

**PROCEEDINGS OF THE  
INTERNATIONAL CARBON NEUTRALITY TRAINEESHIP PROGRAM  
Volume.02, Number.1, 2024, 109-113**

# **Rational Use of Spatial Panning is an Effective Means to Achieve Carbon Neutrality**

**Xiaoqiao LIU**

Chang'an University, Xi'an, Shaanxi, China, 710064

Email: liuxqiao0616@163.com

**\*Corresponding author**

## **Abstract**

Taking the carbon neutrality target of each country as a starting point, we analyzed various influencing factors that have an impact on carbon emissions, selected three representative countries, analyzed different natural and socio-economic conditions of each country, proposed strategies on how to use territorial spatial planning for carbon neutrality management, and proposed priorities for optimizing spatial patterns and planning responses to meet the carbon neutrality target in the future, hoping to provide suggestions for achieving carbon neutrality in other international places. It is expected to provide suggestions for other international places to achieve carbon neutrality.

**Key words:** Spatial panning; carbon neutrality; suggestion.

## **1. Rational use of spatial panning is an effective means to achieve carbon neutrality**

Spatial planning can increase carbon sinks and reduce carbon emissions by optimizing urban spatial forms and changing land use functions, which is important to achieve the double carbon goal. The current planning practice often cuts into low-carbon planning from the perspective of ecological planning, or promotes urban reduction and quality improvement from the perspective of qualitative guidance, with a view to achieving carbon neutrality. However, the main direction and focus of planning vary from country to country, so how should we use spatial planning as a limited means to achieve global carbon neutrality?

In recent years, global high temperature, ocean acidification, sea level rise, extreme heavy precipitation and other climate problems have occurred frequently, greenhouse gas emissions are considered to be the most important factor affecting global climate change, and carrying out carbon emission reduction actions to address climate change has become a common global challenge. In order to effectively control carbon emissions and respond to global climate change, the Kyoto Protocol, the United Nations Framework Convention on Climate Change and the Paris Agreement are the three milestone international legal texts, thus forming the global climate governance pattern after 2020. In order to achieve the climate governance goal of controlling the global average temperature increase to within

2°C higher compared to the pre-industrial period and striving to keep the temperature increase within 1.5, Europe, as a global climate governance leader, proposed a carbon neutral target in 2019 and released the European Green Deal to address climate change at the end of 2019, followed by more and more countries actively proposing carbon neutral targets. On September 22, 2020, President Xi Jinping announced at the 75th session of the United Nations General Assembly that China “will strive to peak its carbon dioxide emissions by 2030 and strive to achieve carbon neutrality by 2060”. This shows that achieving carbon neutrality is an inherent requirement for the global construction of ecological civilization system and the implementation of high-quality development, an inevitable choice for striving to solve the outstanding problems of resource and environmental constraints and achieving the sustainable development of global people, as well as a solemn commitment to build a community of human destiny.

The European Spatial Development Perspective (ESDPI) has taken European spatial planning to a new level. Spatial planning” has also become a special concept. Since the 21st century, with the advancement of globalization and informationization, the urban and rural spaces of various countries, especially the dense urban areas and metropolitan belts in developed countries and regions, have undergone significant changes in spatial and human environments, and in the pursuit of sustainable development goals, human beings have begun to reflect on the nature and orientation of planning. In the process of pursuing the goal of sustainable development, human beings have begun to rethink the nature and orientation of planning. The original planning system of each country has been challenged in the new development context, and in order to maintain the coordination, integrity and strategy of spatial development, more and more countries pay attention to the integration of planning, and shift from traditional urban planning and land use planning to spatial planning and reform and improve the spatial planning system from time to time. Now spatial planning has become an effective means for countries to reasonably allocate land use structure, coordinate urban layout and promote ecological civilization construction.

Therefore, according to the different development characteristics of each country, combined with the preparation and implementation of each country’s territorial spatial planning, building a pattern of territorial spatial development and protection conducive to carbon peaking and carbon neutrality, promoting green and low-carbon transformation of urban and rural construction, advocating green optimization of the pattern of territorial spatial development and protection, strengthening territorial spatial planning and use control, plays a vital role in the implementation of the carbon neutrality target.

## 2. Method

### 2.1. Materials

In this paper, we read a large amount of international well-known literature in the past three years, mainly from Peking University and CSSCI, to establish the interrelationship between land use structure and carbon emissions.

### 2.2. Procedure

Analyze the various influencing factors that have an impact on carbon emissions. The factors influencing carbon emissions include population, economy, technology, and construction land. Among them, population influence factors are often selected from indicators such as population size, population urbanization rate, population growth rate, etc. to analyze the relationship between carbon emission indicators and carbon emission; economic influence factors are often selected from indicators such as total GDP, the proportion of secondary and tertiary production, and the affluence of residents; technology influence factors are often selected from indicators such as the proportion of coal-based energy, energy intensity, etc.; construction land influence factors are often analyzed from the scale of land. The influence of construction land is often analyzed in terms of land size, function type, material structure, etc.

