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Net-Zero Economy and Climate Change Mitigation: Quantitative synthesis of the research through a comprehensive Bibliometric and Network Analysis

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ABSTRACT

A bibliometric network analysis of worldwide research production on net-zero and decarbonization was conducted from 2015 to 2025, using 1884 records from the Scopus database. After applying strict screening based on cross-disciplinary and eligibility criteria, 1,292 studies were included in the study for bibliometric analysis. Analysis tools used for visualizing publication trends, best authors, institutions, and journals include VOSviewer and Bibliometrix (R). After the 2015 Paris Agreement, the number of publications in the field of sustainability and climate economics increased by an average annual growth rate of 20.89%. Using keyword co-occurrence mapping, three generic topics were identified: climate policy/mitigation, economic growth and carbon emissions, and a shift to renewable energy. These generic themes describe an intersection of environmental policy, economic modelling, and technological viability. China now dominates this literature because its global leadership in climate research has grown. Overall, this study empirically maps the intellectual and structural evolution of net-zero research. Future scholars and policymakers are provided with potential new avenues for sustainable development research.

Keywords:Bibliometric Analysis, Climate Change Mitigation, Decarbonization, Net-Zero Economy, Renewable Energy, Sustainability.

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1. Introduction

Climate change has emerged as one of the most pressing challenges of the twenty-first century, posing challenges and altering global priorities across economics, science and policy. A thorough understanding of its causes, consequences and the efforts to mitigate it is essential for advancing sustainable growth and achieving a net-zero economy. Climate change is the long-term shift in global temperatures and weather conditions (Fu & Waltman, 2022). Aside from contributing to global warming, climate change has had immense economic and social impacts.

The IPCC (2022) states that nearly half the global population lives in areas of high climate vulnerability, leading to an average of 23.1 million people being displaced annually between 2010 and 2019 (WMO, 2020). By 2030, the worldwide impact of climate change will amount to the loss of 80 million full-time jobs and US$2.4 trillion in income (ILO, 2019). Consequently, the global economy may experience a 19% decline in per capita income by 2050 due to climate change (Kotz et al., 2024). To counter the impacts of carbon emissions, which have a corollary effect on climate change and the economy, several countries have undertaken commitments to achieve a net-zero economy. To achieve this, the Paris Agreement 2015 aims to limit the rise in global temperature to 1.5 ℃ above pre-industrial levels through Net Zero. IPCC defines net zero as a state in which “anthropogenic removals balance anthropogenic emissions of greenhouse gases to the atmosphere over a specified period”.

As of 2025, there has been a proliferation of research on net zero as it becomes increasingly relevant, with noticeable impacts on the day-to-day functioning of the green economy. A large corpus of research publications can be better understood through a bibliometric research methodology. Bibliometric analysis is a primary method for exploring and analyzing large volumes of scientific data. It enables us to discern the progressive subtlety of a discipline, while shedding light on the novelty that is bound to emerge. This method has gained considerable relevance in business research; this trend is warranted as we observe an annual increase in the number of publications (Donthu et al., 2021). This abundance of research, while improving our collective understanding, complicates the identification of priorities and the formulation of effective strategies for transitioning to a net-zero economy.

Although many global studies have utilized bibliometric analysis to provide helpful information in the fields of environmental science (Tan, Yang, & Zhou, 2024; Sachan et al., 2025), sustainability science (Xu et al., 2023), climate change science (Hanafi et al., 2024), and environmental economics (Tao & Chao, 2023), few bibliometric studies to date have specifically examined net-zero and climate change research about achieving a net-zero economy. The present research aims to fill that gap by systematically mapping intellectual data from 2015 to the present on global net-zero research. This is significant as it condenses an overwhelming body of

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literature and findings to aid in a better understanding of the research domain of net-zero and climate change.

The rest of the study is structured as follows: Section 2 describes the research methodology and data collection process; Section 3 presents the bibliometric results and key findings; and Section 4 discusses the conclusions and outlines the study's limitations and potential directions for future research.

2. Research Methodology:

The main objective of this study is to provide a bibliometric analysis of the research domain of net-zero and decarbonization. The study utilized a bibliometric analysis for its ability to quantitatively evaluate a large volume of interdisciplinary literature, while avoiding the limitations of qualitative systematic reviews (Snyder, 2019; Donthu et al., 2021). Accordingly, this study seeks to answer the research question: What are the key trends, thematic structures, and influential contributors to the research domain of net-zero and decarbonization between 2015 and 2025?

