Study on the Influence Mechanism of Energy Consumption Structure Optimization on Regional Economic Growth

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Keywords: Energy Consumption Structure; Regional Economic Growth; Influence Mechanism; Policy Suggestions; Sustainable Development

Abstract: The purpose of this study is to analyze the mechanism of Energy Consumption (EC) structure optimization on regional economic growth, and put forward policy suggestions accordingly. By combining theoretical analysis with practical investigation, this paper introduces the connotation and classification of EC structure and the theoretical basis of regional economic growth. This paper discusses in detail the four paths of EC structure optimization to regional economic growth: improving energy efficiency, promoting industrial structure upgrading, improving environmental quality and the linkage mechanism between policy and market. In terms of research methods, combined with literature review and other methods, the internal relationship between EC structure and regional economic growth is deeply explored. It is found that optimizing EC structure can effectively improve energy efficiency, promote industrial upgrading, optimize environmental quality and help regional economic growth under the dual role of policy and market. Finally, the research puts forward some targeted strategic suggestions in order to further optimize the EC structure and promote the sustainable development of regional economy.

1. Introduction

Energy plays a key role in promoting economic and social development. Its consumption and utilization efficiency directly affect the country's economic security, environmental sustainability and the overall well-being of society [1]. Facing the aggravation of global climate change and the gradual depletion of traditional fossil energy, adjusting EC structure and improving energy efficiency have become the common concern of the international community and governments [2]. China is one of the largest energy consumers in the world. The optimization of its EC structure is of great significance to the sustainable development of its own economy, and it also bears a decisive responsibility for global energy transformation and coping with climate change [3]. This study mainly discusses the mechanism of EC structure optimization on regional economic growth. It aims to provide theoretical support and practical guidance for policy formulation and regional economic transformation.

In recent years, scholars have conducted extensive research on EC structure, regional economic growth and their relationships [4]. In the field of EC structure, the research focuses on the consumption proportion, trends and influencing factors of different energy types. In the field of regional economic growth, the research focuses on growth motivation, influencing factors and sustainability [5]. However, there are relatively few studies on the combination of EC structure and regional economic growth, especially on the mechanism analysis of how the optimization of EC structure specifically affects regional economic growth [6]. This study is intended to further enrich and deepen the research content in this field on the basis of existing research.

The main goal of the study is to clarify the path of EC structure optimization to regional economic growth, and provide scientific basis for decision makers. The research will focus on the following core questions: What is the connotation and characteristics of EC structure optimization? What are the evaluation indicators of regional economic growth? How does the optimization of EC structure affect regional economic growth?

  DOI: 10.25236/iceesr.2025.040

2. EC structure and regional economic growth theory

2.1. Definition and classification of EC structure

EC structure refers to the relative proportion of various EC in a country or region within a certain period of time [7]. This concept reveals the composition and characteristics of EC and constitutes a key part of energy economics research. According to different classification standards, EC structure can be divided into many types, as shown in Table 1. This classification method helps to clearly identify the structural attributes of EC and provides theoretical support for optimizing the EC structure.

Table 1: Classification of EC Structure

Standard of classification	Type	Specific examples
Energy source	Primary energy	Coal, oil, natural gas and other energy sources directly obtained from nature.
	Secondary energy	Power, heat and other processed and converted energy sources.
Energy form	Solid state energy	Energy in solid form such as coal and coke.
	Liquid energy	Oil, gasoline, diesel oil and other energy sources in liquid form.
	Gaseous energy	Natural gas, liquefied gas and other energy sources in gas form.
Energy nature	Fossil energy	Coal, oil, natural gas and other energy sources formed by ancient biological remains.
	Non-fossil energy	Nuclear energy, wind energy, solar energy, hydropower and other non-fossil sources of energy.
Field of use	Industrial energy	Energy used in industrial production, such as EC in steel and chemical industries.
	Transportation energy	Energy used for transportation, such as gasoline, diesel, electricity, etc.
	Residential energy	Energy sources used by residents in their daily lives, such as electricity and gas.

