https://doi.org/10.54486/fivezero.2023.30

Cilt: 3 Sayı: 2 Yıl: 2023 Araştırma Makalesi / Research Article

Examination of Renewable Energy in The Discipline of Economics: Content and Bibliometric Mapping Analysis

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Article Info

Article History

Received: 22.09.2023
Accepted: 25.12.2023
Published: 31.12.2023

Keywords:
Renewable Energy, Economic Analysis, Bibliometric Mapping Analysis.

ABSTRACT

Economic development and growth depend heavily on energy. Renewable energy and the research on this topic are more valuable because of the limited energy supply and the daily rise in energy demand. The need for further research is demonstrated by the fact that rising renewable energy use is directly correlated with economic growth. Studies carried out with the increase in renewable energy consumption; It is effective in providing guidance to those concerned in the field - researchers and policy makers - by both examining traditional energy uses and evaluating the political, social and economic factors encountered during the integration of new energy systems. It is vital to assess the scope of studies on renewable energy as a result. The main objective of the study is to analyze the state of the scientific literature on the economic dimension of renewable energy. In order to achieve this objective, there are 5,286,683 studies on energy in the date range analyzed in Web of Science. In the field of energy, there are 726,894 studies with the word "energy" in the title. These studies total 14,311 and are all in the field of economics. 1,639 of these 14,311 studies had "renewable energy" in their titles. A total of 1,373 of these studies were released as papers. In the study, bibliometric mapping analysis was performed on 1,373 studies that had a direct focus on renewable energy, were indexed in the Web of Science, and had the phrase "renewable energy" in the title. In the study, the most cited article, the most frequently used terms, the most cited authors, and the most published journals were analyzed.

Yenilenebilir Enerjinin İktisat Disiplininde İncelenmesi: İçerik Analizi ve Bibliyometrik Haritalama Analizi

Makale Bilgileri

Makale Geçmişi

Geliş: 22.09.2023
Kabul: 25.12.2023
Yayın: 31.12.2023

Anahtar Kelimeler:
Yenilenebilir enerji, İktisadi analiz, Bibliyometrik haritalama analizi.

ÖZ

Ekonomik kalkınma ve büyüme büyük ölçüde enerjiye bağlıdır. Yenilenebilir enerji alanındaki araştırmalar, enerji arzının sınırlı olması ve enerji talebinin her geçen gün artması nedeniyle değer kazanmıştır. Artan yenilenebilir enerji kullanımının ekonomik büyümeyle doğrudan ilişkili olması, alanda inceleme yapılmasına duyulan ihtiyacı ortaya koymaktadır. Yenilenebilir enerji tüketiminin artması ile gerçekleştirilen çalışmalar; gerek geleneksel enerji kullanımları üzerinde inceleme gerçekleştirilmesi gerekse yeni enerji sistemlerinin entegrasyonu süresinde karşı karşıya kalınan siyasi, sosyal ve ekonomik etmenlerin değerlendirilerek, alandaki ilgililere -araştırmacılar, politika yapıcılar- kılavuzluk sağlaması noktasında etkinlik göstermektedir. Sonuç olarak yenilenebilir enerji konusundaki çalışmaların kapsamının değerlendirilmesi hayati önem taşımaktadır. Çalışmanın temel amacı yenilenebilir enerjinin ekonomik boyutu konusunda bilimsel literatürün geldiği durumu analiz etmektir. Bu amaca ulaşmak için Web of Science'ta incelenen tarih aralığında enerji konusunda 5.286.683 çalışma bulunmaktadır. Enerji alanında başlığında "enerji" kelimesine yer verilen 726.894 çalışma bulunmaktadır. Bu çalışmalar toplamda 14.311 adet olup çalışmaların tamamı ekonomi disiplini çerçevesinde yazılmıştır. Bu 14.311 çalışmanın 1.639'unun başlığında "yenilenebilir enerji" ibaresi yer almakta ve 1.373'ü makale olarak literatüre kazandırılmış bulunmaktadır. Çalışmada, doğrudan yenilenebilir enerji konusuna odaklanan, Web of Science'da indekslenen ve başlığında "yenilenebilir enerji" ibaresi bulunan 1.373 çalışmanın bibliyometrik haritalama analizi gerçekleştirilmiştir. Çalışma dahilinde; en çok atıf yapılan makale, makalede en sık kullanılan terimler, alanda çalışması olan ve en çok atıf yapılan yazarlar ile en çok yayın yapan dergiler analiz edilmiştir. Çalışmanın alanda kılavuz olma özelliği göstereceği düşünülmektedir.

Atıf/Citation: Arık, M., Afşar, B. Kazak, H., & Akcan, A.T, (2023). Examınatıon of renewable energy in the discipline of economics: content and bibliometric mapping analysis. *Five Zero, 3*(2), 300-327. https://doi.org/10.54486/fivezero.2023.30

INTRODUCTION

Regardless of whether a country is developed or developing, the energy factor is regarded as one of the most important elements required to support economic growth and development. The relevance of renewable energy is growing daily due to the rising energy demand and the constrained energy supply. Energy is crucial for both safeguarding the natural order and economic prosperity.

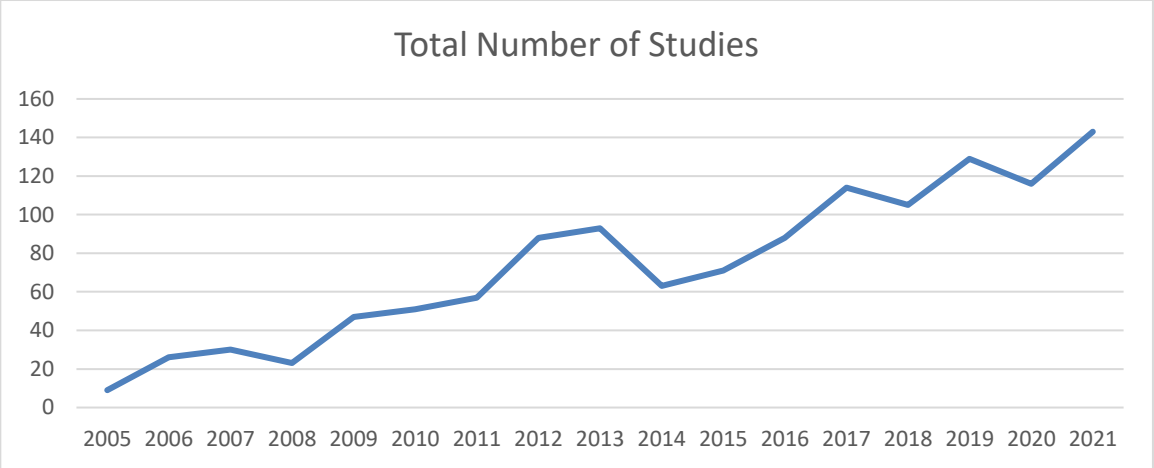
Due to the energy sources used, carbon dioxide emissions have usually increased since the industrial revolution (Xiaolong et al., 2022). With the acceleration of globalization, the sort of energy sources that different countries employ has emerged as a global issue. To put it another way, environmental pollution's impacts are now a problem that affects the entire world. Environmentally responsible energy use and production techniques produce good outcomes. The importance of a green economy is increased by employing techniques that don't hurt the environment and making economic development sustainable (Jianhua et al., 2022). As a result, the inclination to choose environmentally friendly renewable energy sources is growing in popularity across the globe. The significance of renewable energy is going to grow daily in the future. Given this significance, evaluating research on renewable energy will be crucial in establishing the status of renewable energy in the scientific community.

