

Review

# Renewable Energy, Economic Growth and Economic Development Nexus: A Bibliometric Analysis

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**Abstract:** The present research aims to conduct a systemic review on Renewable Energy, Economic Growth and Economic Development and look for links between the papers published between 2008 and May 2021. Using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology, it was possible to reach a sample of 111 articles selected by Web of Science and a sample of 199 academic articles selected by Scopus in that specific period. The analysis of the group of Renewable and Non-renewable Energy Consumption, Economic Growth and Economic Development shows that most of the articles published in this subsample use the quantitative methodology in economic sciences. The results indicate that research on the subject has a growing trend and that most of the articles are post-2015 publications. In addition, China has been the leading nation in published works. The journal *Renewable and Sustainable Energy Reviews* is considered the most relevant in this category, and Sustainability has the most publications. Finally, a research gap was identified to be explored, lacking studies aimed at understanding the consumption of renewable energies and economic development and studies that focus on renewable energies and economic growth in less developed economies.



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**Keywords:** bibliometric analysis; development economics; economic growth; energy; renewable energy

## 1. Introduction

The investigation of what drives economic growth and development is thematic and will never cease to be relevant in academia. The nexus between economic growth and energy consumption has been a significantly explored subject in academia over the years; for example, in recent years, this nexus was investigated by several researchers [1–9]. These and other studies pointed to a relevant relationship between energy consumption and economic growth, and the results obtained are of paramount importance in the development of policies and strategies according to the behavior of economic growth in the face of energy consumption.

After observing an increase in carbon dioxide emissions, research began to find evidence that related this increase with an increase in economic activity; therefore, we began to investigate the gap in which energy consumption was inserted, as in, [10–12]. Ref. [13] conducted a bibliometric review on this topic and concluded that there is a relationship of bidirectional causality between economic growth and CO<sub>2</sub> emissions; thus, stimulating a reduction in emissions will reduce economic growth [13].

The existence of difficulty in reconciling economic activity and energy consumption with the conservation of the environment is clear, as is the need to encourage sustainable economic growth. Having said this, the present paper proposes to build a bibliometric review that takes into account studies investigating the relationship between renewable energy, economic growth and economic development nexus in order to understand which direction this field of study is taking.

The present research accessed the WoS and Scopus database to search keywords, titles and abstracts related to the terms renewable energy, economic growth and economic

development between the years 2008 and May 2021. The selection of articles used in the research was made through the PRISMA methodology. This research was also proposed to quantify the impact of the papers and journals published on the subject in that period, using some descriptive information to identify which journal(s) and which author(s) is the most relevant within the sample collected. Finally, an analysis was made, with the help of VOSviewer software, to find clusters and links between the terms used and the researchers.

The remainder of this study is structured as follows. Section 2 presents a brief literature review. Section 3 discusses the research methodology of the paper; Section 4 presents results, findings and discussion of this paper based on the study aims. Section 5 provides some concluding remarks, limitations of this study and suggestions for future papers.

## 2. Literature Review

In this section, a brief literature review on bibliometric reviews and systemic reviews is made. The authors of [14,15] set out to study the footprints of degradation. While one focused on environmental degradation itself [14], the other focused on the carbon footprint [15]. Studies differ methodologically; ref. [14] published a bibliometric analysis, while [15] published a systematic review. Ref. [14] researched the keywords “water footprint”, “carbon footprint”, “land footprint”, “biodiversity footprint”, “chemical footprint”, “nitrogen footprint”, “phosphorus footprint”, “PM2.5 foot-print”, “PM10 footprint” and “ozone footprint” in the Web of Science (WoS) database for the period 1986–2019 after screening processes reached a sample of 4352 articles. The results indicate that the U.S. and China are the countries that have conducted the most research on the subject in the period aforementioned and are those with the highest cooperation among themselves. In addition, it was emphasized that “water footprint” and “carbon footprint” are the most studied terms in relation to the others used in the research. Finally, the authors concluded that the most recent research focuses on the carbon footprint related to supply production chains, greenhouse gas emissions, water consumption in agriculture and environmental issues related to construction [14]. In the study proposed by [15], we used the same database, except for the 1992–2019 interval, and only searched the keyword “carbon footprint”, obtaining a sample of 7450 articles. The results indicate that research on the subject began to grow in 2008, and four topics were “international trade”, “life cycle assessment”, “ecological footprint”, and “supply chain”. There was also a significant interaction between the US and European Union (EU) research; however, in recent years, research from China has been increasing and standing out. The Journal of Cleaner Production is the most prominent. Finally, research in Economic and Political Economics seems to be the most recent ascending [15] theme. Ref. [16] developed a systematic review on carbon leakage with the following questions: What are the generation channels and the factors of the leakage? What methodologies are used to evaluate the leak? Which topics need more attention to formulate more effective climate policies? [16]. The research used the keywords “carbon leakage” and “emission transfer” in the WoS database for the period 2000–2020, with screening techniques reaching 407 articles for research. The researchers concluded that many studies have focused on the loss of competitiveness in the intense emission sectors, caused mainly by international trade, and there is not enough debate about the negative leak channel. In addition, the authors point out the absence of quantitative methodologies for carbon leaks [16].

With the intention of providing an overview of the work performed on the Environmental Kuznets’ Curve (EKC), ref. [17] proposed a bibliometric analysis. Using the WoS database, he analyzed the publications made in the period of 1999–2010, with the PRISMA approach, and reached a sample of 1775 articles to study. The results of the study indicate that research has grown exponentially in recent years and that China, the U.S., Turkey and Pakistan are the countries with the highest academic publication on the subject. In addition, the authors surveyed the journals that published the most in that period, which are Environmental Science and Pollution Research, Journal of Cleaner Production, Ecological Economics and Energy Policy. The author with the most publications is Muhammad Shahbaz [17]. Furthermore, on the topic of EKC, [18] used the WoS database to conduct a

study of publications on the subject in the last two decades (1999–2019). From a universe of 59,225 documents, 2384 were investigated in this research. The results found by the authors, based on co-citation, indicate that the most relevant journal on this topic is Ecological Economics; in addition, of the ten most relevant journals, Elsevier publishes seven. The countries with the highest number of citations are China, the USA and Turkey. The same order was obtained by [17]. The most influential researcher is Muhammad Shahbaz, with the same result obtained by [17]. It is no coincidence that the most relevant institution is the Beijing Institute of Technology, where Muhammad Shahbaz is a professor [18]. Moreover, [19] proposed a systemic and bibliographic review on industry 4.0. The study used two databases for the survey of Scopus as well as WoS articles published until 2020. The terms used for research were “Industry 4.0”, “Industrie 4.0” and “Fourth Industrial Revolution”, following PRISMA protocols, and a sample of 745 articles were obtained. The authors concluded that industry 4.0 is motivated by profit; the value of digital transformation is materialized as corporate profit. In addition, the authors highlighted factors that can determine success or failure, which depend on favorable conditions such as government incentives and an abundance of resources for the digital transition in Industry 4.0 to be achieved [19].

With the objective of detailing the stage and the current research trends on Thermal Energies Storage (TES), [20] elaborated a bibliometric analysis on the subject. The Scopus database was used for the research that used all available coverage until 21 September 2020. The authors divided the results of the research into three categories, including buildings, districts, and roads and bridges [20]. As far as buildings are concerned, the results indicated that it is and the most studied category. The USA was the country to publish the first relevant studies on the subject, and the most researched line is the demand for cooling by optimized control techniques. While in Europe, of latent heat thermal energy storage through passive techniques and demand management strategies, in China, there is a focus on material study, and economic analysis seems to be the trend of the most recent studies for buildings. Studies on TES applied to districts began to increase in 2013 and are led by Europe. TES at the district level was investigated at the system level, mainly applications of solar systems and cogeneration systems. The most recent studies have investigated economics and techno-economic. Finally, studies applied to roads and bridges do not attract many researchers. Norway, Japan and China are the countries with the most Publications [20]. Ref. [21] conducted a bibliometric study between 2000 and 2019 on TES in order to understand the trend and future of this field of research. The authors’ analysis concludes that latent-heat TES has been the focus in recent years, but thermochemical TES and its hybrid TES technologies appear to be the next focus of researchers [21].

A bibliometric and systematic review was proposed by [22] to understand the standards of key performance indicators (KPI) and multicriteria decision-making models (MCDM/A) in the context of renewable energy technologies (RET). The following questions were raised: “Is there a pattern in the use of performance criteria to select and assess RET performance?”; “Is there a pattern in the use of multicriteria models for decision making to select and assess RET performance?”. To find these answers, 142 articles from the WoS database were selected between 1998 and 2019. The authors concluded that there is a growing trend in this research, mainly from 2015. According to the authors, the results of this study demonstrated a preference in the use of synthesis models rather than overlap, the importance of considering political and technical indicators beyond those related to the Triple Bottom Line in decision-making and the importance of MCDM/A in achieving the sustainable development goals of the United Nations agenda [22].