Based on the regulation between influencing factors and carbon emissions and identified three representative countries, namely Germany, Denmark and China, according to the characteristics of spatial planning in different countries, and analyzed the natural and economic development of each country respectively, and proposed the use of The effective strategies to achieve carbon neutrality through spatial planning are proposed for each country.

### **3. Results**

From the history of human civilization development, the function, scale, structure and layout of the territorial spatial pattern in different periods have influenced carbon emissions. In the period of agricultural civilization, the spatial pattern of the country with the growth of agricultural land was formed, the focus was on guaranteeing food production and survival needs, and since fossil energy was not used, the main influence on carbon emission was some human agricultural activities, and the pressure of carbon emission was not obvious; in the period of industrial civilization, the use of fossil energy promoted the priority development of urban space, and the spatial pattern of the country with the growth of construction land was formed. The scale of intensive use of construction land and the proportion of industry all affect carbon emissions and lead to a significant increase in carbon emissions and increasing ecological pressure. Under the concept of ecological civilization in the new era, countries should adhere to the concept of sustainable development and promote the optimization and coordination of the territorial spatial pattern on the basis of ecological priority. The key is to reshape the territorial spatial pattern by optimizing the industrial structure, improving energy efficiency and restraining the spatial expansion of construction land, so as to enhance the ecological carbon sink capacity on the one hand and realize carbon emission reduction and intensive transformation development on the other.

In general, the spatial pattern of land affects the carbon balance of the region through the structure and intensity of land use and its changes, as well as the way of carrying human activities. On the one hand, the pattern and characteristics of regional natural carbon balance are determined by natural processes such as photosynthesis and respiration. On the other hand, human activities greatly change the carbon balance of natural regions through industrial activities, resource development, energy consumption and land use. The impact of the change of territorial spatial pattern on regional carbon balance has two sides. For different land spaces, fossil energy consumed by industrial production, transportation and living is the main cause of carbon emission from construction land, while agricultural activities, land reclamation, ecological restoration and forest management can enhance the ecological carbon sink capacity of agricultural land and forest land.

Therefore, emission reduction/sink enhancement and regulation of regional carbon balance can be achieved by optimizing the spatial layout of national land and human activity intensity constraints. For example, from the spatial proximity and connectivity relationship, the diversified proximity layout of carbon source/sink function land can help the carbon absorption in proximity, the proximity layout of high energy-consuming industrial land and clean energy land can help to get rid of the dependence on fossil energy in the production process, and the optimization of transportation land pattern can help to improve the energy utility efficiency, all of which can help to reduce the carbon emission intensity and significantly change the regional carbon balance.

### **4. Discussion**

In recent years, many developed countries have adopted legislation based on carbon neutrality targets, and some of them have achieved remarkable results. Based on this, this paper selects Germany, Denmark and China as representative samples to explore their methods of achieving carbon neutrality through spatial planning as an effective means.

#### **4.1. Germany**

Germany was the first country in the world to carry out spatial planning, which consists of federal planning, state planning, regional planning and local planning. German spatial planning, with its emphasis on “order”, focuses on whether regional and social development is balanced, the impact of development on the environment and whether development is sustainable.

Germany is in the cool westerly zone between the continental climates of the eastern Atlantic Ocean. Agriculture is well developed and highly mechanized. Forests cover an area of 10,766,000 hectares, accounting for about 30%

of the country's area. Territorial spatial planning can ensure that Germany's forest area does not decrease and the mechanization level of intensive agricultural land use does not decrease through reasonable land use indicators.

Germany is a relatively poor country in terms of natural resources. Apart from its rich reserves of hard coal, lignite and salt, it relies heavily on imports for raw materials and energy, and imports about 2/3 of its primary energy. The German Association for Environment and Nature Conservation and others believe that spatial order planning needs to be given more power in areas such as land protection, mining management, and spatial layout of wind energy facilities to avoid excessive power of local subjects to the detriment of public interest. Spatial planning can be used to reduce the damage to forests and the environment in the mining process as well as to do the reclamation work after mining.

Industrial development focuses on heavy industry. The automobile and machinery manufacturing, chemical and electrical sectors are the pillar industries. Spatial planning should use policies such as precise land supply and mixed industrial land supply to guide traditional industries to green and digital upgrade, develop new green industries, and promote the creation of a green, low-carbon and circular economic system.

## 4.2. Denmark

At present, Danish spatial planning is divided into three levels: national planning, municipal planning and local planning. The objectives of Danish spatial planning are always in line with the economic and social development and the external environment of the country. In recent years, the Danish national planning has focused more on European integration, national and regional center building, environmental protection, and so on.

In recent years, Danish national planning has focused more on the issues of European integration, national and regional center construction, and environmental protection, playing a strategic leading role in infrastructure construction, ecological protection, water conservation and energy construction.

Denmark has a temperate maritime climate with warm winters, cool summers, abundant precipitation, a mild and stable climate throughout the country, and relatively uniform annual precipitation. Therefore, sustainable reforestation and restoration of degraded forests are good measures advocated in the national plan. This measure increases carbon dioxide uptake, while increasing the resilience of forests and promoting a circular bio-economy.