Renewable energy sources are among the most researched topics in the literature. The economic dimension of renewable energy resources is of high importance in many issues, especially economic growth and the sub-issues that support economic growth. Determining the point where renewable energy sources have reached in the scientific literature is important for creating ideas for future studies. The main purpose of the study is to analyze the economic dimension of renewable energy resources as far as it is in the scientific literature and to determine the point reached in this regard. For this purpose, an analysis of the 100 most cited studies in the field of economics in which renewable energy sources were investigated was conducted. In addition, a bibliometric analysis of studies in the field of renewable energy, regardless of the number of citations, was also conducted. The desired result of the study is to determine the content of the most effective studies that investigate the economic dimension of renewable energy sources and in general, to analyze the relationship between the studies investigating the economic dimension of renewable energy resources and each other.

To ascertain the scientific standing of the research pertaining to renewable energy and the economy, bibliometric mapping and content analysis were carried out. The importance of science is expanding in lockstep with the importance of energy. There were 5,286,683 studies about energy that were scanned in the Web of Science as of June 10, 2022. In the field of energy, there are 726,894 studies with the word "energy" in the title. These studies total 14,311 and are all in the field of economics. 1,639 of these 14,311 studies had "renewable energy" in their titles. Finally, 1,373 publications based on these investigations have been published as article. Our study includes a bibliometric mapping analysis of 1,373 studies, especially renewable energy, indexed under the title of "renewable energy" in the Web of Science, as well as a content analysis of the 50 most recently published studies and the 100 most cited studies.

When the papers that were the focus of bibliometric analysis were analyzed, some of the 1373 studies that will be investigated date back to 1980. The chart below shows a few of the target studies for the years 2005 through 2021. When the graph is inspected, it can be seen that more articles have been written about "renewable energy" than they were the year before. This demonstrates how the significance of the topic has grown throughout time.

Chart 1. *Total Number of Studies in Renewable Energy Field*



Source: It was created by the author using the World Bank database.

The graph shows a surge in demand for renewable energy as a result of globalization and climate change, as well as growing awareness of the negative effects of non-renewable energy. By doing a content analysis of publications published in the area of renewable energy and expressing the relevant analyses, this study establishes the position of renewable energy in the academic literature.

CONTENT ANALYSIS

The 100 most-cited publications on the topic as well as the 50 most current pieces on renewable energy will be submitted to content analysis. Within the purview of the review, the responses to the queries of what category the studies fall under, in what terms they were designed, what sort of analyses they underwent, and which methodologies were employed are included. Tables 1 and 2 display the results of the content analysis.

The 50 most recent publications on renewable energy that were located in the "Web of Science" database are listed in Table 1.

Table 1. *Analysis of 50 Most Recent Studies in Renewable Energy*

50 LATEST WORKS			
CATEGORY	**TREND**	**ARTICLES**	**METHOD/MODEL**
RENEWABLE ENERGY AND ECONOMY	**Renewable Energy, GDP and Economic Growth, Employment, Trade Deficits**	Afşar and Özarslan-Doğan(2021)	Panel Data Analysis
		Ye et al. (2022)	ECM Model
		Lin et al.(2022)	Empirical Analysis
		Zhang et al.(2022)	Empirical Analysis
		Li and Ho(2022)	Panel Data Analysis
		Pommeret and Schubert(2022)	Empirical Analysis
		Lei et al.(2021)	NARDL Analysis
		Keady et al.(2021)	Survey Method
		Henry et al.(2021)	SEERE Model
		Koengkan et al.(2021)	PARDL Analysis
		Zhang et al.(2021)	The PSTR Model
	Renewable Energy and Technology	Appiah et al.(2022)	Structural Equation Model
		Adekoya et al.(2022)	Panel Data Analysis
		Pradhan and Ghosh(2022)	Computable General Equilibrium Model

		Wen et al.(2022)	Panel Data Analysis Instrumental Variable Fixed Effect Analysis
		Persoon et al.(2022)	NONE
	Renewable Energy Sources	Cholewa et al.(2022)	PESTEL Analysis
		Obeidi et al.(2022)	Structural Equation Model
		Sendstad et al.(2022)	DD Method
		Usman and Balsalobre-Lorente(2022)	Panel Data Analysis
		Qiblawey et al.(2022)	NONE
	Stock Management	Wang et al.(2022)	GARCH-MIDAS Model
	Renewable Energy and Tourism	Díaz et al.(2022)	NONE
RENEWABLE ENERGY AND POLICY	**Political Editing/Review**	Shrivats, Firoozi, & Jaimungal (2021)	Variation Analysis
		Song et al.(2021)	Dynamic System Method
		Semmler et al.(2022)	Judd-Peterson Model NMPC Model
		Thompson and Toledo(2022)	Empirical Analysis
		Martens(2022)	Empirical Analysis
		Vesely et al.(2022)	Empirical Analysis
		Lagendijk et al.(2021)	NONE
		He et al.(2022)	NONE
	Environment	Li et al.(2022)	Panel Data Analysis
		Komendantova et al.(2021)	SWOT Analysis
		Nelson and Puccio(2021)	NONE
		Albert(2021)	NONE
		Adekoya et al.(2022)	Panel Data Analysis
		Susskind et al.(2022)	NONE
		Zheng et al.(2021)	Panel Data Analysis
		Marra and Colantonio(2022)	Panel VAR Model
	Carbon (Emissions/Footprint)	Yan et al.(2022)	Empirical Analysis
		Abrell and Kosch (2021)	Empirical Analysis
		Cai et al.(2021)	Least Squares Method VAR Analysis
		Li et al.(2022)	NONE
		Jack et al.(2021)	Empirical Analysis
		Saqib(2022)	Panel Data Analysis
	Subsidy/Tariff	Mekawa et al.(2021)	Empirical Analysis
		Bai et al.(2021)	Partially Linear Functional Coefficient Model
RENEWABLE ENERGY AND COVID-19		Dong et al.(2021)	ARDL Limit Test
		Li and Meng(2022)	Time-Frequency Domain Spread Index Wavelet Model Dynamic Conditional Correlation Model

When the research are analyzed, it becomes clear that the 50 most recent publications all took place between 2021 and 2022. The studies are divided into three categories: "renewable energy and economy," "renewable energy and policy," and the third is "renewable energy and Covid-19," which examines how the 2019 global health crisis affects this field of research. When the research' focus is analyzed, it becomes clear that per capita income, economic development, commercial mobility, resource availability, and technical innovation are the main areas of interest. Since switching to renewable energy directly correlates with an increase in the level of economic development, these issues have been chosen as the main focus. A focus on political development has been established in addition to economic development. This can be explained by the incapability to assess politics and the economics independently. From this vantage point, it is apparent that the economic and political research required to enhance the usage of renewable energy has increased in recent years.