A mapping of a 21st-century problem, poverty energy, was proposed by [23]. Thus, a bibliometric analysis was made using the Web of Science database, and for the 1999–2019 temporal sample, they obtained 1018 articles in the sample. The results show that 2003 was the founding year of energy poverty research. Nine hundred eighty-two institutions developed research on the subject. In addition, the results indicate that the largest cooperation occurred between the UK, USA, Australia and Italy. Among the periods, Energy Policy

publishes on the subject for the longest period, while Renewable and Sustainable Energy Reviews publishes the studies with greater influence; Sovacool is the researcher with the highest number of publications and the most influential. Finally, the authors highlighted four areas that should be research trend in the coming years: energy poverty in developing countries, impacts of energy poverty on vulnerable groups, root causes of energy poverty and consequences of emission reduction policies [23].

### 3. Materials and Methods

In this section, we explain the database, period and methodology applied in the selection of the investigated articles and the techniques applied for analysis. There are several databases for scientific document searches, for instance, the Web of Science (WoS) and Scopus. This investigation chose to use the database provided by WoS and Scopus for the period 2008 to 21 May 2021. The year 2008 is the first year of commitment to reducing carbon emissions of the Kyoto protocol subscriber countries; this first cycle being finalized in 2012, the chosen period covers the years of the first cycle and the subsequent period.

The first step of this investigation was the choice of the sample, using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology proposed by [24]. The PRISMA methodology is a guideline developed to deal with unsatisfactory systematic reviews, which focuses on making the research transparent; therefore, the researcher needs to be aware of the purpose of the review, what the procedure was, and finally, what the findings were [24].

According to [24], the PRISMA methodology was developed to be applied in systemic reviews that assess the effects of interventions in the health area. The PRISMA approach provides guidance that contributes to a methodological improvement to identify, evaluate and synthesize studies; this technique consists of applying a checklist with 27 items in order to have a more accurate screening. Although developed to be applied in the health area, the checklist is relevant and applicable for systematic reviews with mixed methodologies, which include quantitative and qualitative studies [24], a scenario faced by this research.

First, all the documents in the Web of Science (WoS) database related to the three terms of the research (Renewable Energy, Economic Growth and Economic Development) were researched for the period 2008 to 21 May 2021. Immediately, 3382 documents were identified. When applying the procedures, only open access documents were considered; this limited the search to 1.025, excluding 2357 documents. Then only the following areas of research, Environmental Science, Energy Fuels, Environmental Studies, Economics, Management and Business, thus eliminating 426 documents and having 599 documents. Then, the type of documents and language was limited, taking into account only scientific articles and in the English language, leaving 428 articles with the possibility of making the final sample. Finally, titles and abstracts were analyzed; in this stage, 317 articles were disregarded, thus leaving 111 to make up the Web of Science sample. Figure 1 summarizes the screening process.

Second, all the papers in the Scopus database relating to the words Renewable Energy, Economic Growth and Development Economic were identified. The search with these words was directed in keywords, title and abstract, resulting in 2836 identified documents. Following the identification was the screening stage where only open-source documents were chosen to be analyzed, resulting in 790, so there was a reduction of 2046 documents. The second stage of screening was to exclude the research areas that are not related to the focus of the investigation of this research, considering only the following fields of study: Environmental Science, Energy, Social Sciences, Economics, Econometrics and Finance, and Business, Management and Accounting. With this restriction, 377 documents were eliminated, leaving 413 with the possibility of entering the study. Then, we limited the types of documents. We took into account only articles, finding 300 articles. In addition, these were limited to the English language, which resulted in the exclusion of 9 articles, making 291 eligible. Finally, an analysis was made of the abstracts, titles and keywords of these 291 articles to determine which ones would be considered for the investigation of this

systematic review, based on the information found. Ninety-two articles were disregarded, so 199 articles were considered for analysis, as can be seen in Figure 2. The protocol applied to the Scopus database can be found in Appendix A of this research.

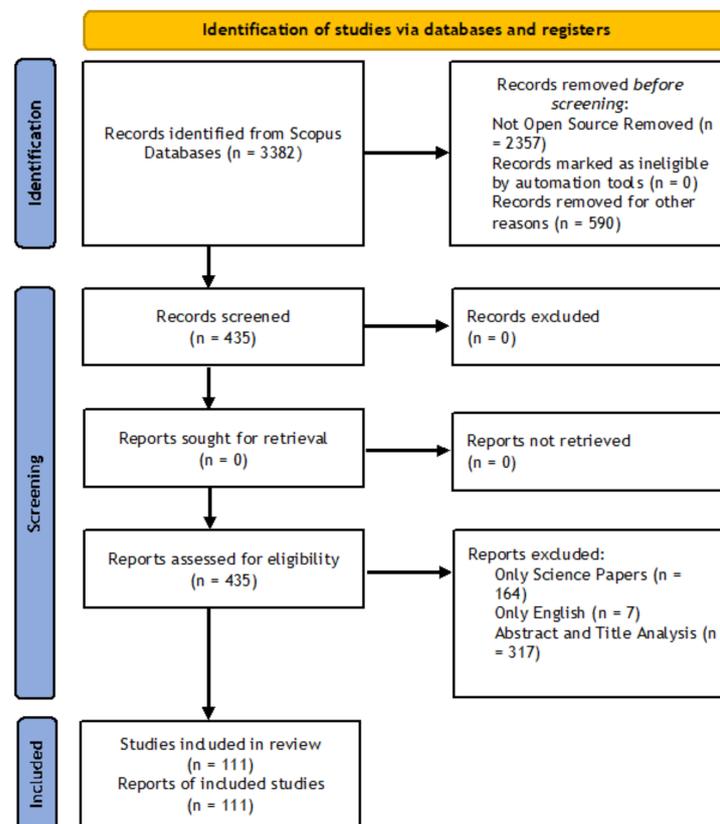
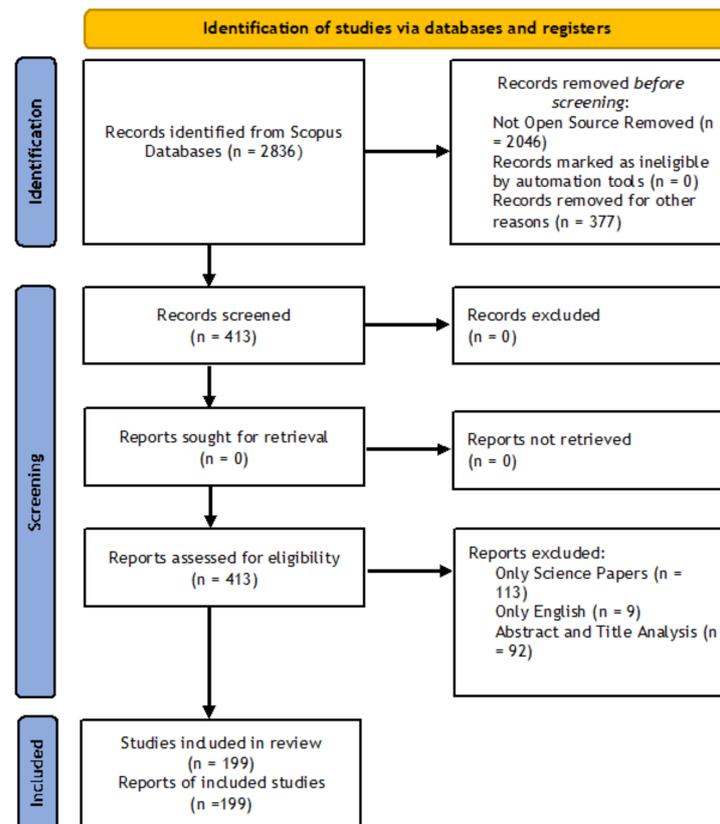


Figure 1. Identification of Studies Via Web of Science Database.

The eligibility of the articles used in this research was mirrored in the strategy applied by [13]. In the stage of determining the eligibility of the articles, the title, abstract and keywords of the individually selected articles were reviewed. In this final stage of screening, we identified the articles that could be part of the study sample. Having exposed this, the articles included in the research explore the link between economic growth, renewable energy consumption and economic development. It should be emphasized that at this stage, only scientific articles were taken into account, so documents such as thesis, dissertations, articles published in a non-English language, editorial notes, books, book chapters, among other types of documents, were disregarded. Finally, it was possible to obtain the 199 articles used in this research, which relate to the keywords in question, from a sample of 74 international journals between 2008 and 21 May 2021.

