

Research on the Management Driving Mechanism of Sustainable Energy Technology

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Abstract: This article focuses on the management-driven mechanisms of sustainable energy technologies, aiming to deeply explore how to promote the development and application of sustainable energy technologies through effective management measures. Through a review and analysis of relevant literature, key management elements influencing the development of sustainable energy technologies are identified, including policy management, market management, innovation management, and social management, among others. The research constructed a comprehensive management driving mechanism model, elaborating on the interaction among various elements and their driving paths for the development of sustainable energy technologies. Finally, a series of targeted suggestions were put forward in light of the actual situation to promote the wide application and sustainable development of sustainable energy technologies on a global scale.

Keywords: Sustainable Energy Technology; Management Driven Mechanism; Policy Management; Market Management; Innovative Management

1. Introduction

With the rapid development of the global economy and the continuous growth of the population, the consumption of traditional fossil energy is increasing day by day. The extensive use of traditional fossil energy not only leads to an increasingly prominent energy shortage problem, but also triggers serious global challenges such as environmental pollution and climate change [1]. Energy shortages pose risks to energy supply security for all countries, while problems such as air pollution and water pollution in environmental

pollution seriously threaten human health and the balance of the ecosystem. The frequent occurrence of extreme weather events and the rise in sea levels brought about by climate change pose a huge threat to the sustainable development of human society.

Sustainable energy technologies, such as solar energy, wind energy, hydropower and bioenergy, are regarded as key approaches to solving energy and environmental problems due to their clean and renewable characteristics [2]. Solar energy, as an inexhaustible and endless source of energy, has wide distribution and development potential. Wind power generation technology is mature and has a relatively small impact on the environment. The hydropower resources are abundant, which can realize large-scale power production. Bioenergy can convert organic waste into energy and achieve the recycling of resources. However, despite the huge potential for development of sustainable energy technologies, they still face many obstacles in the actual promotion and application process. High technical costs are one of the key factors restricting the development of sustainable energy technologies. For instance, the manufacturing costs of solar photovoltaic cells and the maintenance costs of wind power generation equipment are relatively high, which makes their power generation costs lack competitiveness in the market. [3] Weak market competitiveness is also reflected in the comparison with traditional fossil energy. Traditional fossil energy dominates the energy market, and its price formation mechanism and infrastructure are relatively complete. However, sustainable energy technology needs to re-establish its market system and infrastructure, which increases the difficulty of its promotion. Insufficient policy support is also a key issue. Although some countries and regions have introduced relevant policies to

support the development of sustainable energy technologies, the stability, consistency and effectiveness of these policies still need to be improved. [4] Therefore, in-depth research on the management driving mechanism of sustainable energy technologies and overcoming these obstacles through effective management measures have significant theoretical and practical significance for promoting the development and application of sustainable energy technologies.

2. Literature Review

2.1 Current Status of Sustainable Energy Technology Development

In recent years, significant progress has been made in global sustainable energy technologies. The cost of solar photovoltaic technology is constantly decreasing, and its power generation efficiency is gradually improving. With the continuous innovation of technology and the emergence of scale effects, the manufacturing cost of solar photovoltaic cells has dropped significantly over the past decade, making solar power generation economically competitive in an increasing number of regions [5]. Meanwhile, the conversion efficiency of photovoltaic cells is constantly improving. The research and application of new and highly efficient photovoltaic cell technologies have further promoted the development of solar power generation.

Wind power generation technology is becoming increasingly mature, and offshore wind power has become a new development hotspot. Offshore wind power has advantages such as stable wind speed and no occupation of land resources, and has developed rapidly in recent years. Europe is a leading region in the development of offshore wind power, with its installed capacity of offshore wind power accounting for the vast majority of the global total [6]. China is also actively promoting the development of offshore wind power and increasing investment in the research and development of offshore wind power technology and project construction.

Bioenergy technology is constantly innovating in areas such as the cultivation of energy crops and the production of biofuels. The cultivation techniques of energy crops have been continuously improved, enhancing crop yields and energy conversion efficiency. Biofuel

production technology is also constantly upgrading. The second and third generation biofuel technologies are gradually maturing, capable of producing biofuels from non-food crops and organic waste, reducing the potential impact on food security [7].

2.2 Research on Management-Driven Mechanisms

Scholars at home and abroad have conducted extensive research on the management-driven mechanisms of sustainable energy technologies. In terms of policy management, many studies have shown that government subsidy policies, tax incentives and mandatory quota systems play a significant role in promoting the development of sustainable energy technologies. In terms of market management, the design and improvement of market mechanisms, such as carbon trading markets and green power certificate trading markets, can guide resources to be allocated to the sustainable energy sector and enhance the market competitiveness of sustainable energy. In terms of innovation management, measures such as strengthening cooperation among industry, academia and research, establishing innovation platforms, and encouraging enterprises to increase investment in research and development are conducive to promoting innovation and breakthroughs in sustainable energy technologies. In terms of social management, enhancing public awareness and acceptance of sustainable energy and strengthening social supervision can create a favorable social atmosphere and promote the development of sustainable energy technologies.

