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General Equilibrium Model Applications in Energy Research: A Bibliometric Analysis

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Abstract

This study investigates the scholarly landscape of General Equilibrium (GE) model applications within the field of energy research through a bibliometric lens. Utilizing a dataset of 864 journal articles indexed in Scopus from 1974 to 2022, the research maps publication trends, identifies leading contributors, and uncovers prevailing thematic clusters within the field. The analysis employs VOSviewer to visualize co-authorship networks, as well as institutional and country-level productivity, source relevance, and keyword co-occurrence patterns. Results reveal that China, the United States, and Japan are the most prolific countries, while *Energy Policy* and *Energy Economics* emerge as the most influential journals. Among the authors, Masui T. stands out as the most productive, while Paganetti H. registers the highest number of citations, reflecting a significant scholarly impact over recent years. Keyword mapping highlights dominant research themes centered on "computable general equilibrium analysis," "computable general equilibrium model," and "emission control," reflecting the field's alignment with climate-related energy policy evaluation. This bibliometric overview not only provides a structured understanding of intellectual developments in GE-energy research but also identifies underexplored areas that warrant further investigation—particularly the integration of GE models with renewable energy transitions in developing economies and the incorporation of behavioral and distributional dimensions within energy policy assessments. The study contributes to the advancement of interdisciplinary dialogue by informing future research directions and supporting evidence-based policymaking in the energy-climate nexus.

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1. Introduction

Energy has long been recognized as a fundamental driver of economic growth, technological advancement, and improved standards of living across both developed and developing nations [1–6]. In virtually every sector of the economy, energy functions as a critical input, enabling production, transportation, and innovation [7–9]. As economies expand and modernize, their energy demands increase, underscoring the strategic role of energy in sustaining macroeconomic stability and

promoting inclusive development [10–13]. In recognition of this pivotal role, the United Nations has designated access to affordable, reliable, sustainable, and modern energy as one of the Sustainable Development Goals (SDG 7). While notable strides have been made—particularly in broadening electricity access and scaling up renewable energy adoption—deep global disparities persist. As of 2019, an estimated 759 million people remained without electricity, predominantly in Sub-Saharan Africa [14]. The COVID-19 pandemic further undermined progress, exposing the fragility of energy infrastructure in low-income regions and reversing years of incremental gains. Although international commitments toward SDG 7 have been reaffirmed, recent data from the International Energy Agency (IEA) indicates that by 2023, approximately 685 million people still lacked access to electricity [15–17]. This marginal improvement underscores the uneven pace of progress and suggests that without substantial increases in targeted investment, many of the world's poorest regions will continue to face energy poverty. In addition, recent market disruptions and supply chain constraints have prompted a temporary rebalancing of energy portfolios in several countries, occasionally slowing the momentum of low-carbon transitions [18].

Against this complex and dynamic backdrop, the field of energy economics has increasingly turned to sophisticated modeling frameworks to understand and evaluate the impact of energy-related policies. Among these, applied general equilibrium (AGE) models have emerged as one of the most powerful tools for capturing the multi-sectoral and economy-wide consequences of energy interventions [19–21]. AGE models simulate how changes in policy or external conditions affect prices, outputs, incomes, and trade across all sectors of the economy, taking into account both microeconomic behaviors and macroeconomic constraints [22]. These models are particularly well-suited for energy research due to their ability to incorporate technological substitution, input-output linkages, and environmental externalities into a unified analytical framework. De Melo & Robinson [23] noted that general equilibrium models offer a coherent structure for simultaneously assessing the impacts of macroeconomic and microeconomic policies, making them especially relevant in the context of energy transitions and climate mitigation.

As energy issues become increasingly intertwined with global sustainability agendas [24–27], AGE models have been widely adopted in research evaluating carbon pricing, fossil fuel subsidy reform, renewable energy integration, and energy efficiency policies [28, 29]. Recent studies have employed general equilibrium approaches to analyze the implications of climate policies on energy markets, labor dynamics, household welfare, and interregional trade [30–32]. These models allow for nuanced evaluations that static or partial equilibrium models cannot fully capture, particularly in contexts where energy policy has far-reaching consequences across multiple sectors and agents. The application of GE models in energy research reflects an evolving methodological trend that emphasizes policy relevance, economic realism, and systems thinking [33].

Despite the growing volume of research utilizing GE models in the energy domain [28–35], there has been limited effort to systematically review or map this expanding body of knowledge. Existing literature reviews tend to focus on thematic content, methodological frameworks, or policy implications of specific studies, but few have adopted a bibliometric perspective to analyze publication trends, influential authors, collaborative networks, or emerging research fronts. Bibliometric analysis provides a powerful lens through which the development of a research field can be visualized and interpreted, offering insights that are not readily apparent through qualitative review methods. Given the increasing complexity and interdisciplinarity of energy modeling, a bibliometric approach is particularly useful for identifying knowledge gaps, tracking evolution in modeling techniques, and guiding future research agendas.

A preliminary search of the Scopus database reveals over 11,000 documents containing the keywords "general equilibrium" and "energy," indicating a rich and diverse corpus of literature at the intersection of these two domains. However, without a comprehensive bibliometric mapping, it remains difficult to discern the intellectual structure of this research area, including which subtopics dominate, which authors or institutions are most prolific, and how the field has evolved over time. Such an understanding is essential not only for academic scholars but also for policymakers and practitioners seeking to ground their decisions in the most relevant and robust evidence available.

