

Research on Energy Green Development under Chengdu-Chongqing Twin Cities Economic Circle

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Abstract

This paper analyzes the current problems of energy development in Chengdu-Chongqing economic circle, including the challenges of high carbon emissions and unreasonable energy structure. Combined with the policy orientation under the background of double carbon, this paper discusses the paths and measures to promote the green transformation of energy, including strengthening the formulation and implementation of carbon emission reduction policies, promoting the innovation and application of clean energy technologies, and establishing carbon markets. Based on the relevant experience at home and abroad, through case analysis and comparative research, the feasibility and key factors of promoting green energy development under the background of dual carbon are summarized. Only through the effective integration of inter-regional coordination and cooperation, policy guidance, technological innovation and market mechanism, can Chengdu-Chongqing twin-city economic circle achieve a virtuous circle of energy structure transformation, carbon emission reduction and sustained economic growth, and provide a feasible path and practical experience for the construction of low-carbon ecological civilization urban agglomeration.

Keywords

Green Energy Development; Dual Carbon; Coordination and Cooperation.

1. Introduction

Against the backdrop of rapid global economic development, the Chengdu Chongqing Economic Circle, as one of the most dynamic and promising economic regions in western China, has become an important engine for China's economic transformation and upgrading. However, with the acceleration of economic growth and the advancement of urbanization, the Chengdu Chongqing dual city economic circle is also facing increasingly severe energy and environmental challenges. The unreasonable structure and high pollution characteristics of energy consumption have become one of the main obstacles to the sustainable development of the region.[1].

In this context, accelerating the promotion of green energy development has become one of the key factors for achieving sustainable development in the Chengdu Chongqing Economic Circle. Green energy development aims to achieve coordinated economic, social, and environmental development by optimizing energy structure, improving energy utilization efficiency, and reducing pollution emissions. Therefore, in-depth research on the path and strategy of energy green development under the Chengdu Chongqing dual city economic circle has important theoretical and practical significance.[2].

This article aims to focus on the theme of "Green Energy Development under the Chengdu Chongqing Economic Circle", systematically analyze the current energy situation in the region, explore the paths and strategies for green energy development, and provide reference and support for green energy development in the Chengdu Chongqing Economic Circle through

practical case analysis and policy recommendations. Through this study, the aim is to promote a virtuous cycle of economic growth and environmental protection in the Chengdu Chongqing Economic Circle, and provide theoretical support and policy recommendations for the implementation of the national sustainable development strategy.[3].

2. Research Status

The Chengdu Chongqing Economic Circle is one of the most dynamic and promising economic regions in western China, covering the two major cities of Chengdu and Chongqing, as well as their surrounding areas. This region has a unique geographical advantage and abundant natural resources. Since the reform and opening up, economic growth has continued to grow rapidly, becoming an important support point for the development of western China. By comprehensively analyzing the formation process, geographical advantages, and economic characteristics of the Chengdu Chongqing Economic Circle, we can better understand the current status and challenges of energy green development in the region.[4].

Green energy development refers to the coordinated development of energy production, consumption, and the environment through optimizing energy structure, improving energy utilization efficiency, and reducing environmental pollution emissions, while maintaining sustained economic and social development. This concept not only encompasses various aspects of energy production, utilization, conversion, and consumption, but also involves multiple economic, social, and environmental benefits, making it comprehensive and systematic. [5].

Domestic and foreign scholars have made certain progress in the research of energy green development under the Chengdu Chongqing dual city economic circle, involving energy structure optimization, energy conservation and emission reduction, and the utilization of renewable energy.

Regarding the path selection for green energy transformation (Li Xin et al., 2019),[6] taking 2015 as the benchmark year and every 5 years as a time node, combined with four emission reduction measures: scale reduction, structural reduction, technological reduction, and end of pipe treatment, the LEAP model was used to simulate the main pollutant emissions of the steel industry in the Beijing Tianjin Hebei region from 2015 to 2030 under four single policy scenarios and four combination policy scenarios, [7]in order to seek a transformation path. Based on the DP method, Chen Rong et al. (2018) developed a provincial-level renewable energy planning model and applied it in the planning and optimization of the renewable energy system in Sichuan Province. [8] In terms of the promotion effect of energy green transformation policies, Zhou Yunheng (2013) believes that many institutional and mechanism obstacles, such as lack of coordination in functional organization management, multiple political outlets, lagging energy market reform, and insufficient government regulatory capacity, will affect the implementation effect of energy conservation and emission reduction policies. [9]Suggest establishing a coordinated energy regulatory agency and strengthening the government's regulatory functions. Xiong Wenhua (2020) believes that sustainable energy transformation is highly susceptible to political factors such as traditional energy industries and local resistance. The process of energy transformation depends not only on technological innovation and market environment, but also on social and political environment.[10].

