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Study on the Development of Urbanization Pathway in Sichuan Province under the Background of "Dual Carbon"

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Abstract: In the traditional mode, the rough urbanization development mode has triggered problems such as resource shortage and environmental pollution, therefore, how to balance the relationship between urbanization, carbon emission and ecological environment has become the key to high-quality economic development. As a large province in China in terms of resources, population and economy, Sichuan Province has made certain achievements in urbanization and low carbon development, but this paper finds that Sichuan Province is still facing problems such as carbon not reaching its peak and urbanization level lower than the national average by further analzing the current situation of its energy emission and urbanisation development. Based on this, this paper discusses the future development path of new urbanisation in Sichuan under dual-carbon background, and proposes corresponding counter measures.

Keywords: "Double Carbon" Target; New Urbanization; Carbon Emission; Sichuan Province.

1. Introduction

China clearly proposed the "dual-carbon" goal in 2021 - striving to achieve carbon peaking before 2030 and carbon neutrality before 2060. Implementing the "dual-carbon" strategy requires us to transform the extensive urbanization development mode and achieve low-carbon transformation of the economic structure. In recent years, China's urbanization level has exceeded 60%. However, with the development of urbanization, the phenomenon of "virtual urbanization" has become increasingly prominent. Under this background, the proposal of a new type of urbanization emphasizes the transformation from pursuing urban scale and spatial expansion under the traditional model to improving the humanistic environment and quality of public services in cities, thus creating truly livable cities.

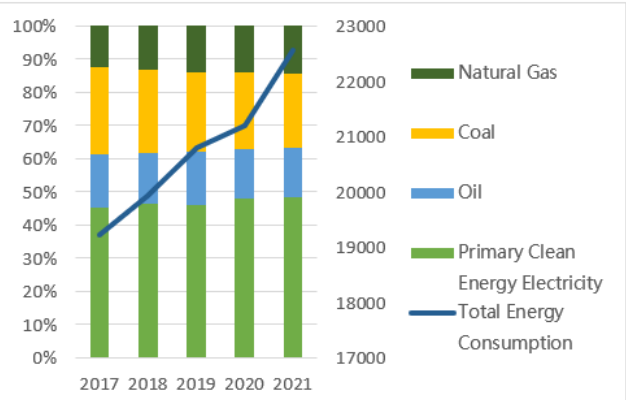
Sichuan Province is located in the southwestern region of China, with large differences in landforms and complex terrain. It has become a major province in terms of resources, population, and economy. In response to the extensive growth of the past economy, Sichuan Province has carried out a series of actions such as the "Ten Actions for Carbon Peaking" and the creation of "The Park City". However, there is still a problem of significant reduction in carbon emissions and the peak value of carbon peaking has not been clearly determined. As of 2022, the urbanization rate of the permanent population in Sichuan Province was 58.4%, which is lower than the national average of 69%, and the regional imbalance in urbanization is still prominent. As one of the core carriers of the dual-city economic circle, the construction of the urban system in Sichuan is of vital importance.

2. Current Situation of Urbanization Development in Sichuan Province under the Background of "Dual Carbon"

2.1. Status of Energy Consumption and Carbon Emissions

2.1.1. Energy Consumption Status

Thanks to the geographical advantage and hydropower resources, Sichuan has basically established a clean energy dominated energy production structure, while also has the disadvantage of natural gas and other new energy resources. In 2021, Sichuan total energy consumption growth rate of 6.53%, basically to achieve a balance between supply and demand. In the energy consumption structure, primary clean energy consumption of electricity accounted for 55.9%, higher than the national average of about 32.2%, while oil, coal, natural gas accounted for 17%, 25.9%, 16.7%, respectively, which stays at a lower level around the country.



