Scientometric Analysis of Clean Energy Topics Based on Carbon Emissions

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Abstract. Net Zero stands as a crucial climate change metric and a significant stride towards accomplishing global carbon emission reduction targets. Carbon emissions, emanating are the release of carbon dioxide and other greenhouse gases due to human activities, underscore the urgency for action. Clean energy, characterized by its minimal environmental impact during production and usage, particularly in low greenhouse gas emissions, emerges as a pivotal solution in this trajectory. Hence, the advancement and application of clean energy technologies are paramount in the pursuit of global carbon emission reduction objectives and combatting climate change challenges. This study delves into the field of clean energy and carbon emissions, 461 articles in the Web of Science (WoS) database were analyzed. The findings from scientific metrology indicate a pronounced academic interest in clean energy and carbon emission discourse. Notably, the United. States leads to research contributions, closely followed by China. The publication sources mirror the interdisciplinary essence of the research domain, while key research themes encompass aspects such as consumption, energy utilization, and carbon emissions, among others. Research trends emphasize a concentrated exploration of decomposition strategies and CO2 emissions as pivotal focal points. In essence, a demand persists for enhanced scholarly investigations about climate change and ecological footprints, underlining many intricate considerations and a vast expanse for future developments.

1 Introduction

In recent years, the environmental problems brought by excessive carbon emission have become more serious, which not only affects the environment, but also limits the sustainable development of our country's economy [1]. However, few studies have revealed the urgency of reducing emissions [2]. China has made progress in improving air quality in its energy transition, but still faces challenges such as further reducing ambient PM2.5, mitigating O3pollution and controlling CO2 emissions [3]. The green hydrogen industry has many benefits. It is conducive to establishing a new energy structure, optimizing the system and promoting the transformation [4]. Some studies point out that in the context of a digital platform for carbon emission information services, the value proposition of artificial intelligence on the environment is elucidated [5].

China aims to reach carbon peak by 2030 and carbon neutrality by 2060, and aims to fully builds its energy system [6]. The contemporary global crises concerning clean energy, carbon emission, and water shortage necessitate the creation of innovative materials that can tackle these pressing issues [7]. Clean energy is a necessary means, and marketization is the inevitable result [8].

Based on 461 literature in the WOS database, this paper studies clean energy and carbon emissions, and draws relevant pictures to provide relevant ideas for researchers' reference.

2 Data and Methods

To get technical points on fintech and carbon emissions, we used WoS to search for them:

TS=("clean energy") AND TS=("carbon emission")

A total of 461 articles were used. We drew using VOS viewer and bibliometric.

The methods involved in the scientometric analysis include data collection, data cleaning, descriptive analysis, temporal analysis, network analysis, correlation, regression analysis, text mining, validation and interpretation. The scientometric analysis used in this article is a research method that uses mathematical and statistical techniques to analyze scientific literature and academic communication and is of high value. It involves data collection, cleaning, network analysis, descriptive statistical analysis, correlation, regression analysis, temporal analysis, statistical techniques, validation, and interpretation. It provides researchers with the ability to identify patterns, trends, and relationships within the scientific commun.

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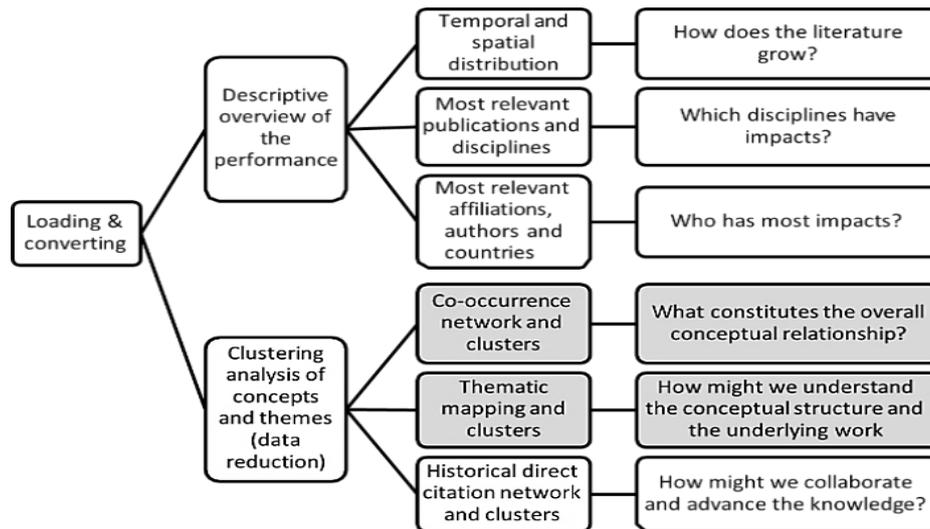
Fig. 1. Workflow of the research (Source: Authors' own work).

