

Energy Financing Competitiveness Contribution In The Business Sector

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ABSTRACT

This report presents a bibliometry about the research topic "Energy financing competitiveness contribution in the business sector". It was made using the Scopus database, a set of 2,609 documents was obtained in a first search with the keywords energy AND financing (period 2011-2021). In the second search, the words business AND sector were applied as a filter. The results were 119 studies; the two samples were analyzed using the Bibliometrix package of the statistical software R.

Keywords: Bibliometrix package, Energy financing, business sector

1. INTRODUCTION

A bibliometric analysis is made on the topic: Energy financing competitiveness contribution worldwide and specifically the business sector to delve into the following research questions:

- Q1: Who are the most relevant authors, countries, and institutions of energy financing competitiveness fields in the business sector worldwide?
- Q2: What are the most cited authors, documents, and sources on the topic of energy financing competitiveness in the business sector worldwide?
- Q3: What are the collaboration networks among authors, institutions, and countries?

The other sections of this work are organized as follows: Section 2 specifies the methodology used. Section 3 presents the research general information consulted and section 4 describes the results obtained in terms of authors, countries, institutions, and co-citation network.

In the first research results, it was identified that the publications world production presents an upward trend with the largest number of scientific investigations presented in the year 2021. One of the most relevant authors is Wang Y with 13 published documents, United States is the country with the most publications that contribute to this research area, one of the most cited documents (680) is by Author Kabir, E, from the 2018 issue of *Renewable and Sustainable Energy Reviews*. In the results after the filter, it was identified that the world production of publications presents an upward trend with the largest number of scientific investigations presented in the year 2020. Authors with great relevance are not observed, the contribution of the first 20 is 2 published documents, the United Kingdom contributes with the most publications to this research area (31) and one of the most cited documents (143) is by the author Shahbaz M., from the year 2016 of the *Energy Policy* magazine.

2. METHODOLOGY

This study is a bibliometric analysis that allows validating the study progress in terms of the research question: What has been the contribution to the energy financing competitiveness in the business section worldwide? (Li, Zhou, Xue, & Huang, 2014). (Pritchard, 1969). It is quantitative in nature because it measures the variables under study in published texts (Flores, Muñoz, & Cabañero, 2004), for which it relies on inferential statistics and mathematical techniques (Thelwall, 2009), (Norton, 2001). It is desired to identify authors, journals, institutions, with the purpose of evaluating the impact of the publications regarding citations, periodicity, a number of authors, and countries (Kostoff, Tshiteya, Pfeil, Humenik, & Karypis, 2005), achieving filtering of the published texts through statistical filtering (Carvalho, Fleury, & Lopes, 2013) and thereby strengthen the search for publications for a timely qualitative interpretation that would support any state of the art (Urquhart & Dunn, 2013).

In this sense, the first systematic literature search was made in the Scopus database using the keywords "Energy" AND "Financing", initially limited by the year of publication. The year 2011 was established as the lower limit and the year current one as the upper limit (both inclusive) and with documents with languages in English or Spanish, leaving the search equation as follows:"

(TITLE-ABS-KEY (energy) AND TITLE-ABS-KEY (financing)) AND PUBYEAR > 2010 AND (EXCLUDE (DOCTYPE , "ed") OR EXCLUDE (DOCTYPE , "sh") OR EXCLUDE (DOCTYPE , "tb") OR EXCLUDE (DOCTYPE , "dp") OR EXCLUDE (DOCTYPE , "er")) AND (EXCLUDE (LANGUAGE , "Russian") OR EXCLUDE (LANGUAGE , "Chinese") OR EXCLUDE (LANGUAGE , "French") OR EXCLUDE (LANGUAGE , "German") OR EXCLUDE (LANGUAGE , "Polish") OR EXCLUDE (LANGUAGE , "Portuguese") OR EXCLUDE (LANGUAGE , "Ukrainian") OR EXCLUDE (LANGUAGE , "Korean") OR EXCLUDE (LANGUAGE , "Czech") OR EXCLUDE (LANGUAGE , "Italian") OR EXCLUDE (LANGUAGE , "Bosnian") OR EXCLUDE (LANGUAGE , "Japanese") OR EXCLUDE (LANGUAGE , "Persian") OR EXCLUDE (LANGUAGE , "Turkish"))".