Table 2. *Analysis of the 100 Most Cited Studies in Renewable Energy*

100 MOST CITED WORKS			
CATEGORY	**TREND**	**ARTICLES**	**METHOD/MODEL**
RENEWABLE ENERGY AND ECONOMY	**Renewable Energy, GDP and Economic Growth, Employment**	Apergis and Payne(2014)	Panel Unit Root Nonlinear Panel Co-integration
		Tugcu et al.(2012)	Hatemi J-Causality Autoregressive Distributed Latency Approach
		Ohler and Fetters(2014)	Granger Causality
		Tahvonen and Salo(2001)	Empirical Analysis
		Salim and Rafiq(2012)	ARDL Limit Test Panel Co-integration Tests FMOLS DOLS Granger Causality Test
		Koçak and Şarkgüneşi(2017)	Heterogeneous Panel Causality Test
		Apergis and Payne(2010)	Panel Unit Root Test Co-integration Tests Granger-Causality Test
		Chien and Hu(2007)	Data Envelopment Analysis
		Sadorsky(2009)	Panel Co-integration Tests
		Apergis and Payne(2010)	Panel Unit Root Test Co-integration Tests Granger-Causality Test
		Apergis and Payne(2012)	Granger Causality Test
		Ji and Zhang (2019)	Unit Root Test
		Salim and Hassan(2014)	Panel Unit Root Test Panel Co-integration Tests Granger Causality Test
		Bloch et al.(2015)	ARDL Limit Test Vector Error Correction Models
		Jebli and Youssef(2013)	Panel Co-integration Tests Panel Unit Root Test Granger Causality Test
		Inglesi-Lotz(2016)	Panel Data Analysis
		Menegaki(2011)	Panel Causality Test

		Lehr and Lutz(2011)	NONE
		Lehr et al.(2008)	NONE
	Investments and Foreign Investments	Masini and Menichetti(2012)	Empirical Analysis
		Doytch and Narayan(2016)	Blundell-Bond Dynamic Panel Estimator
		Conture and Gagnon(2010)	NONE
		Polzin et al.(2015)	PCSE, OLS, REE Regression Test
		Bürer and Wüstenhagen(2009)	Survey Method
	Renewable Energy and Technology	Moriarty and Honnery(2016)	NONE
		Kobos et al.(2006)	Empirical Analysis
		Popp et al.(2011)	Empirical Analysis
		Owen(2006)	NONE
		Neij(1997)	Empirical Analysis
		Pohl and Mulder(2013)	NONE
		Foxon et al.(2005)	NONE
	Renewable Energy, CO2, Oil Prices	Reboredo(2015)	Risk analysis
		Dong et al.(2018)	Panel Data Analysis
		Paramati et al.(2017)	Panel Unit Root Test Panel Co-Integration Test FMOLS Causality Test
		Reboredo et al.(2017)	Granger Causality Test
		Sims et al.(2003)	Empirical Analysis
		Ferrer et al.(2018)	Empirical Analysis
		Mensah and Wolde-Rufael (2010)	Granger Causality Test
		Deichmann et al.(2010)	NONE
		Renn and Marshall(2016)	NONE
		Shafiei and Salim(2014)	Panel Unit Root Test Panel Cointegration Test Johansen Fisher Co-integration Tests Westerlund Cointegration Test
		Kelly-Yong et al.(2007)	Empirical Analysis
		Dong et al.(2019)	Dumitrescu–Hurlin Panel Cointegration Tests CADF and CIPS Panel Unit Root Test Westerlund Panel Co-Integration Test
		Apergis et al.(2010)	Panel Unit Root Test Panel Co-integration Tests Panel Causality Test

		Troster et al (2018)	Pivot and Andrews Test (ZA) Augmented Dickey Fuller (ADF) Granger Causality Test Elliot's Test ADF GLS Test Ng-Perron Kwiatkowski-Phillips Schmidt-Shin (KPSS) Test
		Sadorsky(2009)	Panel Cointegration Test
RENEWABLE ENERGY AND POLICY	**Political Editing/Review**	Scarpa and Willis(2010)	Mixed Logit Model
		Karekezi and Kithyoma(2002)	NONE
		Haas et al.(2004)	NONE
		Mitchell and Connor(2004)	NONE
		Dinica(2006)	NONE
		Bergmann et al.(2006)	Select Experiment Techniques
		Cherni and Kentish(2007)	NONE
		Lesser and Su(2008)	NONE
		Resch et al.(2008)	NONE
		Fouquet and Johansson(2008)	NONE
		Delmas et al.(2011)	NONE
		Stegen(2015)	NONE
		Walker et al. 2010)	NONE
		Carley(2009)	Regression Analysis
		Barradale(2010)	NONE
		Mourmouris and Potolis(2013)	NONE
		Musall and Kuik(2011)	Survey Method
		Papaefthymiou and Dragoon(2016)	NONE
		Chen et al.(2014)	SWOT Analysis
		Frondel et al. (2009)	NONE
		Edenhofer et al. (t.y.)	NONE
		Roggers et al.(2008)	NONE
		Kitzing et al.(2012)	NONE
		Wüstenhagen and Menichetti(2012)	NONE
		Aguirre and Ibikunle(2014)	Augmented Dickey Fuller FEVD and PCSE Estimation Methods
		Richter(2011)	NONE
		Jacobsson, et al.(2009)	NONE
		Longo, et al.(2006)	NONE
		Lewis and Wiser(2005)	NONE
		Bauwens(t.y.)	NONE
		Jacobsson and Johnson(2000)	NONE
		Sugiawan and Managi(2016)	ARDL Limit Test

		Wang, et al.(2010)	NONE
	Environment and Environmental Policies	Nesta, et al.(2014)	Pre-Sample Mean (GMM) Analysis
		Arent, et al.(2011)	NONE
		Alvarez-Herranz et al.(2017)	Empirical Analysis
		Johnstone et al.(2008)	Panel Data Analysis
		Akadiri et al.(2019)	ARDL Limit Test
		Bergmann et al.(2008)	Empirical Analysis
		Vries et al.(2007)	Empirical Analysis
		Horst (2007)	NONE
	Transport	Lung and Kempton(2008)	EnergyPLAN Computer Model
		Andersen et al.(2009)	NONE
	Barriers, Tariffs and Drivers, Subsidies	Pegels(2010)	NONE
		Verbruggen et al.(2010)	NONE
		Zoellner et al.(2008)	Survey Method Regression Analysis
		Mondal et al.(2010)	NONE
		Marques et al.(2010)	Panel Data Analysis
		Klessman et al.(2011)	NONE
		Stokes(2013)	Case study
		Yu, et al.(2016)	Panel Data Analysis
		Ouyang and Lin(2014)	Empirical Analysis

Table 2 evaluates the categories, trends and methods categories, trends and methods of the top 100 papers on renewable energy.

