

Conceptual Model and Evaluation Index of Low-Carbon Urban Economy

Jun Liu^{a*}, Yuanyuan Liu^b, Yao Wang^c

Guizhou University of Finance and Economics, Guiyang 550025

^aemail: liujunsucceed@163.com, ^bemail: 5267865@qq.com, ^cemail: 479095320@qq.com

Key words: Evaluation Index; Low-carbon Urban Economy; Conceptual Model

Abstract: Conceptual model and evaluation index of low-carbon urban economy are researched in this paper through the case study method. First of all, challenges of low-carbon city economic development in Zunyi are analyzed. After that, conceptual model and design idea of index of low-carbon urban economy are given. Finally, some policy suggestions are propounded to how to develop low-carbon economy in Zunyi.

1 Introduction

Low-carbon city refers to market with low-carbon economy as direction of development^[1], people with low-carbon life as concept and behavior characteristics, government management with low-carbon society as construction specimens and blueprint. In 2008, the Swedish capital, Stockholm, put forward the construction of low-carbon city for the first time, followed by some developed countries which have also put forward their own low-carbon city development plan.

Low Carbon City refers to promote low-carbon economy, realize low-carbon emissions^[2]. Swedish capital Stockholm put forward to develop low carbon city in 2008 for the first time, then Paris, London, Tokyo, etc have also proposed low carbon city development blueprint.

Due to our long-standing imbalance in regional development, developed area has entered the late stage of industrialization. Production structure is becoming more rational, the primary manufacturing massive migrate to Zunyi. Developed areas, in the past development process, has accumulated a large amount of greenhouse gas emissions. With rapid industrialization and urbanization, Zunyi carbon dioxide emissions will certainly continue to increase.

2 Literature Review

Shwayri s. t. (2013) believed that the carbon emissions per person should be used to assess the level of low-carbon cities, not total carbon emissions. Because human activities are the source of greenhouse effect intensifying. Carbon emissions is huge in some big cities of Korea, after divided by the number of urban population's, per capita carbon emissions become very small, which complies with the standard of low-carbon green city^[3]. Dai Yixin (2009), Tsinghua University, believed that the development level of low-carbon cities can be seen from intensity of carbon emissions^[4]. The other is using comprehensive index systems. S. Rory et al. (2013) from the target of ecological environment protection, according to the world bank data in 2010, using eight indicators of garbage harmless treatment rate, carbon productivity, carbon emissions per unit of building area, forest cutting, etc., assessed the level of ten low-carbon cities in United Nations and the results show that the level of Stockholm is the highest^[5].

To sum up, at present, the shortcomings of low-carbon urban economy research are as follows: (1) low-carbon city is a multidimensional concept, whose connotation is rich. Single indicator cannot express low-carbon economic development, city residents' low carbon life and other important aspects; (2) comprehensive evaluation index system can more comprehensive evaluate low-carbon cities, but often confused with low-carbon cities and eco city; (3) using the same index system to measure developed regions and Zunyi neglects the different stages of development in these regions. Zunyi in a faster growth phase is bound to be accompanied by higher energy consumption and carbon emissions

3 Challenges of Low-carbon City Economic Development in Zunyi

(1) Rapid economic growth has caused a sharp rise in production energy consumption. In 2007, GDP growth rate of Zunyi was up to 14.2 percent, the first time in the history that more than developed regions. After this, there are five consecutive years that more than developed regions. The development of Zunyi is inseparable from coal, petroleum-based fossil fuel resources. Under the background of high-carbon energy structure, to maintain rapid growth and large scale industrial production, it is bound to release a large amount of greenhouse gas in production field, which is a challenge for the formation of low-carbon city economic.

(2) Rapid population growth has caused greenhouse gas emissions continue to rise. In the last five years, the urbanization of Zunyi has accelerated, and average annual rate of urbanization was 2.1 percent, which is about twice as high as developed region. In Zunyi, there is more than 600,000 new urban population each year. If they can reach current level of coal consumption of urban residents, it will increase by about 42 million tons of greenhouse gas emissions per year, which will bring more challenges for the construction of low-carbon cities.

