

Renewable Energy and Firm Performance: A Bibliometric and Science Mapping Analysis of the Literature



Rabia Şen¹ , Gülfen Tuna² 

¹Department of Accounting and Tax, Sakarya Vocational School, Sakarya University of Applied Sciences, Türkiye

¹rabiasen@subu.edu.tr

²Department of Business Administration, Faculty of Business, Sakarya University, Türkiye

²geksi@sakarya.edu.tr

Citation: Şen, R. & Tuna, G. (2026). Renewable Energy and Firm Performance: A Bibliometric and Science Mapping Analysis of The Literature. *Journal of Environmental Management and Tourism*, 3(83), 287 - 303. [https://doi.org/10.14505/jemt.v17.3\(83\).05](https://doi.org/10.14505/jemt.v17.3(83).05)

Article info: Received 15 June 2026; Received in revised form 6 July 2026; Accepted 27 July 2026; Published 28 August 2026.

Abstract: Climate change is a major issue for ecosystems, the economy, human health and livelihoods. Therefore, it has been important to build international cooperation and increase investment between governments and companies to effectively address climate change through emissions reduction and environmental protection. This study aims to review and reflect on studies on the effect of renewable energy on firm performance. For this purpose, an analysis of studies on the effect of renewable energy on the performance of firms using renewable energy sources was conducted. This study conducts a bibliometric analysis for a systematic literature review that examines 1953 scientific studies on the effect of renewable energy on firm performance from 1993 to 2025.

VOSviewer software was used to analyze the data and visualize the findings using the Web of Science database. The findings are presented in nine categories: distribution of studies by year, distribution of studies by genre, distribution of studies by language of writing, author-source- country-institution-keywords analysis.

The analysis reveals a significant increase in annual publications on renewable energy sources and firm performance, indicating a growing global interest in renewable energy. Moreover, the country with the most publications is the People's Republic of China. The author with the most publications and most citations is Saad Mekhilef. The institution with the most publications is "Xi an Jiao Univ" and the source with the most publications is "Energies". The most used word in the studies is "renewable energy". The concept of sustainability, which is involved to renewable energy, ranked 12th in the list of frequently used words, and this may be thought to be due to the fact that this concept is more up to date than the others. The direction of the studies to be conducted in this field will fill the gap in the literature.

Keywords: renewable energy; firm performance; bibliometric analysis; VOSviewer; sustainability; Web of Science.

JEL Classification: Q42; L25; M14; Q56; O13; C80.

Copyright© 2026 The Author(s). Published by ASERS Publishing 2026. This is an open access article distributed under the terms of [CC-BY 4.0 license](https://creativecommons.org/licenses/by/4.0/).

Introduction

Fossil fuels such as coal, natural gas, and oil are used in energy production, but these fuels are non-renewable and are at risk of depletion. Fossil fuel production not only harms the environment but also contributes to global warming through greenhouse gas emissions. Renewable energy sources, on the other hand, are constantly replenished and, while causing far less environmental damage than fossil fuels, offer numerous advantages. The advantages of renewable energy sources include protecting the environment, reducing carbon dioxide emissions,

reducing dependence on foreign energy sources by providing domestic energy resources, increasing employment, and lowering energy consumption (Alper & Oguz, 2016). Various actions are also required to realize these advantages and increase the share of renewable energy sources in total energy production. In this regard, both the public and private sectors play a crucial role in financing renewable energy projects (Kim & Park, 2016).

Various incentives offered by governments also contribute significantly to the adoption of renewable energy sources. Thanks to these incentives, renewable energy is overcoming the limitations of current energy consumption models and enabling the modernization that the energy sector requires. This, in turn, supports the achievement of sustainable development goals in the energy sector. Extensive financial investments are largely required to effectively manage this energy transition process. In this context, financial performance is of great importance; it serves as a key factor in determining energy producers' capacity for transition and plays a decisive role in shaping investment decisions. (Dopierala *et al.* 2022). In this context, the study examines research that analyzes the effects of investments in renewable energy sources on corporate performance. Understanding the impact of renewable energy investments on companies' financial and operational performance is important both for businesses' strategic decision-making processes and for the formulation of sustainable development policies. Although there are numerous bibliometric studies in the literature focusing on the field of renewable energy, it is evident that these studies largely concentrate on renewable energy technologies, energy policies, energy transition, and sustainable energy systems. In contrast, research that evaluates studies examining the relationship between renewable energy and firm performance from a comprehensive bibliometric perspective is quite limited. In this regard, this study aims to fill a significant gap in the existing literature by systematically mapping not only the renewable energy literature but also the development, knowledge structure, and research trends of studies examining the impact of renewable energy investments on firm performance.

In this context, the systematic compilation of studies on the subject makes it possible to identify the evolution of the literature, prominent research themes, influential authors, institutions, countries, sources, and the most frequently used keywords. Thus, while the scientific structure of the field is evaluated from a holistic perspective, the diversity of research and the direction of knowledge production are also highlighted. The findings are expected to help researchers identify new areas of study and assist investors and policymakers in their decision-making processes.

The Web of Science database was selected as the data source for this study. Web of Science was chosen because it covers peer-reviewed journals with high impact factors, provides standardized bibliographic and citation data, and is one of the reliable databases widely accepted internationally for bibliometric analyses. The high quality of the data, the ability to consistently track citation relationships, and the capability to perform analyses compatible with the VOSviewer software enhance the reliability and scientific validity of the findings.

This study distinguishes itself from existing research in that it examines studies published over a broad time span covering the period 1993 - 2025, is based on a comprehensive dataset, and holistically evaluates the relationship between renewable energy and firm performance using bibliometric methods. The study aims not only to reveal the intellectual structure and developmental dynamics of the field but also to provide a guiding framework for future empirical and theoretical research. In this way, by bridging the literature on sustainability, renewable energy, and firm performance, it makes significant contributions to both academic scholarship and practice.

1. Renewable Energy Sources

Renewable energy sources are energy sources that have no specific depletion period and are constantly replenished through natural processes. These sources cannot be permanently depleted by humans. A large portion of renewable energy sources is generated through the conversion of solar energy into various forms (Üçgül & Elibüyük, 2017).

Renewable energy sources are considered to be potential alternatives to fossil fuels, and various efforts are currently underway to develop technologies in this field. The most used renewable energy sources include hydropower, geothermal energy, biomass energy, solar energy, and wind energy (Koç *et al.* 2015).

1.1 Solar Energy

The Sun is an indispensable renewable energy source for the Earth and human life. Solar energy consists of energy from the Sun, which ranges from 0-1100 W/m² at the Earth's surface. (Şengül *et al.* 2015)

Solar energy is a powerful form of energy produced when hydrogen atoms are converted into helium as a result of fusion reactions occurring in the Sun's core. Solar energy reaches Earth in the form of sunlight, and specific technologies are used to harness this energy. Thanks to these technologies, solar energy can be used as heat or electricity. (Koç *et al.* 2015).

1.2 Wind Energy

Wind energy is generated by the interaction of air masses with different temperature zones. Wind turbines convert this energy into electricity, providing a sustainable energy source. Wind energy is one of the preferred forms of renewable energy because it does not emit harmful gases into the environment, reduces dependence on foreign sources, and is a domestic, continuously available energy source (Şengül *et al.* 2015).

1.3 Geothermal Energy

Geothermal energy is defined as the thermal energy derived from natural heat accumulated deep within the Earth's crust, in the form of pressurized hot fluids (water vapor, gas) and hot dry rocks. Geothermal energy is a new, inexhaustible, sustainable, environmentally friendly, domestic, green, and renewable energy source. This energy is used efficiently in both electricity generation and heating systems (Koç *et al.* 2015; Şengül *et al.* 2015).

1.4 Biomass Energy

It is a form of energy derived from biological and organic materials such as wood, charcoal, animal manure, agricultural and forestry waste, alcohol and methane fermentation, and various aquatic plants (Torunoğlu Gedik, 2015).

The use of biomass energy dates back to ancient times. While it was initially used primarily to generate heat, today it is also used to generate electricity through various technologies (Şengül *et al.* 2015).

1.5 Hydraulic Energy

Hydraulic Energy is one of the most widely used forms of renewable energy. The most basic method of harnessing this energy involves building dams on rivers to store water in reservoirs and converting the potential energy of the stored water into electrical energy through turbines. Hydroelectric power plants (HPPs) play a significant role in this process (Koç *et al.* 2015).