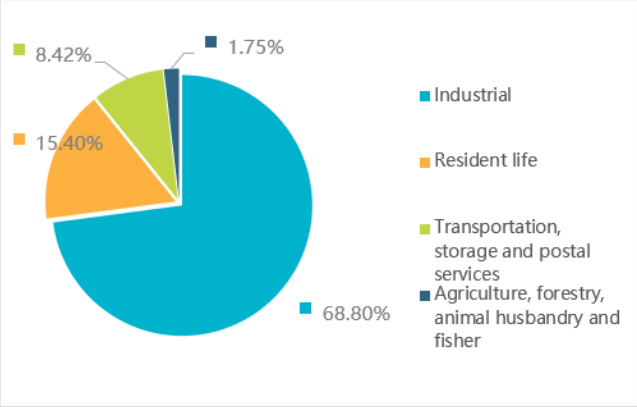
Data Source: Sichuan Statistical Atlas (2017-2022)

Figure 1. Total Energy Consumption and Composition in Sichuan Province, 2017-2021

As can be seen from Figure 1, boasting sufficient wind and hydropower as clean energy sources, the total energy consumption in Sichuan Province is growing slowly in the short term. However, considering the province's economic development is still mainly driven by industry and manufacturing, the energy consumption base is still large, and the pressure of carbon reduction still exists; meanwhile, Sichuan Province lacks other clean energy sources, which means it is difficult to fully realize the low-carbon goals by relying on electricity alone, and the energy structure still needs to be adjusted.

2.1.2. Carbon Emissions Status

From the point of view of total carbon emissions, Sichuan province's total carbon emissions during 2010-2014 grew gently and had a downward trend year by year; during 2014-2017, the total carbon emissions almost fell in tandem with the total amount of energy consumption, while the growth rate of carbon emissions reached its peak in 2017; in 2021, the total carbon emissions of the province of Sichuan will be about 300 million tons, ranking 14th in the country, while the per capita carbon emissions will be 3.57 tons, only higher than Tibet. In terms of industrial division, 68.8% of the province's carbon emissions come from industry, 15.4% from residential life, followed by transportation, warehousing and postal services, while agriculture, forestry, animal husbandry and fisheries account for the least, accounting for only 1.75%.



Data Source: Sichuan Statistical Atlas (2017-2022)

Figure 2. Industrial Composition of Carbon Emissions in Sichuan Province in 2021

Since 2017, the growth rate of total energy consumption has slowed down, but the total amount of carbon emissions still tends to rise, and thus there is no carbon peak value yet. In addition, as can be seen from Figure 2, at this stage, the added value of the six major energy-consuming industries in Sichuan Province accounts for about 30% of the total industrial added value, while the share of energy consumption is as high as 77%, and carbon emissions account for more than 40% of the total amount, so the task of industrial low-carbon transformation remains arduous. Third, with the accelerated urbanization, energy demand will continue to grow, and the current level of per capita living energy consumption is still low, but the population will also face a substantial rigid growth, carbon peak is a long way to go.

2.2. Current Status of New Urbanization

2.2.1. General Trend

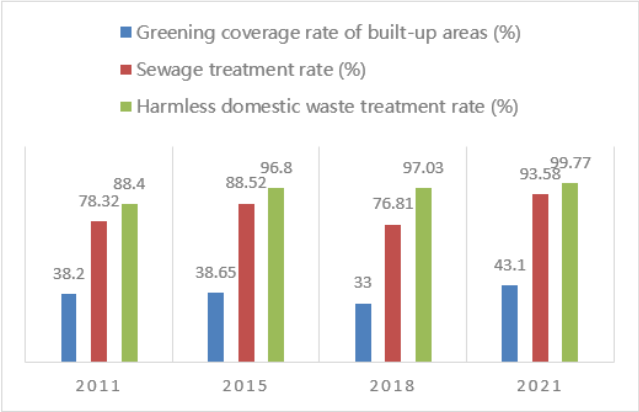
At present, the urbanization process in Sichuan Province is in a period of accelerating advancement, the economy continues to grow, the growth rate is slowing down, and gradually showing some trend characteristics: from the point of view of the population flow, the agricultural transfer population will remain large-scale, stabilized at about 26 million; in the terms of the spatial distribution of the population of towns and cities and counties, "the two ends of the" agglomeration situation are Obvious, with 40% of the province's urban resident population living in urban areas and 30% living in towns; regarding to the resource factors, the population flows frequently across provinces and cities, and the supply capacity of urban public services does not match the growing demand of the foreign population, and urbanization is accelerating from an urban-rural relationship to a conjunction relationship between urban-rural and regional areas.

