

Analysis of New Domestic Energy Productivity based on CiteSpace

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ABSTRACT

The new quality productivity of energy is a major technical decision we have made in the field of energy in the face of a new round of scientific and technological revolution, and has recently gained a lot of academic attention. In order to explore the research hotspots and evolution directions in the field of new energy productivity, this paper is selected from 224 articles collected by CNKI in the field of new energy productivity from 2014 to 2024, based on CiteSpace bibliometric software, the articles in this field were visually analyzed from the number of published papers, keyword co-occurrence and its clustering and evolution, and the cooperation network of authors and their institutions. From the research results, it can be seen that the number of published papers shows a steady growth trend, but the cooperation between scholars and institutions needs to be further strengthened. In addition, it can be seen from the results obtained from the co-occurrence of keywords that scientific and technological innovation, energy transition, and digitalization are the current research hotspots. Future research should focus on research methods, research perspectives, academic exchanges, and resource integration.

KEYWORDS

Energy New Quality Productivity; Research Hotspots; Future Trends.

1. INTRODUCTION

Since the proposal of the new energy security strategy of 'Four Revolutions and One Cooperation' ten years ago, the energy industry has continuously strengthened the energy technology revolution, and today it ranks among the world leaders in energy investment and technological innovation. However, what we cannot ignore is that the proportion of new energy usage is increasing year by year, while traditional energy shows characteristics of homogenization in terms of competition. How can we provide new paths for the development of energy? Nowadays, the General Secretary has given an answer.--New type of productive forces. In the current new environment, only by integrating energy with new types of productive forces can new directions for energy development be provided, that is, new types of productive forces in energy. The concept of new-type productive forces was first proposed by General Secretary Xi during his inspection tour in Heilongjiang in June 2023. At the end of 2023, General Secretary Xi emphasized at the Central Economic Work Conference that technological innovation should drive industrial innovation, particularly by using disruptive and cutting-edge technologies to generate new industries, new models, and new momentum, and to develop new quality productive forces. Subsequently, during the collective study session of the Central Political Bureau in 2024, General Secretary Xi systematically elaborated on the relevant concepts of new quality productivity and emphasized the importance of studying new quality productivity. ^[1]. Finally, at the National People's Congress and the Chinese People's Political

Consultative Conference, General Secretary Xi made specific arrangements for 'vigorously promoting the construction of a modern industrial system and accelerating the development of new quality productive forces' in a more systematic and comprehensive manner. What is new-quality energy productivity? Based on the basic connotation of new-quality productivity (promoting industrial innovation through technological innovation, especially the creation of new industries, new models, and new driving forces through disruptive and frontier technologies) and considering the severe situation of energy development, new-quality energy productivity refers to an advanced form of productivity in the process of energy production, conversion, and utilization. It involves improving production efficiency, conversion efficiency, utilization efficiency, and quality comprehensively through technological innovation and optimized allocation of production factors, thereby promoting sustainable economic and social development.^[2]The report of the 20th National Congress of the Communist Party of China proposed accelerating the planning and construction of a new type of energy system, while new energy productive forces provide the fundamental support and driving force for the establishment of such a system. Actively exploring practical paths for developing new energy productive forces and focusing on promoting the construction of a new energy system will play a positive and crucial role in ensuring China's energy security, stable supply, and exploring green and low-carbon transformation and development.

2. DATA SOURCES AND RESEARCH METHODS

When conducting research, the accuracy and reliability of data sources, along with the appropriateness of research methods, can directly affect the authenticity of the research results. Therefore, before conducting research, it is essential to prepare thoroughly at each stage to ensure that both the data sources and research methods align with the theme of the study

2.1. Data Source

This study uses China National Knowledge Infrastructure (CNKI) as the core database, conducting a topic search in this database with the theme 'new qualitative energy productivity', selecting 'all journals' as the source, and setting the time frame from 2014 to 2024. However, since 'new qualitative energy productivity' is a recent hot topic, only 224 publications were identified.

2.2. Research Method

CiteSpace is a software developed by Professor Chaomei Chen for analyzing scientific literature data. Since its introduction to China in 2006, the software has been used by many scholars to identify core authors, research institutions, research hotspots, and evolution patterns in different research fields.^[3] Therefore, the main tool used in this study is CiteSpace (6.1.6), which is employed for co-occurrence, clustering, and other analyses of the data. Specifically, it includes: clustering analysis, co-occurrence analysis, and temporal analysis of keywords; co-occurrence and collaboration analysis of authors; and co-occurrence and collaboration analysis of research institutions.