2. Literature Review

The widespread adoption of changing energy policies in recent years has offered companies engaged in renewable energy investments significant advantages, such as enabling sustainable growth, enhancing competitiveness, and reducing financial risks. In the literature, the impact of renewable energy investments on firm performance has been examined using various methods. This section reviews national and international studies focusing on the relationship between renewable energy sources and firm performance. These studies reveal that performance indicators vary and that renewable energy sources lead to different changes in firm performance.

The studies were categorized into two groups: those examining the relationship between renewable energy investments and firm performance, and those aimed at measuring the financial performance of renewable energy companies.

Studies Examining the Relationship between Renewable Energy Investments and Firm Performance;
Studies examining the relationship between renewable energy investments and firm performance have primarily focused on identifying the factors that influence firms' financial performance, using panel data analysis and econometric methods. In this context, Halkos and Tzeremes (2012) aimed to evaluate the financial performance of companies operating in the renewable energy sector in Greece. To this end, in their analysis using the Data Envelopment Analysis (DEA) framework, they demonstrated that the firms' performance was positively influenced by high levels of return on assets and return on equity, as well as low debt-to-equity ratios.

Marti-Ballester (2017) employed panel data analysis to examine a sample of 574 multinational companies from 36 countries and found that the adoption of sustainable energy systems enhanced firm performance in the short term without adversely affecting long-term firm performance. Similarly, Dopierala *et al.* (2022), by analyzing 328 energy producers operating in the Baltic Sea region using panel data methods, concluded that financial performance is influenced by both firm-specific and macroeconomic factors, and that private limited companies perform better. Environmental and institutional factors affecting financial performance in the energy sector also constitute an important area of research in literature. Paun (2017) compared the performance of energy-producing companies in Romania with that of traditional energy producers using fossil fuels. While noting that investments emerged through opportunistic methods based on subsidies rather than long-term financial performance, Zhang *et al.* (2022) demonstrated that country risks and government incentives have significant effects on firm performance in Chinese energy companies. Similarly, Ibarloza *et al.* (2018) found that solar energy companies in Spain were particularly affected by regulatory changes and economic conditions. In their study, Kludacz-Alessandri and Cyganska (2021) aimed to examine the relationship between the adoption of corporate social responsibility and financial performance at 219 companies in 32 countries operating in the energy sector. In their analysis, which used

2020 data, they found statistically significant relationships between financial performance and the implementation of CSR strategies by energy sector companies.

Leventakos and Dagoumas (2019) compared European energy companies and reported that the renewable energy sector exhibited higher profitability potential, whereas oil and natural gas companies operated at lower levels of risk. There are also studies that examine the impact of energy transition and sustainability practices on firm performance from various perspectives. Morić *et al.* (2020) found that, in a sample of more than 4,000 European SMEs, the impact of circular economy practices on firm performance varied depending on the stages of the adoption process, while Findık (2023), on the other hand, found a positive and significant relationship between circular economy activities and firm performance among SMEs operating in European Union member states and candidate countries.

Another significant group of studies in the literature focuses on evaluating the financial performance of companies operating in the renewable energy sector using multi-criteria decision-making techniques. Methods such as TOPSIS, MOORA, EDAS, WASPAS, ARAS, and similar approaches are widely used in these studies. In this context, Eyüboğlu and Çelik (2016) evaluated the financial performance of 13 energy companies using the TOPSIS method in their study. In their study, Bağcı and Yüksel Yiğiter (2019) assessed the financial performance of 15 energy companies listed on the Istanbul Stock Exchange using the SD and WASPAS methods, determining that the performance rankings of these energy companies varied from year to year. Erdoğan *et al.* (2022) evaluated the financial performance of companies using the SWARA and WASPAS techniques. The study analyzed the three-year financial performance of four renewable energy companies listed on Borsa Istanbul over the 2018–2020 period. The findings of the study, obtained using the SWARA technique, concluded that the most important factor determining the financial performance of the companies participating in the research was the financial leverage ratio. Based on the data obtained using the WASPAS technique, it was determined that companies generating electricity from a single renewable energy source are financially more successful than those generating electricity from multiple renewable energy sources. Similarly, Metin *et al.* (2017) compared energy companies listed on Borsa Istanbul using the TOPSIS and MOORA methods and demonstrated that performance rankings can vary depending on the method used. Özdemir and Parmaksız (2022) aimed to analyze the financial performance of companies operating in the BIST energy sector using the TOPSIS and EDAS methods. By comparing the TOPSIS and EDAS methods, they determined that the two methods produced similar results, albeit with minor differences.

Kılıçarslan (2023), on the other hand, used a combination of the Cloud Index, TOPSIS, ARAS, and Copeland methods to conduct an integrated evaluation of the performance of renewable energy companies listed on Borsa Istanbul. Özçelik (2024) examined the financial performance of renewable and conventional energy companies listed on Borsa Istanbul using the DuPont analysis method. The findings indicated that renewable energy companies achieved higher net profit margins despite having lower asset turnover ratios, whereas conventional energy companies experienced a decline in their financial performance in recent years.

İskenderoğlu *et al.* (2015) aimed to evaluate the performance of the Turkish and European energy sectors using ratio analysis. Based on an analysis of sectoral financial statements covering the 2009–2012 period, the authors found that companies operating in the European energy sector outperformed their counterparts in the Turkish energy sector.

A review of the literature reveals that studies generally focus on two main areas. The first group includes studies that use econometric methods to examine the impact of renewable energy investments, sustainability practices, and institutional factors on firm performance. The second group consists of studies that evaluate the financial performance of companies operating in the energy sector using multi-criteria decision-making methods and financial analysis techniques.

However, while the vast majority of existing studies focus on specific countries, sectors, or company samples, it is evident that there are very few studies that holistically assess the overall development of the literature on the relationship between renewable energy and firm performance - including trends in scientific output, research networks, and the intellectual structure - using bibliometric methods. Therefore, this study aims to fill this gap in literature and provide a comprehensive roadmap for future research by conducting a bibliometric analysis of publications in the Web of Science database using a broad dataset covering the period from 1993 to 2025.

3. WEB of Science - Based Analysis of the Relationship between Renewable Energy and Firm Performance

This section of the study presents the research objective, the dataset, the analyses conducted, and the findings.

3.1 Purpose of the Study

Based on bibliometric analyses of the impact of renewable energy sources on firm performance, using quantitative data and numerical metrics, this study aims to present research on this topic to researchers from a holistic perspective.

3.2 Data and Analysis

The bibliometric method was proposed by Alan Pritchard in 1969. The number of studies conducted worldwide using bibliometric analysis techniques is increasing day by day. The growing use of bibliometric techniques has been facilitated by improved access to scientific data through major bibliographic databases such as Scopus and Web of Science. Furthermore, the development of specialized software tools, including Leximancer, Gephi, and VOSviewer, for the analysis and visualization of bibliometric data has significantly contributed to the increasing adoption of bibliometric analysis in academic research (Öğüt *et al.* 2023).

Bibliometric analysis has become an increasingly popular quantitative research method within the academic community and continues to gain widespread acceptance across various disciplines. The interaction between researchers who employ bibliometric methods and those who utilize the findings of such analyses is also of considerable importance (Ellegaard, 2018).

Bibliometric analysis is a quantitative approach employed to objectively examine the intellectual structure and development of a specific research field. Bibliometric analysis is an effective quantitative approach that combines statistical and mathematical techniques to map the current state, intellectual structure, and emerging trends within a particular research field. Bibliometrics is widely used by the academic community and researchers as an important tool for examining specific research topics, identifying research trends, and analyzing developments within a particular field (Chen *et al.* 2022; Dash *et al.* 2023).

The study conducts a bibliometric analysis of the existing literature to identify the most influential authors, sources, publication years, countries, institutions, and keywords within the research field. The following analyses were carried out in this study: (1) distribution of publications by year, (2) distribution of publications by document type, (3) distribution of publications by language, (4) author analysis, (5) co-authorship analysis, (6) source analysis, (7) country analysis, (8) institutional analysis, (9) keyword analysis. The bibliometric analysis was conducted using VOSviewer. VOSviewer is a widely used software tool that enables the construction, visualization and interpretation of bibliometric networks, thereby facilitating a more comprehensive analysis and presentation of relationships within the scientific literature (Dereli, 2024).