2.2.2. Specific Features

Considering the representativeness and operability of the data and referring to the existing research results, the overall level of urbanization in Sichuan Province is analyzed from four aspects, namely, ecological, economic, social and spatial urbanization, as follows:

(1) Ecological urbanization:

In 2022, the overall ecological environment of the province will be "good", with an ecological environment index of 70.9. The proportion of green area in built-up areas will increase from 38.2% in 2011 to 43.1% in 2021; however, the rate of harmless treatment of domestic garbage and sewage treatment rate fluctuates, which may indicate that the rise of urban population will have a negative impact on urban environmental development. The rise of urban population has put some pressure on the development of urban environment.



Source: Sichuan Statistical Atlas (2012-2022)

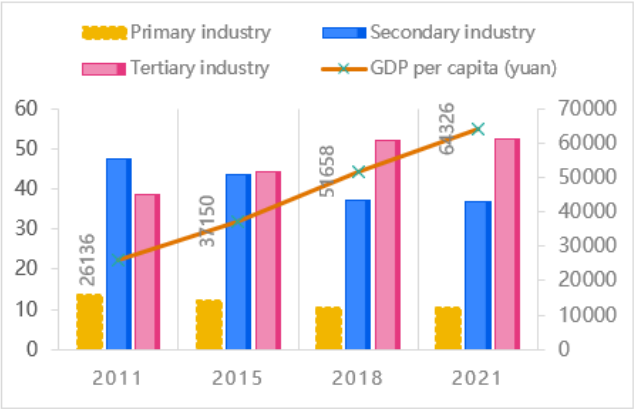
Figure 3. Trend of Ecological Urbanization in Sichuan Province, 2011-2021

(2) Economic urbanization

In terms of economy, the proportion of tertiary industry in the total GDP has increased from 38.8% in 2011 to 52.5% in 2021; the per capita GDP also increases remarkably, which tripled in 2021. Per capita disposable income and consumer spending will continue to rise, reaching RMB 29,080 and RMB 21,518 respectively in 2021. Overall, Sichuan's economy is developing at a fast pace, with major development in all factors and some success in urbanization.

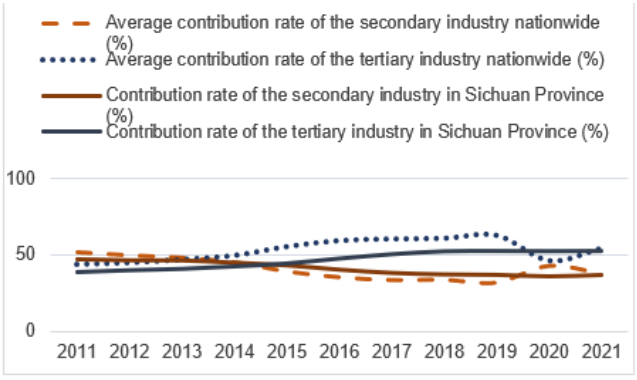
However, among the 21 cities in the province's statistics, only 7 cities have a per capita GDP higher than the average, and there is a large development gap between cities and towns. Besides, the contribution rate of the secondary and tertiary industries to the economic value added in 2021 will be lower than the national average of 1.4% and 2.4% respectively, reflecting that the industrial structure of Sichuan still favors traditional agriculture and heavy industry, and the industrial

structure still needs to be reformed.



