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Impact of Electricity Sales on Economic Development in Western Regions

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Abstract

As a region abundant in energy resources in China, the economic development of electricity sales in the western region is directly linked to the national energy security strategy and the coordinated development of the regional economy. Against the backdrop of electricity market reform, this paper conducts an in-depth analysis of the current characteristics, constraining factors, and optimization pathways for the development of the electricity sales economy in the western region. The research indicates that the electricity sales economy in the western region exhibits distinct features such as prominent resource endowment advantages, continuously enhanced transmission capacity, and progressively increasing marketization. However, it simultaneously faces challenges including an imperfect market structure, inadequate price formation mechanisms, and imbalanced regional coordinated development. By establishing a unified electricity market system, improving price transmission mechanisms, and optimizing resource allocation efficiency, the high-quality development of the electricity sales economy in the western region can be effectively promoted.

Keywords

Western China; Electricity Sales; Economic Development; Market-Oriented Reform; Resource Allocation.

1. Introduction

The western region of China possesses over 70% of the nation's coal resources and more than 90% of its wind and solar energy resources, making it a critical energy production base [1]. With the deepening implementation of the "West-to-East Electricity Transmission" strategy and the ongoing reforms in electricity marketization, the power sales economy in the western region faces new opportunities and challenges. As a crucial link between power generation and consumption, the development of the power sales economy directly impacts the efficiency of electricity resource allocation and the quality of regional economic growth. Therefore, an in-depth study of the development patterns of the power sales economy in western China holds significant theoretical and practical value for optimizing energy structures and promoting coordinated regional development.

The essence of the power sales economy lies in realizing the value conversion of electricity as a commodity through market mechanisms, with its core objective being to enhance the efficiency of power resource allocation and meet the multi-tiered electricity demands of socioeconomic development. Against the backdrop of constructing a unified national electricity market system, the development of the power sales economy in western China must not only leverage its inherent resource endowment advantages but also actively integrate into the nationwide electricity market framework[2] . By adopting market-driven approaches to optimize resource allocation, the region can maximize economic benefits [3].

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2. Current Development Status of the Power Sales Economy in Western China

2.1. Sustained Enhancement of Power Production and Supply Capacity

Western China, leveraging its abundant energy resources, has experienced sustained and rapid growth in installed power generation capacity and electricity output. By the end of 2023, the region's installed power capacity accounted for over 45% of the nation's total, with renewable energy comprising more than 60% of this capacity. The development of clean energy-including hydroelectric, wind, and photovoltaic power-has progressed rapidly, establishing Sichuan and Yunnan as core hydropower bases and Xinjiang and Inner Mongolia as key wind-solar power hubs. This has laid a solid material foundation for the growth of the electricity sales economy.

The optimization and adjustment of the power production structure have facilitated the transformation and upgrading of the sales economy. The increasing share of clean energy has not only enhanced the environmental attributes of electricity products but also created new value opportunities for power sales[4]. Emerging markets such as green power certificate trading and carbon emission rights trading have provided additional revenue streams for electricity sales in Western China. These developments are driving the transition of the power sales economy from mere electricity volume sales to comprehensive integrated energy services.

2.2. Continuous Expansion of Cross-Regional Electricity Sales

The continued advancement of the "West-to-East Power Transmission" project has significantly expanded the market space for electricity sales in Western China. To date, the region has established multiple ultra-high-voltage (UHV) transmission lines, with annual electricity exports exceeding 200 billion kilowatt-hours, providing robust support for the economic development of central and eastern China. Cross-regional power sales not only optimize the allocation of electricity resources but also generate substantial economic benefits for Western China.

The development of cross-regional electricity sales has driven innovation in the power sales model in Western China. Transitioning from traditional planned allocation to market-oriented trading, and from simple electricity volume sales to diversified energy services [5], the electricity sales economy in the region has exhibited a new developmental trend. Emerging trading mechanisms, such as inter-provincial power trading and cross-regional spot markets, have provided more flexible market-oriented tools for electricity sales in Western China.

2.3. Steady Progress in Electricity Marketization Reforms

Western China has actively responded to the national power sector reform initiatives, leading to a continuous increase in the marketization of its electricity sector. Provinces in the region have successively established electricity trading institutions and implemented diverse forms of market-based electricity trading. The proportion of electricity traded through market mechanisms relative to total electricity consumption has been rising annually, while the electricity pricing mechanism has become increasingly refined.

The deepening of electricity market reforms has injected new vitality into the development of the power sales economy in Western China. The introduction of market competition mechanisms has driven power sales enterprises to enhance service quality, reduce operational costs, and innovate business models [6]. The pilot reforms in incremental distribution businesses have created new channels for private capital to participate in electricity sales, further stimulating market dynamism.

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3. Analysis of Constraining Factors

3.1. Imperfect Market Structure

The structure of the electricity market in western China still exhibits certain imperfections, primarily reflected in the limited diversity of market entities and insufficient market competition. The electricity sales market remains dominated by traditional grid enterprises, while the development of private electricity retail companies lags behind, preventing the full formation of a competitive market landscape. This market structure hinders the robust growth of the electricity sales economy and constrains further improvements in resource allocation efficiency.

Furthermore, the market access mechanism requires refinement. In some regions, excessively stringent entry barriers for electricity retail companies restrict the diversification of market participants. Simultaneously, the market exit mechanism remains underdeveloped, lacking an effective survival-of-the-fittest mechanism, which undermines the full release of market vitality.