This research chose to work with the Scopus database due to its great coverage and multidisciplinary. In addition to being peer-reviewed, updated frequently and has resources that assist researchers in the development of work. According to [25], the biggest advantages of the Scopus database are the inclusion of open access articles, tools to find authors, a wide catalog of scientific and technological journals, automatic generation of h-index, more content published in Europe compared to WoS [25].

The screening criterion applied in the Web of Science (WoS) database, which final filter according to the Prisma technique, shows a sample of 111 documents; moreover, 50 articles that represent 45% of the searches found in the WoS database are also listed in the Scopus database.



**Figure 2.** Identification of Studies Via Scopus Database.

After defining the investigated studies, this research analyzes the information of the articles, considering some indicators: number of publications, h-index and citations, as was performed in [26]. However, it is important to emphasize that the literature does not yet have an accurate and conclusive methodology to evaluate articles, journals, and so on, let alone be able to determine their value. This field of research, which tries to measure the value of an article, the researcher or even the institution, is criticized. A criticism pointed out by [26] assumes that an article published in a journal of greater relevance should have a higher value than one published in a median journal, but this is a challenge since each article, regardless of where it is published, will be assigned the same value [26]. The databases, trying to work around these difficulties (for example, the Scopus database), have three metrics that are based on the citations received to assign quantitative values, whether to the author, article, journal or institution, they are: CiteScore (CS), SCImago Journal Ranking (SJR) and the Source Normalized Impact per Paper (SNIP), while, in the WoS database the metrics are available in the Journal Citation Reports (JCR) from Clarivate Analytics

The CiteScore from Scopus is not similar to the impact factor calculated by JCR of the Web of Science (WoS). The difference occurs only in the period used to make the calculation. The CS considers the number of citations in the last 3 years and divides these by the number of publications in the same period, while the ones calculated by WoS are based on the interval of the last 2 years. Nevertheless, according to [26], these metrics are not 100% reliable since it is possible to circumvent them using self-citations [26]. Another Scopus metric used to rank journals is the SJR, which measures the weighted citations received by the journal; the weighting of the citations takes into account the subject field and the prestige (SJR) of the journal it cites.

As a certificate that auto citations are a problem for these metrics, the same problem should be taken into account when the absolute number of citations is considered as a metric. However, in this case, when dealing with already conceptualized studies, this

problem tends to be less significant since it is expected that reputable articles are more cited. Intuitively, there is a number of citations that is much higher than the number of articles [26] since they are considered as references. Hereby, the number of citations can be taken into account with the purpose of measuring the influence of an institution, author or journal [26]. Nonetheless, there may be flaws, for example, a great article recently published and that has not yet become popular or even research conducted in a very specific scientific field.

Finally, there is the h-index, proposed by [27], which combines the number of publications and citations. Taking this research as a reference, which has an h-index of 34, this tells us that at least 34 articles published in the period investigated received 34 or more citations. Just as the other metrics, it also has criticisms. For instance, an extreme case pointed out by [26]: if a researcher publishes more than 100 articles and three received more than 1000 citations, while the rest are not cited, the index of this researcher will only be three [26]. Instinctively, it is possible to conclude that this hypothetical researcher has an academic relevance significantly higher than three. Despite the criticisms, this index is useful and relevant in academia; therefore, it is appropriate to the scope of this research in the criterion of evaluating the relevance of research, researcher, journal or institution.

In addition, with the help of VOSviewer software, textual analysis is made in order to identify the relationships between articles, keywords and researchers in the Renewable Energy, Economic Growth and Economic Development theme. The VOSviewer software allows for a relationship network construction between the articles published in the specified period.

#### 4. Discussion

In this section, we analyze and discuss the information from the sample, starting with a temporal reading of the evolution of the publications in the years investigated. The following Figure 3 informs us of the annual amount of articles published on the subject from 2008 to May 2021.

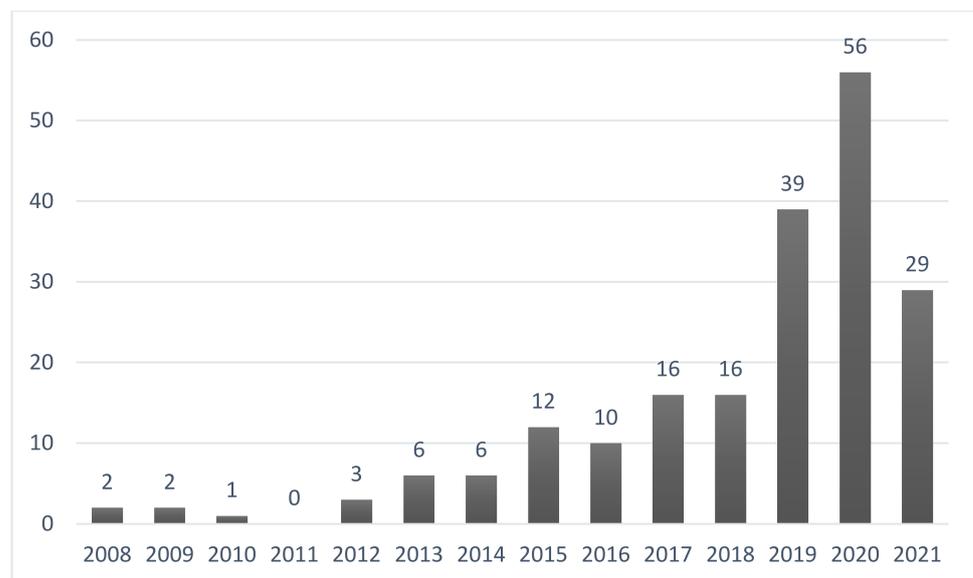


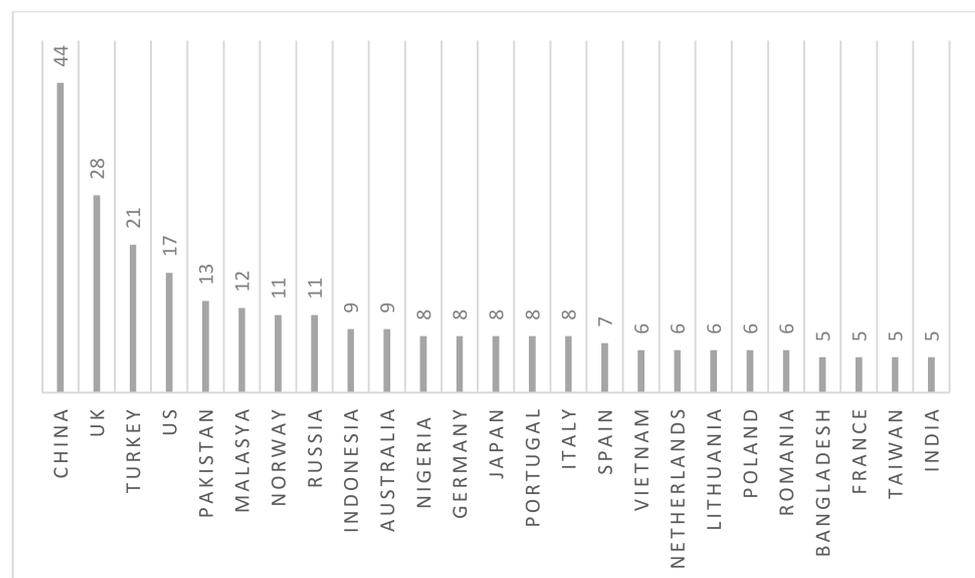
Figure 3. Number of Annual Publications (2008–May/2021).

The X-axis represents the years of research, while the Y-axis represents the number of articles published. A growth trend is easily noticeable, with the exception of 2010, 2011 and 2016. The number of articles published annually grew by the year. The considerable increase in publications in the last 5 years is remarkable; these years concentrate 78.39% of the papers published in that period. The decrease in the number of articles from 2020 to 2021 is most likely due to the sampling period of the research since it does not include

the year 2021 as a whole; therefore, we cannot consider it as an indictment of a drop in publications. It is possible that by the end of the year 2021, there will be a number of publications similar to 2020, providing the theme continues with the growth trend.

The growth of publications in the second half of the decade of the 2010s may be the result of the first cycle of commitments of the Kyoto Protocol (2008–2012), which should have fostered research to analyze the effects. Within the scope of this research, in the sample raised, many studies consider emissions and effects on economic activity. It is believed that the first cycle of responsibilities of the Kyoto protocol has a fundamental role in increasing research on renewable energy consumption, non-renewable and which way these matrices are less harmful to the environment affect economic activity.