3. RESULT ANALYSIS

3.1. Post Volume Analysis

The volume of publications can intuitively and clearly reflect the development process and research scale of a field. After statistics were conducted on the selected journals, it was found that from 2014 to 2022, there were almost no publications related to 'new quality of energy productivity,' but the publication volume began to increase in the following two years. During the period from the introduction of the concept of new quality productivity to its formal recognition as a development

strategy, the corresponding publication volume also increased accordingly. Among the 224 selected documents in this study, 7 publications related to 'new quality of energy productivity' were released in 2023, whereas in 2024, there were 217 such publications.

3.2. Keyword Analysis

3.2.1. Keyword Co-occurrence Analysis

The keywords of an article can reflect its key content, while the high-frequency keywords among numerous articles can indicate the hot topics and research characteristics in that field. By using CiteSpace to analyze keyword co-occurrence, it is found that nodes such as 'technological innovation,' 'energy transition,' 'future industries,' 'digitalization,' and 'greening' are the most prominent, indicating that these research directions receive the highest attention in this field. Overall, the density of keyword co-occurrence is relatively low, research directions are not concentrated, and peripheral nodes are sparse, indicating that research on 'new-type energy productivity' is still in its early stages, and there are still unexplored areas and directions.

3.2.2. Keyword Cluster Analysis

Clustering the keywords of the selected literature can help understand the research hotspots and trends in this field. By using CiteSpace to cluster similar keywords, three major cluster modules were obtained. Generally, clustering analysis using CiteSpace can be judged for research significance by modularity values (Q value) and average silhouette values (S value). When $Q > 0.3$, it indicates that the identified cluster modules are significant; when $S > 0.7$, the cluster is considered valid and reliable [4]. In the clustering analysis of this study, $Q = 0.7418$ and $S = 0.9255$, indicating that the cluster modules are significant and valid.

Cluster #0: Technological innovation mainly includes keywords such as new energy, future industries, and self-reliance. This indicates that scholars in this category focus their research on the study of new quality productivity in the area of technological innovation. For instance, Zou Cainen and others, from the perspective of new energy and emerging industries, analyzed the domestic and international usage proportions of new energy and related policies. They concluded the pathways and measures for accelerating the formation of new quality productivity through emerging new energy industries, and found that technological innovation is the primary factor driving the development of new quality productivity. Emerging new energy industries are an important component of new quality productivity, and accelerating the layout and development of these industries will allow China to gain an advantage in the new round of technological revolutions and industrial transformations, among other conclusions.^[5]; Sun Bailin demonstrates to readers the role of new-quality productivity in the energy system and derives methods to accelerate the formation of new-quality productivity in the energy sector. He proposes increasing technological and institutional innovation, using key energy and power technologies as breakthrough points, vigorously promoting the intelligence, greenness, and integration of the energy and power industry, clearing the bottlenecks that restrict the development of energy and power, and establishing an open, innovative business system with global competitiveness.^[6]

Cluster #1 energy transition mainly includes industrial upgrading, development paths, synergy effects, and dual carbon goals. Scholars in this category focus their research on the new-type energy productivity primarily in the aspect of energy transition. For example, Liu Shuai and others, based on data from 30 provinces from 2012 to 2022, constructed an evaluation index system for new-type productivity to analyze the impact of new-type productivity on energy transition. Research shows that new quality productivity has a strong driving effect on the low-carbon transformation of the energy structure, and this impact gradually increases over time. Moreover, new quality productivity can promote the low-carbon transformation of the energy structure through the dual channels of advancing industrial upgrading and industrial clustering.^[7]; Wang Xueting believes that there is a close interrelationship between energy transition and new quality productivity. On one hand, energy

transition provides a solid material foundation and technical support for the development of new quality productivity; on the other hand, the development of new quality productivity further promotes the deepening of energy transition. Based on the intrinsic connection between energy transition and new quality productivity, the author demonstrates that there are synergistic effects between the two in terms of technological innovation, industrial development, economic benefits, and social welfare. The author also analyzes the risks faced in leveraging this synergistic effect and proposes corresponding countermeasures and recommendations, such as technological innovation and R&D, industrial chain coordination and optimization, and infrastructure construction and improvement.^[8]

Cluster #2, digitalization, is one of the three coordinated transformations, which altogether include digitalization, intelligentization, and greening. Wang Huijian validates the statement made by General Secretary Xi that 'green development is the essence of high-quality development, and new quality productivity is itself green productivity' from three aspects: the inherent 'innovation' in green productivity as a feature of new quality productivity, the key characteristics of 'innovation,' green productivity meeting the intrinsic requirements of new quality productivity, and green productivity containing the driving force for the formation and development of new quality productivity. From the perspective of energy, green productivity can continuously produce products with lower energy consumption, laying a foundational driving force for the formation of new-quality productivity in the energy sector. The author provides examples in the text: under the guidance of green development, China's wind and photovoltaic technologies are leading internationally and have achieved full industrial chain localization. Additionally, the newly installed capacity of renewable energy in China has already surpassed that of fossil energy, greatly boosting confidence in achieving China's energy transition and carbon neutrality goals. It can be expected that in the context of rapid development of new-quality productivity, new energy technologies will continue to release more ecological benefits for the energy revolution in the future.^[9]