Examining the top 100 referenced studies reveals that all of them were published between 1997 and 2019. Examining the 100 research in the table reveals that there are two main areas of attention. These are politics and economics. For the development of renewable energy, as shown in Table 1, economic and political arrangements must be formed, and technology must be updated with cutting-edge trends. In this regard, the top 100 most cited articles cover economy and politics, which are crucial for the development of renewable energy.

According to the analysis, the word "policy" is used 114 times, and the phrase "renewable energy policy" is mentioned 56 times. Currently, among the 50 most recent categories of studies with a political analysis focus, there are the following: Shrivats et al. (2021), Song et al. (2021), Semmler et al. (2022), Thompson et al. (2022), Martens (2022), and Vesely (2022). Political review and editing are the goals of the works of Klöckner et al. (2022), Lagendijk et al. (2021), and He et al. (2022). Additionally, based on the analysis, it can be claimed that among the studies in the subject, the quantitative studies are the most common.

Political regulations based on the environment are among the most current research, in addition to those mentioned above. The investigations mentioned above include those by Li et al. (2022), Komendantova et al. (2021), Nelson et al. (2021), Albert (2021), Adekoya et al. (2022), Susskind et al. (2022), Zheng et al. (2021), and Marra et al (2022). Studies on environmental issues and environmental policy have increased as a result of the bad impacts of non-renewable energy on the environment and the good effects of renewable energy distribution on the ecosystem. The authors' present research aims to support renewable energy.

Further study reveals that 8 of the 100 most frequently referenced studies were produced within the framework of environmental policy, whereas 33 of were produced on the basis of political regulation. Additionally, about 50 percent of the 100 research have a political focus. Table 2 displays these studies produced for political analysis and regulation.

METHOD

Two different analysis methods were used in the study. First, the content analysis of the 50 most recently published studies and the 100 most cited studies of renewable energy resources in the discipline of economics were analyzed. Subsequently, a bibliometric analysis of a total of 1373 studies belonging to the economics discipline of renewable energy resources was carried out. In the content analysis part, the sub-economic categories of the 50 most recently published studies and the 100 most cited studies belonging to the economics discipline of renewable energy resources were identified. These studies were classified according to their trends after the subeconomic categories were identified. Finally, the authors and year information of the 50 most recently published studies and the 100 most cited studies are given and the method and model information applied in these studies are given.

Bibliometric analysis examines the bibliometric relationships between studies. The relationship between the authors of the studies, by which authors, by which countries, by which citizens, by which university staff, and the relationship between these authors, countries, universities, and other aspects is called a bibliometric relationship.

The method "bibliometric analysis" refers to the qualitative and quantitative study of data pertaining to studies in a certain field. Bibliometric analysis often includes performance analysis and scientific mapping of publications in an area (Lardo et al., 2022). The VOSviewer tool, developed by the faculty at Leiden University in the Netherlands, was used to conduct the bibliometric mapping analysis for our study.

The VOSviewer application transforms the similarity matrix into a map, making it easier to see and understand (Wu et al., 2022). The comprehensibility and permanence of the subject are increased by transforming the similarity matrices of the studies into maps. For this reason, 1373 papers in the subject of renewable energy were analyzed using bibliometric mapping in this section of the study.

FINDINGS

These 1373 articles were written in the field of "renewable energy," and through bibliometric mapping analysis, the most frequently used terms, repetitive words in the abstract, most active authors in the field, universities with joint publications, most cited journals with publications on renewable energy, and most cited authors in the bibliography were all examined. In this section of the study, the expressed data will be looked at under various subheadings.

Most Used Words in Abstract

The most commonly used words in article abstracts were determined by using the bibliometric mapping technique. These words are displayed in large font and colored in Figure 1 in accordance with how frequently they are used. While the most frequently used words were written in high font, the terms with infrequent usage frequency were expressed in smaller fonts.

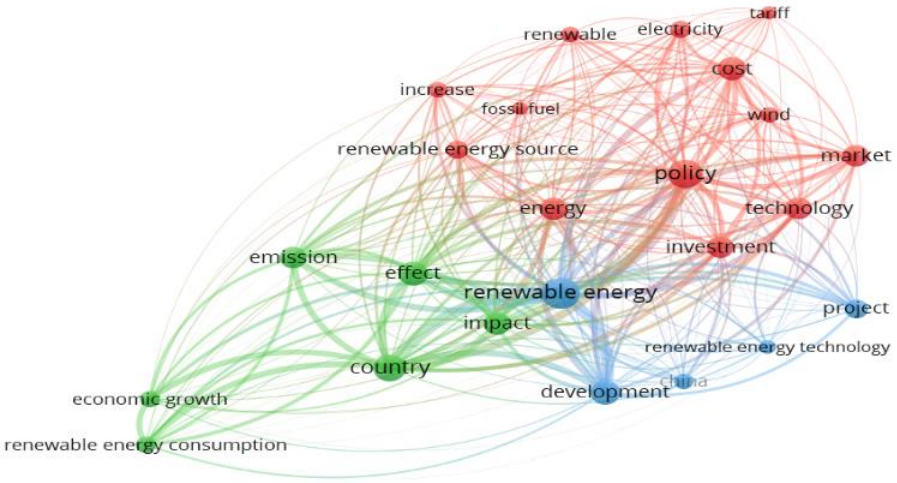


Figure 1. *The Most Frequently Used Words in the Summary Section*

The term "renewable energy", which was used 1162 times in the abstract, was determined as the most frequently used word when the words were analyzed as a result of "mapping analysis the term "renewable energy" appears in 69 of the 100 most cited studies when the most commonly used keywords are evaluated. After this word, it has been determined that the most frequently used word in the abstracts is "politics". In order to promote the use of renewable energy on a national and international level, policy-based research has a significant role in the literature. This significance explains why the word "policy" is used 923 times. When other words and frequency of use are examined; country (847), development(629), impact(609), cost(600), impact(529), energy(506), technology(488), investment(478), emissions(471) , market(462) , project(362), renewable energy consumption(257), economic growth(236), increase(228) et al. were repeated in the studies. The terms that will enhance the usage of renewable energy are currently the ones that are most commonly utilized. In addition to these phrases, one of the nations that is most commonly highlighted in the abstract of the studies is China, which offers a quick orientation in the transition to renewable energy.

