Research on the strategy of low-carbon urban planning based on residents' living and consumption

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Abstract. Low-carbon urban planning is a key means of lessening the impact of global climate crises, and human activities is the main cause of climate change. Therefore, from the three perspectives of carbon source of human activities, carbon emission and carbon capture, in combination with the theme of spatial, traffic and industrial, this paper puts forward the strategic measures of low-carbon urban planning. These measures provide guidelines for the construction of green low-carbon city to achieve the sustainable development.

1. Introduction
Climate is an important factor of the survival of mankind. In recent years, the world has encountered the most extreme weather for more than one hundred years. The bad weather is that we cannot imagine. The fifth assessment report of Intergovernmental Panel on Climate Change (IPCC) made it clear that the average surface temperature of the earth has risen by 0.85 degree since 1880. Since the 20th century, the earth's temperature has risen by 0.89 degree. Over the past century, the sea level has risen by 19 cm[1], which mainly causes by ice melting and sea water swell, while the key to the temperature rise is the increase of carbon emissions. The city is the main cause of carbon emissions, from which the solution of greenhouse effect can be worked out.

In recent years, many cities have introduced a variety of policies to deal with climate warming. Such as "green city", "ecocity", "low-carbon city" are all out of the climate changes, these ideas are helpful to finally reduce carbon emissions. Hence "low carbon" should be taken considerations as the core element. The key measure to cope with the development of low-carbon city is urban planning, which is an action guide of low-carbon city construction.

The report of Intergovernmental Panel on Climate Change (IPCC) in 2013 shows that the possibility of global warming for human activities is 95%[1]. According to the incomplete statistics, the greenhouse gas emissions of the major cities in the world accounted for 80%, while the energy consumption reached up to 75%. This major cities are the focus of high-carbon emissions and high energy consumption. From the analysis of energy use, the city energy is mainly used for industry, transportation, residence and so on; from the root analysis of carbon emissions, city is the concentration of construction, industry, population, transportation and logistics. In the main channel of carbon emissions, industrial emissions ratio is about 29%, transport emissions ratio is 33%, building emissions ratio is 39%. These energy consumption and carbon emissions are mainly used for home life. Therefore, this paper analyzes the factors and measures of low-carbon urban planning from the perspective of residents' living and consumption, which is the key issue of constructing low - carbon city.
2. The concept of low-carbon city planning

The concept of "low carbon" comes from the word "low carbon economy" put forward by the British government in the Energy White Paper in 2003. Since then, with the climate change and the increasing awareness of the residents' living environment, "low-carbon economy", "Low-carbon society" and "low-carbon city" have gradually become research hotspot of national experts. At present, the concept of "low-carbon city" has no unified definition international, experts unscrambled it as follows: Low-carbon city is a model of urban construction and social development helpful to reduce carbon emissions through economic development model, the concept of consumption and lifestyle changes, and the premise of ensuring the improving quality of life[2]; Through zero-carbon and low carbon research and its wide application in urban development, Low carbon city saves and intensively uses energy to reduce carbon emissions[3]; Low-carbon city has taken urban space as the carrier to develop low-carbon economy, implement green transportation and construction, change the concept of consumer consumption and innovate low-carbon technology, so as to achieve maximum reduction of greenhouse gas emissions[4]. On the basis of the current research, this study suggests that low-carbon city practices the combination of low-carbon economy and low-carbon society to implement low-carbon production, living and consumption way, so as to form an ecological synthesis catering for residents' life and promoting harmonious and sustainable development of the environment.

3. The core element

The establishment of low-carbon city is a systematic project involving all aspects of city works, which calls for the policy support from the government and change the way of residents' life and consumption. Low-carbon city planning includes three aspects including spatial planning, transportation planning and industrial planning. From the perspective of urban planning, the realization of low-carbon city needs three parties working together: reducing the carbon source (the result of carbon reduction), cutting down carbon emissions (the process of carbon reduction) and strengthen the carbon capture (the results of carbon reduction). On the basis of 'the three parties' principle mentioned above, the core elements of low-carbon urban planning is analyzed from the perspective of residents' living and consumption patterns. (see table 1).