The development of the previous equation generated 2,609 results. From which, due to database restrictions, only the most relevant 2,000 were downloaded in.bib format. These initial results were examined in the Bibliometrix package of the statistical software R. To obtain a content general idea of the exploration.

Consecutively, a second search was made. The first exploration was filtered with the keywords "business" AND "sector" as shown in the following search equation. :“(TITLE-ABS-KEY (energy) AND TITLE-ABS-KEY (financing) AND TITLE-ABS-KEY (business AND sector)) AND PUBYEAR > 2010 AND (EXCLUDE (LANGUAGE, "Bosnian") OR EXCLUDE (LANGUAGE, "Chinese") OR EXCLUDE (LANGUAGE, "German") OR EXCLUDE (LANGUAGE, "Portuguese") OR EXCLUDE (LANGUAGE, "Russian"))”.

After applying the filters, the derivations achieve were 119 documents, which were downloaded from Scopus in CSV format. After it, the documents were imported from the package mentioned above, where the bibliometric analysis was applied, which generated an indicators series that counted the digit of documents published in the selected time, the association in areas of knowledge, the authors with the greatest contribution, the sources procedure, the entities, and countries with the greatest contribution in the publications, as well as the frequent horizon of the citations received.

Regarding the structure of the document, the results are shown according to each search, detailing the bibliometrics laws, for which the document entitled A Bibliometric Analysis of Trends in Humanitarian Logistics (Ceballos-Parra) is taken as a presentation model (Sarache, & Gomez, 2018).

The general information of the studies retrieved in the first search is presented in Table 1.

3. RESULTS

3.1 First search results

Table 1. General information of the first search of 2,000 documents

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2011:2022
Sources (Journals, Books, etc)	875
Documents	2000
Average years from publication	4,34
Average citations per documents	10,17
Average citations per year per doc	2,078
References	72501
DOCUMENT TYPES	
article	1106
book	43
Book chapter	175
Business article	6
Conference paper	471
Conference review	18
note	50
review	131
DOCUMENT CONTENTS	
Keywords Plus (ID)	7114
Author's Keywords (DE)	4499
AUTHORS	
Authors	4830
Author Appearances	5774
Authors of single-authored documents	435
Authors of multi-authored documents	4395
AUTHORS COLLABORATION	
Single-authored documents	537
Documents per Author	0,414
Authors per Document	2,42
Co-Authors per Documents	2,89
Collaboration Index	3

3.1.1 Laws of bibliometrics

Authors' Productivity Law (Lotka's Law): As can be seen in Table 2, 4,829 authors were identified. According to the logarithmic representation shown in Figure 1, the articles were analyzed to fulfill Lotka's law. In other words, in the energy field financing, a small number of authors have the largest contributions number and are consolidated as the most productive. In this case, 88.13% of the identified authors have made only one contribution to the field of study, 8.61% made 2 contributions, and only 3.25% have published three or more papers. Although Lotka's law is complied with, research in this area of study is characterized by many transitory authors (98.63% with three or fewer contributions) and few specialized ones (66 authors out of 4,829 identified).

Table 2. The number of authors and contributions made

Number of contributions	Number of authors
1	4256
2	416
3	91
4	35
5	14
6	7
7	2
8	1
9	1
10	3
11	1
12	1
13	1
Total contributions: 5710*	Total: 4829

* The total number of contributions was obtained by multiplying the number of authors by the number of contributions