The search was conducted on the Scopus database, one of the largest and most comprehensive databases available, making it an ideal source for bibliometric analysis. It contains a wide range of global journals and offers numerous tools for analyzing citations and identifying trends across multidisciplinary fields (Baas et al., 2020; Singh et al., 2021). Accordingly, a broad search string was developed that included different variants of terms related to both concepts. The search appropriate string was defined as ["net zero" OR "net-zero" OR "Carbon Emission*" OR "Carbon Dioxide" OR "Decarbonisation" OR "Carbon Neutrality* "AND "Climate Change" OR "Global Warming" OR "Environment" OR "Sustainable Development" OR "Sustainability"] for the time period from 2015 to 2025. The search was further filtered to include only studies published in English and classified as final print, and only those in the Economics & Finance subject areas, to ensure the interdisciplinary aspect of the study was applied. This led to the extraction of 1884 studies.

The subsequent studies then underwent several rounds of purification. The first step involved screening abstracts and titles to exclude any irrelevant studies. The second and more detailed screening process was conducted according to specific inclusion and exclusion criteria. The studies characterized as “balanced,” which utilized both economic and scientific analyses and methodologies suited to our interdisciplinary approach, were not excluded. Studies that tended to be too “narrowed”, focusing on either a single country or a single discipline, and that were solely in economics or hard science, were excluded. Once screened, we determined that the final

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selection provided a global context for the study. In the end, this led to the finalization of 1292 studies.

After selection of the final studies, a comprehensive bibliometric analysis was performed using VOSviewer (Van Eck and Waltman 2010) and Bibliometrix (Aria M & Cuccurullo C. 2017). The primary reason for conducting a bibliometric analysis was to outline the domain's bibliometric and intellectual structure systematically. By assessing publication patterns, citations, and connections among authors, countries, and institutions, we can provide a data-driven, more evidence-based view of the research landscape. This is a more objective and comprehensive means of giving an overview of the field's evolution and helps identify key thematic clusters and research gaps that would be difficult to locate through a manual review (Zupic & Čater, 2015). A performance analysis and science mapping was then performed on the studies. These analyses were crucial, as they helped deepen understanding of the research domains of net-zero and climate change.

The performance analysis, conducted primarily with Bibliometrix, assessed the field's research output using a quantitative approach. This included identifying key trends such as the most cited articles, the increase in the number of publications over time, and the most influential journals, countries, and authors. Overall, this provides an overview of the research domains, productivity, impact, and leading contributors.

Science mapping, primarily using VOSviewer, was used to visualize the intellectual structure of the research domain. This approach is qualitative and aims to uncover relationships and connections within the body of literature. This was mainly done by constructing co-citation networks or authors and co-occurrence networks of keywords, which allowed for the identification of the prominent research themes and gaps. This visual mapping provides a more in-depth understanding of the direction of the research domain's evolution and where key areas of research are concentrated.

3. Data Findings:

Bibliometric and network analysis are especially influential methods for discerning the development of scholarly study. Bibliometric analysis measures publications quantitatively to determine trends, dominant nations, top institutions, most productive authors, and seminal works in a discipline. Network analysis enhances this by graphing associations between keywords, co-authored papers, and co-citations to uncover intellectual clusters and patterns of collaboration that structure academic discourse. These analyses are typically conducted using tools such as the R package and VOSviewer, which provide visualization functions for large bibliometric networks and enable researchers to explore trends in large datasets efficiently. These methods,

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applied to data analysis, follow the evolution of the sustainability economics literature, identify research lacunae, monitor methodological approaches in economic modelling, and assess scholarship in terms of its fulfilment of global climate obligations. For instance, bibliometric data indicate a peak in publications on renewable energy economics after the 2015 Paris Agreement, confirming the policy's impact on the research agenda. Together, network analysis and bibliometric analysis offer a systematic and comprehensive method to connect theoretical research with practical policymaking in favour of the global transition to net-zero emissions and sustainable development.

Table 1. Main Information about Data

Description	**Results**
Time period	2015:2025
Sources (Journal Articles)	277
Documents	1292
Annual Growth Rate %	20.89
Author's Keywords	3616
Authors	3726
International co-authorships %	34.06
Article	1230
Review	62

Table 1 presents an overview of the bibliometric dataset used to analyze the Net-Zero and decarbonization literature from 2015 to 2025. The records comprised 1,292 documents from 277 journal sources, with an annual growth rate of 20.89%, indicating increasing research interest in this area. There are 3,726 authors in the dataset, of whom 151 have single-authored records, indicating high levels of collaboration. In addition, 34.06% of the studies had international co-authorships, highlighting global collaborative research. Documents, on average, had 23.14 citations, indicating significant scholarly influence. The dataset comprises mainly journal articles