Table 1. Core elements of low-carbon urban planning based on residents' living and consumption

| Content            | Effect                  | Elements                              |
|--------------------|-------------------------|---------------------------------------|
| Spatial planning   | The source of carbon reduction | Using land                           |
|                    | The process of carbon reduction | Controlling urban density            |
|                    | The result of carbon reduction | Building ecological unit             |
|                    | The source of carbon reduction | Using low (zero) carbon vehicles      |
| Traffic planning   | The process of carbon reduction | Developing public transport           |
|                    | The result of carbon reduction | Establishing the Green Railway        |
| Industrial planning| The source of carbon reduction | Using low-carbon new energy           |
|                    | The process of carbon reduction | Upgrading traditional industries      |
|                    | The result of carbon reduction | Curing pollution and recycling waste  |

4. Low-carbon urban planning strategy

4.1. Low-carbon urban spatial planning

4.1.1. Improving the mixed use of land. Urban land use planning is a process of rationally arranging and coordinating the nature of the land in each block of the city. At present, in the process of urban land planning, in order to pursue the beautiful view and short-term benefits, the government neglects the actual land use efficiency and the convenient life of the residents, which causes: the degree of mixed land use is low, the urban land use structure is irrational, the proportion of land use is poor, land
planning function of the suburbs and the rare area of population is single, etc. These phenomena leads to the increase of unnecessary traffic trips and the waste of land and construction resources in the city and increase of the carbon emissions as well. In the process of land use planning, we should pay attention to the proportion of various types of land use balance and increase the mix use of land in the construction area of the cities. In addition, we should take a notice to the scale of various land blocks, the implementation of compact space use, so that urban residents could meet their demands of life, work, and entertainment in the lowest carbon way.

4.1.2. Controlling urban density. According to the survey, the characteristics of modern city was pie-shaped. The residents are separated from workplace and residence. Due to the unhealthy phenomena of urban real estate the school district housing and land property market, the urban regional development is uneven, thus increasing the environment, traffic and resource pressure of the central part of the city and downtown district. We can solve these problems by controlling the city density and reducing its scale.

(1) The reasonable control of construction land is the core of urban scale growth management. The government controls the excessive growth of real estate and makes effective use of land space. It should also consider the layout of the construction land to prevent the erosion of the carbon sink space, but also take into account the differences in regional development. The area which has higher output efficiency and less impact of ecological environment should be rationally distributed.

(2) In the area of community and urban regional planning, the shape of "compact city" and "multi-center network city" should be promoted, and the effective mix of urban land should be encouraged. The root of residents' separation from workplace and residence is caused by uneven housing price gap and educational resources. By narrowing the gap between the two, the government encourages the development of suburban cities and small cities to form a number of central urban areas that can relieve the commercial centers and property pressures of large cities, which solves the problem of "weekend family", "long-distance families". By reducing carbon emissions, the quality of residents' life has been improved.

4.1.3. Building ecological unit. Urban planning is designed to draw policy of the "zero-carbon residential" issued by the British government, The sun and wind community of Danish Beder, the low-carbon technological innovations in UAE Masdar, and the eco-city in Tianjin, China[5], the low (zero) carbon community planning and construction should pay attention to:

(1) Construct the pollution-free and low-pollution energy use of the communities; and build wind power communities and solar energy communities by local resources;

(2) Build public areas of waste recycling and energy recycling in the communities, following the principle of zero carbon, zero waste, etc..

(3) Create green space system in cities based on its ecological and landscape feature. Combined with the urban natural resources and spatial structure, the construction of green space system gives priority to mountain, water, field and forest, supplemented by the green space in the inner part of the city. It is built between the traffic corridor and river system surrounded by the green belt.

4.2. Urban public traffic planning

4.2.1. Encouraging the use of low (zero) carbon vehicles. Vehicle exhaust emissions is an important component of urban carbon emissions.

(1) To encourage the purchase of electric energy private cars, the government introduces preferential policies, such as car concessions, driving concessions and others to encourage residents to buy electric energy vehicles.

(2) To encourage residents to travel by bike, the government create a good environment for them, constructing urban bicycle road separated from pedestrian and motor vehicle tracks, setting up a
special bike road in the city overpass and underground passageways, establishing bicycle parking lots with modern management system to prevent stealing and keep the environment clean.