Source: National Statistical Yearbook (2022)/Sichuan Statistical Atlas (2012-2022)

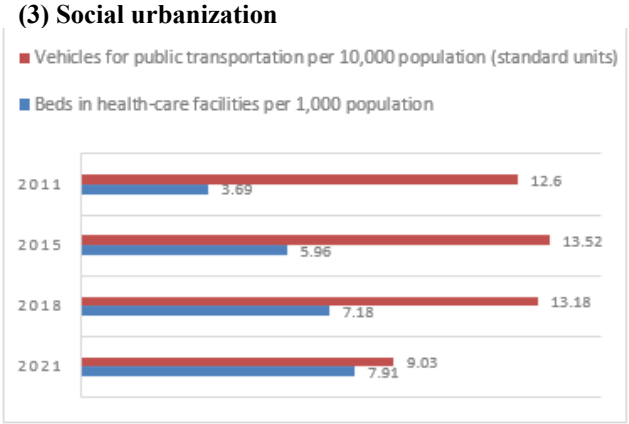
Figure 4. Trends of Economic Urbanization in Sichuan Province, 2011-2021



Source: National Statistical Yearbook (2022)/Sichuan Statistical Atlas (2012-2022)

Figure 5. Comparison of Industry Contribution Rates between the Whole Country and Sichuan Province, 2011-2021

(3) Social urbanization



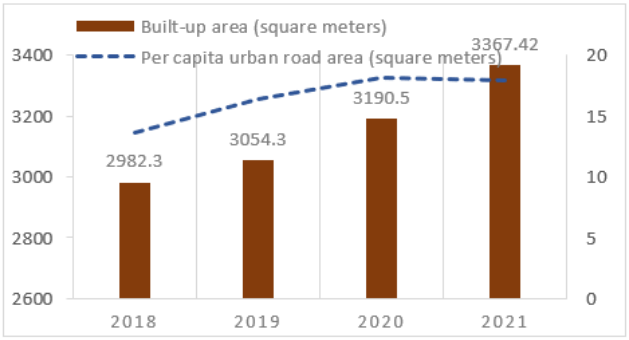
Source: Sichuan Statistical Atlas (2012-2022)

Figure 6. Development trend of social urbanization in Sichuan Province, 2011-2021

Social urbanization reflects the social security and social welfare of residents in urban life, embodying the core idea of new urbanization. From the statistical data, all the indicators of social urbanization in Sichuan Province have been improving, and the coverage rate of social security has shown an upward trend. Among them, the number of public automobile and tram vehicles per 10,000 people has decreased by a total of 4.15 standard units in the past three years, which is mainly caused by the increase in private car ownership of the residents under the rapid development of the economy rather than the insufficient investment in public transportation. Secondly, through the strengthening of the health-care system, the number of health technicians per 10,000 people and the number of beds in health-care facilities per 1,000 people have shown a year-on-year trend of increase, and are generally higher than the national average.

(4) Spatial urbanization

Spatially, the built-up area of Sichuan Province has been increasing year by year, and the built-up area rises to 3367 square meters in 2021, reflecting the trend of expanding urban areas; while the ratio of urban built-up land area to urban area and the per capita road area fluctuates, implying that problems such as traffic congestion, environmental pollution and increased energy consumption may affect the sustainable development of Sichuan Province.



Source: Sichuan Statistical Atlas (2012-2022)

Figure 7. Spatial Urbanization Trends in Sichuan Province 2018-2021

In addition, the scale of population flow in Sichuan Province is also increasing year by year, and the new population is mainly accumulated in Chengdu City and its surrounding areas. 2021, the proportion of the resident population in Chengdu City is close to 25%, which means that Chengdu City will increase the pressure on the city in the future, and at the same time, it will also further deepen the current regional development disharmony.

3. Path Choice of Urbanization in Sichuan Province under the Goal of "Double Carbon"

3.1. Promote Industrial Upgrading and Improve the Ecological Environment Level

At present, carbon emissions in Sichuan Province mainly come from the primary industry, which restricts the emergence of the peak inflection point. Therefore, accelerating the development of emerging industries and increasing the proportion of knowledge-, technology- and information-intensive industries will be conducive to reducing the reduction of carbon emissions. Secondly, it is also necessary to promote industrial innovation and development while deepening supply-side reform. For example, to promote the transformation and upgrading of traditional industries such as energy and chemical industry, non-ferrous metallurgy, innovation of green production technology, control of pollutant emissions, etc., so as to jointly promote the realization of the goal of "double carbon".