(3) Low-carbon urban development concepts of cadres and masses exist errors. Due to low-carbon cities still belongs to new concept, in current domestic (especially Zunyi) , the understanding to low-carbon urban economic levels and patterns is not yet clear. Some misleading of low-carbon city economic direction simply emphasizes the absolute reduction of carbon emissions, resulting in Zunyi City is over cautious for some high-energy consumption industry in the process of urban economic development. In fact, the essence of low-carbon city economy is "base on the rapid economic and social development, carbon emissions maintain at a relatively low level". If regardless of economic growth, blind to reduce carbon emissions, we will lose the original meanings of low-carbon city economy. Therefore, the accurate understanding to low-carbon city is particularly important. For Zunyi, the construction of low-carbon city is not to maintain the poor and the original, but to truly achieve the high growth of low-carbon.

4 Conceptual Model and Design Idea of Index

Zunyi is a typical less developed areas in China, also one of the important low-carbon pilot cities determined by central government to. As early as 2010,Zunyi began to promote low-carbon urban economy. How about is the low-carbon urban economic for the last few years in Zunyi. What is worth attention and improvement. All these problems depends on the quantitative measurement of index system.

4.1 Conceptual Model of Low-Carbon City Economic Development in Zunyi

City is main place of production and consumption, it is the important carrier of population, industry and market. With a large number of products and rapid influx of population, carbon dioxide released by urban carbon sources (mainly three major carbon sources: production, transportation, construction and residents living) will increase significantly. On the other hand, cities also have two big carbon sink resources: forest and Greenland, which can remove carbon dioxide out from atmosphere. From the point of carbon source and carbon source, the construction of low-carbon city is the process of reducing carbon sources and increasing carbon sink, as shown in Figure 1.