Fig. 1 illustrates the four stages of process in this article: data collection, analysis, visualization, and narration. The second step mentions descriptive overview and cluster analysis, the third stage is the visualization stage, and the fourth process provides evidence or empirical basis for the data story.

3 Research Findings

This paper mainly studies the methodology of the author's own research work, research trends of related topics, major countries, sources and author keywords.

3.1 Annual Scientific Production and Related Statistics

This study collected 461 papers related to this topic in the WoS database on 2024.5.22. These articles were cited 9910 times in total, with an average of 21.5 times per article. The H-index was 46. There were fewer articles published in 2009. Since 2017, the number has increased significantly. The largest increase occurred from 2019 to 2023, and growth is expected to continue. Relevant statistics are in the Table 1 below.

Table 1. Relevant statistics.

Item	Number
Number of Results Found	461
Total Times Cited	9910
Average Citations per Term	21.5
H-index	46

3.2 Main countries and sources

Fig. 2, "AU" is the author, "AU_CO" is the author's country, "CR_SO" is the source of publication, and the thickness of the line shows the quantity. The graph shows the interrelationship between authors, countries, and publication sources. The authors are from different countries collaborate in research exchanges, and the largest of authors are Chinese. China has made the most contributions to Pakistan, the United Kingdom, Saudi Arabia, Canada, Japan and Iran. China has done even more research on clean energy and carbon emissions. It reflects China's active pursuit of solutions in these areas in frontier areas. Journal of Cleaner Production has the highest number of publishing sources.
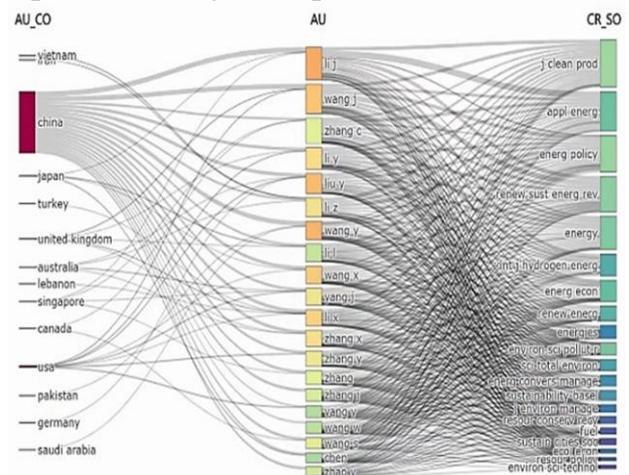

Fig. 2. Three-Fields Plot.

3.3 Main theme

Measured by using network centrality, the theme map divides the centrality (x-axis) and density (y-axis) of the theme (topics or keywords here), as shown in Fig. 3. Common explanations for the thematic composition of these four quadrants: motor themes (located in the first quadrant, it indicating that there has been outstanding development), niche themes (located in the second quadrant, indicating that there are been some development but it is not significant), basic themes (located in the fourth quadrant, significant but not well developed), and emerging-declining-themes (located in the third quadrant, just emerging or about to disappear).
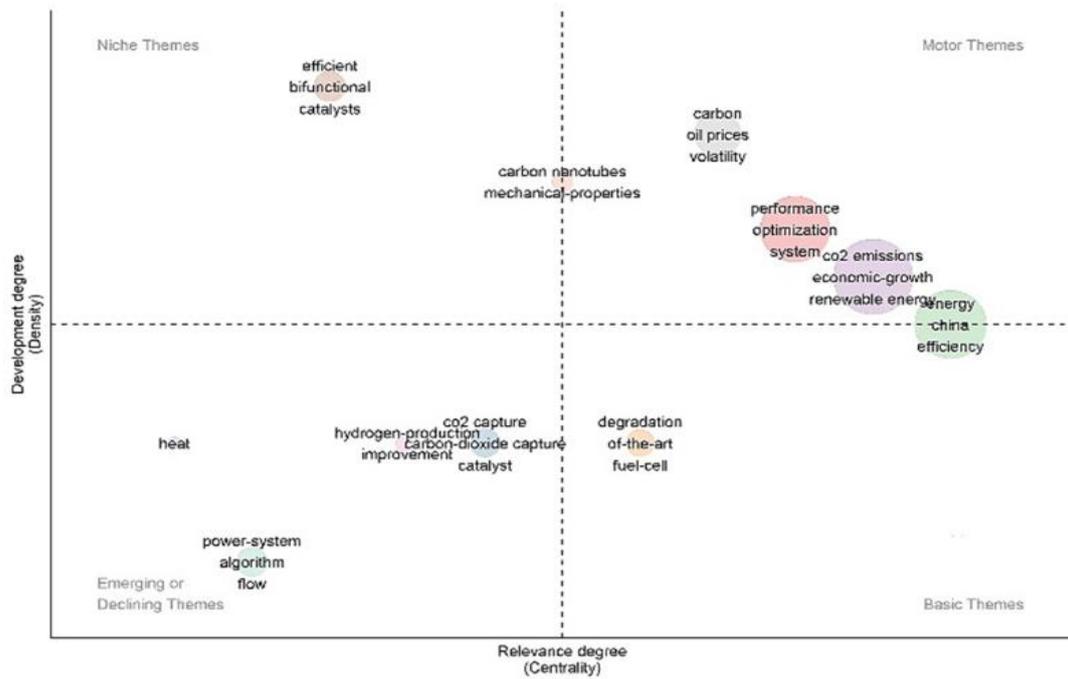
Fig. 3. Thematic map.