In Figure 4, we chose to make a geographical analysis, that is, to identify how many and which countries have the most publications on the subject in that period. At first, when considering any number of publications, we obtained 63 countries with research published on this theme of the 194 existing countries. This reveals that only 32% of nations developed research on renewable energy, economic growth and economic development up to the moment of this research. However, it should be noted that this does not mean that only 30% of the countries in the world were investigated in relation to this theme, but that the research is concentrated on around 30% of the countries. In order to facilitate understanding, we did not consider all 63 countries; we chose to make a minimum count of publications, which is five. Thus, the following graph considers only those countries that had more than five publications during the period of the development of this study.



**Figure 4.** 25 Countries with more publications between 2008 and May 2021.

Only 25 countries have more than five articles published; China is noticeably an outlier. The number of Chinese publications is greater than the other countries; consequently, China is responsible for 22.11% of the publications in that period. Another attention-calling factor is that on all continents, there is at least one country with at least five publications on the subject, except Latin America.

Being a multidisciplinary research area, many journals publish about this theme. Seventy-four periodicals were published in that period. In Table 1, the periodicals are ranked according to the metrics stipulated by the WoS and Scopus databases.

Table 2 above shows us the number of articles in the area that were cited in some way in the research period. There are a total of 167 articles. It should be noted that this number is lower than the total sample, which is 199. This is because some articles (32 or 16.080%) have not yet been cited. When analyzing the citations, it seems that the number is low when compared to other research areas in which there are articles that have more than

1000 references. In this sample, no article reached such a number. It was clear that most of the published papers have less than 50 citations, which should change in the future as there is expected to be an increase in articles with more than 50 citations since the increase in publications on this subject is notorious in recent years.

**Table 1.** Source Ranking.

R	Journal Name	H-Index	Citations	Publications	Percentage	>200	>100	>50	<50	CS	SJR
1	Renewable and Sustainable Energy Reviews	295	74	4	2.010	0	0	1	3	30.4	3.632
2	Global Environmental Change	177	228	1	0.503	1	0	0	0	20.2	4.304
3	Water Research	303	28	1	0.503	0	0	0	0	15.6	2.932
4	Renewable Energy	191	45	4	2.010	0	0	0	4	10.8	2.052
5	Resources, Conservation and Recycling	130	37	1	0.503	0	0	0	1	14.6	2.215
6	Journal of Industrial Ecology	102	332	1	0.503	1	0	0	0	12.8	1.808
7	Energy Economics	152	87	3	1.508	0	0	0	3	2.7	0.977
8	Energy Policy	217	774	15	7.538	0	3	3	9	10.2	2.168
9	Science of the Total Environment	244	443	9	4.523	0	2	1	6	10.5	1.661
10	Journal of Environmental Management	179	24	2	1.005	0	0	0	2	9.8	1.321
11	Entrepreneurship and Sustainability Issues	25	5	1	0.503	0	0	0	1	7.0	1.171
12	Environmental Sciences Europe	35	5	1	0.503	0	0	0	1	4.8	1.774
13	Progress in Planning	48	24	1	0.503	0	0	0	1	8.4	0.913
14	Urban Studies	147	0	1	0.503	0	0	0	1	6.6	1.618
15	Mitigation and Adaptation Strategies for Global Change	71	25	1	0.503	0	0	0	1	5.9	1.112
16	Technological and Economic Development of Economy	47	119	3	1.508	0	0	1	2	6.0	0.622
17	British Journal of Management	108	21	1	0.503	0	0	0	1	6.8	1.522
18	Aerosol and Air Quality Research	55	7	1	0.503	0	0	0	1	5.9	0.965
19	Financial Innovation	18	66	1	0.503	0	0	1	0	4.2	0.847
20	New Political Economy	56	42	1	0.503	0	0	0	1	5.4	1.748
21	Environmental Science and Pollution Research	113	144	16	8.040	0	0	0	16	5.5	0.788
22	Energy Reports ****	33	113	6	3.015	0	0	0	6	2.7	0.977
23	Energy Strategy Reviews ****	33	414	3	1.508	1	0	0	2	7.8	1.336
24	Energy Journal	77	9	1	0.503	0	0	0	1	4.4	1.480
25	Review of International Political Economy	70	15	1	0.503	0	0	0	1	3.6	1.823
26	Climate and Development	35	1	1	0.503	0	0	0	1	4.8	1.047
27	Journal of Security and Sustainability Issues	23	34	3	1.508	0	0	0	3	3.1	0.375
28	Environmental and Resource Economics	92	0	1	0.503	0	0	0	1	4.2	1.401
29	International Journal of Energy and Environmental Engineering	30	16	1	0.503	0	0	0	1	3.9	0.528
30	Borsa Istanbul Review	21	0	1	0.503	0	0	0	1	4.3	0.684
31	Energy, Sustainability and Society	25	43	2	1.005	0	0	0	2	4.2	0.658
32	Environment, Development and Sustainability	56	2	2	1.005	0	0	0	2	3.8	0.548
33	Sustainability (Switzerland) *	85	383	39	19.598	0	0	0	39	3.2	0.581
34	Economic Analysis and Policy	29	21	1	0.503	0	0	0	1	3.6	0.776
35	Energy Exploration and Exploitation	30	22	2	1.005	0	0	0	2	2.8	0.489
36	International Journal of Energy Economics and Policy **	33	99	17	8.543	0	0	1	16	3.5	0.371
37	Journal of International Studies	17	4	1	0.503	0	0	0	1	3.7	0.541
38	Journal of Sustainable Development of Energy, Water and Environment Systems	14	11	1	0.503	0	0	0	1	3.7	0.400
39	Environmental and Climate Technologies	17	5	1	0.503	0	0	0	1	2.3	0.326
40	Journal of Economics, Finance and Administrative Science	13	0	1	0.503	0	0	0	1	1.4	0.308
41	Atmosphere	37	3	1	0.503	0	0	0	1	2.9	0.698
42	Frontiers in Energy Research ****	30	6	5	2.513	0	0	0	5	2.6	0.641
43	Thermal Science	43	3	2	1.005	0	0	0	2	2.4	0.495

Table 1. Cont.

R	Journal Name	H-Index	Citations	Publications	Percentage	>200	>100	>50	<50	CS	SJR
44	EAM: Ekonomie and Management	22	9	1	0.503	0	0	0	1	2.3	0.322
45	Environmental Economics and Policy Studies	23	6	1	0.503	0	0	0	1	2.9	0.483
46	Structural Change and Economic Dynamics	48	1	1	0.503	0	0	0	1	3.5	0.621
47	Polish Journal of Environmental Studies	54	6	3	1.508	0	0	0	3	2.4	0.366
48	Asia and the Pacific Policy Studies	14	14	2	1.005	0	0	0	2	2.7	0.533
49	Environment and Development Economics	62	2	1	0.503	0	0	0	1	2.8	0.787
50	Energy Sources, Part A: Recovery, Utilization and Environmental Effects	45	34	1	0.503	0	0	0	1	3.3	0.319
51	Emerging Markets Finance and Trade	34	47	1	0.503	0	0	0	1	2.6	0.444
52	International Journal of Innovation and Sustainable Development	20	8	1	0.503	0	0	0	1	3.9	0.528
53	International Journal of Renewable Energy Development	12	5	2	1.005	0	0	0	2	3.9	0.528
54	Economic Annals—XXI	14	1	1	0.503	0	0	0	1	1.5	0.234
55	Economy of Region	14	0	2	1.005	0	0	0	2	1.9	0.351
56	GeoJournal	12	28	1	0.503	0	0	0	1	2.2	0.232
57	Cogent Economics and Finance	16	112	1	0.503	0	1	0	1	2.0	0.252
58	Management and Marketing	11	1	1	0.503	0	0	0	1	1.9	0.218
59	Social Science	19	11	1	0.503	0	0	0	1	2.3	0.239
60	Latin American Economic Review	8	50	1	0.503	0	0	1	0	2.4	0.346
61	Banks and Bank System	16	0	1	0.503	0	0	0	1	1.0	0.216
62	Comparative Economic Research	8	5	1	0.503	0	0	0	1	1.3	0.195
63	Geography, Environment, Sustainability	8	1	1	0.503	0	0	0	1	1.2	0.286
64	International Organizations Research Journal	7	6	1	0.503	0	0	0	1	1.1	0.295
65	Copenhagen Journal of Asian Studies	13	0	1	0.503	0	0	0	1	1.2	0.175
66	Pakistan Development Review	26	7	1	0.503	0	0	0	1	1.0	0.143
67	Environmental and Socio-Economic Studies	3	4	1	0.503	0	0	0	1	0.6	0.381
68	Informação e Sociedade	6	0	1	0.503	0	0	0	1	0.4	0.256
69	Wit Transactions on Ecology and the Environment	21	4	2	1.005	0	0	0	2	0.6	0.142
70	Russian Journal of Economics *****	12	1	1	0.503	0	0	0	1	0.2	NA
71	Environment and Planning C: Government and Policy <sup>2</sup>	69	9	1	0.503	0	0	0	1	3.5	0.998
72	European Research Studies Journal <sup>*3</sup>	34	44	1	0.503	0	0	0	1	2.6	0.274
73	Journal of Reviews on Global Economics <sup>1</sup>	6	12	1	0.503	0	0	0	1	0.2	0.227
74	Ekonomika Vilniaus Universitetas	NA	1	1	0.503	0	0	0	1	NA	NA
	Total		4163	199	100						

\* Listed since 2009; \*\* Listed since 2011; \*\*\*\* Listed since 2013; \*\*\*\*\* Listed since 2014; \*\*\*\*\* Listed since 2015; <sup>1</sup> Coverage period 2016–2019;

<sup>2</sup> Listed until 2017; <sup>3</sup> Listed until 2018; R = Ranking; >200 Number of articles with more than 200 citations; >100 Number of articles with more than 100 citations; >50 Number of articles with more than a 50 citations; <50 Number of articles with less than a 50 citations.