3.2.3. Keyword Temporal Analysis

Conducting a temporal analysis of keywords can further help understand the research trends of domestic scholars in the field of new energy productivity. By using CiteSpace to perform a temporal analysis of keywords, a keyword timeline analysis is obtained. The study shows that in 2023, the keywords are solely centered around technological innovation, such as self-reliance, self-strengthening, and green development. However, with the further improvement of the framework for new quality productivity, research on new quality productivity in the energy sector has gradually increased. By 2024, studies on new quality productivity in energy have begun to show a trend of intersection, evolving from initial technological innovation to a combination of technological innovation and digitalization, technological innovation and energy transition, as well as energy transition and greening. This has laid a certain foundation for the emergence of some interdisciplinary research

3.3. Author and Their Collaborations

The author collaboration network can reflect the key players in this research field and their cooperative relationships. By using CiteSpace to analyze the co-occurrence of authors and their collaborations, it is evident that nodes representing authors such as Li Wei, Han Wenlong, and Zhao Yanyan are prominent, indicating that they contribute the most publications in the field of new energy productivity and have their own unique insights in this area. From the recent research directions of Li Wei, Han Wenlong, and Zhao Yanyan, Li Wei's research on new energy productivity focuses on energy transition.^[10]; Han Wenlong's research on new-quality energy productivity focuses on the relationship between new-quality productivity and green productivity, as well as the measurement of the development level of new-quality productivity.^[11]; Zhao Yanyan's research on new-quality energy productivity focuses on the digitalization and intelligence of energy.^[12] From the perspective of collaboration, aside from Xu Zheng, Li Zongyao, Zhang Jiaoyu, and a few others who have

collaborative relationships, most scholars conduct research independently and have relatively weak collaboration connections with authors who publish frequently. Therefore, in future studies, efforts should be made to further strengthen the collaboration among authors in order to build a larger academic community,

3.4. Research Institutions and Their Collaborative Analysis

Comparing domestic institutions that study new quality productivity can help to gain a deeper understanding of the dynamic changes in this field, promote academic collaboration and communication, and provide important decision-making support and reference for policymakers, researchers, and institutional managers. ^[13]. By using CiteSpace to analyze the selected research institutions, it can be seen that in terms of the nature of the institutions, energy organizations and associations are the main forces in researching new energy productivity, and their publication volume is relatively high compared to other institutions, such as China Industry News, China Coal Industry Association, and Shandong Energy Group. At the same time, the connections between universities in the same region are relatively close, especially those between universities and party schools in Shanghai and Jiangsu, reflecting that higher education institutions have a certain level of specialization and research depth in the field of new energy productivity. From a geographical perspective, coastal areas conduct more research on the new quality of energy productivity, such as Shanghai, Jiangsu, and Shandong, all of which belong to the eastern coastal region. However, overall, the connections between different regions and institutions are relatively weak. This is because the concept of the new quality of energy productivity has been proposed for a relatively short time, and various institutions have different levels of attention to research on this topic, making it difficult to form significant cooperation and connections on the whole. Therefore, future research should strengthen the connections between different institutions and regions, such as enhancing the links between colleges and research institutes, as well as between colleges and energy organizations. This would help build larger academic communities and enrich the research content in the field of new energy productivity.

4. RESEARCH HOTSPOTS AND FUTURE TRENDS

4.1. Research Hotspo

Research hotspots can highly summarize the research directions of a certain field. Based on the keyword analysis results above, the current research hotspots in the field of new energy productivity mainly focus on three aspects: technological innovation, energy transition, and digitalization. Different research directions have different perspectives, as detailed below:

(1) Scholars who focus on technological innovation as their main research direction believe that the unprecedented global changes in a century are accelerating, a new round of technological and industrial revolutions is sweeping across the world, and technological self-reliance and strength are also one of the important strategies for national development. Therefore, promoting the formation of new-quality energy productivity relies crucially on the guidance and drive of technology. Through new green technologies, the production efficiency, conversion efficiency, utilization efficiency, and quality of energy can be comprehensively improved, thereby promoting the sustainable development of energy.

(2) Scholars who focus on energy transition as their primary research area believe that, with the increasing global environmental demands and the severe challenges of climate change, it is necessary to gradually reduce dependence on traditional fossil fuels, increase the development and utilization of renewable energy, and promote the development of energy in a green, low-carbon, and sustainable direction. These measures are key to fostering new qualitative productivity in the energy sector.