Keyword Analysis

Another component that needs to be looked at in the analysis is the frequency of usage of keywords, which have the property of providing the most basic explanation of the studies. Figure 2 depicts these keywords, which are used in varying amounts depending on how well they are described on the map.

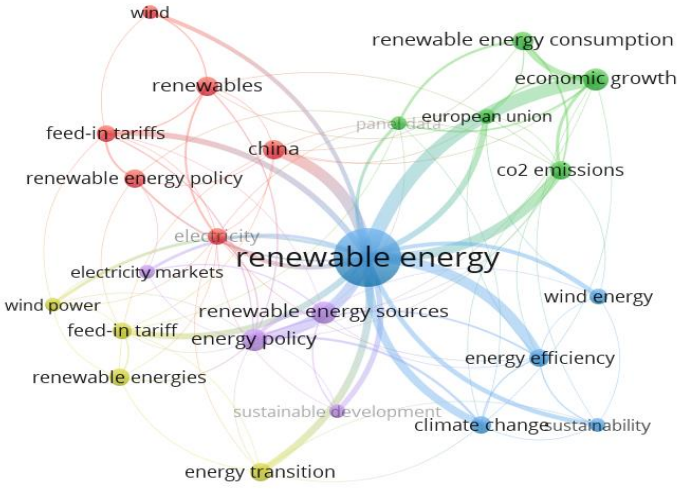


Figure 2. *Most Frequently Used Keywords*

When the keywords for the research are evaluated, the term "renewable energy" is the most

commonly used concept, with 541 usages, as can be seen in the analysis of the summary words. The idea that is used the most after those that are connected tries to assess the economic impact of renewable energy. The word economic growth was repeated 47 times in keyword references. Two co-authored studies and three co-authered studies in 2014 were published in the field of economic growth by Apergis and Payne (2010), the first two authors to conduct the most research in the field.

In addition to "economic growth", the term "renewable energy sources" is also widely used. The term clearly indicates the global trend towards renewable energy sources and technology. Ohler and Fetters' (2014) study examines at economic expansion to calculate the effect of renewable energy on GDP based on OECD nations. Tahvonen & Salo's case study is another example (2001). This study's objective is to assess how the switch from conventional to renewable energy affects economic expansion. The analysis revealed that this increase has a favorable impact on CO2 emissions as well as income. Evaluation of the impact of economic growth in Eurasia can be summed up as the study's objective, according to Apergis & Payne's (2010) publication. In addition to related studies; Apergis & Payne (2014), Tugcu, Ozturk & Aslan (2012), Salim & Rafiq (2012), Koçak & Şarkgüneşi (2017), Chien & Hu (2007), Sadorsky (2009), Apergis & Payne (2010), Apergis & Payne (2012), Ji & Zhang (2019), Salim & Hassan (2014), Bloch, Rafiq & Salim (2015), Jebli & Youssef (2013), Inglesi-Lotz (2016), Menegaki (2011), Lehr & The studies of Lutz (2011), Lehr, Nitsch, Kratzat, Lutz & Edler (2008) also show the feature of being studies built on the basis of economic growth.

Following these words; energy policy(46), China(35), renewables(33), renewable energy consumption(32), CO_2 emission(29), energy transition(29), renewable energy policy(29), energy efficiency(26) et al. terms can be expressed among frequently used words.

Co-Authors/Most Article

Authors that have published multiple articles in the literature on renewable energy are also included in the information gleaned from bibliometric analysis. Figure 3 displays the amount of articles each author has written. Apergis Nicholas (13) and Payne James conducted the majority of the research, as seen in the Figure 8. Table 3 provides a detailed breakdown of the relevant authors and the number of articles.

Table 3. *Authors Who Have done the Most in Renewable Energy*

Authors	**Number of Articles**
Apergis Nicholas	13
Payne James	8
Gawel Erik	6
Lehmann Paul	6
Resch Gustav	6
Managi Shunsuke	6
Raqwitz Mario	5
Abrell Jan	5
Ji Qiang	5
Wiser Ryan	5
Bauwens Thomas	5
Lin Boqiang	5
Trainer Ted	5
Held Anne	4
Klessmann Corinna	4

The authors listed in the table 3 are shown schematized in Figure 3 below

Figure 3. *Authors Who Have done the Most in Renewable Energy*

While the table lists the authors' information and the number of articles, the chart also includes a color-coded indication of the publication year of the study. While dark blue represents the authors who published in 2010, the closer to yellow the date of the studies gets updated. When the studies are examined on the basis of color, it is seen that the studies expressed in dark blue are less in number than the studies expressed in green and yellow, and the studies conducted at this point are more recent.

Co-Organizations/Most Citation

Universities doing research in this field are as important as the authors who publish the most. The names of the universities, the number of articles, the total number of citations, the average number of citations and the number of countries in which the relevant universities publish are listed in Table 4. Universities that contribute to the field will be identified using this methodology.

Table 4. *Universities with Publication Partnerships*

University	Number of Articles	Total Citation	Average Citation	Number of Universities with Joint Publications
University of California, Berkeley	19	752	39,5	5
Swiss Federal Institute of Technology	13	391	30	5
Massachusetts Institute of Technology	13	682	52,4	4
University of Sussex	12	535	44,5	7
Vrije Universiteit Amsterdam	12	627	52,2	2
University of Piraeus	12	2221	185	0
University of Utrecht	11	367	33,3	7
Danmarks Tekniske Universitet	10	352	35,2	8
University of Cape Town	10	217	21,7	1
The University of Manchester	10	586	58,6	0
Vienna University of Technology	9	423	47	8
Southwestern University of Finance and Economics	9	322	35,7	6
Chinese Academy of Sciences	9	328	36,4	5
National University of Singapore	9	467	51,8	2
Australian National University	9	221	24,5	1

Table 4 shows the number of publications of universities on renewable energy studies in the field

of economy. The most research in the area has been done at the University of California, Berkeley. The Swiss Federal Institute of Technology, the Massachusetts Institute of Technology, and the University of Sussex are listed after the University of California-Berkeley. The universities that received more than 1000 citations from the journals scanned in the Web of Science were the University of Piraeus and Curtin University, respectively. The two universities mentioned have another common feature. Both universities have published articles with their staff, and they have not received any help from the staff of any other university.