Taking the total h-index (34) of this research into account, it is noted that it is not a high value as it only comprises 17.085% of the sample. The number of articles with more than 400, 200, 100 and 50 citations is expected to increase since, as previously mentioned in this study, a growth trend is observed in research on renewable energy, economic growth and economic development.

**Table 2.** General Citation on Renewable Energy, Economic Growth and Development Economic on Scopus.

Citations	2008–May/2021	
	Number of Papers	% of Papers
≥400 citations	1	0.503
≥200 citations	2	1.005
≥100 citations	6	3.015
≥50 citations	9	4.523
≤50 citations	149	74.874
Total	199	83.920

Source: prepared by the authors with data from Scopus.

Table 3 shows us the most cited articles in the research period, in one of the criteria selected to determine relevance. These are the 20 most relevant papers of that period. One is able to notice a good distribution in the journal ranking, which may be an indication that good studies on the subject can be found in most journals listed in this research. Another point is that most of these 20 articles are post-2015, which reinforces the hypothesis that research on the subject still has a horizon of growth.

**Table 3.** Most Cited Articles in the Period (2008–May/2021).

Journal	JR	TC	Title	Author(s)	Year
Energy Strategy Reviews	23	405	The role of renewable energy in the global energy transformation	Gielen, Dolf Boshell, Francisco Saygin, Deger Bazilian, Morgan D. Wagner, Nicholas Gorini, Ricardo	2019
Journal of Industrial Ecology	6	332	How circular is the global economy? An assessment of material flows, waste production, and recycling in the European Union and the world in 2005	Haas, Willi Krausmann, Fridolin Wiedenhofer, Dominik Heinz, Markus	2015
Global Environmental Change	2	228	Energy, land-use and greenhouse gas emissions trajectories under a green growth paradigm	Van Vuuren, Detlef P. Stehfest, Elke Gernaat, David E.H.J. Doelman, Jonathan C. (...)	2017
Science of the Total Environment	9	131	Dynamic impact of trade policy, economic growth, fertility rate, renewable and non-renewable energy consumption on ecological footprint in Europe	Alola, Andrew Adewale Bekun, Festus Victor Sarkodie, Samuel Asumadu	2019
Energy Policy	8	127	China in the transition to a low-carbon economy	Zhang, Zhong Xiang	2010
Cogent Economics and Finance	57	112	Effect of economic growth on CO <sub>2</sub> emission in developing countries: Evidence from a dynamic panel threshold model	Aye, Goodness C. Edoja, Prosper Ebruvwiyo	2017
Science of the Total Environment	9	103	Modelling coal rent, economic growth and CO <sub>2</sub> emissions: Does regulatory quality matter in BRICS economies?	Adedoyin, Festus Fatai Gumede, Moses Iga Bekun, Festus Victor Etokakpan, Mfonobong Udom Balsalobre-lorente, Daniel	2020

Table 3. Cont.

Journal	JR	TC	Title	Author(s)	Year
Energy Policy	8	101	The energy and CO <sub>2</sub> emissions impact of renewable energy development in China	Qi, Tianyu Zhang, Xiliang Karplus, Valerie J.	2014
Energy Policy	8	100	The environmental Kuznets curve in Indonesia: Exploring the potential of renewable energy	Sugiawan, Yogi Managi, Shunsuke	2016
Energy Policy	8	89	Onshore wind power development in China: Challenges behind a successful story	Han, Jingyi Mol, Arthur P.J. Lu, Yonglong Zhang, Lei	2009
Energy Policy	8	79	The driving forces of change in energy-related CO <sub>2</sub> emissions in Ireland: A multi-sectoral decomposition from 1990 to 2007	O' Mahony, Tadhg Zhou, Peng Sweeney, John	2012
Technological and Economic Development of Economy	16	75	Evaluation of renewable energy alternatives using MACBETH and fuzzy AHP multicriteria methods: the case of Turkey	Ertay, Tijen Kahraman, Cengiz Kaya, Ihsan	2013
Financial Innovation	19	66	The relationship between energy consumption, economic growth and carbon dioxide emissions in Pakistan	Khan, Muhammad Kamran Khan, Muhammad Imran Rehan, Muhammad Aized, Tauseef	2020
Renewable and Sustainable Energy Reviews	1	58	Energy security and renewable energy policy analysis of Pakistan	Shahid, Muhammad Bhatti, Amanat Ali Saleem, Muhammad Anandarajah, Gabriel	2018
Science of the Total Environment	9	54	An assessment of environmental sustainability corridor: The role of economic expansion and research and development in EU countries	Adedoyin, Festus Fatai Alola, Andrew Adewale Bekun, Festus Victor	2020
Science of the Total Environment	9	53	Heterogeneous impacts of renewable energy and environmental patents on CO <sub>2</sub> emission—Evidence from the BRIICS	Cheng, Cheng Ren, Xiaohang Wang, Zhen Yan, Cheng	2019
International Journal of Energy Economics and Policy	36	51	The role of renewable, non-renewable electricity consumption and carbon emission in development in Indonesia: Evidence from distributed lag tests	Saudi, Mohd Haizam Mohd Sinaga, Obsatar Roespinoedji, Djoko Razimi, Mohd Shahril Ahmad	2019
Latin American Economic Review	60	50	The dynamic linkage between renewable energy, tourism, CO <sub>2</sub> emissions, economic growth, foreign direct investment, and trade	Ben Jebli, Mehdi Ben Youssef, Slim Apergis, Nicholas	2019
Energy Policy	8	49	Hydropower, social priorities and the rural-urban development divide: The case of large dams in Cambodia	Siciliano, Giuseppina Urban, Frauke Kim, Sour Dara Lonn, Pich	2015
Emerging Markets Finance and Trade	51	47	Financing Renewable Energy Projects in Major Emerging Market Economies: Evidence in the Perspective of Sustainable Economic Development	Kutan, Ali M. Paramati, Sudharshan Reddy Ummalla, Mallesh Zakari, Abdurashed	2018

JR = Journal Ranking; TC = Total Citations.

The taxonomy of the publication was another aim in this research, hereby, the studies selected through the PRISMA methodology were qualified in four subgroups by the authors, I being—Renewable and Non-Renewable Energy Consumption, Economic Growth and Economic Development; II—Transition to a low-carbon economy and energy efficiency;

III—Environmental Degradation; IV—Others. Most of the articles in this sample fall into category II—Renewable Energies, Economic Growth and Economic Development, and the expected result, according to the Scopus database, 127 of 199 (63.819%), is in this category. Although category II relates to the keywords used in the scope, it is not the focal point of the publications. These are more related to energy efficiency and countries with the objective of reducing their carbon emissions and cover around 15.075% (30 documents) of the research. The Environmental Degradation is responsible for 8.04%, in other words, 16 documents. Finally, the other category, with fewer studies, encompasses researches that relate to the subjects but are very specific cases and covers 13.065%, or 26 published papers on that period. When analyzing the methodologies applied in the researches that are part of the sample of this study, a prevalence of quantitative methodologies is observed of the 199 studies. One hundred and sixty-one, or 80.904%, apply quantitative methods to obtain the results of their studies. In the following paragraphs, an analysis of the studies within the given subsamples is performed.