Denmark is a small and open economy with a highly developed agriculture. Spatial planning can be used to increase land dedicated to science, technology and infrastructure and to create new carbon reduction technologies to improve climate change, for example, by promoting production and the use of new sources of protein, which can ease the pressure on agricultural land.

With its extensive coastline and seas where hot and cold currents meet, Denmark is rich in marine resources. It is important to use spatial planning to manage marine space more sustainably, especially to help harness the growing potential of offshore renewable energy. Action can also be taken in maritime transport, including regulating access to its ports by the most polluting vessels and forcing docked vessels to use shore-based electricity and increasing the use of vessels with low carbon emissions.

## 4.3. China

China's territorial spatial planning started late but developed rapidly and consists of three parts: master plan, special plan and detailed plan.

China is a vast country with a large absolute area but a small land area per capita, a complex land use type, a complex urban-rural dual structure, a high degree of intensive land use in cities and towns, and a relatively low efficiency of land use in rural areas, resulting in some land that could be of ecological value not realizing its value. Carbon emission rights and carbon quotas can be used as anchors, and land development rights can be allocated in an integrated manner according to the differences in the functions of the main body of each region, and Urbanized areas focus on emission reduction, while countryside areas focus on sink enhancement. The priority task is to reduce emissions in urbanized areas and increase sinks in rural areas. Establish a trading mechanism for carbon emission rights and carbon credits. Improve the inter-regional trading market for carbon emission rights and the financial transfer payment system to enhance the competitiveness of each region. The government will also improve the inter-regional carbon emission trading market and financial transfer payment system to enhance the consistency of

incentives among regions in achieving low-carbon development transition. To improve the inter-regional carbon trading market and financial transfer payment system, and enhance the consistency of incentives among regions in achieving low-carbon development.

China is still a developing country, with a high proportion of primary and secondary industries in its industrial structure and a significantly low proportion of tertiary industries, as well as an irrational and inefficient internal structure. Spatial planning can be used for structural optimization. Based on the goal of carbon neutral development, theories such as new urbanism and new idyllic city are developed from the perspective of spatial form to study how to promote the optimization of urban form layout and build a low carbon emission land use system.

China has a large regional area with high railroad and highway coverage, and urban travel mostly uses cars as transportation. Land use layout regulation is aimed at promoting carbon emission reduction and carbon sink, improving the utilization rate of clean energy through the adjacent distribution of industrial land and clean energy land, reducing spatial and temporal distance friction through the adjacent distribution of residential land and public facilities land, and enhancing carbon sink capacity through the arrangement of rings, corridors and wedges in green areas. The plan increases the construction of public transportation road network and infrastructure, and increases the use of public transportation to reduce carbon emissions. By reasonably delineating the three zones and three lines, we can ensure that the urban area does not increase excessively and the ecological area does not decrease, increase the efficiency of ecological land use, improve the forest coverage, enhance the carbon sink capacity, and reach the goal of carbon neutrality as soon as possible.

## References

- [1] Huang Zhengxue & Huang Lingxiang. (2019). The logic of the evolution of territorial spatial planning. *Comments on Public Administration and Policy* (06), 40-49.
- [2] Lin Jian & Zhao Ye. (2022). Territorial space planning and use control under the “double-carbon” target. *Science and Technology Guide* (06), 12-19.
- [3] Qiu Chen. (2022). To realize the scientific and reasonable planning of urban construction by means of “carbon neutrality”. Academic Committee of Urban Planning New Technology Application of China Urban Planning Society, Guangzhou Planning and Natural Resources Automation Center. (Eds.) Consolidate the data base to strengthen the innovation engine and enable multi-dimensional scenarios —— 2022 China Urban Planning Informatization Annual Conference proceedings (pp.231-236). Guangxi Science and Technology Press.
- [4] Tan Xueping & Yang Yaoning. (2021). Analysis of the linkage of “double evaluation” system in territorial space planning —— based on the analysis of German strategic environment evaluation. The Urban Planning Society of China. (Eds.) Space Governance for high-quality Development —— 2021 China Urban Planning Annual Conference (13 Planning Implementation and Management) (pp.597-604). China State Construction, Engineering and Construction Industry Press.
- [5] Tang Hang & Jinchuan. (2019). The concept, development and enlightenment of Danish space planning. *Land in China* (05), 50-52.
- [6] Xiao Baixia. (2022). Thinking on the response path of territorial spatial planning under the background of carbon peak and carbon neutrality. *Smart City* (08), 84-86. doi:10.19301/j.cnki.zncs. 2022.08.028.
- [7] Zhang Ying & Huang Yingli. (2022). The International experience and China's path of carbon-neutral practice. *Southwest Finance* (09), 94-106.?
- [8] Zhou Yi smiled. (2020). Thoughts on land use control —— based on the planning practice of sustainable development of land use in Germany. *Urban Planning* (10), 40-50.