This study, therefore, aims to fill this gap by conducting a bibliometric analysis of general equilibrium applications in energy research using data sourced from Scopus-indexed publications. By employing advanced bibliometric tools and techniques, the study seeks to identify key trends, publication patterns, thematic clusters, and influential contributions within the field. This analysis will provide a comprehensive overview of how the use of general equilibrium models in energy research has developed over time and where it is likely to head in the future. In doing so, the study contributes to

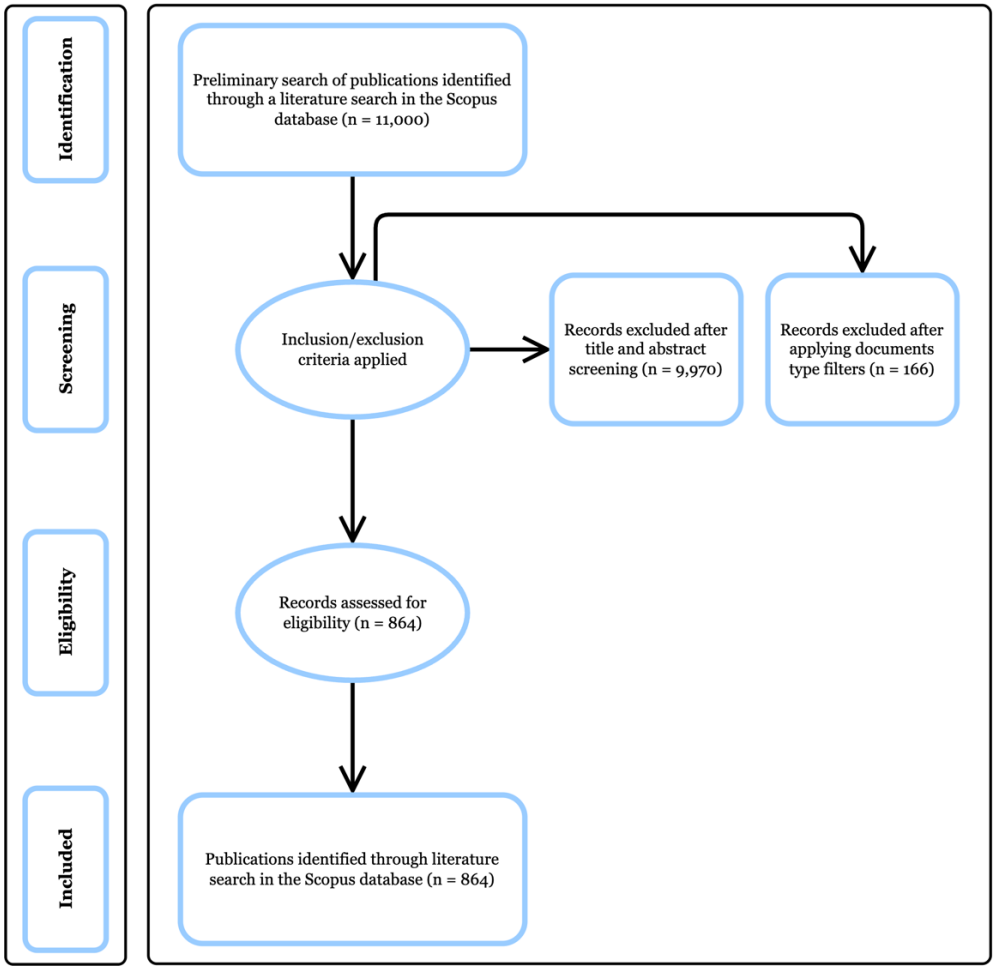


Figure 1. Flow diagram of publication selection process from Scopus database.

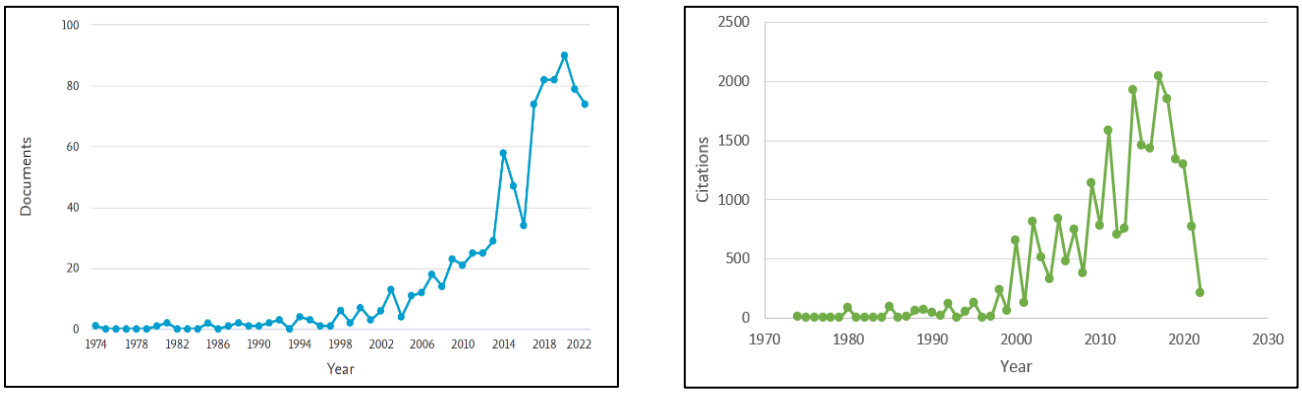
the growing body of bibliometric literature while offering a structured synthesis of the state-of-the-art in this important area of research.

The findings of this paper are expected to serve multiple audiences. For researchers, the bibliometric mapping will highlight underexplored areas and foster new avenues for inquiry. For educators and graduate students, it offers a roadmap for engaging with foundational works and emerging trends. For policymakers and international organizations, it provides evidence on the scope, scale, and trajectory of energy modeling efforts worldwide. Ultimately, this study affirms the value of bibliometric approaches in enhancing our understanding of complex, multidisciplinary research landscapes, particularly those like energy modeling, which sit at the intersection of economics, environment, and policy.

2. Materials and Methods

This study adopts a bibliometric analysis approach to systematically map the intellectual landscape and research trends of general equilibrium applications in the energy domain. Bibliometric analysis quantitatively assesses large volumes of academic literature and provides a robust framework for identifying influential publications, thematic clusters, collaboration patterns, and temporal dynamics within a specific scholarly field [36, 37]. In the context of this study, bibliometric techniques are employed to uncover the structural composition and developmental trajectory of research that integrates general equilibrium modeling with energy-related topics.