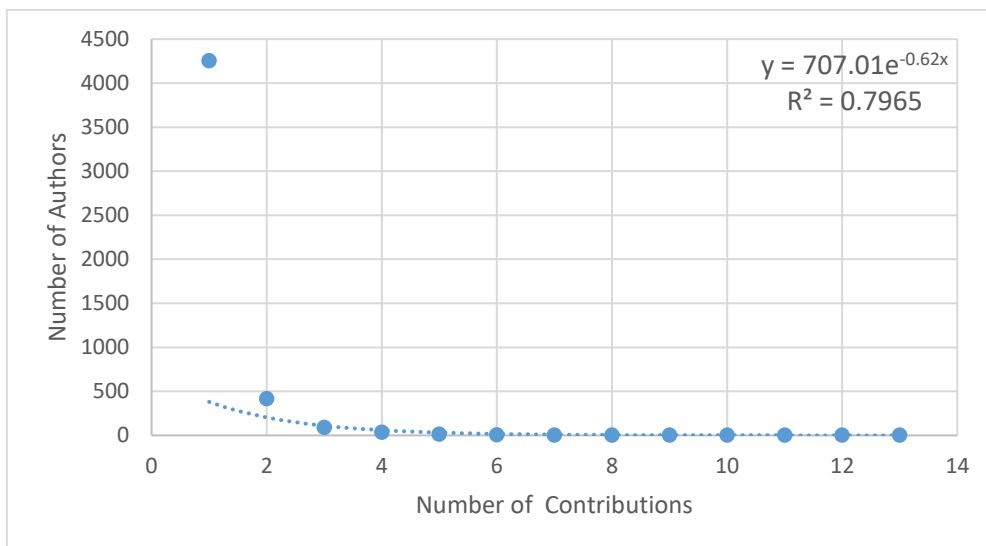


Figure 1. Graphic behavior of the Lotka function

Law of dispersion of the scientific bibliography (Bradford's Law): According to this law, 33.45% of the publications analyzed (2000) in the research area are concentrated in only 24 journals, the first six are: Energy policy, Renewable and sustainable energy reviews, Energies, E3S web of conferences, Sustainability (Switzerland) and IOP conference series: earth and environmental science. In Table 3 it can be seen how, in the first 24 journals, 669 of the published articles are concentrated.

Table 3. The journals number and papers published in the research area

Journal	Number of papers accumulated	Journal	Number of papers accumulated
1	119	13	506
2	184	14	525
3	227	15	543
4	263	16	561
5	298	17	577
6	332	18	592
7	363	19	607
8	390	20	620
9	416	21	633
10	442	22	645
11	467	23	657
12	487	24	669

Law of exponential growth: A slightly increasing distribution was observed since 2011, with some peaks of lower productivity without these signifying a continued decrease in scientific production on the subject under study, as shown in Figure 2.

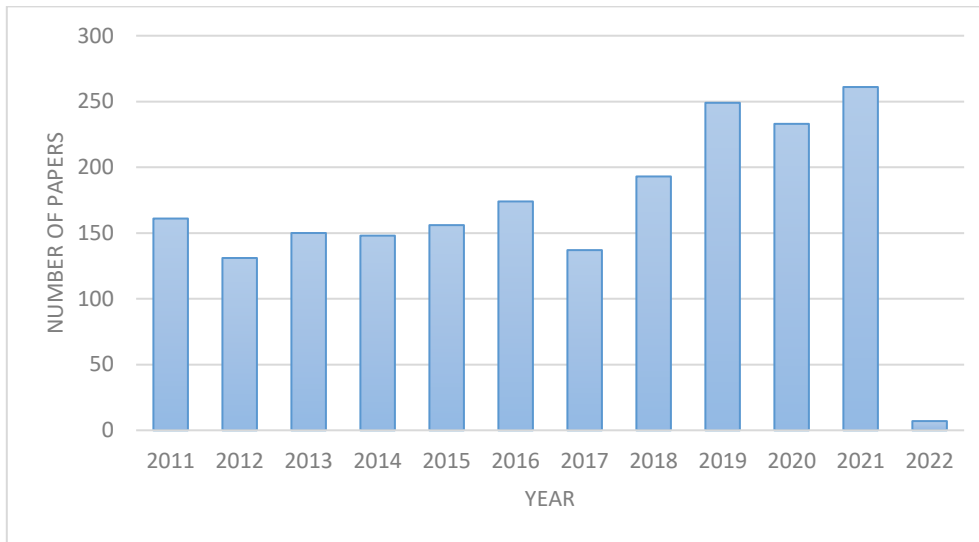


Figure 2. The article number per year

3.1.2 Bibliometric indicators

Personal indicators: For the purposes of this study, only the authors' geographical point was investigated to identify the territories with the highest obtaining. Therefore, 97 countries worldwide were identified investigating energy financing". "The 4 most productive countries in this field of study were: the United States, China, the United Kingdom, and Germany, with 700, 480, 265 and 219 contributions, respectively. Figure 3 presents the top 20 countries with the highest publications number.