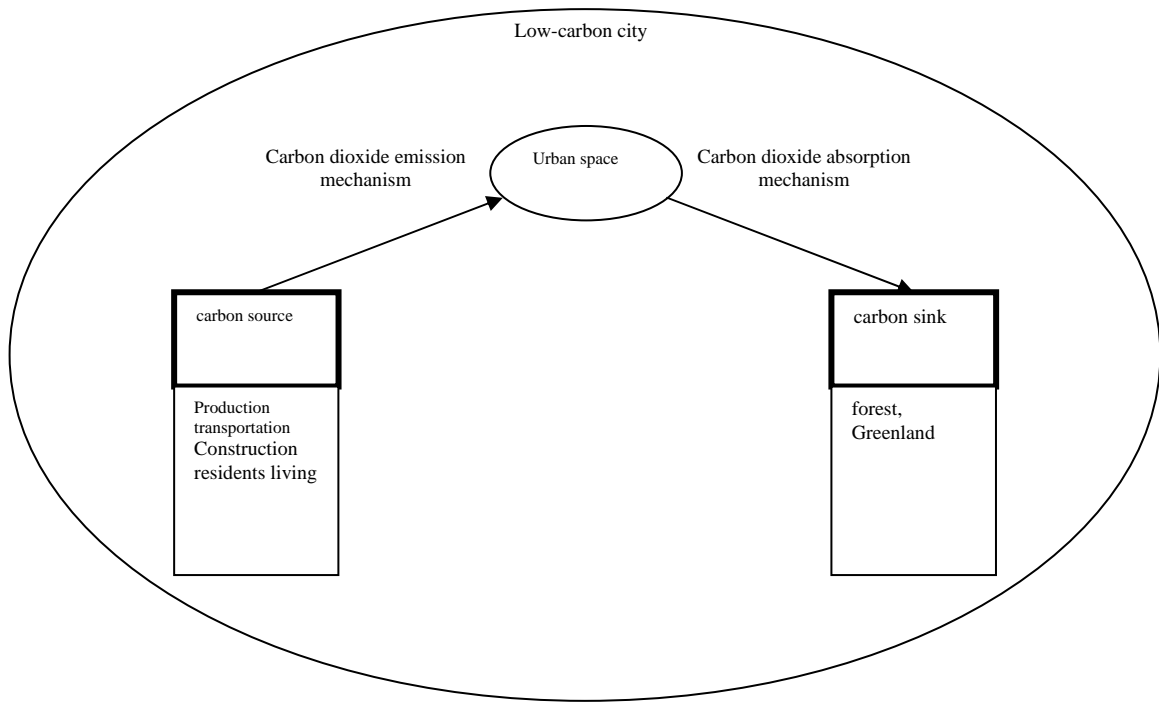


Fig. 1 Conceptual model of low-carbon city economic development in Zunyi

4.2 Design Idea of Index of Low-Carbon City Economic Development in Zunyi

Through the above analysis, it can be found that the level of urban low-carbon can be evaluated from two aspects: carbon source and carbon sink, so this paper will design low-carbon city measure index system from target layer, standard layer, factor layer and index layer, as shown in Figure 2.