Unlike most software programs used for bibliometric mapping, VOSviewer places particular emphasis on the graphical visualization of bibliometric maps. Its functionality is especially valuable for displaying large-scale bibliometric networks in a clear, intuitive, and easily interpretable manner, thereby facilitating the analysis and interpretation of complex relationships within the scientific literature (van Eck & Waltman, 2009). VOSviewer is regarded as a valuable software tool that facilitates the identification of developments, relationships, and emerging research topics within the scientific literature. In addition, it enables comprehensive analysis, visualization, and mapping of bibliometric datasets, thereby providing researchers with deeper insights into the intellectual structure and evolution of a research field (Dirik *et al.* 2023).

3.3 Data Collection and Search Strategy

The dataset used in this study was obtained from the Web of Science (WoS) Core Collection, a database widely employed in bibliometric research due to its standardized bibliographic records and reliable citation data. The Web of Science Core Collection was selected as the sole data source because it indexes high-impact, peer-reviewed journals, offers advanced search functionalities and comprehensive analytical tools, and provides access to high-quality, ethically published research across a broad range of academic disciplines. Furthermore, its international recognition as a reliable source for bibliometric studies and its compatibility with VOSviewer make it particularly suitable for bibliometric mapping and network analysis (Dirik *et al.* 2023).

Data collection was conducted on March 27, 2025. The literature search was performed using the Topic Search (TS) function of the Web of Science Core Collection. The TS function simultaneously searches publication titles, abstracts, Author Keywords, and Keywords Plus, thereby enabling the comprehensive identification of publications relevant to the research topic.

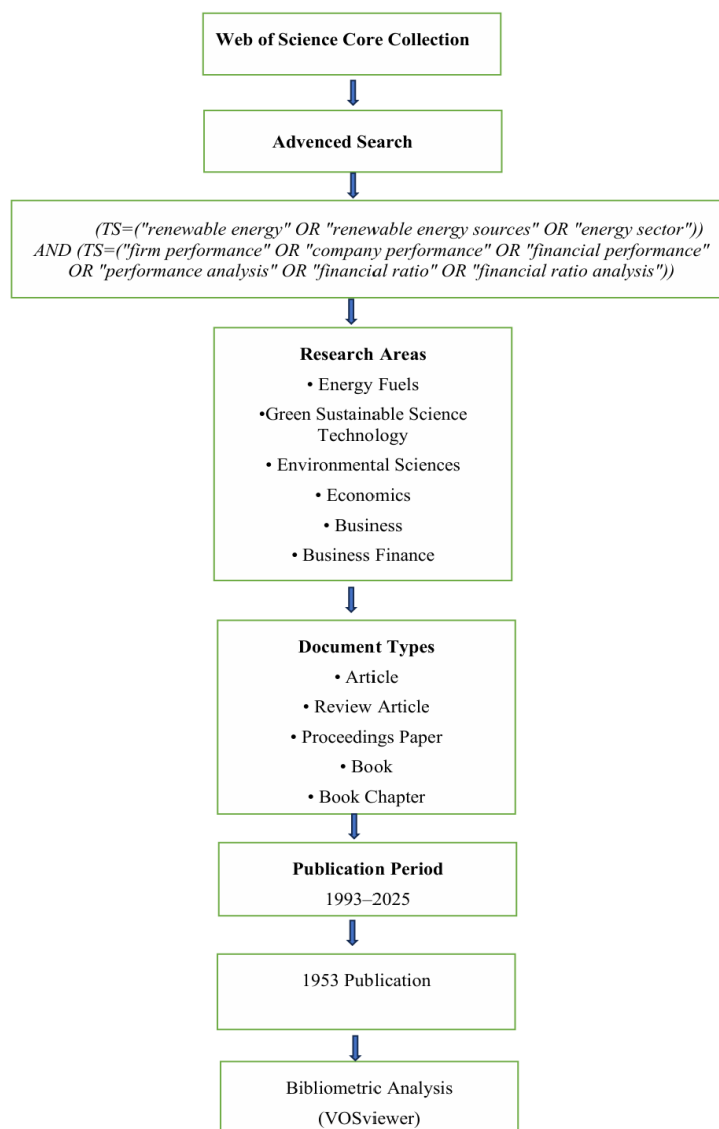
The following search query was used in the study:

(TS=("renewable energy" OR "renewable energy sources" OR "energy sector")) AND (TS=("firm performance" OR "company performance" OR "financial performance" OR "performance analysis" OR "financial ratio" OR "financial ratio analysis"))

During the search process, the research areas of Energy Fuels, Green Sustainable Science Technology, Environmental Sciences, Economics, Business, and Business Finance were selected. To enhance the scientific rigor of the analysis, only publications classified as Articles, Review Articles, Proceedings Papers, Books, and Book Chapters were included in the dataset. Editorial materials, letters, meeting abstracts, corrections, and other similar publication types were excluded because they generally provide limited scientific content and may introduce bias into the results of bibliometric analyses.

Applying the predefined search strategy and filtering criteria yielded a total of 1,953 publications covering the period from 1993 to 2025. Of these, 1,474 were classified as research articles. The retrieved bibliographic data were imported into VOSviewer for analysis. Subsequently, analyses of authorship, citations, countries, institutions, keywords, and abstracts were conducted to reveal the intellectual structure and research trends within the literature. The stages of the research process are presented in the figure below.

Figure 1. Data Collection and Filtering Process



Source: Created by the author.

3.4 Findings

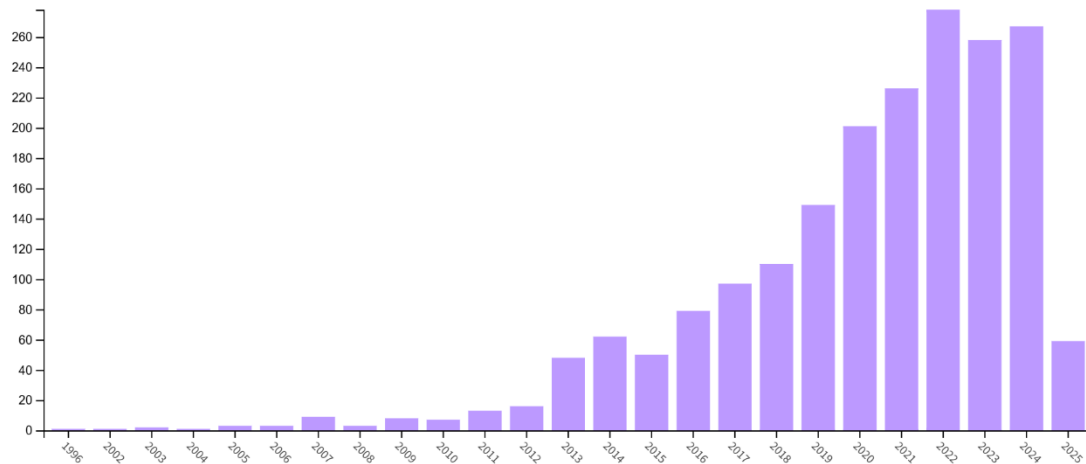
The findings of the study are presented under this heading.

3.4.1. Distribution of Publications by Year

Figure 2 presents the distribution of the studies conducted using the words (TS=(\"renewable energy\" OR \"renewable energy sources\" OR \"energy sector\")) AND (TS=(\"firm performance\" OR \"company performance\" OR

"financial performance" OR "performance analysis" OR "financial ratio" OR "financial ratio analysis"). It is seen that the studies conducted in this field since 1993 have continued to increase until today. With the increasing importance of renewable energy sources, the number of studies in this field has started to increase since 2009. The 59 studies conducted until March 2025 can also be an indicator of the increasing interest in the field.