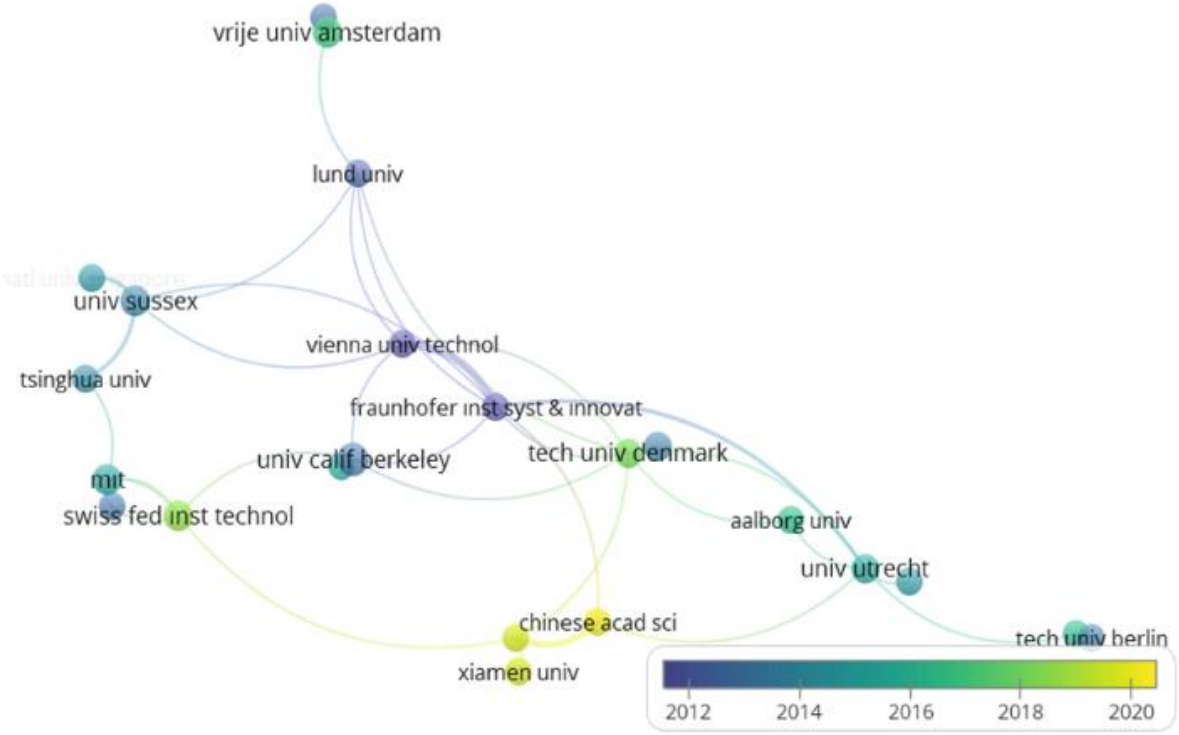


Figure 4. *Publishing Partnership Chart*

Figure 4 shows the publication maps of the universities in question with each other. Universities that do not have joint publications with other universities, such as the University of Piraeus and Curtin University, are not shown on the map. When the current status of the published articles is evaluated, it is possible to say that the Chinese Academy of Science publishes the most up-to-date articles.

Co-Country

All the publications published in the field of renewable energy were made by 92 countries. There are 21 nations with more than 25 publications when the total number of articles is taken into account. The number of articles published by countries in the "renewable energy" issue, the number of citations/average of the publications, and the common country score/average are shown in detail, even though country information is displayed using the mapping approach.

Table 5. *Partner Country Analysis*

Country	Number of Publications	Number of Citations	Average Citation	Partner Country Score	Partner Country Average
USA	243	12793	52,6	128	0,52
Germany	182	7308	40,1	128	0,70
England	130	7307	56,2	102	0,78
Chiana	128	3510	27,4	77	0,60
Netherlands	75	2577	34,3	67	0,89
France	74	3889	52,5	67	0,90
Australia	71	3533	49,7	33	0,46
Spain	67	2868	42,8	36	0,53
Italy	60	1659	27,6	68	1,13
Turkiye	49	1490	30,4	11	0,22
Switzerland	47	2455	52,2	41	0,87
Canada	45	2420	53,7	35	0,77
Japan	41	948	23,1	19	0,46
Sweden	39	1991	51	46	1,17
India	36	916	25,4	25	0,69

The United States has the most publications, as shown in Table 5. The table shows that the USA has published 243 articles, and these articles have received a total of 12,973 citations in the relevant publications. The country average predicted in the analysis was also evaluated and found to be 0.52. If the countries with the most publications are listed; Following the United States is Germany with 182 publications, England with 130 publications and China with 128 publications. The United States and Germany are in the first place with 128 points. If the evaluation is performed on an average basis; It can be said that Belgium is in the first place with a national average of 1.48.

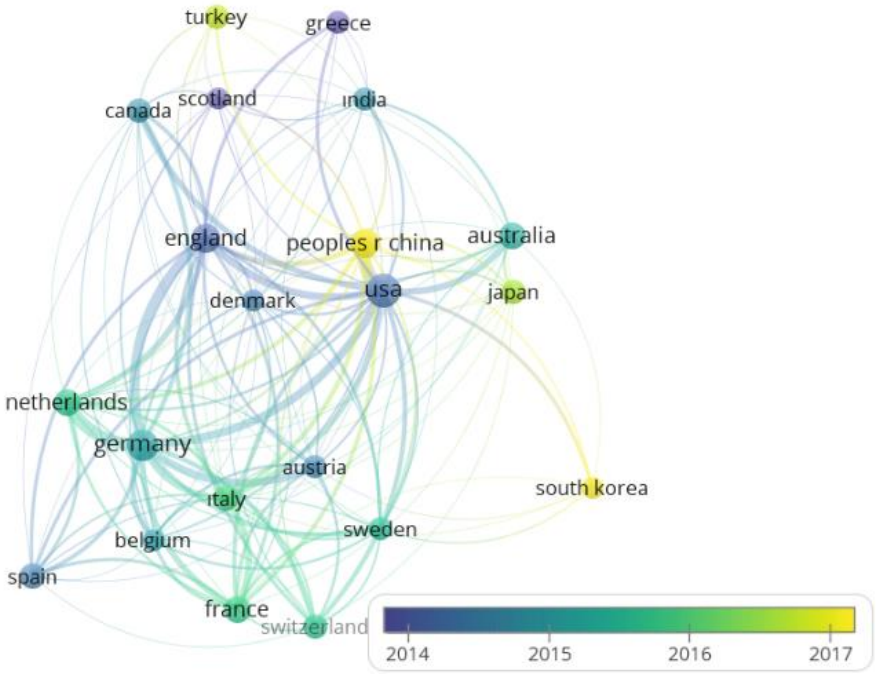


Figure 5. *Partner Country Chart*

As a matter of fact, Figure 5 shows, the publication dates of the publications related to the colors transitioning from dark blue to yellow can seen. While the works progressing in blue in the figure are based

in 2014, yellows show the works of 2017. As a matter of fact, when the relevant publication timeliness of the USA, which is the country that publishes the most, is examined, it is seen that the density was in 2014. At this point, it would be appropriate to say that both the publications and the current citations of the USA are older. Additionally, German publications are highlighted with a greenish tone in figure 6 and are more recent. The most recent 2017 publications are shown in a yellow tone: China (128), South Korea (30), Turkey (49) and Japan (41). The citation numbers of these countries are, respectively; It are seen as 3510, 840, 1490, and 948. At this point, it can be said that although the publication date are new, the number of publications and citations show success.