In addition, current research often places too much emphasis on quantitative results based on econometric models, neglecting the external effects of social policies. Most studies only focus on policy formulation, and there is insufficient exploration on how policies are implemented and their effectiveness. On the basis of qualitative description and quantitative analysis, this study strives to deeply and meticulously reveal the relationship, path mechanism, evolution law,

new energy system and policy guarantee ideas of the Chengdu Chongqing Dual City Economic Circle in the process of energy green transformation from a symbiotic perspective. [11].

3. Analysis of the Current Situation and Problems of Energy Development in the Chengdu Chongqing Dual City Economic Circle

3.1. Current Situation of Energy Development in the Chengdu Chongqing Dual City Economic Circle

The Chengdu Chongqing Economic Circle, as an important economic region in China, has abundant energy resources and good development potential. The current development status and characteristics of the energy industry in the region can be summarized as follows:

3.1.1. Rich Energy Resources:

The Chengdu Chongqing Economic Circle has abundant natural gas and hydraulic resources. The Sichuan Basin is one of the important natural gas production areas in China, with abundant reserves of oil and natural gas resources. In addition, the Sichuan Basin is the region with the richest hydraulic resources in China, with many hydropower stations and the highest installed capacity of hydropower in the country.^[12]

3.1.2. Development of Clean Energy:

The Chengdu Chongqing Economic Circle is committed to accelerating the development and utilization of clean energy to reduce reliance on traditional energy and improve energy utilization efficiency. On the basis of abundant hydraulic resources, the region vigorously promotes the development and utilization of clean energy such as hydropower, wind power, and solar energy. Both Sichuan Province and Chongqing City have multiple hydropower stations and wind farms, and actively introduce advanced technologies to improve clean energy generation capacity.

3.1.3. Complementary Advantages and Coordinated Development:

The coordinated development of the energy industry in the Chengdu Chongqing Economic Circle has achieved significant results. The hydropower resources in Sichuan Province provide stable clean energy for Chongqing, and the industrial demand in Chongqing promotes the natural gas supply and petrochemical development in Sichuan Province. Both sides have conducted close cooperation in energy interconnection, industrial cooperation, and other areas, forming a mutually beneficial and win-win situation.^[13]

3.1.4. Continuously Promoting Energy Transformation:

In response to the challenges and problems faced by the energy industry, the Chengdu Chongqing Economic Circle continues to promote energy transformation. By promoting clean energy, improving energy utilization efficiency, and strengthening environmental supervision, gradually reducing reliance on traditional energy and promoting the optimization and upgrading of energy structure.

3.1.5. Diversified Energy Layout:

The Chengdu Chongqing Economic Circle is gradually achieving diversified energy layout in the development of the energy industry. In addition to hydropower resources, the region is also actively developing emerging energy sources such as natural gas and renewable energy. The Chengdu Chongqing Economic Circle has abundant shale gas resources. Through technological innovation and investment introduction, it accelerates the development and utilization of shale gas and improves the diversity of energy supply. At the same time, the region is also promoting the development of renewable energy, such as wind and solar energy, to reduce dependence on traditional energy and promote the substitution and utilization of clean energy.

3.1.6. Strengthening Energy Technology Innovation:

The Chengdu Chongqing Economic Circle focuses on energy technology innovation and promotes the deep integration of science and technology with the energy industry. Promote technological innovation and industrial upgrading in the energy sector through measures such as introducing and cultivating high-tech enterprises, and building scientific and technological innovation platforms. At the same time, strengthen cooperation between scientific research institutions, universities, and enterprises, promote the transformation and application of scientific research achievements, and enhance the independent research and development capabilities of energy technology.

3.1.7. Smart Energy System Construction:

The Chengdu Chongqing Economic Circle focuses on the construction of smart energy systems in the development of the energy industry. By integrating information technology with the energy industry, intelligent management of energy supply, storage, and use can be achieved. Building smart grids, intelligent energy monitoring systems, etc. to improve the reliability, safety, and efficiency of energy. The construction of smart energy systems not only improves the level of energy management, but also provides support for the sustainable development of the energy industry in the Chengdu Chongqing Economic Circle.

Cross regional cooperation and co construction of energy bases: The Chengdu Chongqing Economic Circle emphasizes cross regional cooperation in the development of the energy industry and jointly builds energy bases. For example, the Chengdu Chongqing Economic Circle jointly constructs the western natural gas transmission pipeline network to achieve the sharing and transmission of natural gas resources. In addition, the Chengdu Chongqing Dual City Economic Circle also promotes complementary cooperation in energy in the Yangtze River region, jointly building competitive and sustainable energy industry clusters.