Figure 2. Distribution of Publications by Year on the Relationship Between Renewable Energy and Firm Performance



Source: Web of Science Database

Table 1. Number of Publications by Year on the Relationship Between Renewable Energy and Firm Performance

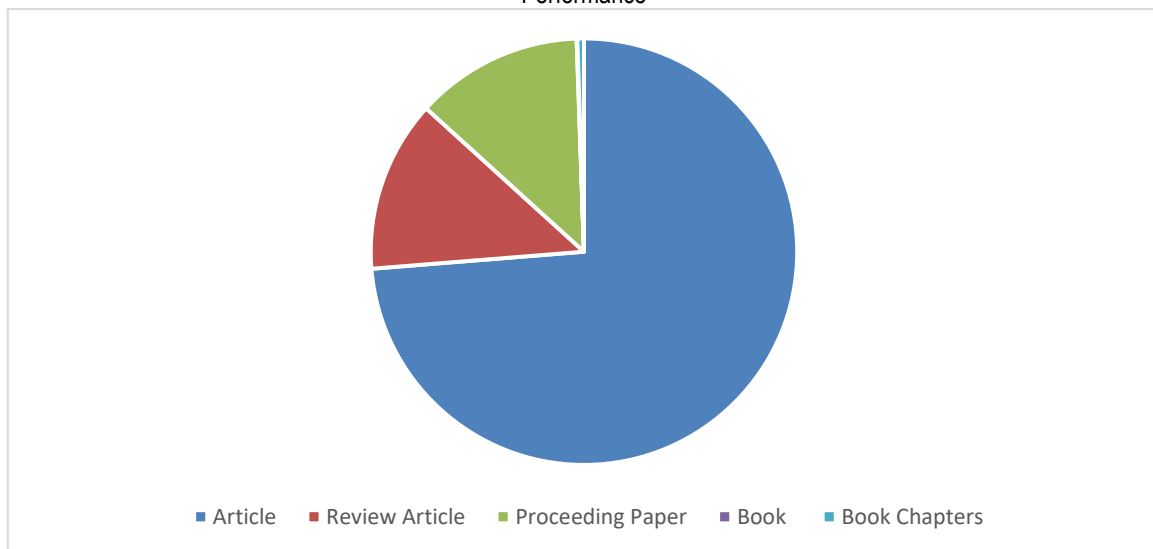
Publication year	Record count	% of 1.953
2025	59	3.021
2024	267	13.671
2023	258	13.210
2022	278	14.235
2021	226	11.572
2020	201	10.292
2019	149	7.629
2018	110	5.632
2017	97	4.967
2016	79	4.045
2015	50	2.560
2014	62	3.175
2013	48	2.458
2012	16	0.819
2011	13	0.666
2010	7	0.358
2009	8	0.410
2008	3	0.154
2007	9	0.461
2006	3	0.154
2005	3	0.154
2004	1	0.051
2003	2	0.102
2002	1	0.051
1996	1	0.051
1994	1	0.051
1993	1	0.051

Source: Web of Science Database

3.4.2. Distribution of Publications by Document Type

Figure 3 shows the distribution of studies on renewable energy sources and firm performance by publication type. According to the table, articles constitute most of the studies. Between 1993 and 2025, 1,473 articles on this topic were published. To enhance the scientific quality of the bibliometric analysis and focus on academic publications representative of the field, the study included the publication types “article,” “review article,” “proceedings paper,” “book,” and “book chapter” in the analysis. These publication types were selected because they have undergone a peer-review process, contribute directly to the production of scientific knowledge, and are commonly preferred in bibliometric analyses. Editorials, letters, conference abstracts, corrections, and similar publication types were excluded from the scope because they offer limited scientific content and may skew citation analyses. As a result of this filtering, a total of 1,953 publications were included in the analysis.

Figure 3. Distribution of Publications by Document Type on the Relationship Between Renewable Energy and Firm Performance

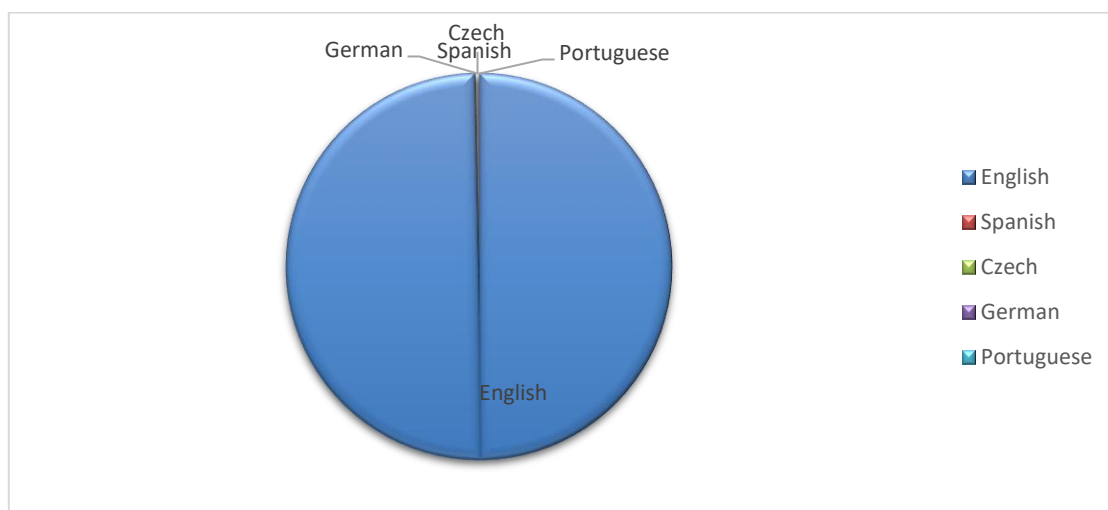


Source: Web of Science Database

3.4.3. Distribution of Studies According to Language of Writing

Figure 4 shows the distribution of studies on renewable energy sources and firm performance according to the language of writing. According to Table 4, approximately 99.6% of the studies were written in English (1947). This is a result that supports the views of authors (Jeyaraj, 2014, p. 1; Ferguson, 2011, p. 41) who state that English is the default language in the scientific world. Other publication languages are Czech (1), German (1), Spanish (3), Portuguese (1).

Figure 4. Distribution of Studies on the Relationship between Renewable Energy and Firm Performance by Language of Writing



Source: Web of Science Database

3.4.4. Author Analysis

Table 2 lists the top 10 authors with the most studies on renewable energy sources and firm performance. There are two commonly used weight attributes. These are the links attribute and the total link strength attribute. The links attribute indicates the number of links between an item and others, while the total link strength attribute reflects the overall effect or strength of these links. For example, the number of co-authorship links between a researcher and others represents the quality of links, while the quality and effect of these links represent the total link strength. These two measures play a critical role in understanding how networks interact. Saad Mekhilef is the most prolific author in the field and the author with the highest number of citations.

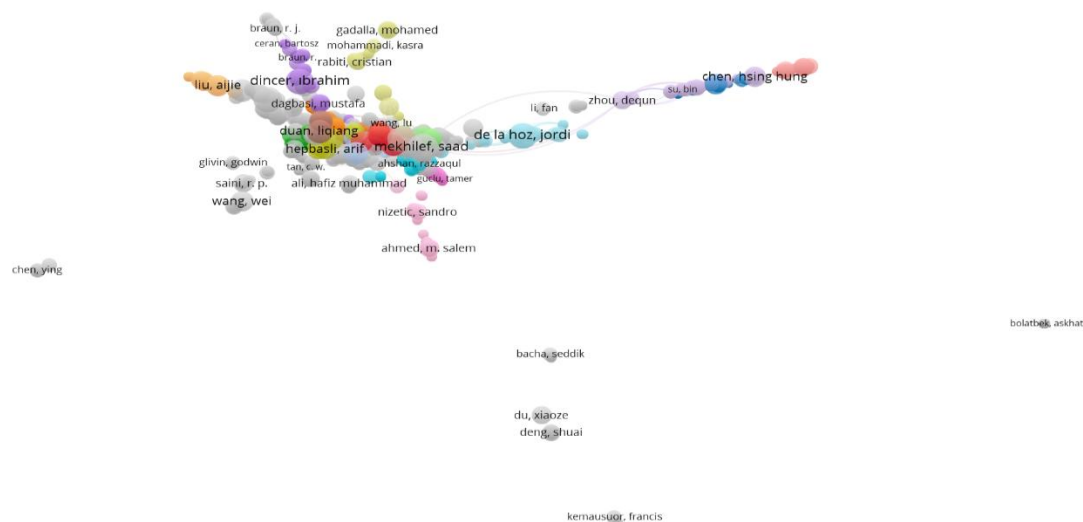
Table 2. Authors with the Most Publications on the Relationship between Renewable Energy and Firm Performance

Researcher	Number of studies	Number of citations	Connection strength
Saad Mekhilef	11	2074	618
Barun k. Das	9	1148	622
Jordi De La Hoz	9	139	237
Helena Martin	9	139	237
İbrahim Dincer	9	230	26
Jiangfeng Wang	9	263	26
Liqiang Duan	8	108	3
Mohamad Ramadan	7	888	37
Pan Zhao	7	148	17
Ruixiong Li	7	28	0

Source: Web of Science Database

Figure 5 shows the visualization of the network analysis on the authors with the most publications on renewable energy sources and firm performance. This analysis aims to easily identify the authors with the most publications and citations. In the study, an author citation analysis based on the criterion of at least one publication and at least one citation was performed to identify citation networks. This analysis was performed on 2779 interconnected units and a total of 52 clusters; 18575 links and 21053 link strengths were identified. The top 3 authors with the most publications are Saad Mekhilef, Barun K. Das and Jordi De La Hoz, while the first of the top 3 most cited authors is Saad Mekhilef with the most publications. The second most cited author is Luisa F. Cabeza with one document and 1330 citations and the next eight authors have one document and 1330 citations.