The dataset utilized in this analysis was derived exclusively from the Scopus database. A search query was formulated using the keywords "General Equilibrium" and "Energy," targeting document titles, abstracts, and keywords to ensure thematic relevance. The search was conducted without restricting subject areas to preserve interdisciplinarity, encompassing economics, energy policy, environmental science, and related fields. The initial search yielded 1,030 documents published over the period from 1974 to 2022. A series of exclusion criteria were applied to refine the dataset for greater consistency and analytical precision. Specifically, non-journal publication types, such as books, book chapters, editorials, conference papers, review articles, and short surveys, were excluded from the final sample. This filtration was conducted to ensure that the corpus



(a) (b)

Figure 2. Trends in (a) publications and (b) citations in general equilibrium and energy research (1974–2022).

exclusively comprised original research articles published in peer-reviewed academic journals, thereby enhancing the reliability and validity of the bibliometric indicators. Following this screening process, a total of 864 journal articles were retained for further analysis (see Figure 1).

While Scopus provides extensive coverage of scholarly publications across disciplines and is widely regarded for its robust indexing and citation-tracking capabilities, it is important to acknowledge the limitations inherent in relying on a single data source. For example, relevant literature indexed exclusively in other major databases, such as the Web of Science (WoS), may not be captured. Differences in journal inclusion policies and citation metrics between databases can result in a partial representation of the research landscape. Nonetheless, the use of Scopus in this study is justified by its breadth of coverage, compatibility with bibliometric tools such as VOSviewer, and strong support for interdisciplinary analysis. Future research could benefit from cross-database integration to further enrich the scope and comprehensiveness of bibliometric insights.

The bibliographic metadata of these articles, including authorship, publication year, journal source, keywords, citations, and institutional affiliations, were exported in compatible formats for analysis. Two primary tools were employed to conduct the bibliometric mapping: VOSviewer and Microsoft Excel. VOSviewer was used to construct and visualize bibliometric networks such as co-authorship, co-occurrence of keywords, citation relationships, and co-citation clusters [38]. This software enables the graphical representation of bibliometric networks, allowing for the identification of thematic concentrations, influential authors, and research frontiers [39]. In parallel, Microsoft Excel was used for descriptive statistical analysis, including annual publication trends, citation distribution, and frequency counts of high-impact keywords [40]. The complementary use of these tools ensured a comprehensive and nuanced examination of both relational patterns and quantitative trends within the scholarly dataset.

3. Results and Discussion

3.1. Publications and Citations Trend

Over the span of 48 years, from 1974 to 2022, a total of 864 peer-reviewed journal articles focusing on the application of General Equilibrium models in the energy sector were identified and analyzed. The publication trend during this period reveals a non-linear progression characterized by periods of both acceleration and stagnation, reflecting the evolving academic and policy-driven interest in the intersection of equilibrium modeling and energy issues.

Figures 2a and 2b illustrate the annual distribution of publications and their corresponding citation counts. A significant surge in publication activity is observed in the most recent decade, particularly between 2018 and 2020, with the highest number of articles published in 2020 (90 articles), followed closely by 2019 and 2018 (82 articles each). This upward trend corresponds with the growing global urgency to address climate change, the rise of energy transition discourse, and the broader integration of computational economic models in policy design. It is likely that these developments stimulated researchers to increasingly apply General Equilibrium frameworks to energy-related issues.

Notably, brief declines in publication frequency were observed in 2015–2016 and again in 2021–2022. These fluctuations may be attributed to several factors. The dip in 2015–2016 might reflect a temporary redirection of research attention or delays in publication cycles, potentially influenced by shifts in funding priorities or geopolitical factors affecting energy policy agendas. In contrast, the drop observed in 2021–2022 may be partially explained by the aftereffects of the COVID-19 pandemic, which disrupted global research activities,

Table 1. Most productive authors in general equilibrium and energy research.

Author	Documents	Citations	Total Link Strength
Masui T.	35	1862	94
Dai H.	28	1518	122
Liu Y.	22	562	84
Lin B.	22	1160	25
Fujimori S.	20	737	57