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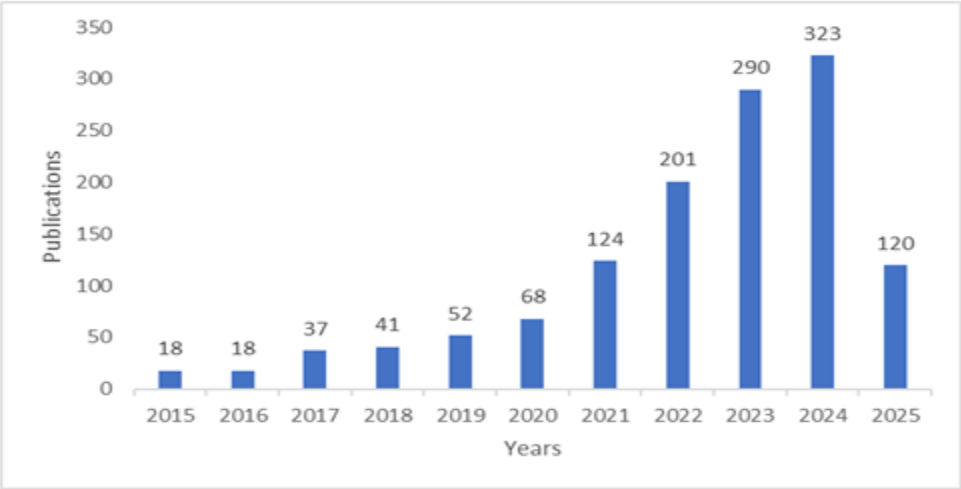
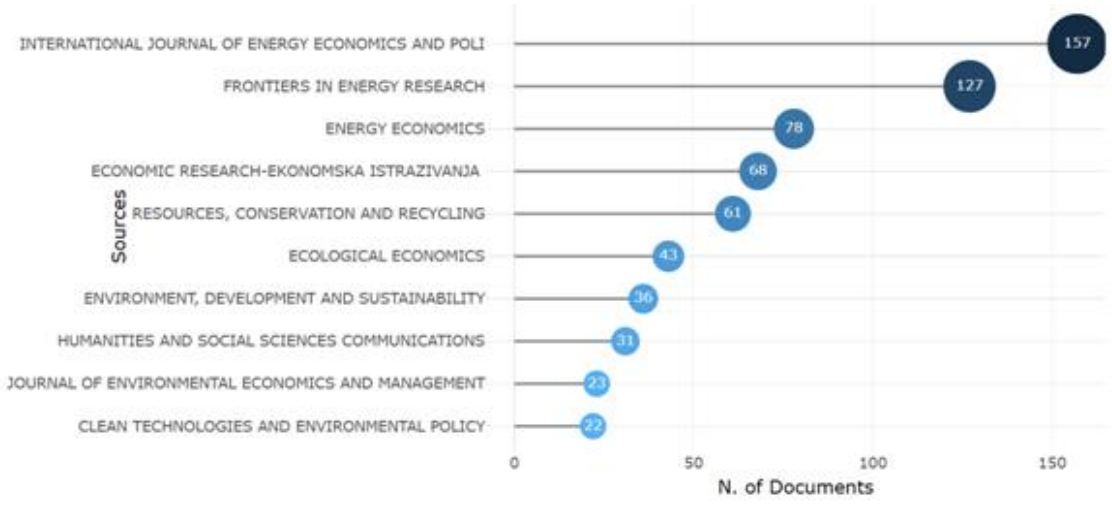
(1,230) and a minor section of reviews (62), reflecting parity between primary research and synthesis studies.

Fig. 1 Research Publication(s) Growth



The number of publications demonstrated subdued, consistent production (18-37 papers) from 2015 to 2017. A steady buildup to 2020 (68 papers) was followed by an explosive, exponential spike from 2021. Research peaked meteorically in 2024, with 323 papers, as the global emphasis on net-zero initiatives intensified. The sharp decline in 2025 (120 papers) is most likely due to incomplete data capture for the last year. The graph illustrates a dramatic increase in academic interest over the past five years.