Fig. 3 shows that the topics of CO_2 emissions, performance, carbon, etc., have been more developed. By contrast, topics such as degradation, of-the-art, fuel-cell, etc., are still important but as part of a more systematic concept, it has not been fully developed. Topics such as efficient, carbon nanotubes, bifunctional, etc., can be further developed into better developed topics. Furthermore, if carbon accounting develops well, topics such as power systems will become important.
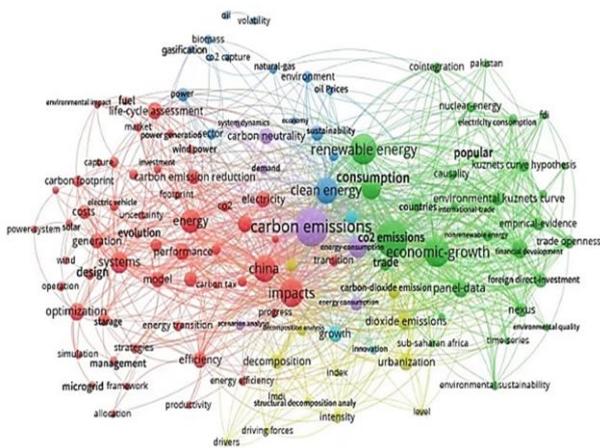
3.4 Analysis of author keywords

Fig. 4. Graph based on the author keyword co-mail: clustered result.

To investigate how concerns and topics relate to each other, Fig. 4 shows the clustering results for the author's keywords, and we determine five clusters. The red cluster (energy) mainly discusses how to assess carbon emissions and make a significant contribution towards mitigating global climate change in terms of energy transition. The blue cluster (clean energy) consists of sustainability, oil prices, and power, and the Green cluster (economic growth) includes keywords such as consumer panel date, CO2 emissions, and so on. The purple cluster (emissions) includes keywords such as energy-consumption carbon neutrality, demand, and all. Yellow cluster (dioxide emissions) includes keywords such as urbanization, decomposition, carbon trade emission, and stuff like that.

4 Conclusion

There is a close relationship between clean energy and carbon emissions, including the use of clean energy can reduce carbon emissions, the development and utilization of clean energy is an important means of reducing carbon emissions, and the carbon pricing mechanism also helps promote clean energy. In general, there is a close positive relationship between clean energy and carbon emissions, and the development of the former helps to reduce the latter. In the face of the climate crisis, the global clean energy transformation must be accelerated to achieve net-zero carbon emissions by 2050. The Group of Seven Major Industrial Countries (G7) released the Clean Energy Economy Action Plan in May 2023. Reaffirming our commitment to the Paris Agreement, to achieve this goal, all sectors need to cooperate further to fill the investment gap in the clean energy transition, thereby reducing the cost of the clean energy transition. The G7 emphasizes the establishment of a safe, resilient, affordable, sustainable clean energy supply chain and a strong industrial foundation. The strategy focuses on "unity and cooperation", "maximizing the impact of incentives" "reducing emissions through trade policies", "Building a resilient global supply chain", "Promoting clean energy technology", "Promoting trade and investment in clean energy products and services", and "Supporting global partners" are the seven core strategies.

Clean energy and carbon emissions are closely

interlinked, such as the use of clean energy can reduce carbon emissions, the development and utilization of clean energy is an important means of reducing carbon emissions, and the carbon pricing mechanism also helps promote clean energy. Overall, there is a strong positive correlation between clean energy and carbon emissions, and the development of the former helps to reduce the latter.

The study analyzes the literature on clean energy and carbon emission technology. According to the results of scient metrics analysis show that scholars pay more keep a watchful eye on clean energy and carbon emission technology. China and United States have relatively outstanding research results; The decentralized nature of the main publication sources reflects the multi-disciplinary nature; The topic of CO_2 emissions and performance in the 2021-2023 period has received attention, but some conceptual frameworks for fuel cells have not been thoroughly studied. In a word, researchers will pay more and more attention to the research of clean energy and carbon emission technologies, and China has contributed the most. There will be more research on clean energy and carbon emissions in the future, and people will pay more and more attention to the module of clean energy and carbon emissions. In short, clean energy is not only an effective means to deal with global climate change, but also an important way to promote sustainable economic development. With the maturity of technology and the expansion of applications, clean energy will occupy an increasingly important position in the future energy structure.

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