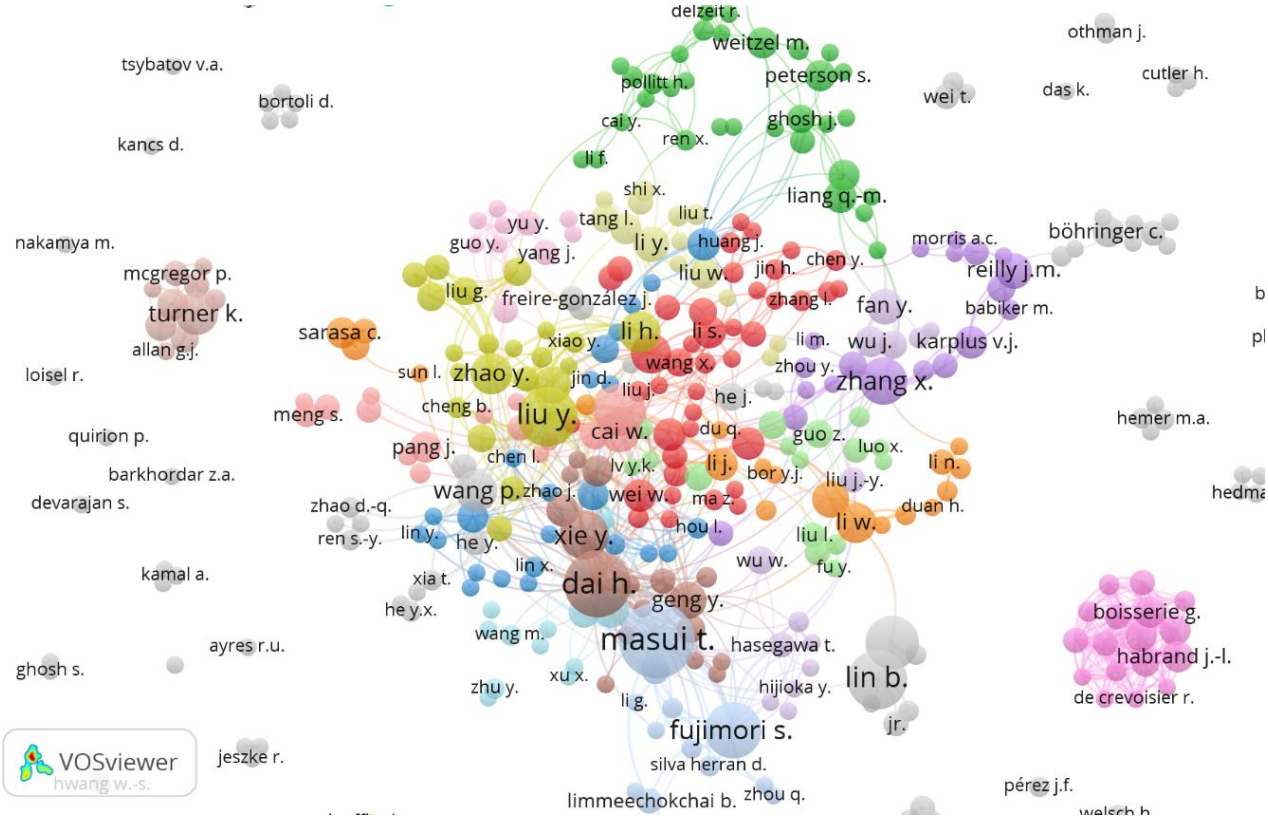


Figure 3. Co-authorship network visualization of the most productive authors.

institutional operations, and academic publishing timelines. Additionally, it is worth considering that publications indexed in Scopus for the most recent years may be incomplete at the time of data extraction, thus partially accounting for the apparent decline.

In terms of scholarly influence, measured through citation frequency, the years 2017, 2014, and 2004 emerge as the most impactful, garnering 2040, 1923, and 1844 citations, respectively. The temporal lag between publication peaks and citation highs suggests that influential articles often accumulate recognition and scholarly engagement several years after their initial publication. This phenomenon may be attributed to the time required for diffusion, integration into academic discourse, and subsequent citation in policy documents or further empirical studies. The observed citation peaks also indicate that certain landmark studies published in those years have become foundational references within the field. These findings highlight the need to assess academic impact over time.

3.2. Most Productive Authors

The body of literature concerning the application of General Equilibrium models in the field of energy has been authored by approximately 2,000 researchers. To refine the analysis and highlight influential contributors, a threshold was applied using VOSviewer, requiring a minimum of two publications per author for inclusion. This filtering process resulted in 498 authors meeting the selection criteria. The data visualization and bibliometric mapping illustrate both productivity and scholarly influence through metrics such as publication count, citation volume, and Total Link Strength (TLS), which represents the strength of co-authorship or citation connections with other researchers in the network.

As presented in Table 1 and visualized in Figure 3, Masui T. emerges as the most prolific author in this domain, with 35 published documents, a total of 1,862 citations, and a TLS of 94. This suggests not only a volume of contributions but also a central role in the academic network surrounding General Equilibrium and energy

Table 2. Highly cited authors in general equilibrium and energy research.

Author	Citations	Links
Paganetti H. (2002)	634	2
Babiker M. H. (2005)	348	9
Hug E. B. (2000)	261	3
Lin B. (2011)	244	25
Zhang Z. (2000)	228	0

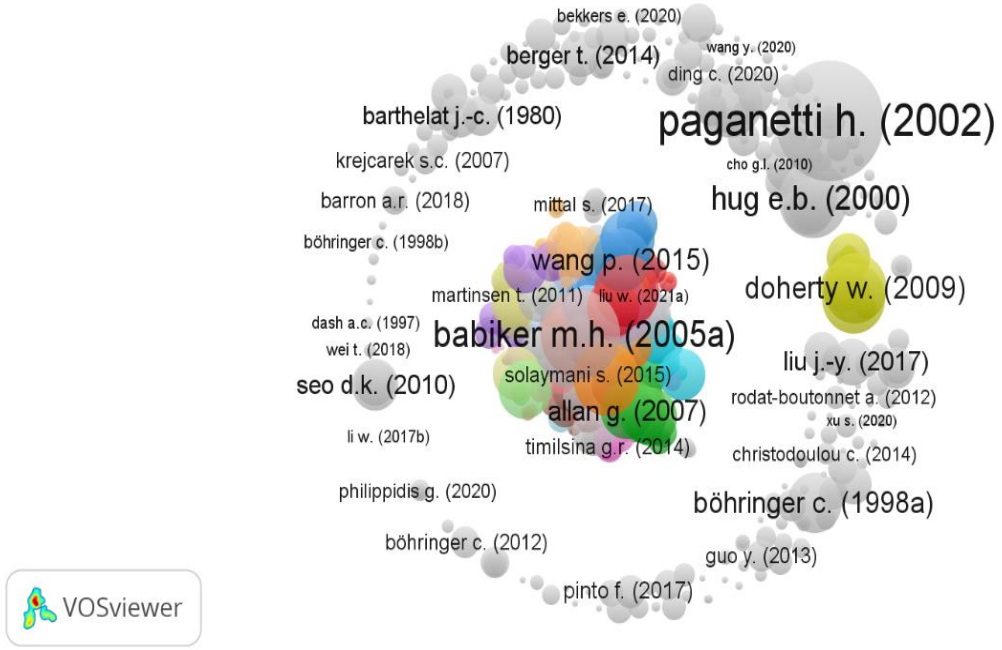


Figure 4. Citation network visualization of the most highly cited authors.

research. Following closely, Dai H. is identified as the second most productive author, contributing 28 publications that have garnered 1,518 citations and achieving a higher TLS of 122, indicating a broader or more interconnected influence within the scholarly network. Ranked third is Liu Y., with 22 publications, 562 citations, and a TLS of 84, reflecting consistent contributions and moderate academic connectivity.