Fig 2. Most Productive Journals in the Research Domain



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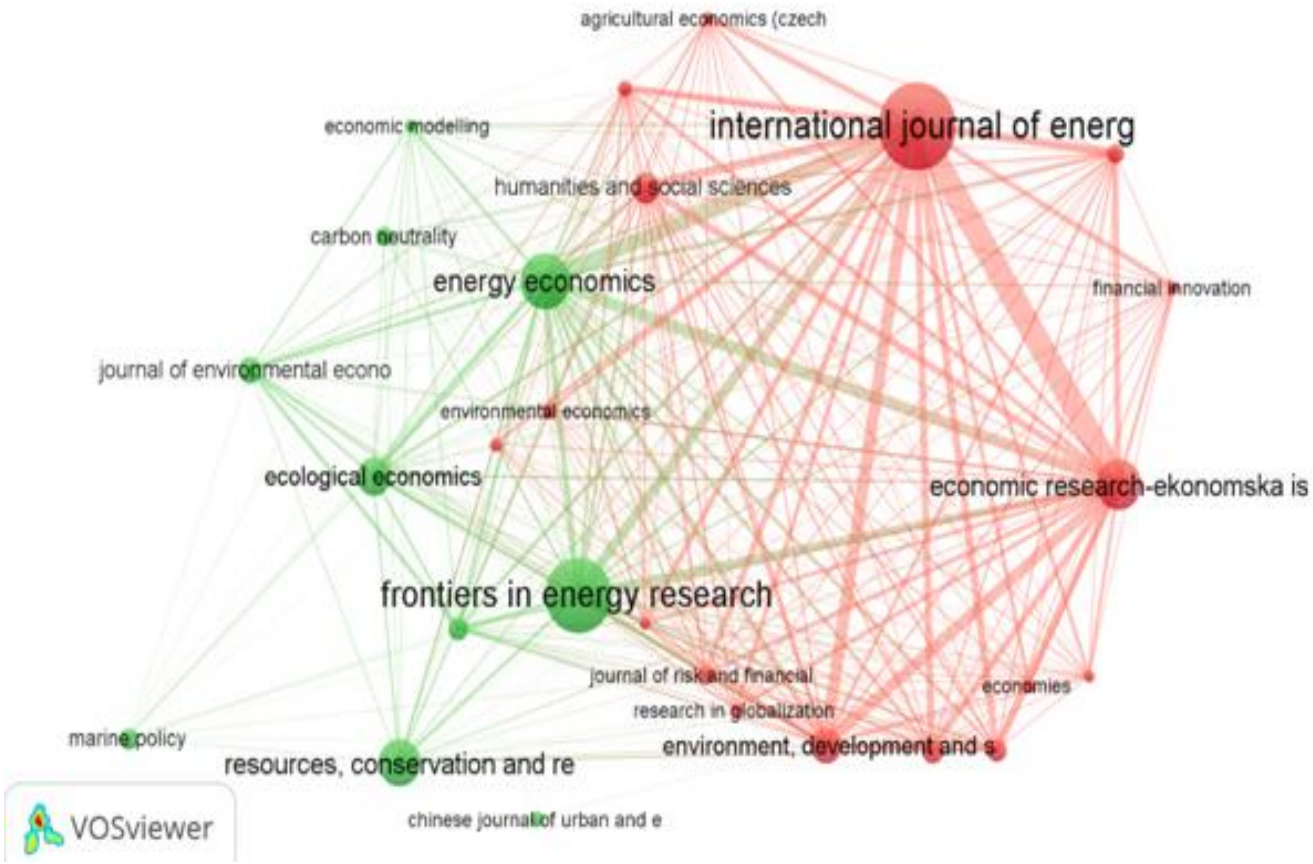
The chart shows the most productive journals in the dataset. The International Journal of Energy Economics and Policy is the leading journal with 157 documents. It is trailed by Frontiers in Energy Research with 127 papers. The size of the bubbles at the end of each bar is commensurate with the number of documents, providing a rapid visual overview of the top two journals. This table helps easily identify the main publication outlets in a given area of study.

Fig. 3 Network Map showcasing Bibliographic Coupling of the Journals



In Fig. 3, each node (or circle) represents a journal; its size indicates the journal's contribution to the data set. The thickness of the lines represents the strength of bibliometric coupling. The various colours indicate separate clusters or research communities. For example, the red cluster includes journals such as the International Journal of Energy Economics and Economic Research-Ekonomska Istraživanja. In contrast, the green cluster comprises Frontiers in Energy Research and Resources and Conservation and Recycling. This indicates that these clusters of journals specialize in different but connected subfields, with the red cluster possibly being more aligned with economics and the green one with environmental science.

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Fig. 4 Word cloud representing core keywords

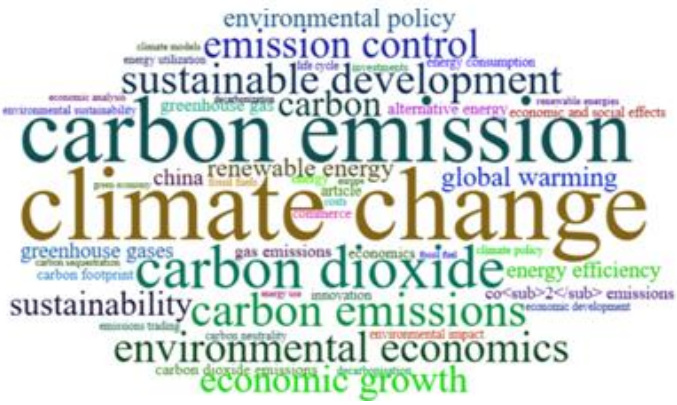
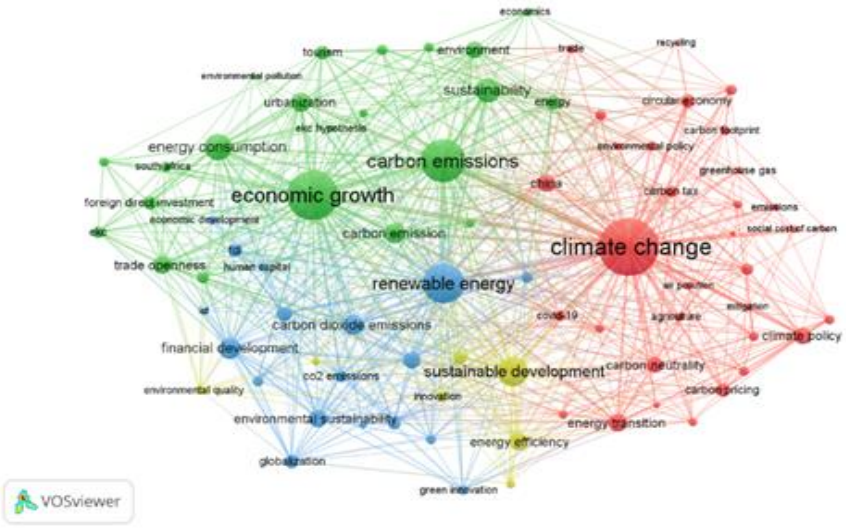