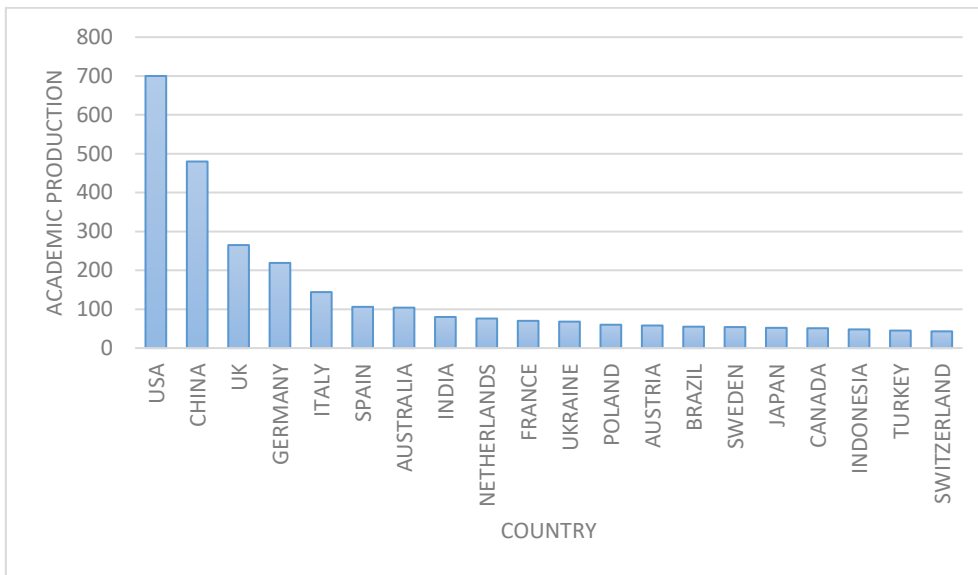


Figure 3. Academic production by country

Productivity indicators: 20 of the first authors make up the group with the highest productivity in the research area. The 5 most outstanding are Wang Y., Sovacool BK, Liu Y., Li Y., and Liu X. As can be seen in figure 4. Although the geographic location indicator highlights the United States, 4 of the most productive authors on the subject are from China.

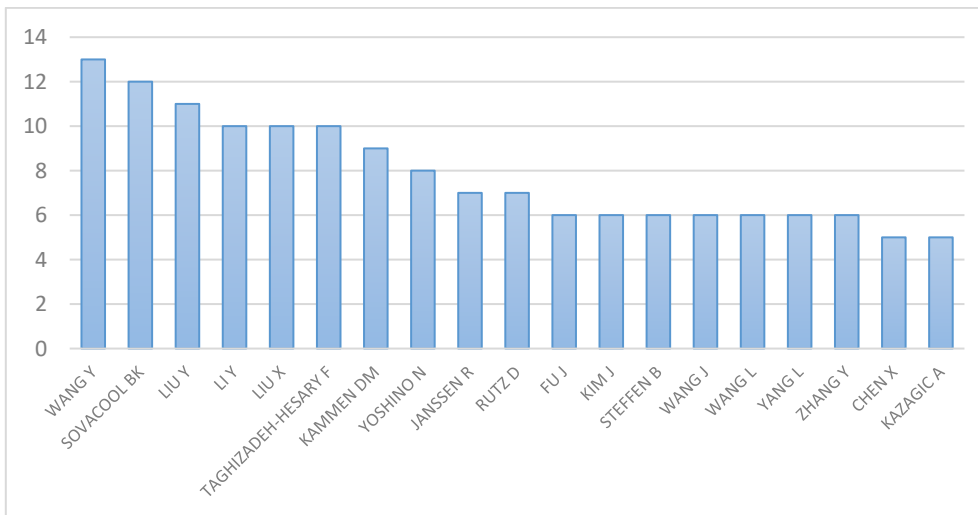


Figure 4. Most relevant authors

On the other hand, 2,138 institutions with publications on the energy financing subject were identified. Of these, the first 20 concentrates 13.8% of the works examined. In Figure # 5,