3.1.8. Environmental Protection and Green Development:

The Chengdu Chongqing Economic Circle emphasizes the coordination between environmental protection and green development in the development of the energy industry. By strengthening environmental supervision and governance, reduce the impact of the energy industry on the environment. At the same time, promote the development and utilization of green energy, and promote a positive interaction between energy and the environment. The Chengdu Chongqing Economic Circle actively participates in international cooperation, promotes green and low-carbon development, and enhances the international competitiveness of the regional energy industry.

In summary, the development of the energy industry in the Chengdu Chongqing Economic Circle is characterized by abundant resources, diversified energy layout, and strengthened technological innovation. At the same time, the region focuses on environmental protection and green development, promoting the transformation of the energy industry towards clean and sustainable development through measures such as the construction of smart energy systems and cross regional cooperation. In the future, the Chengdu Chongqing Economic Circle will continue to strengthen cooperation, increase energy technology innovation and the development of green energy, and make greater contributions to economic growth and environmental protection.

3.2. Problems in Energy Development of the Chengdu Chongqing Dual City Economic Circle

3.2.1. Unreasonable Energy Structure:

Data shows that the energy structure of the Chengdu Chongqing Economic Circle is mainly composed of petroleum and coal, accounting for about 60%, while the proportion of clean energy such as hydropower, wind energy, solar energy, etc. is relatively low, less than 10%. This

structure not only leads to excessive reliance on fossil fuels, but also limits the development space of renewable energy. The high proportion of traditional energy not only poses risks of resource depletion and price fluctuations, but also exacerbates carbon emissions and environmental pollution, which goes against the dual carbon goals.

3.2.2. Low energy Consumption Efficiency:

Although the energy consumption of the Chengdu Chongqing Economic Circle is huge, the energy consumption per unit of GDP is relatively high, indicating that the energy utilization efficiency is not satisfactory. This is mainly due to the unreasonable industrial structure and lagging technological level, including factors such as outdated production processes and aging equipment. With the rapid development of the economy and the acceleration of urbanization, industries and lifestyles with high energy consumption and emissions still dominate, leading to excessive waste of energy resources.

3.2.3. Serious Environmental Impact:

The energy structure and consumption patterns of the Chengdu Chongqing Economic Circle directly affect environmental quality. The extensive use of fossil fuels such as coal has led to a significant increase in atmospheric pollutant emissions, exacerbating the problem of air pollution, especially the frequent occurrence of haze weather, which poses a serious threat to the health of residents and the ecological environment. At the same time, the process of energy development and utilization also generates a large amount of water and soil pollution, which has adverse effects on the ecosystem and sustainable development.

In summary, the Chengdu Chongqing dual city economic circle faces various problems in energy development, such as unreasonable structure, low efficiency, and serious environmental impact. To solve these problems, it is necessary to comprehensively deepen energy transformation, promote the development and utilization of clean energy, improve energy utilization efficiency, strengthen environmental protection measures, and achieve a virtuous cycle of economic development and environmental protection.

4. Strategies and Suggestions for Achieving Green Energy Development in the Chengdu Chongqing Dual City Economic Circle

China's "dual carbon" action has entered the substantive implementation stage, with top-level guidance documents issued and key areas and industry implementation plans gradually released. The secondary industry in the Chengdu Chongqing Economic Circle consumes high energy and has a single structure, which has a significant impact on the overall carbon emissions. In response to this issue, in June 2022, Sichuan Province officially issued the "14th Five Year Plan" for the healthy and green development of the secondary industry in Sichuan Province. Chongqing has also issued the "Implementation Plan for Promoting Green and Low Carbon Development of Manufacturing Industry in Chongqing", which clarifies the implementation plan for peaking carbon emissions in the industrial sector.^[14]

The increase in per capita GDP and urbanization rate has a promoting effect on carbon emissions, but the Chengdu Chongqing dual city economic circle is located in the west and still belongs to underdeveloped provinces, and people's living standards still need to be further improved. Under the premise of pursuing the dual carbon goals, economic development should still be the top priority to promote high-quality economic development in the Chengdu Chongqing Economic Circle. Economic development is the core driving force for promoting the progress of green energy technology and equipment in the Chengdu Chongqing Economic Circle, and is the main contributing factor in driving the consumption of clean energy in the Chengdu Chongqing Economic Circle. Especially, the substitution of clean energy for fossil energy is the core way to reduce carbon emissions in the Chengdu Chongqing Economic Circle.^[15]The

increase in urbanization rate will increase carbon emissions. Currently, the urbanization rate of the Chengdu Chongqing Economic Circle is lower than that of the whole country, belonging to a stable upward cycle. We cannot and cannot hinder the process of urbanization.^[16]