The analysis of group I (Renewable and Non-Renewable Energy Consumption, Economic Growth and Economic Development) shows that most of the articles published in this subsample use quantitative methodology while 89.763% of the studies use some common methodologies in economic sciences. Most studies are analyses of statistical inferences of countries or a country studied in isolation. There are many studies covering various economies [28–34], for example [35–38]. Ref. [35] conducted a study covering 123 countries, 146 countries for Ref. [36], 53 countries for Ref. [37], and in [38], 24 countries are heterogeneous economies. However, when observing the studies that opt for groups, there is a direction to investigate specific groups with some similarities, whether geographical, economic and cultural, among others. Ref. [39] investigated 37 economies considered developed. OCDE member countries were studied from various perspectives by [40–45]. The results obtained by [45] indicate that in the long term, trade openings and technological developments tend to stimulate the consumption of renewable energy in OCDE countries. Emerging economies were investigated by [46–50], still, in the emerging economies, there were more targeted studies, such as papers [51–53]. According to [51], for these economies, the flow of foreign direct investment (FDI) and the development of the financial market are fundamental in promoting the consumption of renewable energies, in addition to reducing emissions and promoting economic growth. The BRICS economies were also investigated in isolation: Brazil was studied by [54–56], Russia by [57], China and India by [58] and China by several [59–65], and there were also investigations for Chinese provinces such as [66,67]. Moreover, Brazil, China and the USA were studied by [68], China and USA in [69], and China, USA, France and Japan by [70]. Continents were also the target of this type of research: Europe was studied by [71–83]. The result obtained by [71] indicates a balance between environmental degradation, economic growth, commercial opening, consumption of renewable and non-renewable energies and fertility rate. Furthermore, it was observed that the consumption of non-renewable energies increases the degradation of the environment, while the consumption of renewables contributes to conservation. As in the case of the BRICS, European countries were studied separately: Portugal by [84]. Portugal, Spain, Denmark and the USA by [85], Ukraine by [86,87], Turkey by [88,89], Romania by [90], Czech Republic and Slovakia by [91], Wales by [92], Poland by [93,94], Estonia, Latvia and Lithuania by [95], Scotland by [96] and Russia [97]. The American continent, to be more precise, Latin America, was also the target of research by [98–101]. The study [99] concluded that the consumption of renewable energies, tourism, and FDI tend to reduce environmental degradation, while foreign trade and economic growth are responsible for the deterioration of the environment. Refs. [102–104] analyzed Bolivia and Ecuador, respectively. Saudi Arabia [105] and Iran [106] were studied in the Middle East. This relationship was studied for the Asian continent, where the Environmental Kuznets' Curve [107] was validated, for the South Asian economies by [108]. Ref. [109] investigated South Asian and Southwest economies, and the results obtained indicate that the consumption of renewable and non-renewable energies promotes economic growth [109].

Belt Road countries were investigated by [110,111], SAARC and ASEAN countries [112], as well as, South Korea [113], Bangladesh [114], Malaysia [115–118], Indonesia [119–123], Vietnam [124], Taiwan [125], Pakistan [126–130], Kazakhstan [131,132], and Thailand [133]. Not many studies dealing with the African continent [134] investigate the continent, [135] sub-Saharan Africa, [136] Rwanda, [137] Cameroon, Nigeria [138], [139] Ethiopia and [140] Tunisia. In Oceania, only [141] investigated Australia. OPEC member countries were studied by [142] and concluded that electricity production improves access to energy and promotes the economy. In addition to quantitative methodologies, other methodological approaches were applied; however, they were the minority in this subsample (10.318%). Similar to quantitative studies, there is an analysis of large groups, such as [143,144], which were analyzed a very different group of economies. The research addressed Europe [145,146], the United Kingdom [147] and Russia [97]. Refs. [148,149] analyzed China, while [150] studied India and China together; Islamic countries were studied by [151], and finally Bangladesh, Indonesia and the USA by [152–154], respectively.

The studies of subsample II (Transition to a Low-Carbon Economy/Energy Efficiency) are a total of 30, of which 22, or 73.333%, are quantitative surveys. Quantitative studies in this sample have a broad profile, such as [155,156]. The results of [156] point out that renewable energy and energy efficiency technologies are the central points for an energy transition. Renewable energy is the key to limiting greenhouse gas emissions and limiting the increase in global temperature by 2° [156]. The continents were also investigated: Asia was studied in [157–159], and the African continent in [160]. The most localized studies have a concentration on research focused on China [161–163]. The results found by [161] indicate that the targets of electricity production through renewable sources in China contributed to an increase of 1.8% between 2010 and 2020. In addition to these, [164] studied India and China. India was also addressed in [165]. Still, on the Asian continent, Pakistan, Vietnam, Kazakhstan and Japan were studied by [166–169], respectively. In Europe, Ireland was surveyed in [170], Turkey by [171], Netherlands by [172], Germany, United Kingdom and Norway in [173]. Regarding the USA, it was found that by achieving innovation targets, there is a reduction in carbon dioxide emissions [174]. In the Middle East, Saudi Arabia was studied by [175], and finally, [176] proposed to investigate quantitatively the impact of public policy of gradual reduction in fossil fuel consumption given through government subsidies; the results indicate that this contributes positively to the performance of macroeconomic factors [176]. In non-quantitative approaches, [177] investigated trends for the global energy market in the medium and long term and concluded that there is a global interest in renewable and non-conventional energies, as well as in improving energy efficiency to reduce an environmental impact on energy generation [177]. Europe was studied by [178,179], while China was studied by [180,181], Russia by [182], the economies of Mexico and Vietnam by [183] and Nigeria in [184].

There is subsample III, in which the documents relate to the keywords used in the research, but the focus of the research is on the degradation of the environment. Having said this, this group has 16 articles, 12 of which are quantitative papers, while the rest applied other methodologies. In the field of quantitative studies, [185] studied 32 countries considered in development. While [186] focused on the BRICS, for these economies, the consumption of renewable energies and the FDI tend to reduce carbon dioxide emissions, the opposite relationship found for GDP, and bank credit with CO<sub>2</sub>, the increase in these variables is accompanied by an increase in environmental degradation, as well as exports [186]. In addition to this research, South Africa was also studied by [187,188], and India, together with Malaysia, Indonesia, Kenya, Mexico, Colombia, and Poland, were investigated by [189]. The European Union was addressed by [190], and concluded that economic factors accelerate environmental degradation; only Turkey was analyzed in isolation from Europe by [191,192]. ASEAN member countries were investigated by [193] and showed that macroeconomic factors contribute to degradation. Still, in Asia, Vietnam and Taiwan were studied by [194,195], respectively. The African continent was studied by [196] and Ghana by [197]. The study with non-quantitative approaches by [198] focuses on the

possibilities of development in the global use of energy, land exploration, emissions and climate change in order to maintain constant sustainable development. The results indicate that a combination of these factors by opting for sustainable alternative, can lead to a strong energy transition towards renewable sources; however, in addition, it is also necessary to apply strict climate policies to reduce the trend of the rising global temperature [198]. Ref. [199] studies how the banking sector can contribute to decarbonization. Finally, [200] is the only country study that investigates Nigeria.

Lastly, in category IV (Others), unlike the aforementioned, where there is a clear predominance of quantitative methodologies, there is a balance. Of the 26 papers falling into this category, 13 (50%) are quantitative, while the other half use other approaches. In this category there are comprehensive studies, which do not necessarily work with continents/countries, for example [201–205], moreover [206] conducted a micro study. In studies dealing with territories for the European continent [207], it was concluded that renewable energy development policies improve the social factors studied (government policy, general public awareness, the market, lobbying activity) [207]. Russia was studied in [208], and the United Kingdom and Germany in [209] together with the USA and Brazil. On the Asian continent, Iran, China and Cambodia were investigated by [210,211] and [212], respectively. Ref. [213] studied the decision-making between financing and not financing renewable energy matrices on the African continent and concluded that investor confidence in regulatory effectiveness is the main concern, besides local construction capacity and political instruments [213]. In non-quantitative approaches, there are also studies without a sample directed to country/continent, such as [214–219]. Ref. [219] proposes two scenarios, a conservative one in which there is no change in the current situation of energy production and a transition, which assumes ambitious targets in the evolution and incentives of renewable energies. The results show that renewable sources may be responsible for providing between 35 and 50% of the world's electricity production by 2040, while the share of fossil fuels tends to decrease [219]. Ref. [220] demonstrated that common law adept countries responded better to renewable energy investment opportunities; in other words, the study points out that legal and regulatory institutions are to blame for the global imbalance in the development of energy [220]. In Europe, only Italy and Macedonia have surveys in this category, [221] and [222] respectively. While only Chinese provinces were surveyed in [223–225], and at the country level, in Asia, only Nepal in [226].

Due to the diverse results obtained in the studies, there is no academic/scientific consensus on the way in which energy consumption affects economic dynamics. There are economies in which the influence is positive, others negative and even economies in which the results are not statistically significant. This is likely to be the effect of specific characteristics of each sample observed in the studies. Despite this, a conclusion regarding the consumption of renewable energies was possible. They are fundamental in mitigating greenhouse gas emissions; therefore, there is evidence that they are essential in conserving the environment.