the most fruitful establishments in the area are exposed. As expected, the 2 most transcendental belong to authors with the highest performance; For example, the University of California, and North China Electric Power University are origins the institutions of Benjamin K. Sovacool and Wang Y., respectively. It can also be seen in the graph that 25 of the articles presented do not report the name of the academic institution originally.

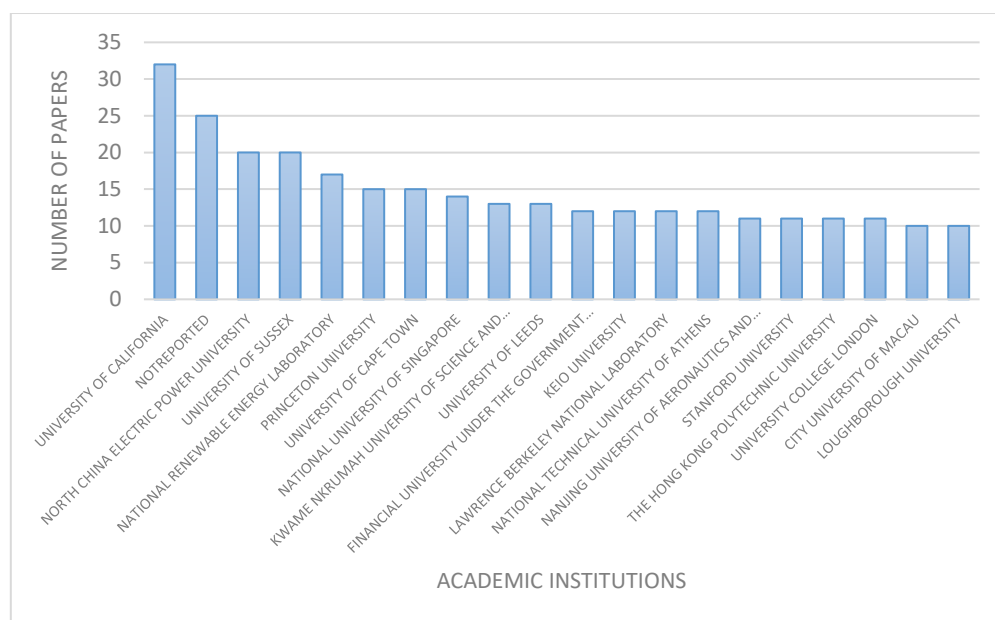


Figure 5. Most productive academic institutions

Dispersion indicators: From the 2,000 publications analyzed, the first 20 have been cited 3,960 times and are listed below in Table 4. It is substantial to suggest that the currently disclosed sections require more time in the disclosure window to be considered among the texts group incorporated into the most mentioned category. For example, if the 20 most cited sections are taken, only 5 of them correspond to the last five years of the study phase.

Table 4. Top twenty most cited documents

DOCUMENTS	DOI	CITATIONS
Kabir E., 2018, Renew ablesustainable energy	10.1016/j.rser.2017.09.094	680
Watts N., 2018, Lancet	10.1016/s0140-6736(18)32594-7	335
Creutzig F., 2017, Natenergy	10.1038/nenergy.2017.140	267
Magagna D., 2015, Int J. mar energy	10.1016/j.ijome.2015.05.001	189