Figure 5. Network Analysis Image According to Authors with the Most Publications



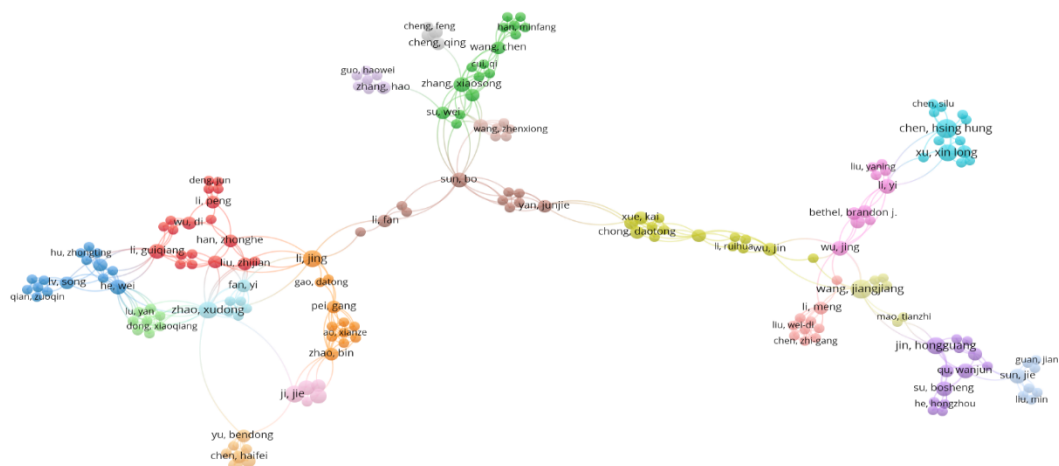
Source: Vosviewer

Each color in the visualization represents a specific cluster of authors, usually of higher relevance. The size of the circles and the font size of the labels indicate the number of occurrences of these clusters. In the link strength analysis, Saad Mekhilef again ranks first with 370 links.

3.4.5. Co-Author Analysis

As a result of the co-authorship analysis of the authors, the authors with the most connections and collaborations were identified. For this purpose, a network map was created by considering at least one publication and one citation criteria. The analysis shows 192 authors coming together in 19 clusters and 601 links in total. The most cited authors (Saad Mekhilef with 2074 citations, Luisa F. Cabeza with 1330 citations and Pablo Dolado with 1330 citations) are not among the most connected authors except Saad Mekhilef, and the authors who have produced the most works (Saad Mekhilef, Jiangfeng Wang, Jordi de la hoz,) do not appear in this group except Saad Mekhilef.

Figure 6. Network Analysis Image of Authors with the Most Connections and Collaboration



VOSviewer

Source: Vosviewer

3.4.6. Source Analysis

Table 3 shows the sources with the highest number of studies on renewable energy sources and firm performance.

Table 3. Sources with the Most Publications on the Relationship between Renewable Energy and Firm Performance

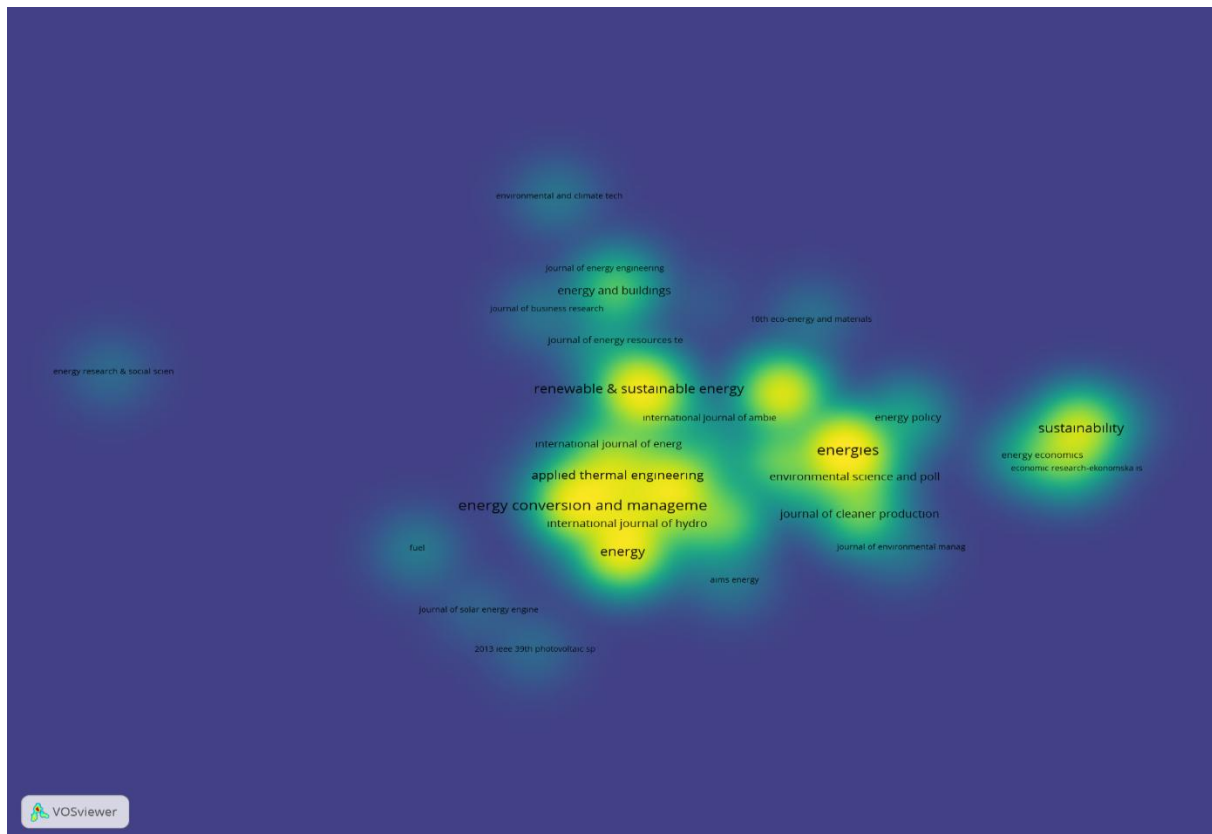
Source	Number of studies	Number of citations	Connection strength
Energies	162	2159	133
Energy conversion and management	133	7040	303
Energy	123	5478	262
Renewable&sustainable energy reviews	119	11382	255
Renewable energy	115	4460	227
sustainability	87	1426	60
Applied energy	62	2834	83
Applied thermal engineering	61	1982	59
Journal of energy storage	59	1034	44
International journal of hydrogen energy	49	1497	72

Source: Vosviewer

The source with the highest number of studies is "Energies" with 150 studies, and the top three sources with the highest number of citations are Renewable & sustainable energy reviews with 10289 citations, Energy conversion and management with 6287 citations, and energy with 4730 citations. The source with the highest link strength is Energy conversion and management.

Figure 7 presents a visualization of the network analysis on the sources publishing on renewable energy sources and firm performance. In the analysis, using the "citation-sources" feature, a network map was created over 192 observation units with at least one published work and one citation. As a result of this analysis, 19 clusters, 601 connections and a total of 633 connection strengths were identified. In this context, Energy conversion and management stands out as the source with the highest link strength with 303 links.

Figure 7. Network Analysis on Sources Publishing on Renewable Energy and Company Performance



Source: Vosviewer

3.4.7. Country Analysis

Table 4 shows the top ten ranking of the most productive countries in renewable energy sources and firm performance.