2.2. Theoretical overview of regional economic growth

Regional economic growth is the core issue of regional economic development. It focuses on the growth of regional economic aggregate in a certain period and the dynamic mechanism behind it [8].The theory of regional economic growth has experienced multi-stage development: from the early solow growth model, it emphasized the promotion of capital accumulation, labor growth and technological progress to economic growth; The endogenous growth theory highlights the decisive role of knowledge accumulation, technological innovation and human capital in economic growth; Then the neoclassical growth theory introduces factors such as system and policy. These theories provide us with multiple perspectives and thinking paths to understand regional economic growth. These theories reveal the inherent law of regional economic growth, and also provide theoretical reference for policy makers to promote regional economic growth.

2.3. Discussion on the relationship between EC structure and regional economic growth

There is a significant correlation between EC structure and regional economic growth. From the perspective of production factors, the optimization of EC structure can effectively reduce production costs, improve production efficiency, and then directly promote the growth of regional economy [9]. For example, increasing the proportion of renewable energy can not only reduce the dependence on traditional fossil energy, reduce energy expenditure, but also alleviate ecological

pressure and enhance the comprehensive competitiveness of regional economy. The optimization of EC structure can also effectively promote the transformation and upgrading of industrial structure and promote the transformation of regional economy to a green and low-carbon model. For example,the cultivation and development of new energy industry can promote the coordinated development of upstream and downstream industrial chains and form a new economic growth pole. It is of great reference value to study the interaction mechanism between them for formulating scientific EC policies and realizing the sustainable development of regional economy.

3. Influence mechanism of EC structure optimization on regional economic growth

3.1. Energy efficiency improvement mechanism

The improvement of energy utilization efficiency constitutes the core link of EC structure optimization, which has a significant catalytic effect on regional economic growth. Scientific and technological progress and technological innovation have promoted the improvement of traditional energy use mode, and made the energy utilization efficiency continuously improve. This improvement in efficiency is not only reflected in creating more economic value with the same energy input, but also in reducing energy waste and production costs. Enterprises have enhanced their market competitiveness by introducing efficient and energy-saving equipment and technology, thus promoting the development of the whole regional industry. The improvement of energy efficiency also promotes the rational distribution of energy resources and ensures that limited energy resources can be transformed into economic benefits more effectively. This mechanism not only promotes regional economic growth, but also lays a solid foundation for the realization of sustainable development.

3.2. Industrial structure upgrading mechanism

The optimization of EC structure accelerates the iterative process of industrial system. Traditional industries with high EC and low added value gradually withdrew from the market stage in the energy transformation, while emerging industries relying on clean energy achieved rapid rise through technological breakthroughs. This restructuring of industrial structure promotes the overall jump of regional economic quality and enhances the anti-fluctuation ability of the economic system. The formation of emerging industrial clusters has given birth to the collaborative innovation of upstream and downstream industrial chains and injected sustained growth momentum into the regional economy. At the same time, the high-end transformation of industrial structure forces the labor market to upgrade, promotes the expansion of skilled talents, and reserves the advantages of human capital for the long-term development of regional economy.

3.3. Environmental quality improvement mechanism

The green transformation of EC structure has a significant positive effect on the improvement of ecological environment quality. The large-scale application of clean energy has effectively alleviated the pollution problem caused by traditional energy utilization. The improvement of EC structure has significantly improved the regional environmental quality, and the environmental indicators such as air and water quality have gradually improved. The improvement of environmental quality not only directly improves the survival and well-being of residents, but also attracts high-quality capital and innovative talents through the release of ecological dividends, forming a benign interaction between environmental benefits and economic benefits. The regional brand effect of high-quality ecological environment construction further strengthens the regional competitive advantage of regional economy and creates the accumulation space of ecological capital for sustainable development.

3.4. Policy-driven and market mechanism

The dual role of government guidance and market regulation constitutes the core power system of EC structure optimization. At the policy level, the government has established an institutional framework for energy transformation by formulating mandatory standards and incentive policy

combinations. For example, through green credit policy, carbon emission trading system and other tools, it not only restricts the expansion of energy-intensive industries, but also provides institutional guarantee for clean energy projects. The market mechanism plays a decisive role in the allocation of energy resources. At the market level, the price mechanism forms an automatic adjustment function of resource allocation through the transmission of energy costs, and guides market participants to spontaneously optimize energy use behavior. This two-wheel drive mode of "policy orientation+market allocation" not only ensures the strategic direction of energy transformation, but also improves the efficiency of transformation through competition mechanism, and finally forms a virtuous circle of systematic optimization, providing institutional guarantee for the high-quality development of regional economy.