These results underscore the concentration of scholarly activity among a relatively small group of high-performing authors. Their sustained research efforts and collaborative engagements have significantly shaped the discourse and methodological development at the intersection of General Equilibrium modeling and energy studies. Their academic networks may also point to regional or institutional hubs of expertise, warranting further investigation into geographic and organizational patterns in future research.

3.3. Highly Cited Authors

Table 2 and Figure 4 provide a comprehensive overview of the leading authors based on total citation counts, as well as a visual representation of their relative influence and connectivity within the broader citation network. These highly cited scholars not only demonstrate strong individual academic impact but also occupy central positions in the intellectual structure of the field, indicating their roles in shaping key research trajectories over time. The identification of highly cited authors provides valuable insights into the most influential contributors in the field of General Equilibrium applications in energy-related research. To determine the most impactful scholars, a citation-based analysis was conducted using VOSviewer, applying a minimum threshold of two citations per author's document. This filtering process ensured the inclusion of authors with consistently cited works, thereby highlighting those with substantive academic influence.

The results indicate that Paganetti H. stands out as the most highly cited author in this field, having accumulated a total of 634 citations. His influential work, particularly the 2002 publication, is widely recognized for its methodological rigor and its foundational role in advancing the integration of equilibrium models in the context of energy markets and policy design. This suggests that Paganetti's contributions not only offered

Table 3. Leading countries in general equilibrium and energy research.

Country	Documents	Citations	Total Link Strength
China	295	8235	129
United States	162	5924	155
Japan	78	2372	64
United Kingdom	55	1971	58
Germany	55	1626	53

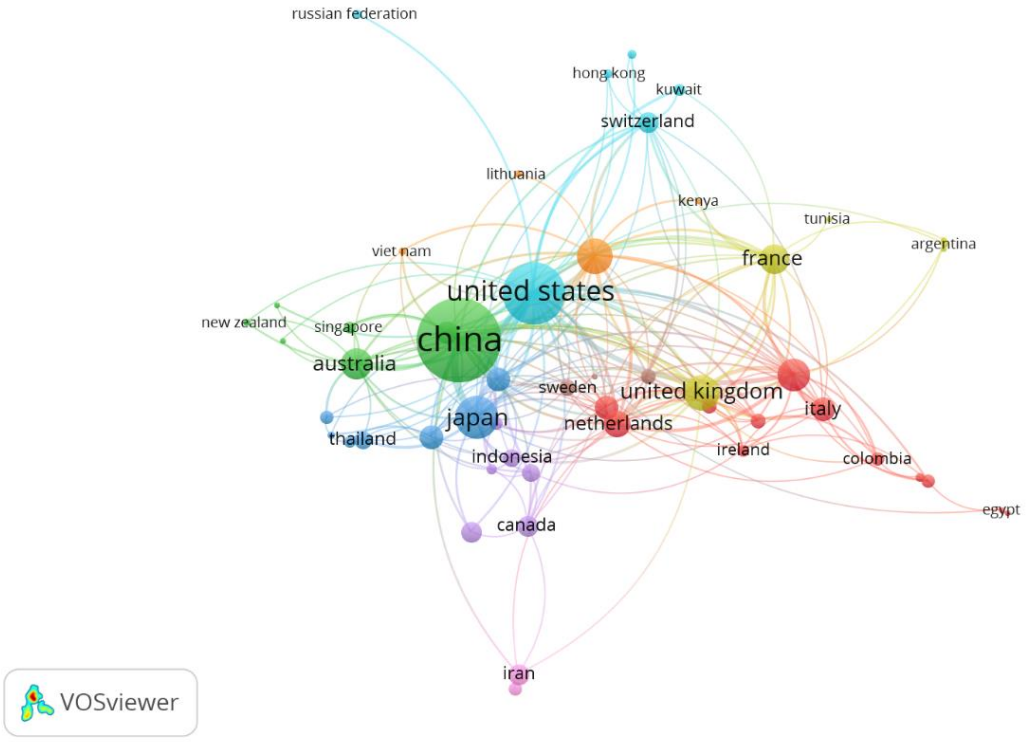


Figure 5. Network visualization of the most productive countries.

robust computational insights but also resonated with researchers aiming to model complex energy systems more accurately. Following Paganetti H., Babiker M. H. ranks second with 348 citations. His prominence in the field is largely attributed to his application of dynamic computable general equilibrium (CGE) models to analyze climate policy and carbon taxation, making his work highly relevant for both academic and policy communities. Babiker's research often bridges the gap between theoretical modeling and real-world environmental concerns, contributing to the growing literature on the economic implications of climate change mitigation strategies.

Hug, with 261 citations, is notable for pioneering work that intersects general equilibrium modeling with health-related energy assessments, particularly in radiological and medical contexts. His interdisciplinary approach has drawn attention to extending the application of equilibrium models beyond conventional environmental economics, thereby broadening the field's analytical scope. Other influential scholars include Lin B. (244 citations) and Zhang Z. (228 citations), both of whom have made substantial contributions to energy efficiency and emissions policy modeling, particularly in the context of developing economies such as China. Their work is frequently cited for its policy relevance and empirical grounding, offering insights that are directly applicable to national energy planning and international environmental negotiations.

3.4. Leading Countries

The results highlight the influential role of a few key countries in advancing both the theoretical and empirical integration of General Equilibrium modeling within energy studies. This dominance is further illustrated through the bibliometric network visualizations presented in Table 3 and Figure 5, which map patterns of scholarly collaboration and citation structures among leading nations in the field. These patterns reveal a concentration of research influence within a group of countries.

Table 4. Leading sources in general equilibrium and energy research.