Fig. 4 provides a quick visual overview of the most critical ideas framing the field of net-zero and decarbonization research. The largest words, "carbon emission," "climate change," and "carbon dioxide", serve as the root problems and leading causes of the entire research sphere. The prevalence of high-support keywords such as "environmental policy," "sustainable development," and "environmental economics" demonstrates the discipline's interconnected emphasis on both economic feasibility and systemic measures. This attests that net-zero research is all about developing and evaluating economically viable approaches (e.g., economic growth, energy efficiency) to address the underlying issue of carbon emissions and respond to climate change. The prevalent use of terms such as renewable energy and emission control further underscores the focus on pragmatic, energy-driven transition pathways to achieve sustainability.

Fig. 5 Network Analysis of keywords



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The map shows keyword clusters based on the frequency with which terms co-occur, and it shows the main research threads in the topic. The Red Cluster, centred on "climate change," focuses on policy and mitigation, using terms such as climate policy and carbon pricing. The leading Green Cluster, centred on "economic growth" and "carbon emissions," focuses on the environmental-economic interface, including topics such as the EKC hypothesis. The Blue Cluster, which is smaller, specialises in "energy efficiency" and "renewable energy," capturing the technology transition pathways. There are strong connections between clusters, especially between the Red and Green clusters, showing that economic forces and policy directives are closely entangled in net-zero research. This keyword mapping captures the interdisciplinary essence of the study: weighing economic growth and climate action.