3. Identification of Key Management Elements for the Development of Sustainable Energy Technologies

3.1 Policy Management Elements

Policy management is an important guarantee for the development of sustainable energy technologies. The government formulates and implements a series of policies to guide and encourage enterprises, research institutions and social capital to participate in the research and development, production and application of sustainable energy technologies. Common policy management elements include fiscal subsidies, tax preferences, mandatory quota

systems, and feed-in tariff policies, etc. Financial subsidies can directly reduce the investment cost of projects and enhance their economic feasibility. Tax incentives can reduce the tax burden on enterprises, increase profit margins, and encourage enterprises to increase investment. The mandatory quota system creates a stable market demand for sustainable energy. The on-grid electricity price policy ensures reasonable profits for power generation enterprises and boosts their investment enthusiasm.

3.2 Market Management Elements

Market management is of vital importance for optimizing the allocation of sustainable energy resources and enhancing market competitiveness. An effective market mechanism can guide resources to flow towards efficient and low-cost sustainable energy projects, promoting their large-scale application. Market management elements cover market access, prices, trading mechanisms, etc. The market access system regulates market order and ensures fair competition. The price mechanism determines the price of sustainable energy based on market supply and demand, reflects the true cost and value, and guides enterprises and consumers to make reasonable decisions. Trading mechanisms such as carbon trading and green power certificate trading markets provide economic incentives for development and promote cross-regional trading and optimal allocation.

3.3 Elements of Innovative Management

Innovation is the core driving force for the development of sustainable energy technologies. The elements of innovation management include the mechanism of cooperation among industry, academia and research, the construction of innovation platforms, and the incentive mechanism for R&D investment, etc. The industry-university-research cooperation mechanism integrates the advantageous resources of universities, research institutions and enterprises to accelerate the transformation and application of scientific research achievements. The construction of an innovation platform provides a favorable hardware and software environment for technological research and development,

promoting technological exchanges and cooperation. The R&D investment incentive mechanism encourages enterprises to increase their investment in sustainable energy technology research and development and enhance their independent innovation capabilities.

3.4 Elements of Social Management

Social management elements play a significant supporting role in the development of sustainable energy technologies. Public awareness and acceptance influence the market demand for sustainable energy products. Social supervision can prompt enterprises and governments to fulfill their responsibilities and ensure the smooth implementation of projects. The main elements of social management include public education and publicity, social supervision mechanisms, and stakeholder participation mechanisms, etc. Carrying out public education and publicity activities can enhance the public's understanding of sustainable energy and strengthen their awareness of environmental protection and sustainable development. Establish and improve the social supervision mechanism, strengthen supervision over the environmental impact and social benefits of the project, and ensure sustainable development. Establish a stakeholder participation mechanism, fully listen to the opinions and suggestions of all parties, and enhance the scientific and democratic nature of decision-making.

4. Construction of a Model for the Driving Mechanism of Sustainable Energy Technology Management

4.1 Model Framework Design

Based on the identified key management elements, this paper constructs a model of the management drive mechanism for sustainable energy technology. This model takes policy management, market management, innovation management and social management as the core driving elements. These elements are interrelated and interact with each other, jointly promoting the development of sustainable energy technologies.

Policy management provides institutional guarantees and policy guidance for the other three elements. Market management optimizes resource allocation through market

mechanisms, provides economic incentives for innovative management, and reflects the effectiveness of social management. Innovation management is the key to enhancing the competitiveness of sustainable energy technologies and providing technical support for the other three elements. Social management creates a favorable social environment and promotes the coordinated development of all elements.

4.2 Analysis of the Interaction Mechanism among Various Elements

Policy management and market management: Policy management guides the normal operation of market mechanisms by formulating market rules and regulatory measures. If the government formulates feed-in tariff policies and mandatory quota systems, it can create a stable market demand for sustainable energy and influence market supply and demand as well as prices. Meanwhile, market management provides feedback for policy management. For instance, fluctuations in the carbon trading market price reflect the supply and demand of carbon emission rights, offering references for the government in formulating carbon emission policies.

Policy management and innovation management: Policy management reduces the innovation costs of enterprises and increases their profits by means of fiscal subsidies, tax incentives, etc., and encourages enterprises to increase investment in the research and development of sustainable energy technologies. If the government provides subsidies for research and development projects, it can relieve the financial pressure on enterprises. Innovation management provides technical support for policy management and promotes the optimization and upgrading of policies. For instance, breakthroughs in sustainable energy technology innovation can reduce technological costs and enhance efficiency, providing a basis for the government to adjust subsidy and quota systems.