3.2. Increase Innovation Drive

Geographic location limitations make the foundation of innovation and development in Sichuan Province does not

have a historical advantage, so the government can increase the innovation and technology cooperation with neighboring regions, through innovation subsidies and other ways to incentive research and development enterprises in various regions. For example, exploring the innovative path of green development, increasing the development and use of clean energy, or achieving the optimal use of limited resources.

3.3. Promote the Coordinated Development of Various Regions in Various Aspects

In terms of urbanization rate and economic development speed, the current urbanization has tended to shift to the relationship of "urban and rural and regional", and the differentiation of the various regions in Sichuan is obvious. In 2021, Chengdu urbanization rate is 79.82%, while nearly half higher than that of Ziyang City, which is 42.12%, and we need to continue to adhere to the "one trunk, many branches". There is a necessity to continue to adhering the development strategy of "one trunk and many branches". For the Chengdu Plain Economic Zone, it is necessary to strengthen the radiant role of the central cities, while for the north of Sichuan and west of Panxi regions, it is necessary to cultivate their cultural and economic characteristics, and realize the synergistic development of the Sichuan region.

3.4. Deepen Reform and Opening Up, and Strengthen Foreign Exports

Since the lack of resources and ports, Sichuan Province has insufficient development power in opening up, therefore, it needs to strengthen its investment in "going out" and further expand foreign investment on this basis, so as to attract domestic and international factor resources, and accumulate capita for the development of cities and towns.

4. Strategies for Urbanization Development in Sichuan Province under the Background of "Dual Carbon"

With the continuous development of urbanization, more market and social entities will participate in carbon reduction, and more cities will become the main players and innovation platforms for "dual carbon" and economic growth competition. In the process of urbanization development, Sichuan Province should not only respond to the requirements of the times and comply with the overall national development strategy, but also fully utilize modern science and technology, adapt to local conditions, keep up with the times, and orderly, effectively and steadily promote development and carbon reduction.

4.1. Promote the Development of Green Buildings

Green buildings refer to buildings that fully consider environmental sustainability in their design, construction, and operation processes. The implementation of green buildings can achieve the goals of energy conservation, environmental protection, and sustainable development. It is also of great significance for achieving the "dual carbon" development goal in our province. Promoting the development of green buildings mainly starts from the following three aspects.

One is to innovate building energy-saving technology. With the continuous development of urbanization in our province, the contradiction between the construction growth rate of construction projects and the growth space continues to increase, and building energy-saving technology will have increasingly broad application space.

The second is to promote the application of green building materials. The construction manufacturing industry is one of the industrial sectors with the largest energy consumption and carbon emissions in the urbanization process of our province. How to effectively reduce carbon emissions in the construction industry is crucial for our province to achieve the overall goal of "dual carbon".

The third is the resource utilization of construction waste. Currently, the waste generated in the construction industry is mainly disposed of through landfilling, incineration, and outdoor stacking, which poses a threat to the ecological environment and people's health. Promote green construction in the field of engineering construction in the development of urbanization, implement classified management of construction waste, source reduction, and resource utilization to reduce carbon emissions and achieve the "dual carbon" goal.

4.2. Developing Low-Carbon Transportation

The logistics and transportation industry are a major carbon emitter. In response to the "dual carbon" goal in our province, the transportation industry needs to have the courage to face it directly, seize the transformation opportunities, and make diversified explorations. It mainly includes the following aspects:

One is in terms of planning and design: in the process of urbanization development, the fundamental starting point is to save resources, reduce carbon emissions, achieve sustainable economic development, and protect the human living environment. In the construction of transportation routes, priority should be given to ground laying, setting up energy-saving slopes, and applying green construction technology, ultimately establishing a accessible, orderly, low emission, and low pollution urban transportation system.