4. Policy suggestions and prospects

Table 2: Implementation Pathways for Policy Initiatives and Regional Economic Development

Direction of policy	Core measures	Implementation tool	Target effect
Promotion of clean energy	Increase R&D and market investment in renewable energy.	Financial/tax incentives+R&D subsidies	Reduce dependence on fossil energy and increase the proportion of clean energy
Industrial supervision and upgrading	Strengthen the supervision of energy-intensive industries and force technological innovation.	Energy efficiency standards+environmental supervision+capacity elimination	Promote the energy efficiency of the industry and reduce pollution emissions.
Industrial transformation guidance	Support low-carbon environmental protection industries and promote industrial integration	Industrial planning+special fund+supply chain standard	Optimize industrial structure and cultivate new kinetic energy of economic growth
Talent support system	Cultivating and introducing green technical talents	Vocational education+Industry-University-Research cooperation+talent subsidy	Provide the talent pool needed for technological transformation
Institutional coordination guarantee	Establish an inter-departmental policy coordination mechanism	Total energy control+carbon trading pilot+regional coordination	Ensure the efficiency of policy implementation and promote systematic coordination.

Facing the dual tasks of optimizing EC structure and promoting regional economic development, policy makers need to adopt a series of concrete and effective policy measures. First of all, it is necessary to increase investment in the research and promotion of clean and renewable energy, and use financial subsidies, tax breaks and other incentives to promote enterprises and individuals to turn to clean energy and reduce their dependence on fossil energy. At the same time, the government must improve the supervision system of EC, strengthen the supervision of high energy-consuming industries, and promote their technological innovation and efficiency improvement. Policies should be committed to guiding the industrial structure to evolve towards low carbon and environmental protection. By defining the industrial development plan, we will establish the priority development areas and support directions, encourage the development of emerging industries and promote the integration of traditional industries and emerging industries. At the same time, strengthen the training and introduction of talents to provide solid human

resources support for the upgrading of industrial structure. See Table 2 for the implementation paths of policy initiatives and regional economic development:

With the progress of science and technology and the evolution of global energy pattern, optimizing EC structure will encounter new opportunities and challenges. Policymakers should keep keen market insight, adjust the policy path in time, and ensure the effectiveness and forward-looking of the policy. At the same time, strengthen international cooperation and exchanges, absorb international advanced experience and technology, and jointly promote the optimization of global EC structure and the sustainable development of regional economy. It is believed that under the guidance of policies and driven by the market, the EC structure will continue to be optimized, injecting new impetus into regional economic development.

5. Conclusions

This study deeply analyzes the interaction between EC structure optimization and regional economic growth, and reveals the internal relationship and mechanism between them. Optimizing the EC structure can improve energy efficiency, reduce production costs, promote the upgrading and transformation of industrial structure, and enhance the competitiveness of regional economy. The improvement of environmental quality has also improved the quality of life of residents and created favorable external conditions for regional economic development. The results show that policy guidance and market mechanism play a key role in the optimization of EC structure. The government needs to strengthen policy support, promote the research and application of clean and renewable energy, strengthen the supervision of EC, and promote technological innovation in energy-intensive industries. The market mechanism should dominate the allocation of resources and use the price mechanism to guide reasonable EC and production.

To sum up, the optimization of EC structure has played a significant role in promoting regional economic growth. The government and enterprises need to make concerted efforts to continuously improve the EC structure and provide solid support for the sustainable development of regional economy. Strengthening policy guidance and market mechanism construction are necessary conditions to ensure the smooth progress of the optimization process. With the joint efforts of many parties, the continuous optimization of EC structure will inject new impetus into regional economic development and realize the harmonious coexistence of economy, society and environment.

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