Table 4. Countries with the Most Publications on the Relationship between Renewable Energy and Firm Performance

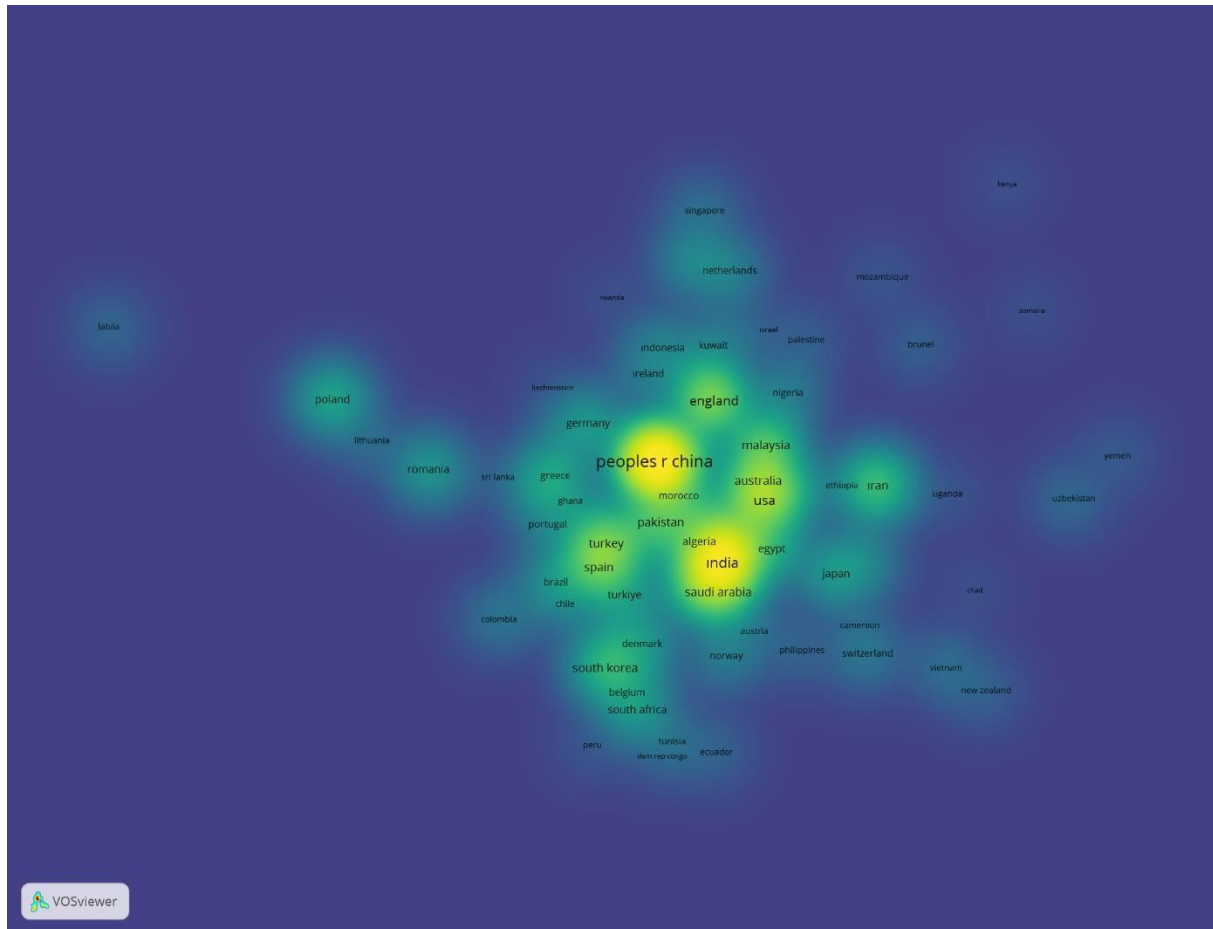
Country	Number of Studies	Number of Citation	Connection Strength
China	474	13407	537
India	281	7705	407
USA	138	4635	310
England	122	4007	232
Italy	115	3350	260
Malaysia	93	6782	607
Saudi Arabia	91	3488	357
Iran	91	5263	313
Spain	85	3224	127
Australia	81	4456	542
Turkey	79	3772	210

Source: Vosviewer

China has contributed the most to the literature in these areas. The top 3 most cited countries are (China with 13407 citations, India with 7705 citations, Malaysia with 6782 citations). While Malaysia ranked 6th in the number of publications, it ranked 3rd in the citation ranking. Turkey ranks 11th in publications and 8th in citations.

Figure 8 shows a visualization of the network analysis on the countries with the highest number of publications on renewable energy sources and firm performance. In order to examine the citations of publications according to their countries of origin, a network map was created using the 'Citation -Countries' feature over 93 observation units that have published at least one work and received one citation. As a result of this analysis, 16 clusters, 909 links and a total of 3557 link strengths were identified. The network analysis image shows clusters in different colors corresponding to the relevant countries. Malaysia (607) stands out as the country with the highest connection strength.

Figure 8. Network Analysis Image of Countries with the Most Publications on Renewable Energy and Firm Performance



Source: Vosviewer

4.4.8. Institution Analysis

Table 5 shows the institutions from which the most studies on renewable energy sources and firm performance came from. Xi'an Jiaotong University from China made the largest contribution to the literature on these issues. The top three institutions in citation ranking are (University of Malaya with 3216 citations, University of Tehran with 2472 citations, University of Sharjah with 1525 citations). Although University of Malaya ranks 4th in terms of the number of documents, it ranks high in the number of citations. Turkey (Ege University) ranks 19th in the number of documents. In the citation ranking, Turkey ranked 13th.

Table 5. Institutions with the Most Publications on the Relationship between Renewable Energy and Firm Performance

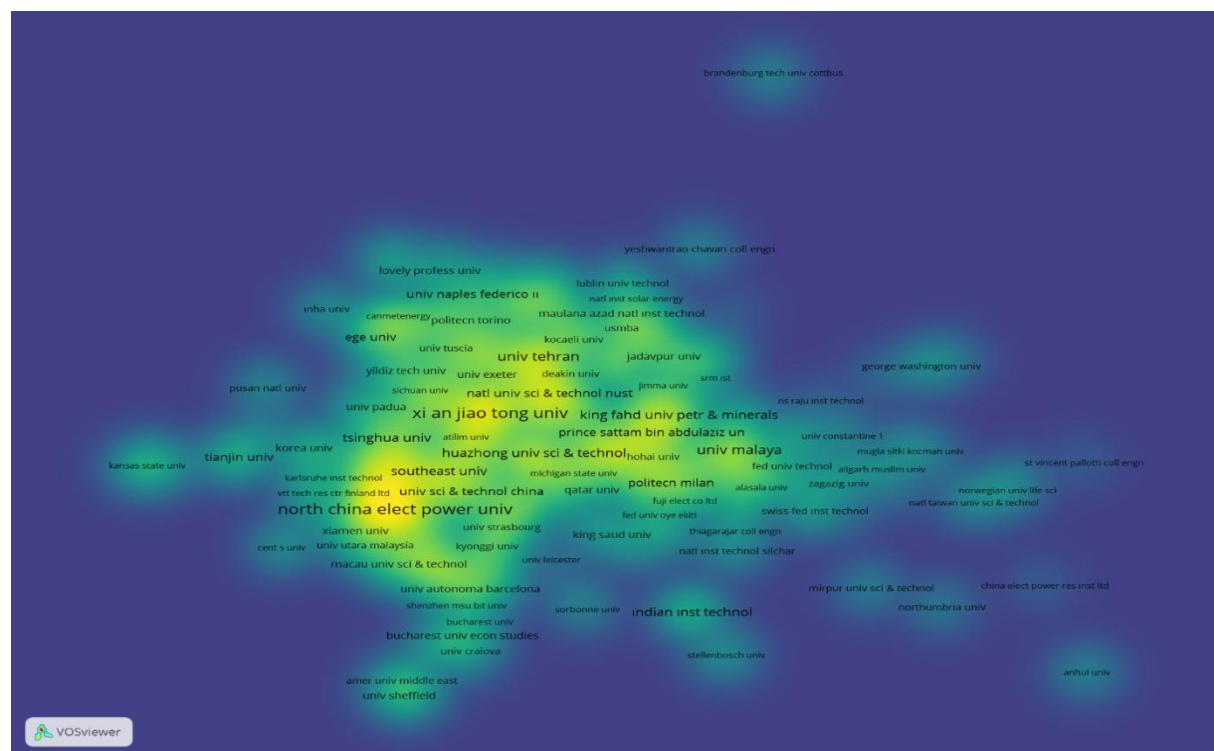
Institution	Number of publications	Number of Citation	Connection Strength
Xi'an Jiaotong University	48	1422	86
North China Electric Power University	47	849	62

Chinese Academy of Sciences	29	845	72
University of Malaya	26	3216	561
University of Tehran	24	2472	161
National Institutes of Technology	21	649	104
Shanghai Jiao Tong University	21	757	33
Huazhong University of Science and Technology	20	1055	148
University of Sharjah	19	1525	143
Institute of Nano Science and Technology	19	630	115

Source: Vosviewer

Figure 9 presents a network analysis of institutions that have published significant publications on renewable energy sources and firm performance. Relevant institutions are grouped in different colours and included in the network analysis visualization. Using the "citation- organization" feature in the analysis, a network map was created over 1126 units that have published at least one work and received a citation. As a result of this analysis, 52 clusters, 5042 links and a total of 6530 link strengths were identified. University of Malaya also stands out as the organization with the strongest link strength (561 link strength).

