial areas to promote upgrading of industrial structure and raise efficiency of land usage. Land use function is becoming even more compact, concentrated and mixed. Furthermore, it is encouraged to plan work, residence and leisure in the same area, thus providing the basis for creating a “green Expo” and “low-carbon economy”.

3.2.3 Mode of comprehensive transportation system

With respect to mode of comprehensive transportation system, we can only reduce transportation energy consumption effectively when we advocate and implement a transportation mode with predominance and priority of public transportation. “The structure of future sustainable low-carbon cities in China” will no doubt be in the framework of bicycle-friendly cities of backbone public transportation lines”. Transportation strategy of low-carbon cities can be realized by controlling the volume of private transport and reducing carbon discharge from private transportation means of units and organizations, with concrete measures including acceleration of construction of rail transit, extension of application of

buses of new energy sources and establishment of public transit transfer hubs at city peripherals. Take Beijing as an example, if car transportation is reduced by one percentage through transfer to public transportation, 420,000 ton carbon dioxides can be reduced every year. European cities have quite advanced experience in their priority of public transportation, and their transportation development of regional differentiation, namely, public transportation for areas of best location, public transportation plus car for areas of intermediate location, and car for remote areas is something we should learn.

3.2.4 Construction of infrastructures

With respect to construction of infrastructures, it mainly includes green energy sources and cyclic resource utilization. Green energy source can be summarized as clean energy and renewable energy, including new technology and new process of sonar energy, biomass energy, wind power and hydropower, cyclic resource utilization refers to large-scale adoption of technologies of cycle economy and clean production to organize economic activities into a feedback flow of “resource – product - regenerative resource”, characterized through low exploitation, high utilization and low or zero discharge. Both of the technologies aim at reducing as much as possible the utilization of high carbon energy and discharge of carbon dioxide. Furthermore, in the planning, we have to consider establishment of a green system of municipal works. For instance, we have to pay attention to renewable utilization of sewage and reclaimed water in the arrangement of sewage systems, as well as classification of garbage and its transformation into resources, so as to reduce resource consumption in the cities.

3.3 Scale of community

The scale of community refers to the level of detailed plan and urban design. Functions of different areas in the cities, as well as their intensity of development and construction and architectural spatial patter differ quite a lot from each other. Therefore, at the level of detailed plan and urban design, technical design measures aiming at reduction of carbon discharge should be adopted in urban areas with concentrated functions.

For example, when planning residential areas, we may make reasonable arrangements under consideration of climatic, meteorological and wind direction conditions to provide good natural lighting and ventilation, create as much green space as possible through exquisite application of natural surroundings to offer even more comfortable microclimate and pleasant residential environment, and introduce a mode of low-carbon conduct to create “green community”. As another example, in the planning of central areas, we may increase ecological sceneries helpful to outdoor fitness activities, oxygen increase and reduction of heat island effect, and reduce large hard-ground squares and grass squares as “image project”, thus improving carbon collection ability of cities and improving their greening function and carbon absorption function of unit green land area.

An initial exploration of the low-carbon planning of the community scale is made in the practice of the low-carbon business district in the Detailed Planning of Hongqiao CBD in Shanghai. There, a pedestrian environment as well as energy-saving building groups are created through a spatial pattern of small housing blocks, high density and low height; long-distance trips are limited through combined distribution of functions; walking possibility is enhance through a diversified public space; pedestrian transport and bicycle transport are encouraged.

The Detailed Planning of Hongqiao CBD in Shanghai

3.4 Scale of site and building

The scale of site and building refers to buildings (group) and design of their peripheral sites. Replacement of traditional buildings through green buildings is the basic method for attaining the low-carbon target. Green buildings refer to those buildings, which, throughout their lifespan, save resources (energy, land, water and material) to the maximum, protect environment and reduce pollution, provide healthy, suitable and efficient space for the people and coexist with the nature in harmony. In the design of peripheral sites of buildings (group), we should emphasize harmony between buildings and their peripheral surroundings, create more green public space, and offer pleasant environment for walking and leisure. All of these will contribute greatly to reduction of carbon discharge. In the meantime, lowest energy consumption of buildings and sites are realized and low-carbon target is attained through control of building materials, sun shading and external temperature preservation of buildings, roof plantation, natural building ventilation, as well as design of solar energy heating system, rain-collecting system and cyclic system of reclaimed water.

4. Conclusion

Urban spatial planning based on the concept of low-carbon city should be such a planning that the concept of low-carbon city is used as a guiding target and inspection criterion, different planning requirements are put forward for different spatial scales, and different planning means are adopted so as to attain the target of reducing the general carbon discharge in the cities. Low-carbon city planning is not water without a source or a tree without roots; it is related very closely to the ecological city and green city under our long discussion. They have the same essence and target, namely, to realize sustainable development in cities. The low-carbon city target is now at the stage of study of quantitative indexes. It will play a practical and effective role in the promotion of energy consumption and discharge reduction

and attainment of low-carbon city target, if we try to find the matching point between spatial planning of cities, mode of land utilization, mode of transportation organization, mode of residential life, design of buildings and sites, implementation of construction and management of utilization on the one side and the “low-carbon” target on the other side, and if all these respects are implemented at the level of material planning and construction measures.

The concept of low-carbon city is just at its initial stage with respect to application to urban planning in our country, and it is under exploration in the cities. It will need a long, complicated research process before a theoretical planning system and planning method can be formed. Moreover, in view of many types of cities and towns in China, they are at different stages of development, showing different characteristics in the respect of geographical location, economic base, development mode and cultural customs. Thus, they should certainly have different methods and means for their low-carbon city planning and construction. In the near future, it is necessary to make pioneer researches on the methods and contents of low-carbon city planning in some typical cities, then on the basis of summary and upgrading, to form a relatively scientific and systematic planning methodology, and furthermore to spread it throughout the country.

The valuable experience process and theoretical summary of low-carbon city planning will not only facilitate promotion of creation and upgrading of our planning theory and methodology, but also provide rich experience and technical support to the construction of low-carbon cities in the world.

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[About the author]

Tao Liang, Shanghai Urban Planning & Design Research Institute,China, Certified planner ,Master
Address: F13, 331, Tongren Road, Shanghai, China
Telephone:13621925256

Email：aircoo@126.com