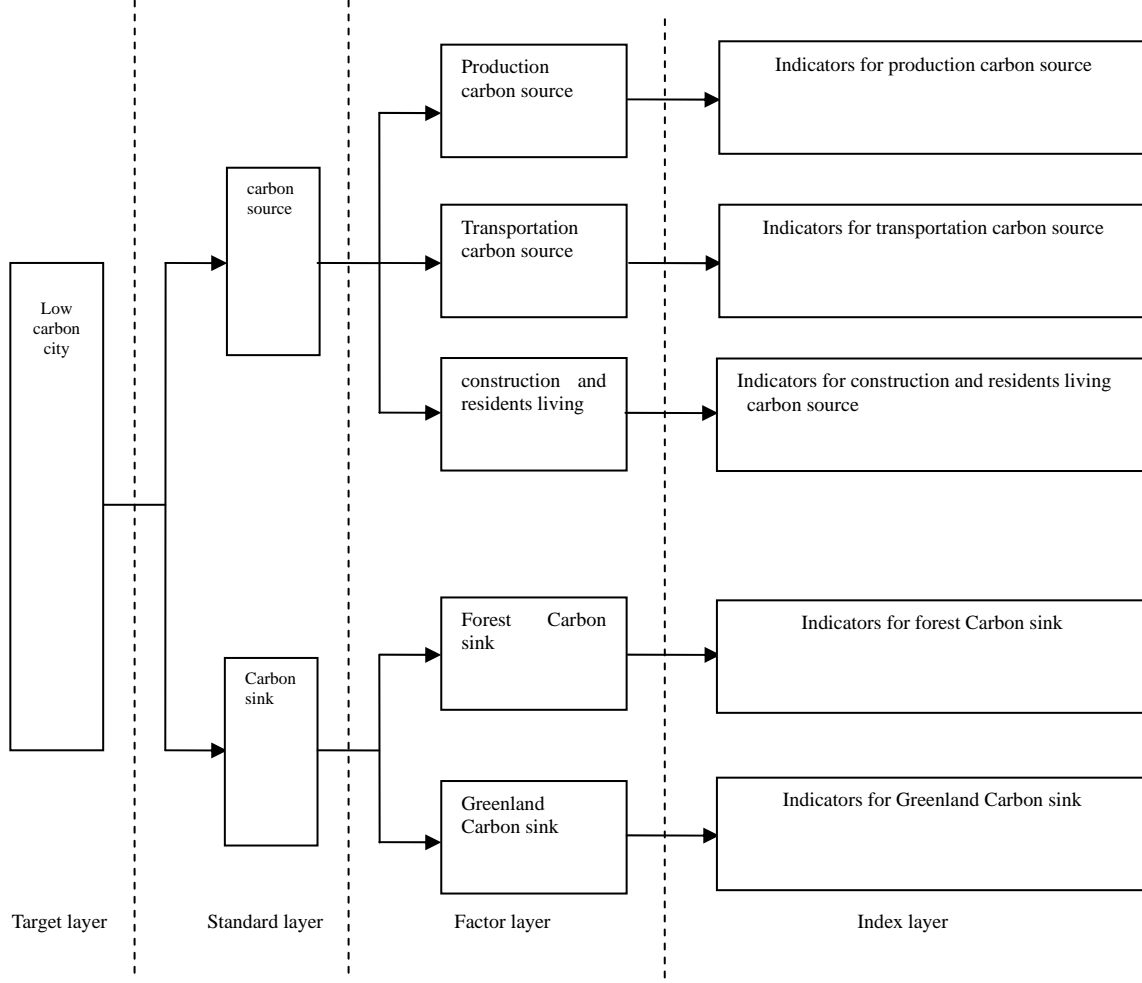


Fig. 2 Design idea of index of low-carbon city economic development in Zunyi

Low-carbon city is a complex system with many factors and multi dimensions. It is necessary to consider index selection criteria and data availability, so the selection of index must follow certain principles.

(1) Scientific and systematic principles. Scientific requires the selection of indicators should be as far as possible be consistent with international and domestic concepts and connotation of low-carbon city, can be able to have a reasonable explanation for low carbonization degree of city. Systematic requires to handle the relationship between part and whole. It is not only reflect the current situation of low-carbon cities, but also take into account the measurement results of target layer, standard layer and factor layer. The indicator layer and other layers are organic combined into a whole.

(2) Comprehensive and streamlined principles. Index system should be able to reflect the main aspects of low-carbon city and can objectively reveal the essence of low-carbon city. However, index system is not the larger the better, but need to consider the degree of difficulty and reliability of quantitative indicators. The selection of indicators should be concise and easy to understand. The selected indicators which got through the repeated screening, should have a general, but also can use the least indicators to reflect the most information.

(3) Comparability and feasibility principles. Low-carbon city measurement should ensure the results of each city can be compared, so that we can analyze the reasons and put forward countermeasures. Therefore, we must pay attention to its universal applicability when choose indicators, so that the index can be horizontal contrast. Low-carbon city measurement need a lot of data as the basis for quantitative calculation. However, low-carbon city is just emerging, statistical departments have not yet set up a sound related database, which makes the measurement work in a dilemma. Therefore, we should select indicators with more complete statistical data to ensure the index system can be applied.

The index system is composed of 13 indexes. According to the above analysis, construction of low-carbon city is the process of reducing carbon sources and increasing carbon sink, we should consider positive and negative of the indicators. Carbon source indicators are negative for the development of low-carbon cities, so should be negative indicators, and carbon sink indicators should be positive indicators. Each index of Low Carbon City Indices System are interpreted as follows:

(1) Indicator of production carbon source. Energy intensity ($Indexe_1$) refers to the proportion of final energy consumption accounted for GDP. It is one of the most commonly used indicators to compare the efficiency of energy utilization in different regions, unit for “tons of standard coal / million Yuan”, reflects energy consumption per unit of GDP. The smaller absolute value of index, the higher degree of production low-carbon. Carbon emission intensity ($Indexe_2$) is the ratio of carbon emissions to GDP. It reflects carbon dioxide released from the production of ten thousand Yuan product. Under the premise of pursuing "zero discharge" in low-carbon cities, the smaller absolute value of carbon emission intensity, the smaller of carbon emission. Since industrial production is a large carbon emissions, carbon emissions ($Indexe_3$) of unit industry GDP is very important. It is characterized by carbon dioxide emissions of every ten thousand Yuan industrial products. Coal is the main fuel for industrial production, and coal combustion will produce a lot of sulfur dioxide, pollution environment, so the unit industrial GDP sulfur dioxide emissions ($Indexe_4$) is one of important measure indexes.