Source	Documents	Citations	Total Link Strength
Energy Policy	83	3050	7518
Energy Economics	78	3527	6701
Energy	34	1275	3589
Applied Energy	32	1752	4338
Journal of Cleaner Production	28	670	3919

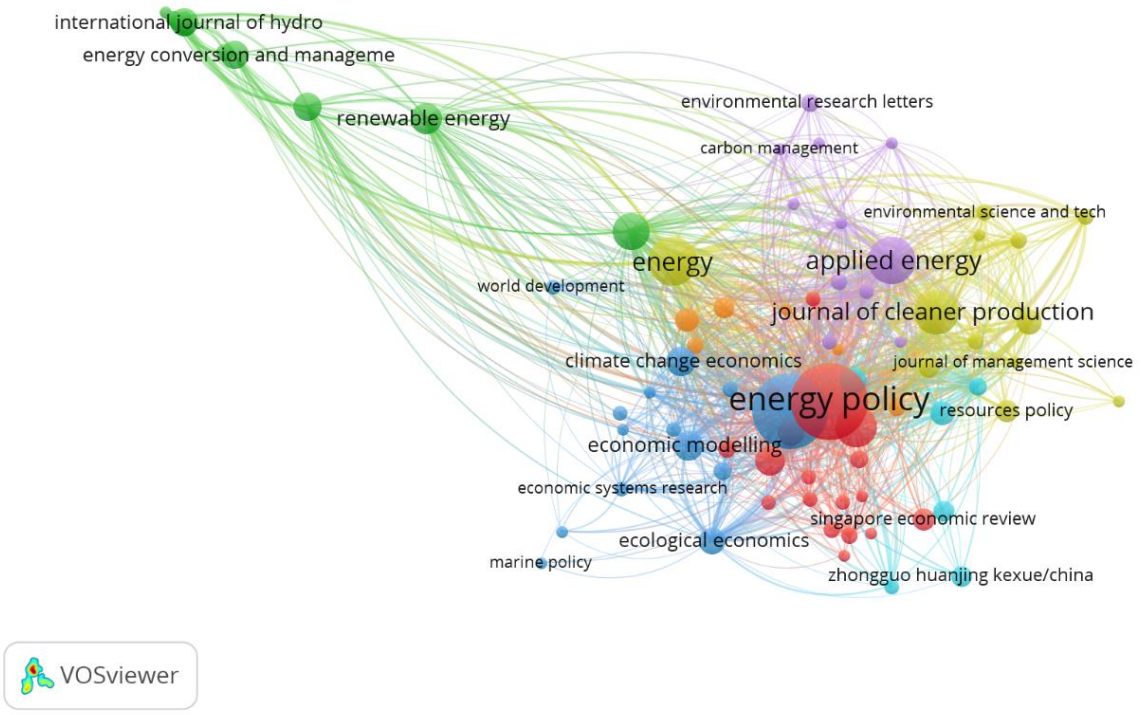


Figure 6. Network visualization of the leading sources.

A closer look at the global research landscape reveals a marked geographical concentration of scholarly output in this domain. Based on bibliometric analysis, China emerges as the most prolific contributor, with 295 research articles, 8,235 citations, and a TLS of 129, reflecting both high research volume and strong international collaboration. The United States follows as the second most active country, producing 162 publications, garnering 5,924 citations, and achieving a TLS of 155, indicating not only a substantial citation impact but also extensive connectivity within the global research network. Japan ranks third, contributing 78 publications, accumulating 2,372 citations, and recording a TLS of 64.

3.5. Leading Sources

The dissemination of scholarly work on General Equilibrium in the context of energy has been concentrated within a select group of academic journals. As illustrated in Table 4 and Figure 6, *Energy Policy* emerges as the most prolific source, having published 83 articles on the subject. These publications have collectively garnered 3,050 citations and achieved a TLS of 7,518, reflecting both the journal's centrality in the research network and the influence of its contributions. Ranked second is the journal *Energy Economics*, which has produced 78 relevant publications, accumulating 3,527 citations and a TLS of 6,701. This journal is recognized for its strong interdisciplinary approach to energy market modeling and policy implications, making it a frequent outlet for general equilibrium analyses. In third place is *Energy*, with a total of 34 articles, 1,275 citations, and a TLS of 3,589. Despite a lower number of publications, the journal's impact is evident in its citation count and network connectivity. These three leading journals serve as key platforms for advancing the discourse on the application of general equilibrium frameworks to energy issues, indicating their relevance for scholars seeking to publish or follow state-of-the-art research in the domain. Their prominence underscores the role of specialized journals in shaping academic and policy-oriented discussions.

Table 5. Most frequently co-occurring keywords in general equilibrium and energy research.

Keyword	Occurrences	Total Link Strength
Computable General Equilibrium Analysis	208	3613
Computable General Equilibrium Model	190	3318
Emission Control	180	3199
CGE Model	157	2201