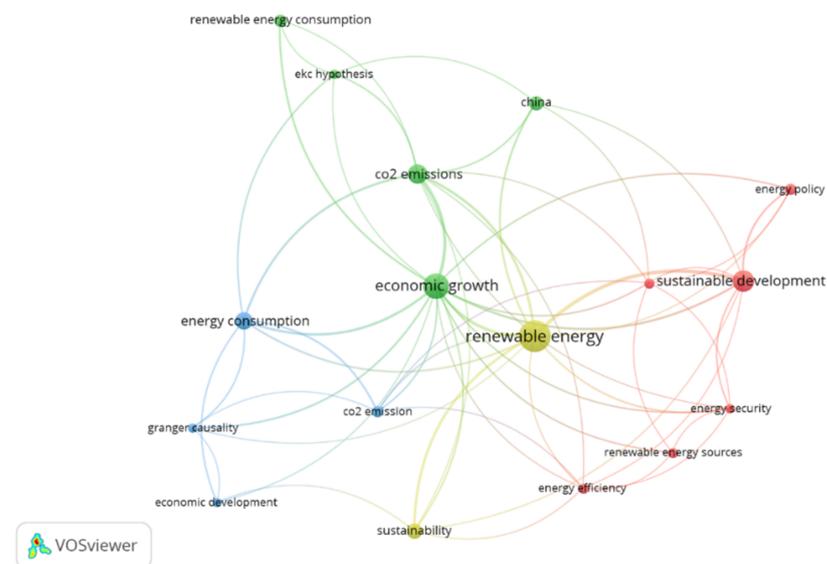
The prevalence and varieties of quantitative approaches in the studies are an indication that information is available so that decision-makers and policymakers can formulate strategies based on statistical evidence.

It is worth noting that when observing the countries taken into account in the above-mentioned studies, they are developed economies. There are many studies for Europe, USA, OCDE member countries, and many studies for developing economies, such as the case of BRICS, but little is investigated for less wealthy economies, as most African and Caribbean economies are countries that find themselves at the bottom of a low point of economic development. Thus, there are indications of a gap to be explored, develop, or even replicate studies already conducted for the most relevant economies, for these countries with lower economic power, in order to ascertain how the consumption of renewable energies affects the economy of these nations.

Along with, according to the analysis of the articles in this sample, a focus on relating energy consumption, whether renewable and non-renewable, with macroeconomic indica-

tors, such as labor force, trade, foreign direct investment, with economic growth, not taking into account variables or socioeconomic indicators, is noticeable. This marginalization of metrics to evaluate economic and social development may be an indication, as it was previously pointed out that there is a growth horizon in the studies of this theme. It is natural that socioeconomic development is promoted from economic growth. Therefore, academia is on the way to understanding the various effects of renewable energies on economic activity, and from this understanding to expand into economic development.

Figure 5 informs us of the most used keywords. A universe of 637 keywords was obtained; however, when we limit it to a minimum of five occurrences, this number drops to 17, thus, following relevance criteria previously stipulated that Figure 4 was made with the existing relationships between these 17 words that were most used by the authors as keywords.

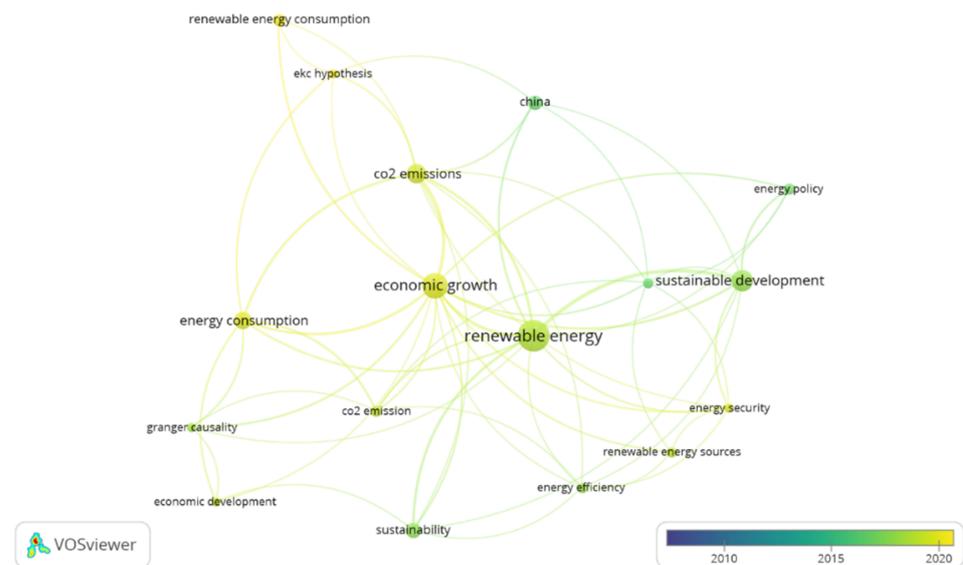


**Figure 5.** Keywords Occurrence Analysis.

Immediately, it is possible to observe that there are four clusters (given the different colors on the image), all of which somehow connect with the keyword “economic growth”, which is the most used term by researchers, followed by “renewable energy”. It is noted that, of the three terms selected in this work, two stand out. This may be an indication that the academy is focused on investigating the relationship between economic growth and energy consumption, a subject that was already investigated, however not overdone, since the focus is now on renewable energy matrices. With regard to the term of economic development, this subject, although extremely relevant, when related to economic growth and renewable energy, appears to be marginalized; that is, there is not much targeted research, so it is possible to conclude that there is a gap that should be explored by researchers.

It is also noted in the keywords with more occurrences there is a certain emphasis on CO<sub>2</sub> in conjunction with keywords that relate to sustainability. This implies an apparent interest in studying how greenhouse gas emissions may be impacting growth and or economic development. To a certain extent, the rise in the temperature of the planet may be one of the factors that have driven research to understand how renewable energies affect economic dynamics.

In addition, Figure 6 shows us that there are indications (given the yellow color) that these keywords, in sets, date to 2015 post surveys, once more, another indication that there is still much to be explored. Finally, China is noted as one of the most cited terms, and this may be one of the reasons why the country has greater prominence in the number of publications on the subject.



**Figure 6.** Keywords Overlay Visualization.

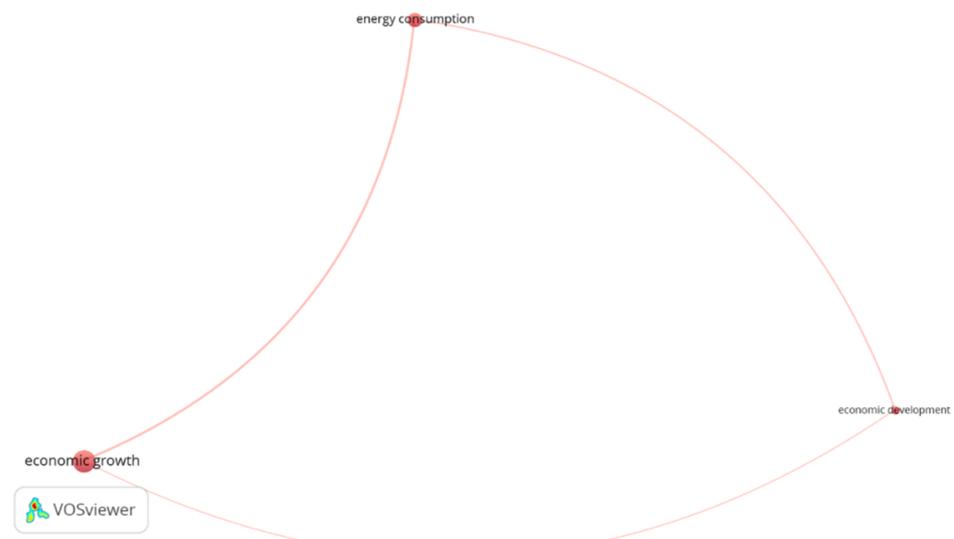
When the links between renewable energy, economic growth and economic development are observed, it is noted that there is no evidence of research relating to economic development and renewable energies, as can be seen in Figure 7 below. According to Figure 7, the existence of two clusters is clear; one between economic growth and renewable energies and the other between economic growth and economic development. The research gap that can be explored is even more evident since there is no direct link between economic development and renewable energies.

However, if we use energy consumption instead of renewable energies, a link is noted with economic development, as can be seen in Figure 8. Once again, this result reinforces the hypothesis of the absence of studies relating the consumption of renewable energies with development.