Figure 9. Network Analysis Image of the Institutions with the Most Publications on Renewable Energy and Firm Performance



Source: Vosviewer

3.4.9. Keyword Analysis

Table 6 lists the most frequently used keywords in the article studies. The concept of "sustainability", which is used extensively in the studies, ranks 12th with 17 repetitions in the list of the most frequently used keywords. This may be due to the fact that this concept is more recent than the others. The most frequently used keyword in the studies on renewable energy sources and firm performance was "renewable energy".

Table 6. Most Frequently Used Keywords in Topics on the Relationship between Renewable Energy and Firm Performance

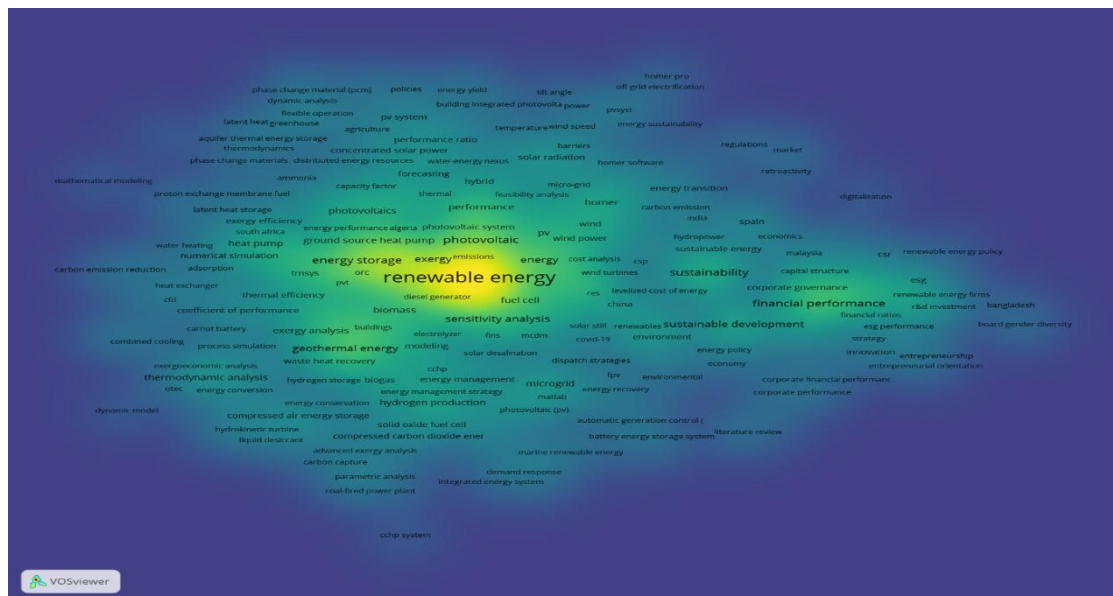
Keywords	Occurrences	Connection strength
Renewable energy	395	866
Solar energy	125	301
Performance analysis	81	139
Energy storage	68	155
Photovoltaic energy	63	174
Financial performance	58	93
Sustainability	53	122
Optimization	46	135
Energy efficiency	46	102
Renewable energy sources	43	96

Source: Vosviewer

Figure 10 shows a network visualization of the analyzed keywords. The most used keyword in the studies analyzed with the "co-occurrence" feature was "renewable energy" with 393 occurrences. In addition to being the most frequently used term, it also has the highest density (866) and frequency. After that, solar energy with 125 repetitions and performance analysis with 81 repetitions follow the order. In terms of connection strength, solar energy (866), performance analysis (301) and photovoltaic (174) were the top 3.

The analysis was performed with 555 observation units that were seen at least three times and had relationships between them, resulting in 20 clusters, 3968 links and a total of 5277 link strengths.

Figure 10. Analysis Image of the Most Frequently Used Keywords on Renewable Energy and Company Performance



Source: Vosviewer

Conclusions and Further Research

The aim of this study is to conduct a bibliometric analysis of the studies on the relationship between renewable energy and firm performance. For this purpose, the advanced search section of the Web of Science database was searched by typing the related words (TS=("renewable energy" OR "renewable energy sources" OR "energy sector")) AND (TS=("firm performance" OR "company performance" OR "financial performance" OR "performance analysis" OR "financial ratio" OR "financial ratio analysis")). It was found that the studies on the subject started in 1993 and continued until 2025. To the data obtained as document type; 'article, review article, proceeding paper, book, book chapters' web of science category Energy fuels, green sustainable science technologies, environmental sciences, economics, business, business finance' special filter was applied and 1953 publications from 1993-2025 were included in the analysis. In the analysis part of the study, the 'analyze results' section of the web of science database was used for the distribution of studies by year, distribution of studies by type, and distribution of studies by language of writing. VOSviewer software program was used to analyze and visualize the relationship between authors, sources, countries, institutions and keywords. As a result of the analysis, tables were created by ranking the

top 10 authors, sources, countries and institutions in terms of number of publications, number of citations and link strength. After the relevant tables, mapping was provided. As a result of the analysis;

- The studies that started in 1993 reached the highest level in 2020 with 280 studies.
- Studies in this field are the most preferred articles
- It is seen that the majority of the studies in this field are articles and 99.60% of the language of writing is English.
- It is seen that Saad Mekhilef is the most prolific author in the related field and also the most cited author.
- The source with the highest number of studies is 'Energies' and the source with the highest number of citations is 'Renewable & Sustainable Energy Reviews'.
- The People's Republic of China made the highest contribution to the related field in terms of the number of studies and citations.
- The most productive institution in terms of number of publications was Xi an Jiao Tong Univ. Univ Malaya is the institution with the highest number of citations.
- The most frequently used keyword in the studies was 'renewable energy', which constitutes the focus of the studies.

This study provides a comprehensive perspective on the scientific development of the research field. While the majority of existing studies have empirically examined the impact of renewable energy investments on firm performance using specific country, industry, or firm-level samples, the present study distinguishes itself by comprehensively evaluating the intellectual structure of the literature, including its research trends, influential authors, institutions, countries, publication sources, and conceptual evolution. In this respect, the study not only synthesizes the existing body of knowledge but also reveals the developmental dynamics of the research field, thereby providing a comprehensive roadmap for future research.

Furthermore, the use of publications indexed in the Web of Science Core Collection, which complies with internationally recognized academic standards, enhances the reliability and comparability of the findings. The scientific collaboration networks, citation networks, and keyword trends identified through bibliometric analysis are expected to assist researchers in identifying knowledge gaps, developing new research directions, and strengthening international research collaborations. In addition, the findings of this study may serve as a valuable reference for policymakers, investors, and firms operating in the energy sector by facilitating the monitoring of research trends in renewable energy and supporting strategic decision-making processes.

The increasing adoption of renewable energy policies offers firms engaged in renewable energy investments significant opportunities to achieve sustainable growth, enhance their competitiveness, and reduce financial risks. At the same time, while firms are expected to assume greater responsibility for renewable energy initiatives, continued support from both central and local governments will be essential to promote the widespread adoption and long-term sustainability of renewable energy.

Nevertheless, this study is subject to certain limitations. The primary limitation is that the analysis is confined to publications indexed exclusively in the Web of Science Core Collection. Future research could provide a more comprehensive understanding of the field by incorporating additional databases, such as Scopus, Dimensions, and Google Scholar. Moreover, complementing bibliometric analysis with systematic literature reviews and content analysis would further enhance the comprehensive evaluation of this research field.

Declarations

Credit Authorship Contribution Statement

Rabia Şen: Conceptualization, Investigation, Methodology, Project administration, Software, Formal analysis, Data curation, Writing – original draft; Funding Acquisition.

Gülfen Tuna: Supervision, Validation, Writing – review and editing; Funding Acquisition.