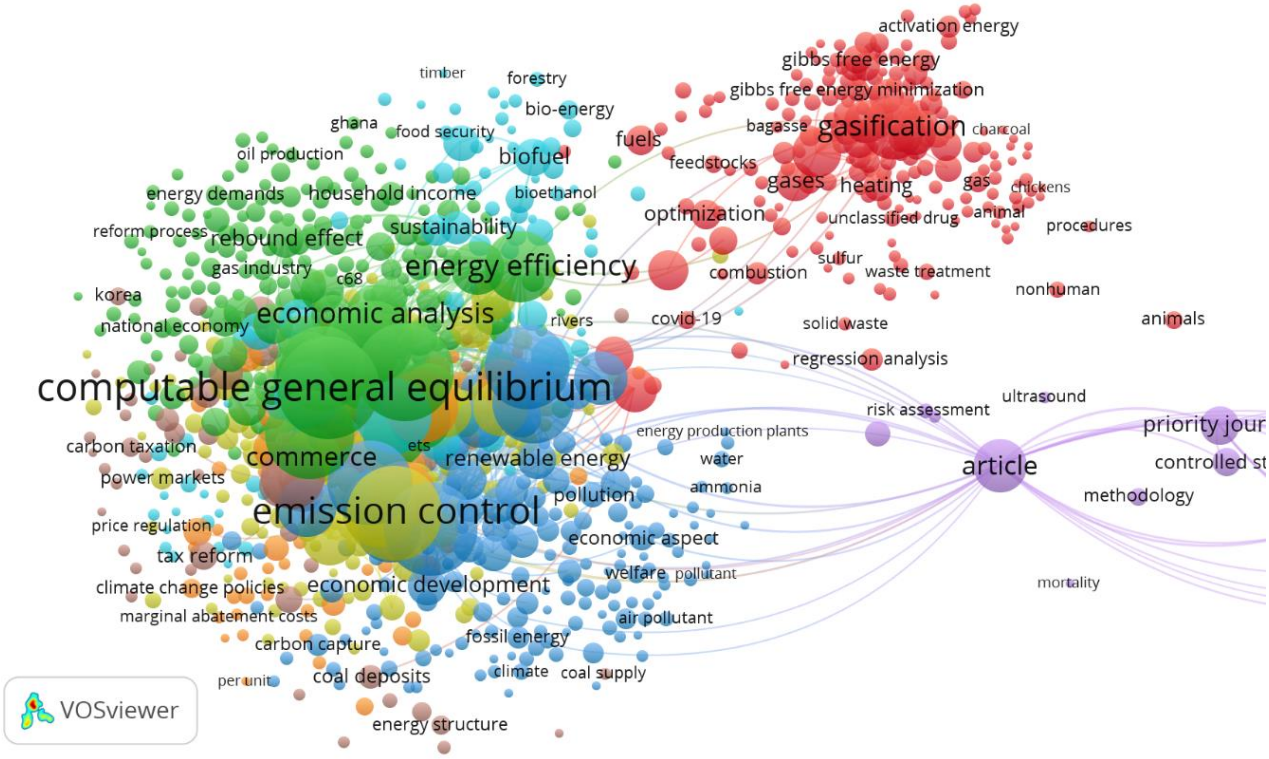


Figure 7. Network visualization of keyword co-occurrences.

3.6. Keyword Co-occurrence Analysis

Table 5 and Figure 7 present the network visualization of keyword co-occurrence within the body of literature addressing General Equilibrium applications in the energy sector. To ensure analytical robustness, a minimum threshold was set: each keyword must appear at least twice within the dataset. From a total of 5,500 unique keywords identified across the 864 publications, 1,644 met the inclusion criteria and were subjected to further analysis. Based on their patterns of co-occurrence, the keywords were grouped into eight distinct thematic clusters, each representing a conceptual or methodological orientation within the research landscape.

Among these clusters, the keyword "computable general equilibrium analysis" emerged as the most dominant in terms of both frequency and network connectivity, with 208 occurrences and a TLS of 3,613. This prominence underscores the centrality of CGE analysis as a methodological framework in energy-related studies employing general equilibrium models. Closely following were the "computable general equilibrium model," which appeared 190 times and exhibited a TLS of 3,318, and "emission control," which was cited 180 times with a TLS of 3,199. These high-frequency keywords reflect key thematic concerns in the literature, particularly the modeling of economic-environmental trade-offs and the evaluation of emission reduction strategies within equilibrium frameworks.

The emergence of multiple keyword clusters also highlights the multidimensional nature of this research domain, which spans topics such as climate change mitigation, energy policy evaluation, carbon taxation, and macroeconomic impacts of environmental regulation. This clustering reveals the intellectual structure of the field and provides insights into evolving research frontiers, such as the integration of renewable energy scenarios and the role of general equilibrium modeling in assessing sustainable development pathways. It also emphasizes the field's growing complexity and interdisciplinary reach.

3.7. Discussion

The analysis of the leading journals in the field of general equilibrium applications in energy research has revealed a clear pattern of dominance by a select few academic sources. *Energy Policy* stands out as the most influential journal, with the highest number of publications and substantial citation impact. This journal's prominence in the energy economics field is not just in the volume of its published research but also in its ability to shape the discourse surrounding energy policy and economic modeling. The high citation count and TLS reflect its central role in advancing discussions on energy market regulation, policy analysis, and sustainability. Similarly, *Energy Economics* and *Energy* also emerge as key platforms for disseminating significant research on the intersection of general equilibrium models and energy issues. The wide-reaching influence of these journals is indicative of the growing importance of interdisciplinary research in energy economics, where general equilibrium modeling is increasingly employed to understand the complexities of energy market dynamics and environmental policies. The prominence of these journals suggests that future research will continue to be influenced by these well-established sources, with scholars increasingly turning to them for publishing their findings on energy-related general equilibrium modeling.

In addition to journal selection, the keyword co-occurrence analysis provides valuable insights into the intellectual structure of the research domain. The dominance of terms such as "computable general equilibrium analysis" and "emission control" signifies the growing integration of environmental concerns within economic modeling frameworks. These findings reflect the broader trend of emphasizing sustainability within energy economics, with researchers using general equilibrium models to evaluate the economic impacts of environmental regulations, carbon pricing, and renewable energy adoption. The clustering of keywords further underscores the multidisciplinary nature of the field, with general equilibrium analysis being applied to a wide array of topics including climate change mitigation, energy policy evaluation, and macroeconomic assessments of environmental regulations. The emergence of renewable energy scenarios and their integration into economic models is becoming an increasingly prominent research area as scholars seek to understand the broader impacts of transitioning to a low-carbon economy. This trend highlights the evolving nature of the field, with general equilibrium models providing a critical framework for analyzing complex environmental and economic interactions.