Policy management and social management: Policy management guides the public to participate in sustainable energy development by formulating public education and publicity policies, social supervision policies, etc. If the government conducts popular science publicity, it can enhance public awareness and

acceptance. Social management provides a social foundation and public opinion support for policy management, promoting the smooth implementation of policies. If the public highly recognizes and supports sustainable energy, it will provide strong public opinion support for the government to formulate stricter environmental protection policies.

Market management and innovation Management: Market management provides economic incentives for innovation management through price and competition mechanisms. Under the pressure of market competition, enterprises will increase their investment in the research and development of sustainable energy technologies and promote technological innovation. Innovative management enhances the market competitiveness of sustainable energy technologies and promotes the improvement of market mechanisms. For instance, technological innovation can reduce technological costs, enhance power generation efficiency, make sustainable energy more competitive in the market, expand market share, and promote the healthy development of the market.

Market management and social management: Market management, through price signals and market competition, guides the allocation of social resources to the sustainable energy sector, influencing public consumption choices and behaviors. Higher prices of sustainable energy prompt consumers to reduce energy consumption and choose energy-saving products and services. Social management influences market demand and consumer behavior, and thereby affects the operation of market mechanisms. If the public's environmental awareness increases and their preference for sustainable energy grows, it will boost market demand and promote market development.

Innovation Management and Social Management: Innovation management promotes technological progress in sustainable energy and provides technical means and solutions for social management. For instance, smart grid technology enhances the efficiency and reliability of energy management and promotes the sustainable development of social energy. Social management provides innovative demands and an environment for innovative management. The social demand for

clean energy and the concern for environmental protection have prompted enterprises and research institutions to increase their investment in research and development and promote technological innovation.

5. Policy Recommendations for Promoting the Development of Sustainable Energy Technologies

5.1 Improve the Policy Management System

The government should formulate a long-term and stable sustainable energy development strategy and policy plan, clearly defining development goals and key tasks. Further improve policies and measures such as fiscal subsidies, tax preferences, and on-grid electricity prices to enhance the pertinence and effectiveness of these policies. Strengthen the coordination and consistency of policies to avoid conflicts and contradictions among them. Establish and improve the policy assessment and adjustment mechanism, and adjust and improve policy measures in a timely manner in accordance with the actual situation of the development of sustainable energy technologies.

5.2 Optimize the Market Management Mechanism

Accelerate the reform of the electricity market, establish and improve the electricity market system, introduce market competition mechanisms, break monopolies, and promote the efficient allocation of sustainable energy and electricity. Improve the quota system for renewable energy and the trading system for green power certificates, expand the scope and scale of trading, and enhance market liquidity. Strengthen market supervision, standardize market order, and ensure fair market competition.

5.3 Strengthen the Construction of Innovation Management Capabilities

Increase investment in the research and development of sustainable energy technologies, establish a diversified mechanism for scientific and technological investment, and encourage enterprises, research institutions and social capital to participate in research and development activities. Strengthen cooperation among industry, academia and research institutions, establish innovation alliances and

cooperation platforms, and promote the transformation and application of scientific research achievements. Improve the innovation incentive mechanism and give recognition and rewards to units and individuals who have made outstanding contributions to the technological innovation of sustainable energy.

5.4 Strengthen the Role of Social Management

Strengthen public education and publicity, and carry out popular science publicity activities on sustainable energy through various channels and methods to enhance the public's awareness and acceptance of sustainable energy. Establish and improve the social supervision mechanism, strengthen supervision over the environmental impact and social benefits of sustainable energy projects, and ensure the public's right to know and participate. Establish a stakeholder participation mechanism, fully listen to the opinions and suggestions of the public, enterprises, research institutions and other stakeholders, and improve the scientific and democratic nature of decision-making.

6. Conclusion

This paper, through the research on the management driving mechanism of sustainable energy technology, has identified four key management elements: policy management, market management, innovation management and social management, and constructed a comprehensive management driving mechanism model. Research shows that various management elements are interrelated and interact with each other, jointly promoting the development of sustainable energy technologies. Policy management provides institutional guarantees and policy guidance for other management elements. Market management optimizes resource allocation through market mechanisms and provides economic incentives for innovative management. Innovation management is the key to enhancing the competitiveness of sustainable energy technologies. Social management creates a favorable social environment for all management elements. With the continuous development of emerging technologies, such as the application of artificial intelligence and big data in the field of sustainable energy, future research can focus on the impact of these emerging technologies

on the management driving mechanism of sustainable energy technologies, and explore more effective management models and methods.

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