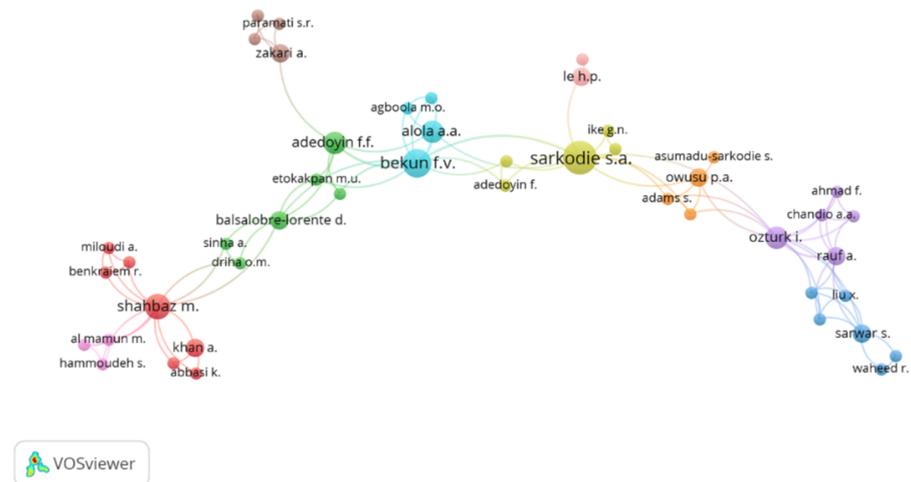
Finally, an analysis of the possible clusters and links between the researchers was also performed. The number of citations is a relevance indicator, even though it is not an accurate metric. In VOSviewer, the software to perform such analysis only considered authors with more than five citations, so the number of authors analyzed is 404 (instead of 665), which is the total number of researchers in this sample. Even though the number of researchers was reduced to 404, a link was found between only 46 of them, as can be seen in Figure 9.



**Figure 7.** Link Between Renewable Energy, Economic Growth and Economic Development.



**Figure 8.** Link Between Energy Consumption, Economic Growth and Development Economic.



**Figure 9.** Authors' Network Visualization.

By observing the number of colors, one can see 10 clusters. However, although there are 10, only 4 clusters stand out because they have more branches; therefore, they are connected to more researchers. These are one led by Bekun in blue, followed by Sarkodie in yellow, then Ozturk is in purple, and finally, the cluster formed by the Shahbaz in red. Notoriously, this relationship does not occur randomly since they are the authors with the highest number of documents published on the stipulated criteria. Sarkodie has eight publications based on the topic in that period, while Bekun has five publications, Shahbaz four publications, and Ozturk three publications.

Among the most referenced studies in the period, Bekun and Sarkodie, of the authors with the highest number of publications, are unique, with works listed among only 20 most referenced in the period. While Shahbaz, already recognized for his academic contribution in research that relates to economics and the environment, as highlighted in [17,18], appears to be relevant in studies relating to renewable energy and economics.

The work developed by these authors in the period investigated also does not study less developed economies, except Ozturk studying energies and ecological sustainability in the Belt and Road Initiative Countries [110], and Sarkodie investigating Ghana's economy in [197], all other studies focus on developed or developing economies. This is a strong indication that these less capable economies are being marginalized in the context of

understanding how renewable energies can affect their economic growth and development, and this negligence may be another factor of delay in their development.

## 5. Conclusions

This research focused on investigating articles published in the Scopus database that studied the relationship between renewable energy, economic growth and economic development between 2008 and May 2021. The results of screening through the PRISMA methodology provided a sample of 111 articles selected by the WoS database and 199 articles selected by the Scopus database. There is a prevalence of quantitative methodologies to the detriment of other approaches. Regarding the ranking of the journals with the highest impact, *Renewable and Sustainable Energy Reviews* were in first place, followed by *Global Environmental Change* and in third was *Water Research*. However, the journal with the largest number of publications was *Sustainability* (Switzerland).

Despite the effort to overcome the difficulty in quantitatively measuring an article, journal or author, this is the major limitation of this research. The metrics used for quantifying are susceptible to failure; thus, they are not accurate because there is no defined methodology that is applicable to the type of approach used in this study. In addition to this, the selected sampling period was also considered since it does not take the year 2021 into account. To be more precise, it is only considered until 21 May. Nevertheless, the number of publications found for this year should not be ignored. Another limiting factor of the research is found in the sample used, considering the information available in the Scopus database in the construction of the analyzed sample, not taking into account all the studies that exist in Web of Science (WoS), which may have relevant studies that of course were not taken into consideration.

The analysis of the data obtained among both databases leads us to conclude that studies with respect to renewable energy, economic growth and economic development are just beginning since it is possible to observe a growth trend. Most of the studies published on that period occurred after 2015, and the articles considered to have the greatest impact are publications that date back to more recent years, which appears to be the result of the end of the first cycle of commitments of the Kyoto Protocol.

It is notorious that the topic is being researched on all continents, and surprising that China is a leader in publications, given that it is one of the countries whose economic growth has been the most damaging to the environment.

This research was able to identify research gaps; studies have focused on understanding how renewable energies have affected economies around the globe, but the observed gap is precisely in one of the keywords used in this research. No studies were observed that connect renewable energies and economic development; therefore, it is suggested that it is a theme to be addressed by academia in the future. There is also a lack of studies dedicated to less developed economies, so there is no evidence of how the factors observed in this study can affect the economic activity of these countries; for these economies, there is a lack of information to outline the best strategies and policy development to promote greater growth. In addition, with the possibility of continuing to work with this sample, it is also proposed in future research to analyze the quality of the research reviewed in this article, with the objective of finding unexplored gaps, which can later be addressed.

This type of study, proposed in this research, is strategic for decision-makers and policymakers in demonstrating that the effects of a variable on the economy. In the case of this research, the nexus between economic growth, renewable energy consumption and economic development may be different between economies. Hence, it is an indication that before any strategic decision-making to promote economic growth, consumption of renewable energies or economic development, statistical studies should be promoted, with the aim of having an evidence-based decision and thus making efficient decisions.

**Author Contributions:** Conceptualization, H.O. and V.M.; methodology, H.O.; software, H.O.; validation, V.M.; formal analysis, H.O. and V.M.; investigation, H.O. and V.M.; resources, H.O. and V.M.; data curation, H.O.; writing—original draft preparation, H.O. and V.M.; writing—review and

editing, H.O.; visualization, V.M. Both authors have read and agreed to the published version of the manuscript.

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**Informed Consent Statement:** Not applicable.

**Data Availability Statement:** Data supporting reported results can be found in Scopus and Web of Science database at <https://www.scopus.com/search/form.uri?display=basic#basic>, accessed on 21 May 2021, and <https://www.webofscience.com/wos/woscc/basic-search>, accessed on 23 July 2021, respectively.

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**Conflicts of Interest:** The authors declare no conflict of interest.

## Appendix A

The search protocol is dated, which is a study limiter. The Scopus database updates its article base quite frequently, making it impossible to replicate and analyze all the papers in it.

On the Scopus (<https://www.scopus.com>), accessed on 21 May 2021, search page, which has restricted access, requiring a login, we researched the three keywords used in our research (Renewable Energy, Economic Growth and Economic Development), obtaining a total of 2836 documents. Articles published in Biochemistry, Genetics and Molecular Biology, Medicine, Physics and Astronomy, Immunology and Microbiology, Pharmacology, Toxicology and Pharmaceutics, Arts and Humanities, Psychology, Health Professions and Veterinary was not taken into consideration. Below can be seen the final research protocol, which resulted in a sample of 291 documents, which later went through another screening stage that culminated in the 199 articles analyzed in this study.

**Table A1.** Search Protocol.

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TITLE-ABS-KEY (RENEWABLE AND ENERGY, AND ECONOMIC AND GROWTH AND DEVELOPMENT AND ECONOMIC) AND PUBYEAR > 2007 AND (LIMIT-TO (OA, "all")) AND (EXCLUDE (SUBJAREA, "ENGI") OR EXCLUDE (SUBJAREA, "EART") OR EXCLUDE (SUBJAREA, "AGRI") OR EXCLUDE (SUBJAREA, "MATH") OR EXCLUDE (SUBJAREA, "BIOC") OR EXCLUDE (SUBJAREA, "MATE") OR EXCLUDE (SUBJAREA, "COMP") OR EXCLUDE (SUBJAREA, "CENG") OR EXCLUDE (SUBJAREA, "MEDI") OR EXCLUDE (SUBJAREA, "MULT") OR EXCLUDE (SUBJAREA, "PHYS") OR EXCLUDE (SUBJAREA, "CHEM") OR EXCLUDE (SUBJAREA, "IMMU") OR EXCLUDE (SUBJAREA, "ARTS") OR EXCLUDE (SUBJAREA, "DECI") OR EXCLUDE (SUBJAREA, "HEAL") OR EXCLUDE (SUBJAREA, "PHAR") OR EXCLUDE (SUBJAREA, "PSYC") OR EXCLUDE (SUBJAREA, "VETE")) AND (LIMIT-TO (DOCTYPE, "AR")) AND (LIMIT-TO (LANGUAGE, "ENGLISH"))

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