Fig 6. Most Productive Authors

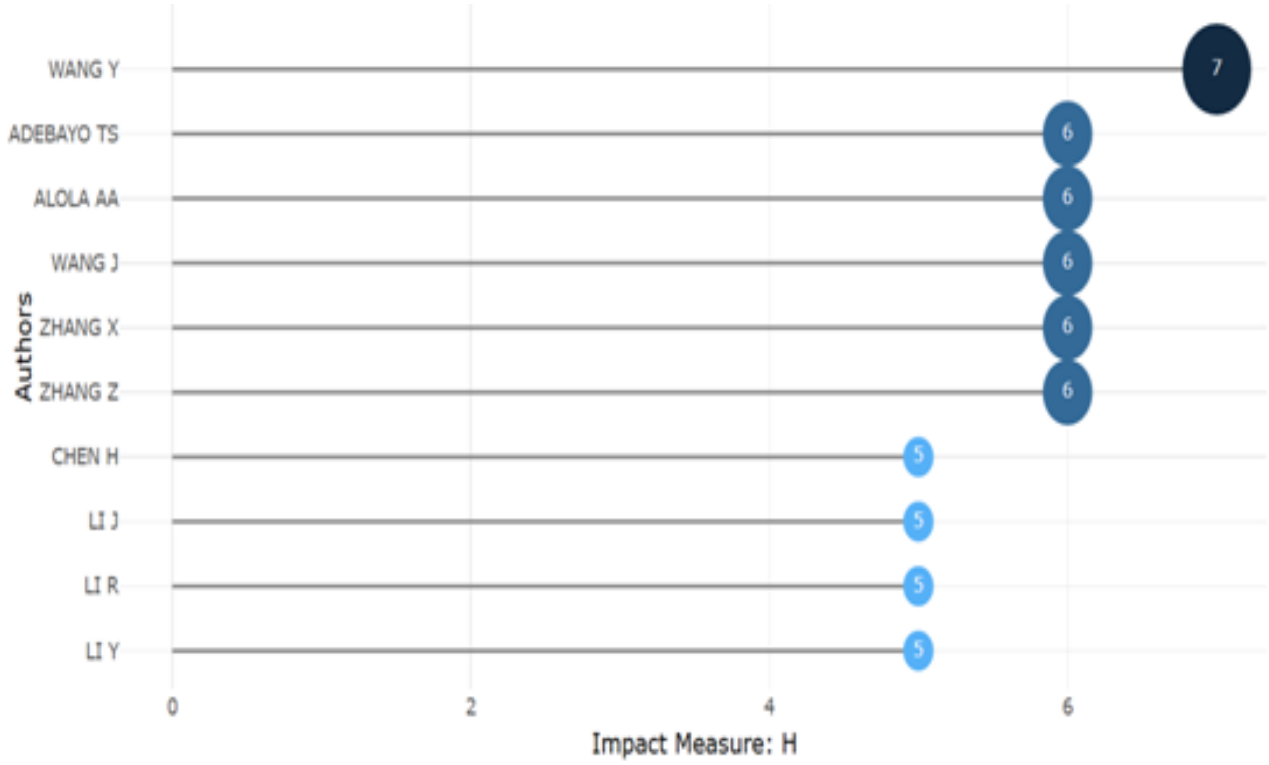

Fig. 6 is a horizontal bar chart with H-index on the X-axis and Authors on the Y-axis. The chart showcases authors' research productivity and citation impact. It uses the H-index to measure impact. The H-index is a metric measuring both the productivity and citation impact of a researcher's publications. Each bubble represents the author, and its size indicates the author's contribution to the dataset. The most impactful researcher has been WANG Y, with a seven followed by several other authors.

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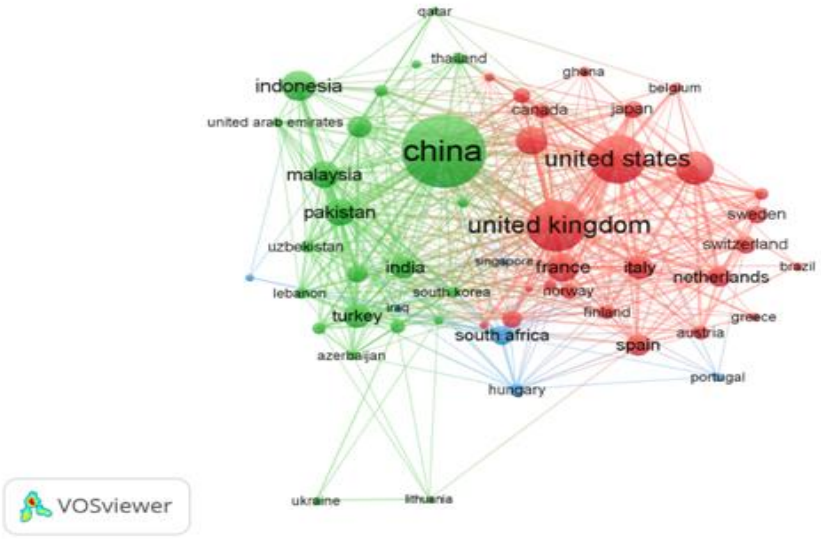
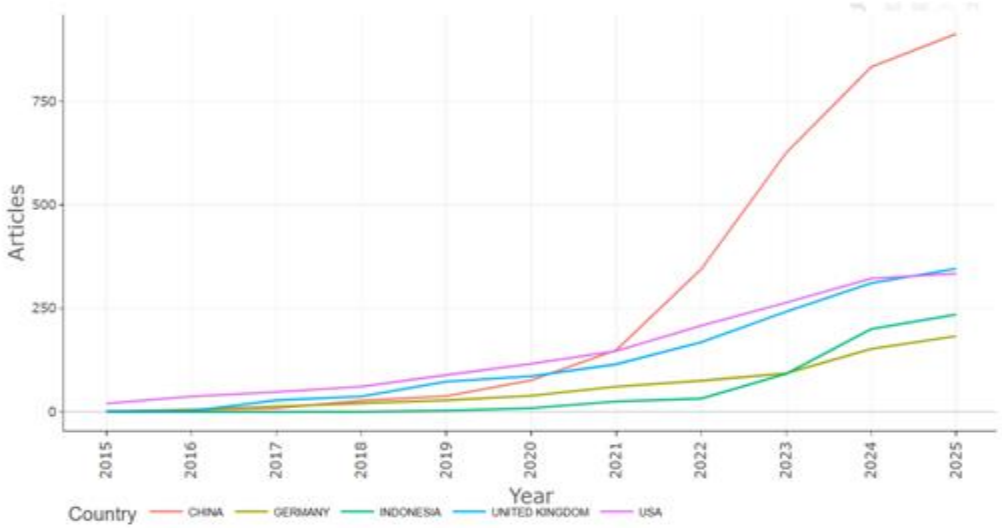
Fig 7. Network visualizing international collaboration of authors



Each node (or) circle represents a country, and the size of the node is commensurate to the number of publications from that country. The lines between countries show co-authorship links; thicker lines indicate more frequent collaboration. The red cluster suggests a stronger western European–North American collaboration network. The green cluster showcases a robust collaborative network across Asia. Some regions are also seen to have strong internal collaboration.