Glover Jl., 2014, Int j prod econ	10.1016/j.ijpe.2013.12.027	187
Masini A., 2012, Energy policy	10.1016/j.enpol.2010.06.062	186
Kitzing L., 2012, Energy policy	10.1016/j.enpol.2012.08.064	179
Yildiz, 2015, Energy res socsci	10.1016/j.eress.2014.12.001	176
Howell St, 2017, am econ rev	10.1257/aer.20150808	168
Ouyang X., 2014, energy policy	10.1016/j.enpol.2014.03.030	168
Hofsetz K., 2012, biomass bioenergy	10.1016/j.biombioe.2012.06.038	165
Baker L., 2014, new polit econ	10.1080/13563467.2013.849674	162
Mazzucato M., 2018, technol forecast socch	10.1016/j.techfore.2017.05.021	157
Shahbaz M., 2016, energy policy	10.1016/j.enpol.2016.09.002	143
BrunkeJc., 2014, j clean prod	10.1016/j.jclepro.2014.04.078	142
thollander P., 2013, applenergy	10.1016/j.apenergy.2013.05.036	139
Vildiz O., 2014, renewenergy	10.1016/j.renene.2014.02.038	133
Ondraczek J., 2015, renewenergy	10.1016/j.renene.2014.10.053	131
Pearlson M., 2013, biofuel bioprod biorefining	10.1002/bbb.1378	127
Doytch N., 2016, energyecon	10.1016/j.eneco.2015.12.010	126

3.2 Second search results

Table 5. Main information of the search for 119 documents

DESCRIPTION	RESULTS
MAIN INFORMATION ABOUT DATA	
Timespan	2011:2022
Sources (Journals, Books, etc)	91
Documents	119
Average years from publication	3,71
Average citations per documents	8,403
Average citations per year per doc	1,678
References	4977
DOCUMENT TYPES	
article	64
book	2

Book chapter	17
Conference paper	22
Conference review	2
note	1
review	8
short survey	3
DOCUMENT CONTENTS	
Keywords Plus (ID)	708
Author's Keywords (DE)	384
AUTHORS	
Authors	344
Author Appearances	383
Authors of single-authored documents	22
Authors of multi-authored documents	322
AUTHORS COLLABORATION	
Single-authored documents	26
Documents per Author	0,346
Authors per Document	2,89
Co-Authors per Documents	3,22
Collaboration Index	3,46

3.2.1 Laws of bibliometrics

Authors' Productivity Law (Lotka's Law): As can be seen in Table # 6, 343 authors were identified. According to the logarithmic representation shown in Figure # 7, the examined sections comply with Lotka's law.

It is noteworthy, in the energy financing field, a small number of authors have the largest number of contributions and are strengthened as the most lucrative. In this case, 89.5% of the recognized authors have made only one contribution to the field of study and the remaining 10.5% have made a maximum of 2 contributions. Despite complying with this law, the analysis on this topic shows several temporary authors in publications related to the study and a few specialized ones.

Table 6. Authors number and contributions made

Number of contributions	Number of authors
1	307
2	36
Total contributions: 379*	Total: 343

*The total of contributions was achieved by increasing the authors' number by the representation of contributions.