Referring to the carbon reduction process of developed countries abroad, the Chengdu Chongqing Economic Circle needs to strengthen legislative constraints and think tank support system construction in the implementation of carbon reduction policies. There are shortcomings in the coordinated promotion of dual carbon policies, innovation roadmap, and promotion system. The medium and long-term action plans of various government departments still need to be further refined. Therefore, in the future, we should establish a sound "dual carbon" promotion and support mechanism under the guidance of top-level design, and continuously improve the deployment of the dual carbon policy system.^[17]

1) We need to improve the legal protection and governance supervision system related to "dual carbon". Under the relevant legal framework of the country, it is necessary to improve and introduce corresponding policies and regulations for the Chengdu Chongqing Economic Circle, in order to maintain the stability of long-term deep emission reduction targets. Institutional economics emphasizes the impact of institutions on economic behavior and development. In the Chengdu Chongqing dual city economic circle, the government can guide market entities to adjust their behavior towards green development by formulating environmental protection laws and regulations, establishing a carbon market trading system, and other means. At the same time, establish a sound intellectual property protection system, protect the innovative achievements of green technologies, and encourage enterprises to increase their research and application of clean energy technologies.^[18]

2) Improve the system and mechanism for promoting the "dual carbon" policy through the coordination of departments at all levels, local linkage, and industry integration in the Chengdu Chongqing Economic Circle. The administrative role is crucial in the implementation of carbon reduction policies. Without a sound system and mechanism for promoting the "dual carbon" policy, there will inevitably be problems of multiple policies coming from different sources, inconsistent policies, and incomplete implementation. In terms of green energy development, the design and improvement of relevant systems are crucial for promoting green transformation. The establishment and improvement of market mechanisms, laws and regulations, and property rights protection systems can provide a favorable institutional environment for green technology innovation and investment. In a market economy, there are situations of market failure, such as environmental externalities and information asymmetry. The government can correct market failures and maximize social benefits through intervention. In terms of green energy development, government intervention can include subsidies, tax regulation, industry access, and other means. The government of the Chengdu Chongqing Economic Circle can guide enterprises to transform towards green development by subsidizing the clean energy industry, increasing investment in environmental research, and establishing entry barriers for environmental protection industries. At the same time, the government can also improve market transparency and competitiveness through means such as information disclosure and market regulation, and reduce market failures caused by information asymmetry.

3) In a market economy, the behavior of enterprises and individuals often fails to fully consider the impact of the environment, leading to environmental pollution and resource waste. Therefore, the governments of the Chengdu Chongqing Economic Circle need to internalize environmental costs through unified taxation, subsidies, and other means to encourage enterprises and individuals to take environmental protection actions. In the Chengdu Chongqing Economic Circle, the government can guide the energy industry to transform towards green development by establishing carbon emission quotas, implementing carbon taxes, and other measures. At the same time, by providing subsidies and tax incentives to the

renewable energy industry, enterprises are encouraged to increase their investment and development in clean energy, thereby promoting the green transformation of the energy structure.

4) Build a monitoring, evaluation, and decision-making consulting support system for the "dual carbon" action, further leverage the decision-making consulting role of research institutes in higher education institutions in the areas of "dual carbon" situation analysis, process evaluation, and major deployment suggestions, and build an institutionalized dual carbon strategy research support system. The government can promote the innovation and application of green technology by collaborating with research institutes of higher education institutions to increase investment in green technology research and development, establishing green technology innovation platforms, and strengthening intellectual property protection. By guiding and supporting enterprises to increase their investment in research and development of green technologies, we aim to promote the application of technological innovation in energy green development. At the same time, strengthening intellectual property protection, encouraging enterprises to engage in technological innovation, and improving their competitive advantage in the market.^[19]

5) Energy and environmental issues belong to public goods, and their consumption is not exclusive and non competitive, meaning that one person's consumption does not exclude the consumption of others, and consumers cannot exclude the use of others through market transactions. Based on the theory of public goods, the government should play an important role in providing necessary public goods and services to address environmental issues. The green development of energy in the Chengdu Chongqing Economic Circle requires the government to increase investment in the construction of public facilities within the economic circle, such as the construction of green transportation systems and intelligent energy management systems. Through government guidance and support, energy utilization efficiency can be improved, pollution emissions can be reduced, and green energy development can be achieved.

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