The second is in terms of operational management: by controlling transportation electromechanical equipment, installing energy management systems, and improving passenger service systems, we aim to improve the convenience and intelligence level of operational management, break barriers, achieve transportation integration, and reduce carbon emissions in cities.

The third aspect is in the application of green and renewable energy: reasonable and effective utilization of spatial resources to establish photovoltaic power generation sites, providing sufficient energy for transportation needs in our province, with good application and energy-saving effects.

Fourthly, in terms of transportation system development: By utilizing the Internet and big data technology, we aim to build a low-cost supply chain circulation system and maximize the realization of a fast and efficient intelligent logistics system.

4.3. Promoting the Application of Clean Energy

As another energy port for energy technology, new clean energy can fundamentally guarantee energy supply, alleviate energy supply pressure, and help achieve the "dual carbon" goal. Vigorously developing new clean energy, establishing a sustainable new energy system, reducing greenhouse gas emissions, effectively protecting the environment, and

promoting coexistence between humans and nature.

One is to reasonably develop renewable energy. In the process of urbanization development, the rational development and utilization of natural products such as wind energy, light energy, and water energy are in line with the trajectory of energy development. And these products are constantly flowing and will establish a sustainable new energy system, fundamentally taking them from nature and using them for nature.

The second is to promote technological innovation and development. Increase investment in research and innovation of clean energy technology, improve the efficiency and reliability of clean energy technology, reduce costs, and promote the application of clean energy to help achieve the "dual carbon" goal.

The third is to establish a unified and open energy market. For the energy market, establishing an energy market mechanism that coordinates and operates at multiple levels across provinces, actively leveraging the role of power grid resource allocation platforms, balancing relevant interests from multiple perspectives, and promoting better flow, trading, and utilization of clean energy.

4.4. Optimize Urban Planning and Land Use

The drawbacks brought about by the continuous acceleration of urbanization have now become prominent. The social, economic, urban planning, public security issues caused by population clustering, as well as the problems of population aging and enterprise desertification in other siphoned areas that cannot be developed, are all telling us that after the urbanization process reaches a certain scale, it is the development potential of other places that is overdrawn.

Under the guidance of the "dual carbon" goal, the overall development of urbanization should be guided by the "two mountain transformation" theory and the "regional development spatial balance model", with carbon emission rights and carbon quotas as anchors, and according to the differences in the main functions of each region, land development rights should be coordinated and allocated. On the one hand, urbanization areas should prioritize emission reduction, increase urban green spaces and parks, increase urban greening rates, protect and restore natural wetlands, forests, and other ecosystems to provide natural carbon sinks and air purification functions. On the other hand, rural areas should focus on increasing sinks and engage in large-scale tree planting, organic agriculture, and pesticide use to increase soil organic matter content, increase carbon storage, and maintain natural land cover and ecological integrity.

4.5. Enhancing Public Awareness and Participation

Currently, the increasing number of extreme weather and natural disasters caused by urbanization has made people fully aware of the importance of green development and environmental protection. When people realize that their actions have an impact on the environment, they are more likely to take measures to reduce carbon emissions, which can promote technological innovation and the development of a green economy.

One is to carry out more practical and efficient national green and low-carbon education, improve people's understanding and understanding of the concept of low-carbon green, and cultivate people's environmental awareness and action ability.

The second is to strengthen awareness and participation in the "dual carbon" goals of carbon peaking and carbon neutrality, laying a solid ideological foundation for the conscious practice of a green and low-carbon lifestyle by the whole nation. And use multimedia and internet resources to promote the concept of green and low-carbon to more people.

The third is to carry out carbon reduction promotion activities to guide the public to develop a green and low-carbon lifestyle. For example, a national energy-saving promotion month with the theme of "Energy Conservation, Emission Reduction, and Low Carbon Life" can be held to create a green ecological atmosphere.

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2022 Strategic Research and Consulting Project of Chinese Academy of Engineering: Study on Strategic Focus and Main Direction of Peak Carbon Achievement and Carbon Neutrality in Sichuan Province (2022-DFZD-27-01).

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