Declaration of Competing Interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Declaration of use of generative AI and AI-assisted technologies: The authors used generative AI solely to assist with the translation of selected sections of the manuscript. No AI-generated content was used in the study design, data analysis, interpretation of the results, or the preparation of the scientific content. The authors reviewed all AI-assisted translations and take full responsibility for the accuracy and integrity of the final manuscript.

References

- Alper, A., & Oguz, O. (2016). The role of renewable energy consumption in economic growth: Evidence from asymmetric causality. *Renewable and Sustainable Energy Reviews*, 60, 953-959. <https://doi.org/10.1016/j.rser.2016.01.123>
- Bağcı, H., & Yiğiter, Ş. Y. (2019). BİST'te yer alan enerji şirketlerinin finansal performansının SD ve WASPAS yöntemleriyle ölçülmesi. *Bingöl Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 9(18), 877-898. <https://doi.org/10.29029/BUSBED.559885>
- Chen, Y., Lin, M., & Zhuang, D. (2022). Wastewater treatment and emerging contaminants: Bibliometric analysis. *Chemosphere*, 297, Article 133932. <https://doi.org/10.1016/j.chemosphere.2022.133932>
- Dash, M. K., Singh, C., Panda, G., & Sharma, D. (2023). ICT for sustainability and socio-economic development in fishery: A bibliometric analysis and future research agenda. *Environment, Development and Sustainability*, 25(3), 2201-2233. <https://doi.org/10.1007/s10668-022-02131-x>
- Dereli, A. B. (2024). VOSviewer ile bibliyometrik analiz. *Communicata*, (28), 1-7. <https://doi.org/10.32952/communicata.1517725>
- Dirik, D., Eryılmaz, İ., & Erhan, T. (2023). Post-truth kavramı üzerine yapılan çalışmaların VOSviewer ile bibliyometrik analizi. *Sosyal Mucit Academic Review*, 4(2), 164-188. <https://doi.org/10.54733/SMAR.1271369>
- Dopierala, Ł., Mosionek-Schweda, M., Laskowicz, T., & Ilczuk, D. (2022). Financial performance of renewable energy producers: A panel data analysis from the Baltic Sea region. *Energy Reports*, 8, 11492-11503. <https://doi.org/10.1016/j.egy.2022.09.009>
- Ellegaard, O. (2018). The application of bibliometric analysis: Disciplinary and user aspects. *Scientometrics*, 116(1), 181-202. <https://doi.org/10.1007/s11192-018-2765-z>
- Erdoğan, H., Tutcu, B., Talaş, H., & Terzioğlu, M. (2026). Performance analysis in renewable energy companies: Application of SWARA and WASPAS methods. *Journal of Sustainable Finance & Investment*, 16(1), 188-209. <https://doi.org/10.1080/20430795.2022.2144107>
- Eyüboğlu, K., & Çelik, P. (2016). Financial performance evaluation of Turkish energy companies with fuzzy AHP and fuzzy TOPSIS methods. *Business and Economics Research Journal*, 7(3), 21-38.
- Fındık, D. (2023). AB ülkelerindeki döngüsel ekonomi uygulamalarının firma performansına etkisi üzerine ampirik bir çalışma. *Verimlilik Dergisi*, (1), 37-52. <https://doi.org/10.51551/verimlilik.1098885>
- Halkos, G. E., & Tzeremes, N. G. (2012). Analyzing the Greek renewable energy sector: A data envelopment analysis approach. *Renewable and Sustainable Energy Reviews*, 16(5), 2884-2893. <https://doi.org/10.1016/j.rser.2012.02.003>
- Ibarloza, A., Heras-Saizarbitoria, I., Allur, E., & Larrea, A. (2018). Regulatory cuts and economic and financial performance of Spanish solar power companies: An empirical review. *Renewable and Sustainable Energy Reviews*, 92, 784-793. <https://doi.org/10.1016/j.rser.2018.04.087>
- İskenderoğlu, Ö., Karadeniz, E., & Ayyıldız, N. (2015). Enerji sektörünün finansal analizi: Türkiye ve Avrupa enerji sektörü karşılaştırması. *İşletme ve İktisat Çalışmaları Dergisi*, 3(3), 86-97.
- Kılıçarslan, A. (2023). Yenilenebilir enerji sektörü şirketlerinin finansal performans analizi: Borsa İstanbul'da bir uygulama. *Kastamonu Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, 25(1), 232-253. <https://doi.org/10.21180/iibfdkastamonu.1191441>
- Kim, J., & Park, K. (2016). Financial development and deployment of renewable energy technologies. *Energy Economics*, 59, 238-250. <https://doi.org/10.1016/j.eneco.2016.08.012>
- Kludacz-Alessandri, M., Cygańska, M., Tsai, W.-H., & Pietrzak, M. B. (2021). Corporate social responsibility and financial performance among energy sector companies. *Energies*, 14(19), Article 6068. <https://doi.org/10.3390/en14196068>
- Koç, E., Kaya, K., & Gör, A. (2015). Enerji kaynakları-yenilenebilir enerji durumu. *Mühendis ve Makina*, 56(668), 36-47.

- Martí-Ballester, C. P. (2017). Sustainable energy systems and company performance: Does the implementation of sustainable energy systems improve companies' financial performance? *Journal of Cleaner Production*, 162(Suppl.), S35–S50. <https://doi.org/10.1016/j.jclepro.2016.12.015>
- Metin, S., Yaman, S., & Korkmaz, T. (2017). Finansal performansın TOPSIS ve MOORA yöntemleri ile belirlenmesi: BİST enerji firmaları üzerine karşılaştırmalı bir uygulama. *Kahramanmaraş Sütçü İmam Üniversitesi Sosyal Bilimler Dergisi*, 14(2), 371–394.
- Moric, I., Jovanovic, J. Š., Dokovic, R., Pekovic, S., & Perovic, D. (2020). The effect of phases of the adoption of the circular economy on firm performance: Evidence from 28 EU countries. *Sustainability*, 12(6), Article 2557. <https://doi.org/10.3390/su12062557>
- Öğüt, A., Ekinci, T., & Gökçe, Ş. (2023). Yeşil yönetim uygulamaları ve firma performansı arasındaki ilişkinin bibliyometrik analizi. *Necmettin Erbakan Üniversitesi Siyasal Bilgiler Fakültesi Dergisi*, 5(2), 258–277.
- Özçelik, M. (2024). Türkiye'de yenilenebilir ve geleneksel enerji şirketlerinin finansal performans karşılaştırması: DuPont analizi yaklaşımı. *Akademik Araştırmalar ve Çalışmalar Dergisi*, 16(31), 345–359. <https://doi.org/10.20990/kilisibfakademik.1508111>
- Özdemir, O., & Parmaksız, S. (2022). BIST enerji işletmelerinin finansal performanslarının çok kriterli karar verme teknikleri ile karşılaştırılması: TOPSIS ve EDAS yöntemleri ile analiz. *Başkent Üniversitesi Ticari Bilimler Fakültesi Dergisi*, 6(1), 34–56.
- Paun, D. (2017). Sustainability and financial performance of companies in the energy sector in Romania. *Sustainability*, 9(10), Article 1722. <https://doi.org/10.3390/su9101722>
- Şengül, Ü., Tan, S., Atak, Ş., & Şengül, B. A. (2015). Türkiye Gökçeada'da yenilenebilir enerji kaynaklarının potansiyeli. *Akademik Araştırmalar ve Çalışmalar Dergisi*, 6(11), 41–55. <https://doi.org/10.20990/aacd.91354>
- Torunoğlu Gedik, Ö. (2015). Türkiye'de yenilenebilir enerji kaynakları ve çevresel etkileri (Yüksek lisans tezi, İstanbul Teknik Üniversitesi, Fen Bilimleri Enstitüsü). <http://hdl.handle.net/11527/13035>
- Üçgül, İ., & Elibüyük, U. (2017). Yenilenebilir enerji kaynakları ve enerji jeopolitiği. *Anka E-Dergi*, 2(1).
- van Eck, N. J., & Waltman, L. (2009). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, 84(2), 523–538. <https://doi.org/10.1007/s11192-009-0146-3>
- Zhang, W., Chiu, Y. B., & Hsiao, C. Y. L. (2022). Effects of country risks and government subsidies on renewable energy firms' performance: Evidence from China. *Renewable and Sustainable Energy Reviews*, 158, Article 112164. <https://doi.org/10.1016/j.rser.2022.112164>