(3) Scholars who focus primarily on digitalization believe that digitalization is one of the three coordinated modernizations, which together include digitalization, intelligence, and greening. The formation of new quality energy productivity is closely related to both technology and a green environment. Green technology is one of the main directions for the development of new quality productivity, and original, transformative, and disruptive scientific and technological breakthroughs can further unleash the ecological efficiency of new quality productivity, thereby providing crucial guidance for the formation of new quality productivity in the energy sector.

4.2. Future Trends

After summarizing the current research hotspots, we can clearly understand the characteristics of research in the field of new energy productivity. However, scientific research is a process that is continuously being improved. In the future, deepening research on new energy productivity should not only be based on the current research status but also propose new perspectives. Therefore, new academic vitality should be injected into the study of new energy productivity from the following aspects.

(1) Optimize research methods. Scientific research generally progresses from qualitative to quantitative. The literature selected for this study, when viewed as a whole, primarily belongs to qualitative research. None of the literature proposed formulaic measurement methods to quantify and assess the formation of new-quality productivity in the energy sector. Therefore, future research should strengthen quantitative studies, using accurate quantification methods to reflect the progress and trends in the formation of new-quality energy productivity, thereby enhancing the credibility of research results and the feasibility of guiding practice. For example, focus can be placed on building an evaluation system for new-quality energy productivity, exploring process indicators and target indicators to assess it.

(2) Shift the research perspective. From the current research hotspots, it can be seen that whether in technological innovation, energy transition, or digitalization, researchers tend to attribute the formation factors of new energy productivity to external factors, without achieving a unity of subject and object. Future research on new energy productivity should appropriately shift the research perspective, paying attention not only to external factors that influence the formation of new energy productivity but also to factors inherent to the energy industry itself. For example, starting from the energy industry, a quantitative research model of new energy productivity suitable for the energy sector can be constructed. This not only ensures the accuracy of quantitative research but also achieves a comprehensive research perspective. Additionally, it should be noted that the energy industry encompasses many sectors, such as oil, natural gas, electricity, and hydrogen. When constructing a quantitative research model for the energy field, if the model can be refined to the level of different enterprises, future research on new energy productivity will yield richer results.

(3) Strengthen academic exchanges and integrate research resources. From the trend of publication volume mentioned above, it can be seen that the research topic of new energy productivity has strong policy guidance, and therefore, the number of publications is expected to continue rising in the future. However, judging from the authors and their institutions, there is little academic exchange between different research entities, and academic research tends to be relatively independent. This is not conducive to the exchange and consolidation of academic ideas and, to some extent, hinders the healthy development of the research field of new energy productivity. Therefore, in future research, the academic community should actively organize academic seminars focused on new energy productivity, integrating research resources from universities, Party schools, and the Chinese Academy of Social Sciences, among others, allowing various research entities to fully share research experiences, discuss research questions, explore research frontiers, and build consensus, thereby promoting more cutting-edge research outcomes in the field of new energy productivity.

5. RESEARCH CONCLUSION

By conducting a comprehensive review of research on new energy productivity, the following conclusions can be drawn:

(1) Interdisciplinary research has begun to converge and is showing a certain preliminary form. From the chronological evolution of keywords, research hotspots have shifted from the initial focus on technological innovation to the current combination of technological innovation with digitalization, technological innovation with energy transition, and energy transition with greening, fully reflecting the exchange of ideas and scholarship among various disciplines. The rise of interdisciplinary fields such as technology, energy, and greening signifies that research on new-energy productivity is advancing along a broader path, and also indicates that interdisciplinary research on new-energy productivity is about to become normalized.

(2) Digitalization, technological innovation, and energy transition will continue to be focal points in the study of new types of energy productivity. With the continuous development of science and technology, future industries based on digital technologies can promote the continual upgrading and integration of the energy industry through disruptive technologies and methods. This enables energy, during production, conversion, and utilization, to achieve comprehensive improvements in production efficiency, conversion efficiency, utilization efficiency, and quality through technological innovation and optimized allocation of production factors, thereby accelerating the formation of new types of productivity in the energy sector.

(3) Domestic scholars should strive to balance quality and quantity in the research field of new energy productivity. In terms of the number of publications, the field of new energy productivity shows a clear policy orientation, so the number of publications is expected to continue rising in the near future. In terms of collaboration among authors and institutions, most scholars and institutions focus on their own academic research, and there are certain differences in attention and research topics. Therefore, research groups find it difficult to communicate intellectually and academically, and their academic potential has not yet been fully realized.

(4) The data used in this study comes from China National Knowledge Infrastructure (CNKI), covering the time span from 2014 to 2024. However, since the concept of new energy productivity was proposed relatively recently, scholarly research on it is still in its early stages, and there are relatively few available studies, which may result in the research being insufficiently comprehensive. Therefore, future studies could consider expanding data sources and types of literature to ensure further in-depth research.

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