Recent advancements in energy policy modeling have led to an increasingly widespread application of GE models, particularly CGE models, to analyze the economic implications of diverse energy-related interventions. A notable development in this area is the integration of energy system models with CGE frameworks, which enhances the analytical power of each approach by combining the technological granularity of bottom-up models with the economy-wide feedback captured by top-down methods. This hybrid modeling approach enables a more comprehensive evaluation of policy scenarios involving carbon pricing, renewable energy adoption, and fossil fuel phase-out strategies, allowing for both sectoral detail and macroeconomic consistency [41]. The soft-linking of national CGE models with detailed energy systems models, such as TIMES or MARKAL, has proven especially effective in simulating long-term transitions, taking into account technological change, behavioral responses, and dynamic price effects [42]. Moreover, GE models have been pivotal in evaluating emissions trading schemes, especially those that are revenue-neutral, by providing insights into their efficiency, equity, and sectoral redistribution effects [43]. These models help elucidate how different revenue recycling mechanisms, such as lump-sum transfers, reductions in distortionary taxes, or public investment, can alter both the environmental and economic outcomes of carbon pricing [44, 45].

Beyond market-based instruments, CGE models have also been employed to investigate the rebound effects of energy efficiency improvements, which refer to the indirect increase in energy use that may offset direct energy savings. Systematic reviews of this literature indicate that rebound effects can vary significantly by sector and income group, underscoring the need for holistic assessments that capture economy-wide interactions [46]. These models are increasingly applied to analyze hydrogen economy scenarios, carbon border adjustment mechanisms [47], and the economic implications of renewable energy technology diffusion [36]. GE models are also being refined to incorporate just transition principles, particularly through the inclusion of labor market frictions and household heterogeneity, enhancing their capacity to support equitable climate policy. The increasing sophistication of these models and the diversity of their applications underscore their central role in climate and energy research, not only as tools for policy evaluation but also as platforms for integrating complex systems, managing uncertainty, and informing multi-level governance aligned with long-term sustainability goals.

Looking ahead, the future of research in general equilibrium models applied to energy economics appears promising, with several emerging areas of focus. One key avenue for future exploration is the development of more robust models that incorporate renewable energy integration into broader economic systems. As renewable energy technologies evolve and become more prevalent, it will be crucial to understand their economic implications, particularly in relation to energy market structures, employment, and social welfare [25, 48]. Additionally, the role of energy policy in addressing income inequality, particularly in developing economies, presents an important research direction. Energy access and affordability remain significant challenges in many regions, and general equilibrium models can offer valuable insights into the potential economic effects of policy interventions aimed at reducing disparities in energy access [49, 50]. Moreover, the increasing availability of big data and advancements in computational techniques offer an opportunity to refine existing models and improve their predictive capabilities [51, 52]. Future research could explore cross-country comparisons of energy policy effectiveness, examining how different countries adapt their general equilibrium models to address unique energy challenges. This research direction would contribute to a more global understanding of the economic impacts of energy policy and provide valuable insights for policymakers working in diverse contexts. Overall, the integration of new technologies, sustainability concerns, and cross-disciplinary approaches will continue to shape the future of energy economics, making general equilibrium models an essential tool for understanding the complexities of global energy transitions.

4. Conclusions and Implications

This study has provided a comprehensive bibliometric overview of research on the application of General Equilibrium (GE) models in the energy domain over the span of nearly five decades, from 1974 to 2022. By systematically analyzing 864 journal articles indexed in Scopus, the findings reveal a dynamic and evolving scholarly landscape. Although early contributions were modest in number, the last decade has witnessed a significant surge in publication output, particularly between 2018 and 2020, indicating growing scholarly attention to the intersection of energy policy and equilibrium modeling. Citation patterns also underscore the intellectual influence of key publications, with a concentration of highly cited works emerging in the mid-2010s, a period marked by heightened global discourse on climate change and energy transition. This reflects the field's rising importance.

The analysis identified the most prolific authors, institutions, and countries contributing to this specialized body of literature. Masui T., Dai H., and Liu Y. stood out as the most productive scholars, while China, the United States, and Japan led in national research output. In terms of publication outlets, *Energy Policy* and *Energy Economics* emerged as the most influential journals, both in terms of the number of publications and citation impact. The co-occurrence analysis of keywords revealed eight distinct thematic clusters, with recurring terms such as "computable general equilibrium analysis," "computable general equilibrium model," and "emission control." These findings reflect the field's predominant focus on quantitative modeling, environmental regulation, and energy systems and illustrate how CGE models have been applied to evaluate the impacts of emissions control policies, economic restructuring, and technological interventions in the energy sector.

Taken together, the bibliometric evidence presented in this study offers a clear map of the intellectual structure and development of GE applications in energy research. It highlights key knowledge hubs, influential scholarly actors, and emerging thematic trends that may inform future research directions. As energy transitions accelerate under global climate imperatives, the role of GE modeling is likely to grow more integral in supporting policy evaluation and cross-sectoral impact assessment. Therefore, continued bibliometric tracking and meta-analytical synthesis will be essential in ensuring that academic inquiry remains aligned with real-world policy challenges and technological transformations in the energy sector.

These findings offer several important implications for both researchers and policy practitioners working at the intersection of energy and economic modeling. Academically, the study provides a structured overview of the intellectual terrain in this field, helping scholars identify key contributors, influential sources, and thematic concentrations that have shaped the discourse over time. This mapping can inform the direction of future inquiries, particularly by drawing attention to less-developed clusters and emerging areas of interest. For policymakers, the prominence of themes such as emission control and economic impact analysis suggests that computable general equilibrium models remain a valuable tool for evaluating policy trade-offs in the energy sector. Strengthening collaborations, particularly among leading countries and institutions, may further enhance the relevance and policy utility of such research in addressing global energy and climate challenges.

Despite its contributions, the scope of this analysis is shaped by certain limitations that future research may

address. The reliance on the Scopus database, although comprehensive, may overlook relevant publications indexed in other repositories, such as Web of Science, particularly those from niche or regionally focused journals. Additionally, the exclusion of grey literature, including conference papers, working papers, and institutional reports, may limit the capture of cutting-edge developments and policy-relevant insights not yet formalized in journal articles. Future studies may benefit from a broader data integration strategy and comparative bibliometric approaches to deepen and diversify the mapping of this research domain.

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