Fig. 8 Contribution of the Countries in the Research Domain



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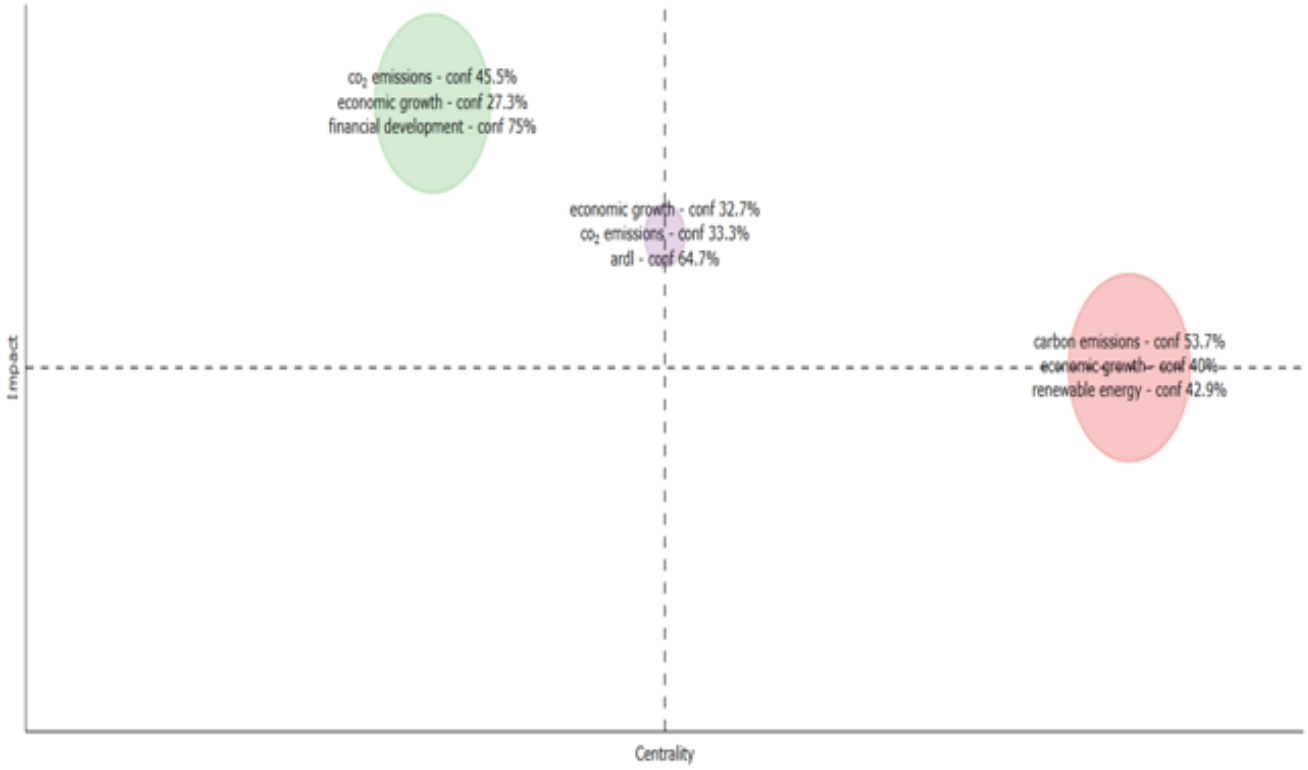
The line graph shows the contributions of five countries to research, highlighting publication trends. While the USA and UK followed steady, incremental growth, the most striking trend is the skyrocketing of publications from China. China's production has a steep, accelerating rise after 2021, reaching a level far higher than all other included nations. This transformation indicates China's entry as the leading scholarly contributor to the net-zero and decarbonization research space by 2025.

Fig. 9 Thematic clusters of the Research Domain



The figure is a strategic map that shows clusters of research topics by impact and centrality. Centrality on the x-axis indicates a topic's connectedness and significance in linking other research fields. Impact, on the y-axis, indicates the strength of influence of a topic within its particular cluster. The green cluster highlights highly influential and emergent issues that are poorly connected to others; it has also set the direction for future research. The purple cluster lays the foundation for other topics; it is well-connected to them and ensures the domain has robust, integrated concepts. The red cluster serves as a connector among different areas of research, even while not making a big impact; it also ensures that the research domain remains holistic and policy-relevant.