4.2.2. Vigorously developing public transport. Public transport mainly refers to the bus tram, subway, light rail, bicycles, taxis and sharing small cars.

   (1) Improve urban bus system. The city government can build a wide coverage of the public transport network, design reasonable bus station, provide convenience for residents' travel, designate bus lanes to strengthen the bus operation management shorten the residents' travel time, and reduce bus fares according to the residents' bus cards they hold.

   (2) Speed up the construction of rail transit. Because the subway and light rail bear the characteristics of large volume, high speed and low carbon emission, the urban residents prefer to these. The urban government rationally plan urban rail transit with the development of urban overall planning and urban land development.

   (3) Innovate sharing of electric cars and bicycles. Firstly, increase the sharing of bicycle usage. Many cities have now put up bike-share program to facilitate the use of residents. By increasing the type and number of bicycles, the city does not ask for returning the rent bikes, simplifying the steps of using the bicycles, in order to encourage citizens to travel by bicycles; secondly, share the innovation of small cars. The idea of sharing the power of private cars has long been proposed, but has not been put into practice. In recent years due to the deterioration of urban environment and fog invasion, the government has increased capital and technology inputs to achieve the sharing of private cars.

   (4) Control the amount of private cars. From the perspective of government policy, the city should establish a series of measures on implementing the vehicle tail number limit system, controlling the car brand index, strengthening and regulating the public area parking management system and establishing fees management system of the city's public parking and so on.

4.2.3. Establish a green wedge green space system for carbon sink absorption. Carbon sinks refers to the amount of CO\textsubscript{2} absorbed and stored by plants. The green space between the bus roads can form a public transport green wedge corridor in conjunction with water systems, wetlands and so on. Besides, it can maximize carbon capture, absorb and reduce the atmospheric CO\textsubscript{2} composition in order to promote the development of ecological units evenly.

4.3. Urban industry planning

4.3.1. Innovating low-carbon new energy. The city can increase the cultivation of new industries, expand the connotation of urban industry. The city can cultivate low-carbon emerging industries, relying on existing resources, and independently developing new energy and new materials, vigorously developing solar energy, bio-energy, urban waste power generation, green logistics and other industries, so as to improve the proportion of the tertiary industry and light industry.

4.3.2. Adjusting and optimizing the industrial structure. Industry is the pillar of urban economic development, the proportion of industrial structure adjustment, optimization and upgrading is a fundamental guarantee to change the way of urban economic growth and achieve urban low-carbon development. Most of the city's economic development depends on the first and second industries, but the tertiary industry development of low energy consumption and low carbon emissions is not complete. Therefore, the adjustment of urban heavy and light industry ratio and the optimization of industrial structure have become an important way to promote the development of low-carbon city.

The city can start from the following aspects:

   (1) Increase funding and technical support. The city government should gradually improve related laws and regulations of the low-carbon, strengthen the dissemination and education of low-carbon ideas and promotion; through investment, finance, taxation and other means, encourage, guide
and support the transformation of high energy consumption enterprises and the creation of new energy companies, provide funds and talents for low-carbon R & D projects;

(2) Increase the market share of low-carbon products. The government can improve the inherent power of low-carbon production enterprises, strengthen the understanding and use of low-carbon products in order to promote the formation of low-carbon industrial structure.

4.3.3. Vigorously improving the efficiency of resources, energy efficiency and recycling waste. The development of renewable resources industry and environmental protection industry is not only conducive to saving resources, energy, but also reduces the greenhouse gas emissions and waste dust on the environment pollution. According to the development needs of the process of urban modernization, the city combines the changes in the national energy consumption structure with the improvement of urban fuel supply, expanding oil and gas consumption, and maximizing the level of gasification and high-quality fuel supply in all types of cities. The city should focus on research and development of advanced power generation technologies such as clean coal, nuclear energy, solar energy, wind energy, advanced energy-saving technologies, carbon capture and storage, and renewable energy.

5. Conclusion
Urban planning determines the long-term and sustainable development of urban development, the construction of the city's physical environment requires a lot of resources, and have a great impact on the residents' life and consumption. The realization of low-carbon city needs common efforts through technology innovation, advocacy of healthy lifestyles and building a better green earth home.

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