(2) Indicator of transportation carbon source. Automobile tail gas is main carbon source in the Copenhagen agreement. Private car ownership ($Indexe_5$) per hundred people can reflect the degree of low carbonation in the city. Natural gas, methanol and other clean energy vehicles can significantly reduce carbon emissions, so using clean energy vehicles is the future development trend of low-carbon transportation. The current clean energy vehicles are not yet universal, it can use the proportion of non clean energy vehicles ($Indexe_6$) to reflect transportation carbon source. Per capita transportation carbon emissions ($Indexe_7$) can reflect the overall status of carbon dioxide emissions from transportation carbon source. The total amount of carbon emissions is affected by size of cities, which cannot reflect the comparability of index system.

(3) Indicator of construction and residents living carbon source. Green building is an important place for urban energy saving and emission reduction, which is also the key area of low-carbon city construction in the future. But now the construction of our country that can reach green building standards is very little. Therefore, we can use the proportion of non-green buildings (Index₈). Lighting, home appliances, domestic hot water, etc. consume a lot of energy, which is the main source of residents living carbon emissions. Therefore, we can use per capita electricity consumption (Index₉) to character residents living carbon source.

(4) Indicator of forest carbon sink. Forest carbon sink can be increased by actively promoting artificial afforestation. Planting area per hundred people (Index₁₀) can well reflect the ability of carbon neutral in low-carbon cities. Forest coverage (Index₁₁) will grow with the increase of tree planting area, decrease with the expansion of cutting area, dynamically reflect the change of forest carbon sink in low-carbon city.

(5) Indicator of Greenland Carbon sink. Green space is the most important carbon sink in the city, plays a strong role in carbon absorption. The proportion of Green area accounted for a total area of urban (Index₁₂) reflects the general situation of green space in macro urban space. While per capita green area (Index₁₃) reflects the status of green carbon sink in micro level, which can avoid the impact of size and population of city, ensure the comparability of various medium scale cities.

5 Policy Suggestions

Zunyi has the characteristics of high growth (high driving force). The pressures of urban population, resources and environmental will become more and more. We cannot at the expense of economic development and people's quality of life to achieve "low-carbon". Therefore we must consider that in the form of "carbon neutral" to ensure low-carbon city economy. Government can focus on supporting a number of carbon emissions trading market in Guiyang, in these markets, vigorously promote green finance, green credit and policy tilt, encourage enterprises to actively participate in carbon emissions offset mechanism. Government should also develop measures to protect forests, grasslands, wetlands and other carbon sinks which can fully play the role of carbon absorption.

Acknowledgements

Research on evaluation of tobacco farmers classification and differential management in southwestern Guizhou (2011-15); Study on the mechanism of foreign assets of tobacco farmers cooperatives inclusive (2015-9); Guizhou Province Science and Technology Fund project (Qiankehe J [2015] No. 2028); Science and technology project of China National Tobacco Corp Guizhou Branch (201224); National social science fund project (14CJL032)

Reference

- [1] World Resources Institute. Climate analysis indicators tool[R]. New York , U. S. A. : WRI,2010:3-4.
- [2] Malla S. CO₂ emissions from electricity generation in seven Asia-Pacific and North American countries: A decomposition analysis[J].Energy Policy, 2009, (37):1-9.
- [3] Shwayri S. T. A model Korean ubiquitous eco-city? the politics of making songdo[J]. Journal of Urban Technology, 2013,20(1): 39-55.
- [4] Dai Yixin, Concept evolution and measure of low carbon urban development [J]. Modern Urban Research, 2009,(11): 7-12.
- [5] Rory S., Andy G., Webber P. Funding low carbon cities: local perspectives on opportunities and risks[J]. Climate Policy, 2013,13(4): 514-529.