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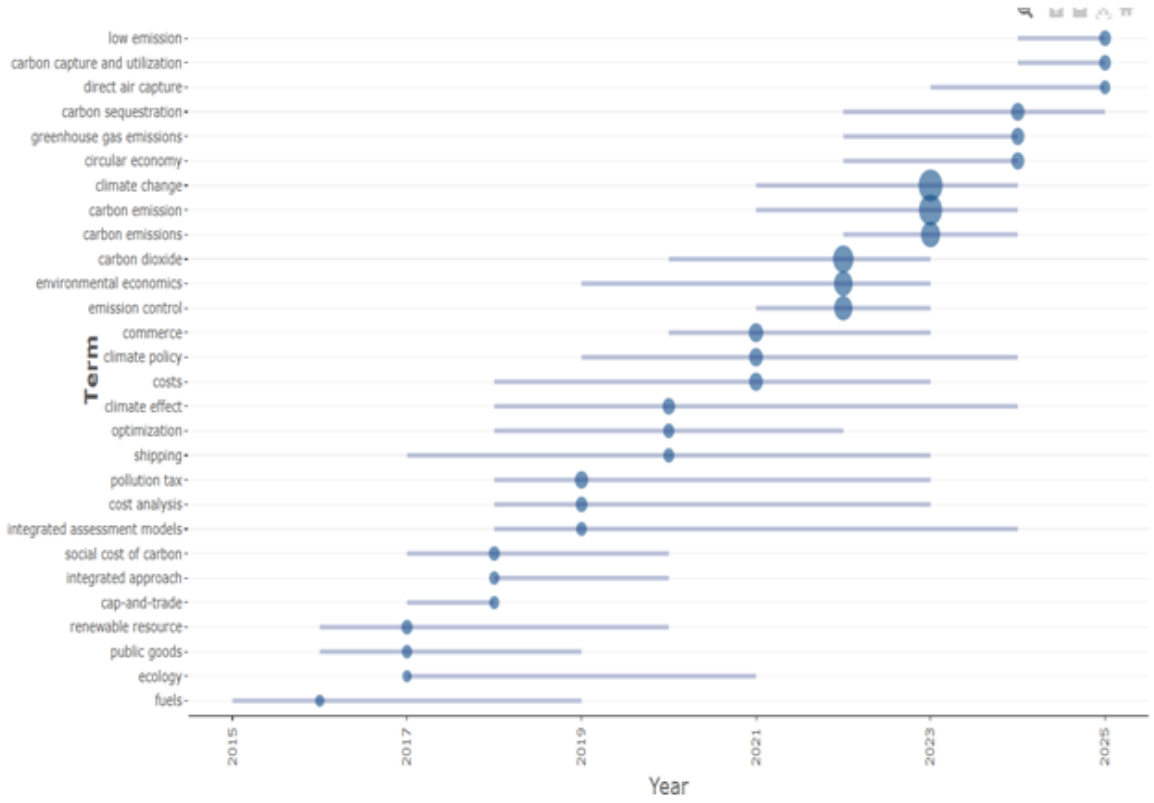
Fig 10. Timeline chart showing emerging research topics



The time-series chart reveals a maturation of the research focus from general environmental concerns to specific, policy-critical analysis. Early research (pre-2018) addressed broad terms like "fuel" and "ecology". The emergence of "social cost of carbon" and "integrated assessment models" around 2018-2019 signalled a pivotal shift towards quantitative economic modelling and policy valuation. Most recently, there's been explosive growth in core, interconnected terms: "climate change," "carbon emissions," and "low emissions." This sharp increase signals the field's accelerated focus on the primary problem and the necessary technological solutions to achieve global decarbonization goals.

5. Conclusion

The paper examines the global body of literature on published net-zero and decarbonization research, comprising 1227 items across 277 journals, 3726 authors, and 34 countries. The study highlights the prospects of bibliometrics and network analysis approaches for mapping the body of published net-zero and decarbonization literature, identifying key players, and analysing interactions among policy, economics, and the environment. The number of papers published

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increased rapidly after 2021, reflecting the world's urgent need for climate action. The most productive countries were China, the United States, and the United Kingdom. This shows the very international and collaborative nature of the field, and topics such as carbon pricing, renewable energy technology, and integrated assessment models demonstrate just how advanced the research area has become, moving beyond comprehensive concepts of sustainability. Thus, beyond providing a review of a disparate body of work, the study outlines an agenda for future research in the field of policy diffusion and economic transitions modelling. Ultimately, our results highlight the need for interdisciplinary-driven data analyzes to achieve the world's net-zero vision.

This study has several limitations. The study used only the Scopus database, which might not contain all relevant research. The keyword set was relatively narrow, possibly excluding new and developing terms in the research domain. Valuable non-English studies were not taken into consideration; only English-language publications were included. The focus on journal articles excluded other academic formats such as reports and conference papers. Future studies could offer a more comprehensive and expansive understanding of the research domain by expanding the databases, keywords, languages, and publication types.

Author's Contribution:

All the authors have equally contributed towards the Conceptualization, Formal analysis, Software and data Visualization, Research Methodology, Writing – Original Draft, Review and Editing.

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