Most Cited Journals and Papers

The citation map determined by bibliometric analysis is shown in Table 6. In the studies conducted in the field, it is seen that 22 articles received 300 or more citations. The relationship map of the articles with each other is as follows.

Table 6. *Number of Citations and Publications*

Publication	Citation
Johnstone, Popp and Haščič (2010)	739
Apergis and Payne (2010)	655
Lund & Kempton (2008)	603
Jacobsson and Johnson (2000)	513
Menyah and Wolde-Rufael (2010)	500
Van Der horst (2007)	478
Sadorsky (2009)	475
Shafiei and Salim (2014)	465
Apergis and Payne (2010)	463
Menanteau (2003)	456
Couture and Gagnon (2010)	432
Apergis and Payne 2012	420
Sadorsky (2009)	389
Menegaki (2011)	370
Sims, Rogner and Gregory (2003)	361

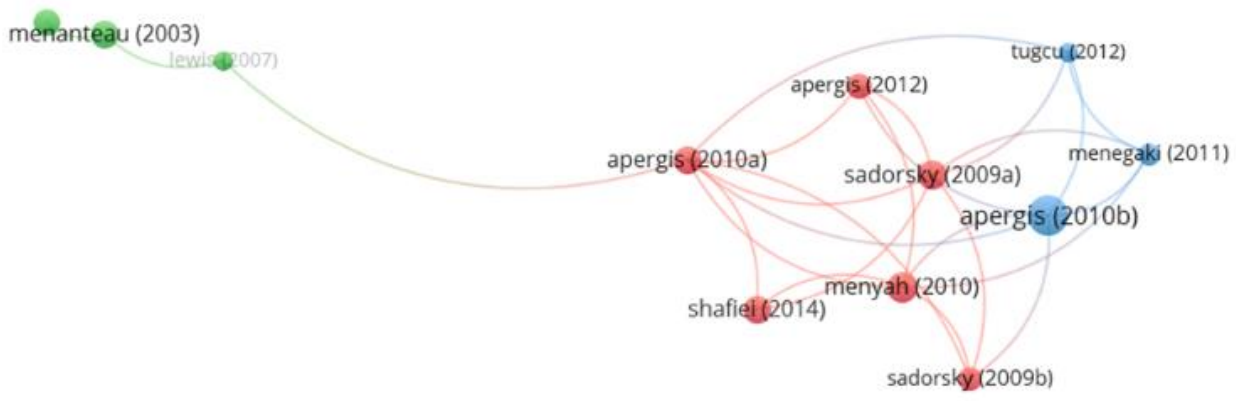


Figure 6. *Authors Publishing Related to Each Other*

The work of Apergis (2010a, 2010b, 2012) expressed in the figure is built based on economic growth, and the author has produced a joint publication with other authors in the figure. Additionally,

Menegaki (2011), renewable energy and economic growth in Eurasia, Tugcu (2012) economic growth in G-7 countries, Sadorsky (2009a, 2009b) renewable energy consumption in both G-7 countries and developing countries, Menyah (2010)) based on economic growth in the USA and Shafiei (2014) examined the effect of consumption and CO2 in OECD countries between 1980 and 2011, and related authors, and their works correlated with each other.

While expressing the related studies, another essential element that needs to be said is seen in the journal. The journals that the authors publishing in the field have chosen to focus on are given in Table 7. Accordingly, the journals with the highest citation points are shown below

Table 7. *Most Cited Journals*

Journal	**Citation**	**Publication**
Energy Policy	35800	690
Energy Economics	8253	142
Ecological Economics	1268	17
Environmental and Resource Economics	947	8
Energy Journal	648	34
Economics Modelling	395	5
Journal of Environmental Economics	363	6
Resources and Energy Economics	346	13
Futures	337	8
Applied Economics	301	16
World Development	241	9
Technological And Economic Development	234	8
Economics Bulletin	211	10
European Economic Review	183	2
Structural Change and Economic Dyn	180	9
Journal of Business Economics and	100	3

The table shows the most published journals in the field of renewable energy and the most cited journals. The first of the journals in the area is “Energy Policy”, with 690 publications and 35,800 citations. At this point, the clear difference between the journal with the second-highest number of citations and publications shows that the journal is the journal that conducts the most active workers in the field. Following the related journal, the “Energy Economics Journal” comes with 8253 citations and 142 publications. Although it has only 17 publications, the “Ecological Economics” journal, which has 1268 citations, is also essential for its contribution to the field. The journals in the table are also expressed visually in Figure 7, and the journals that are made prominent are represented in large font.