3.2. Imperfect Price Formation Mechanism

The electricity pricing mechanism in western China still requires further improvement. On one hand, government-regulated pricing remains dominant in electricity sales, and a market-oriented pricing mechanism has yet to be fully established. On the other hand, the price formation mechanism for cross-regional electricity sales is complex, involving multiple provinces and market entities, resulting in significant coordination challenges.

Although the reform of transmission and distribution pricing has been initiated, certain issues persist in its implementation. In some regions, the determination of transmission and distribution tariffs lacks precision, and cost supervision is not stringent enough, which undermines the rational formation of electricity prices. Additionally, the subsidy mechanism for renewable energy remains imperfect, hindering the market-oriented sales of clean energy electricity [7].

3.3. Regional Development Imbalances

The issue of imbalanced development within China's western region remains prominent. On one hand, there are significant disparities in electricity development levels among different provinces, leading to uneven economic progress in power sales. On the other hand, noticeable developmental gaps persist within individual provinces, with an evident lack of coordination between urban and rural electricity sales economies [8].

Inadequate infrastructure construction is a major constraint on the development of the electricity sales economy in the western region. In some remote areas, grid development lags behind, and insufficient power supply reliability hinders the stable growth of electricity sales. Additionally, the relatively low level of informatization restricts the widespread adoption of modern electricity sales services.

4. Development Pathways and Policy Recommendations

4.1. Establishing a Unified Electricity Market System

Accelerating the Development of an Integrated Electricity Market in Western China to Establish a Unified, Open, and Competitive Electricity Market System.To promote the construction of a unified and well-regulated electricity market in Western China, it is essential to establish and improve market access and exit mechanisms, lower market entry barriers, and encourage fair participation from diverse market entities [9]. Additionally, a robust market supervision framework must be implemented to strengthen anti-monopoly regulation and maintain a fair competitive market order.

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Active participation in the development of a nationally integrated electricity market system is crucial, requiring enhanced coordination and connectivity with electricity markets in the eastern and central regions. A well-functioning cross-regional electricity trading mechanism should be established to facilitate the optimal allocation of power resources across broader areas. Furthermore, advancing the construction of electricity spot markets will enable the market to play a decisive role in resource allocation.

4.2. Improving Price Formation Mechanisms

Deepening Electricity Pricing Reform and Advancing Market-Oriented Mechanisms.To further advance electricity pricing reform, it is imperative to gradually liberalize pricing in competitive segments, establishing a market-driven electricity pricing mechanism. A well-regulated transmission and distribution pricing system should be implemented, ensuring a scientifically sound and rational tariff structure. Additionally, a market-based consumption mechanism for renewable energy must be developed, leveraging green power trading and renewable energy certificate (REC) markets to reflect the environmental value of renewable energy.A robust ancillary services market should be established to incentivize diverse market participants to provide essential grid-supporting services-such as frequency regulation, peak shaving, and operating reserves-through market-based mechanisms. Furthermore, differentiated pricing policies, including time-of-use (TOU) tariffs and seasonal pricing, should be refined to guide rational electricity consumption and enhance the operational efficiency of the power system.

4.3. Optimizing Resource Allocation Efficiency

Leveraging Regional Resource Endowments to Accelerate Clean Energy Development in Western China.To fully capitalize on the resource advantages of Western China, it is essential to accelerate the development and utilization of clean energy, thereby enhancing the sustainability of power supply. Efforts should be made to transition traditional coal-fired power generation toward cleaner and more efficient technologies, improving the overall efficiency of the power system. Additionally, enhancing the power system's flexibility and regulation capacity is crucial to increasing renewable energy integration.

Further integration of electricity retailing with comprehensive energy services should be promoted to expand the scope and value chain of power sales [10]. Strengthening demand-side management and adopting smart electricity technologies will improve power consumption efficiency. The development of distributed energy resources, along with the coordinated advancement of generation-grid-load-storage integration, will enhance the flexibility and resilience of the power system.

4.4. Strengthening Infrastructure Development

Enhancing Investment in Power Grid Infrastructure to Improve the Power Supply Capacity in Western China.To strengthen the power supply guarantee, it is essential to increase investment in power grid infrastructure, optimize the grid structure in western regions, and enhance power transmission efficiency. Accelerating the development of smart grids and promoting the application of advanced power technologies and equipment will significantly improve grid operational efficiency and reliability. Additionally, upgrading rural power grids is crucial to narrowing the urban-rural disparity in electricity access and ensuring equitable energy development.

Advancing the Informatization of the Power Market for Efficient Trading Services.The establishment of a comprehensive power trading platform and information management system is vital to providing market participants with efficient and convenient transaction services. By leveraging big data analytics in the power sector, the precision and intelligence of electricity sales can be substantially enhanced, facilitating data-driven decision-making and optimized resource allocation.

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5. Conclusion

The development of the electricity sales economy in China's western region faces both significant opportunities and numerous challenges. To achieve high-quality growth in this sector, it is essential to adhere to the direction of market-oriented reforms, accelerate the establishment of a unified and open electricity market system, improve pricing mechanisms, optimize resource allocation efficiency, and strengthen infrastructure construction. Only through comprehensive and deepening reforms can the full potential of the electricity sales economy in the western region be unlocked, providing robust support for regional economic and social development. Future research could further explore cutting-edge issues such as the coordination between the electricity sales economy and renewable energy development in the western region, the application of digital technologies in electricity sales, and the synergistic development of electricity sales and carbon neutrality goals. Such studies would offer more precise theoretical guidance and policy recommendations for the advancement of the electricity sales economy in the western region.

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