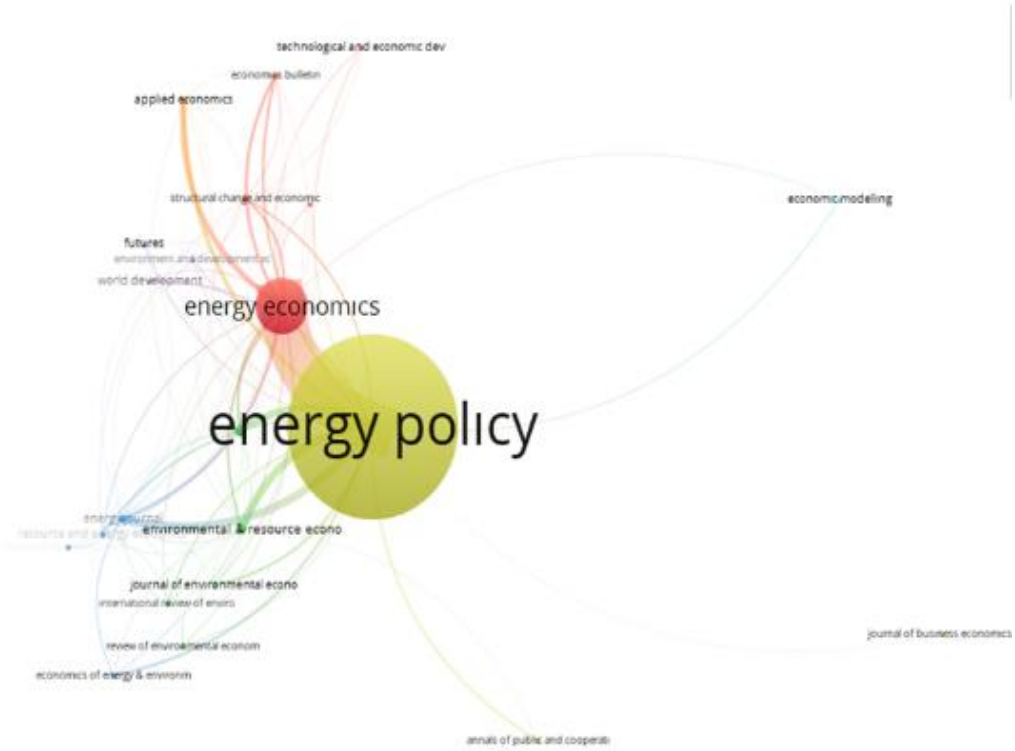


Figure 7. *Journals with the Highest Citations*

In addition to the relevant information, examining the bibliography, which is the basis for creating publications, is essential for the referenced authors and works. At this point, the most frequently used references in the bibliography of 1373 studies brought to publication life in the field of renewable energy are expressed in table 8. Table 8 indicates the ten authors most frequently included in the bibliography, the publication year of the work, and the published journal.

Table 8. *Most Referenced Journals and Their Scores*

	Publication	Date	Journal	Score
1	Sadorsky	2009	Energy Policy	73
2	Apergis	2010	Energy Policy	62
3	Sadorsky	2009	Energy Economics	60
4	Johnstone	2010	Environmental And Resource Economics	59
5	Menanteau	2003	Energy Policy	57
6	Im	2003	Journal of Econometrics	55
7	Levin	2002	Journal of Econometrics	52
8	Menegaki	2011	Energy Economics	52
9	Sensfuss	2008	Energy Policy	46
10	Mitchell	2006	Energy Policy	46

The table above shows the reference scores of the ten most cited journals and related journals. The most cited authors in the relevant journal and the most cited studies are also indicated. In Figure 8, the most mentioned works in the bibliography of academic studies in the field are shown within the mapping analysis. Authors expressed in red are the most frequently cited, while those expressed in green appear less frequently than in red.

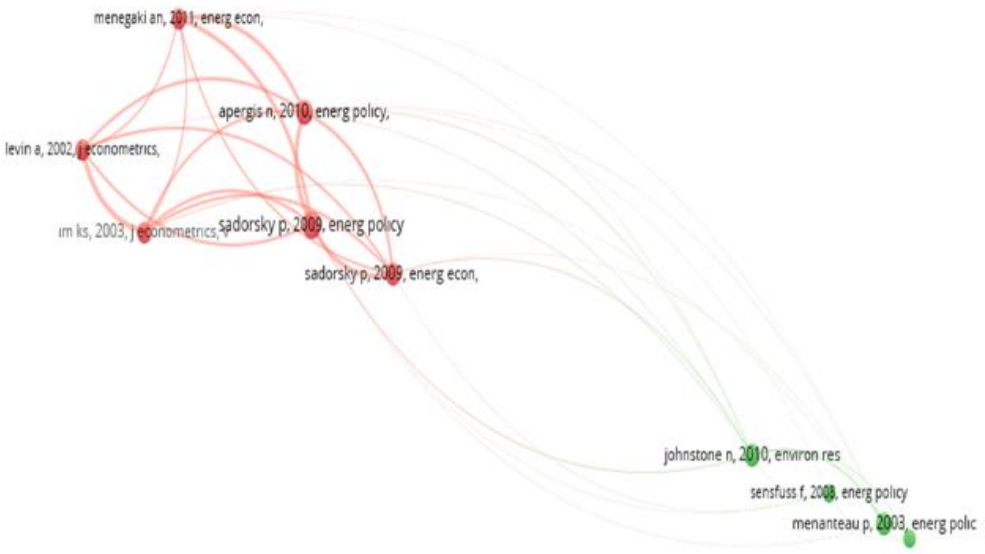


Figure 8. *Most Cited Studies in References List*

The real persons (based on human being and institution reports excluded) in the bibliography of these 1373 studies carried out in the field of renewable energy are included in Table 9.

Table 9. *Most Cited Authors in the Bibliography of Studies*

Authors	**Score**
Apergis, N.	398
Sadorsky, P.	211
Peseran, M. H.	182
Shahbaz, M.	128
Pedroni, P.	116
Del Rio, P.	115
Popp, D.	104
Fischer, C.	101
Walker, G.	101
Marques, A. C.	100

Citation scores are expressed in the table; Apergis (398), Sadorsky (211), Peseran (182), Shahbaz (128), Pedroni (116), Del Rio (115), Popp (104), Fischer (101), Walker (101), Marques (100) has the score.

CONCLUSION

There are many studies in the literature on renewable energy sources. In addition to research studies on renewable energy sources, compilation studies are also frequently encountered. This study differs from the other studies in the literature in that it includes only the studies indexed by the web of science and belonging to the economics discipline of renewable energy resources. Another difference between the study and the studies in the literature is that it includes the content analysis of the 50 most recent studies indexed by the Web of Science and the content analysis of the 100 most cited studies.

Bibliometric studies on renewable energy sources are also found in the literatüre. However, the difference between the bibliometric analysis in this study and the bibliometric analysis in other studies is that the bibliometric analysis of renewable energy resources includes only the bibliometric analysis of studies belonging to the discipline of economics.

The related study was created to analyze the articles written in the field of renewable energy and

published in the academic literature, using the "mapping analysis" method. The study was created due to a bibliometric analysis of 1373 articles written in the field of renewable energy, including in the literature, and scanned into the Web of Science. In the study, the most recent 50 studies on a lot of renewable energy and the 100 most cited studies were examined and expressed in the table by performing content analysis. Additionally, through analysis; the most frequently used words in renewable energy studies, the most repetitive words in the abstracts of the studies, the most used Keywords, the authors with the most publications on the relevant subject, the universities with publication partnerships, the countries with the study publication partnership, the journals with the highest number of citations. The most frequently cited studies in the bibliography were analyzed.

In working results, intensity is observed in economic growth and policy-based studies. The most frequently used word in studies in the field is the word of "renewable energy," which has been used 464 times. Again, the most used word in the summary section is "renewable energy," with 1162 uses. The most published was Nicholas Apergis, who carried out 13 studies. Three of the related studies are also among the 100 most cited studies. The University of California ranked first among the universities with publishing partnerships. The relevant university has published 19 articles and received 752 citations. When evaluating the partner country analysis, the United States of America is in the first place. The number of publications in the USA was 243, the number of citations was 12,793, the average number of citations was 52.6, and the partner country score was 128. When the most-cited journal is examined, with 690 and 35,800 publications, Energy Policy journal has the highest number of citations. The final analysis was conducted to determine the bibliography's most frequently cited work and author. From this viewpoint, the most cited work in the bibliography is Sadorsky (2008), published in the Energy Policy journal. The most cited author in the bibliography should be Apergis, with 398 citations.

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