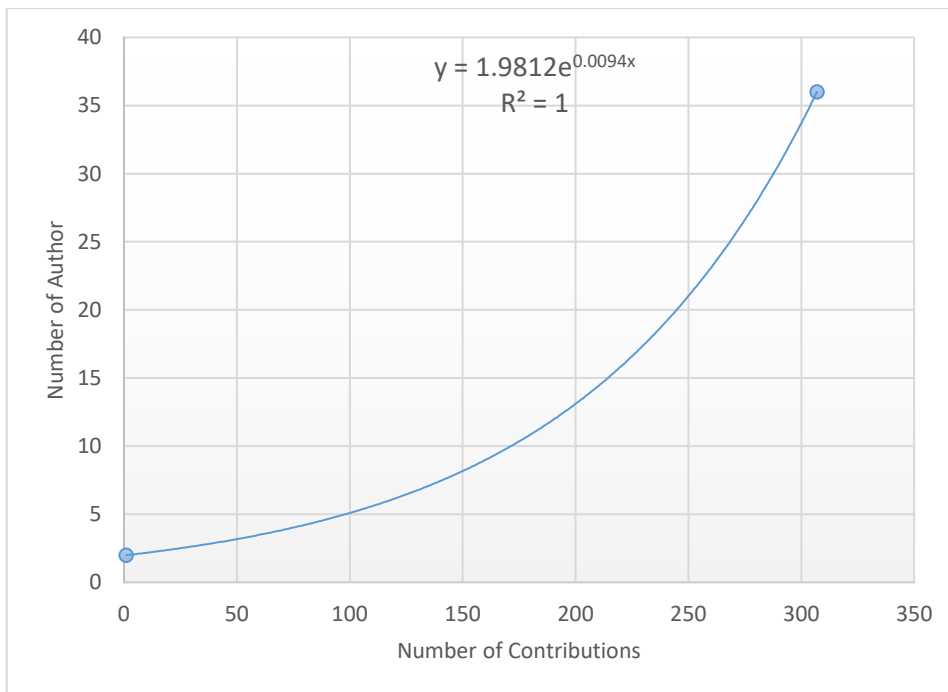


Figure 7. Graphic behavior of the Lotka function

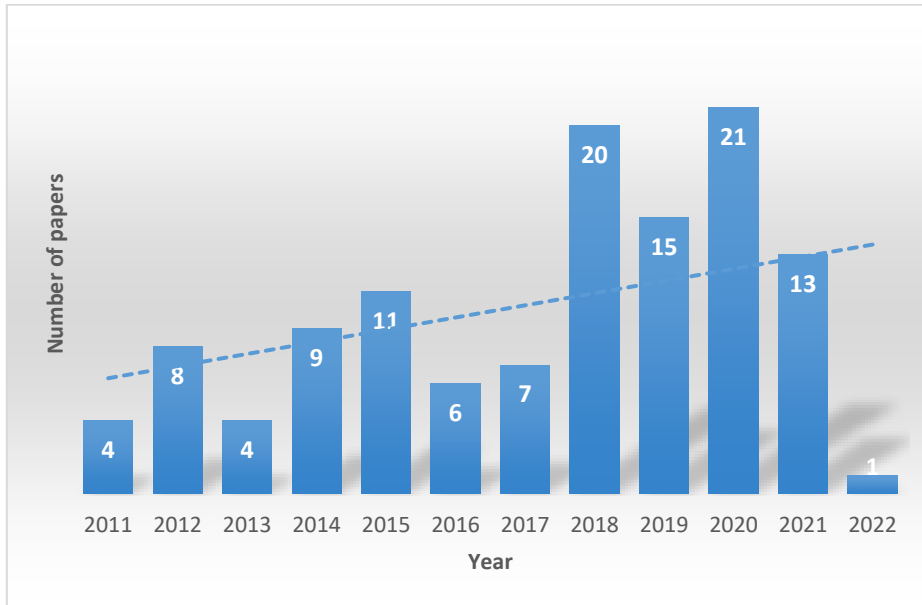
Law of dispersion of the scientific bibliography (Bradford's Law): According to this law, 34.45% of the publications analyzed (119)” in the exploration field are grouped into only 14 journals, the first six are: Energy policy, and Energy Research, and Social Science, E3S web of conferences. Energy efficiency and international journal of energy sector management. In Table# 6 you can see how, in the first 14 journals, 41 of the published articles are concentrated.

Table 6. Authors number and contributions made

Journal	Number of papers accumulated	Journal	Number of papers accumulated
1	9	8	29
2	13	9	31
3	16	10	33
4	19	11	35
5	22	12	37
6	25	13	39
7	27	14	41

Law of exponential growth: A slightly increasing distribution is observed from 2011 to 2022, with some peaks of lower productivity without these meaning a continued decrease in scientific production on the subject under study, as shown in Figure #8. The period where the greatest effective collection was obtained was in 2020 (21).

Figure 8. The number of articles per year



3.2.2 Bibliometric indicators

Personal indicators: For this study purposes, only the geographical location of authors was analyzed to identify the regions with the highest productivity. As a result, 53 countries worldwide were identified investigating energy financing. The 4 most productive countries in this field of study were: the United Kingdom, United States, Italy, and Germany, with 31, 26, 21, and 13 contributions, respectively. Figure #10 presents the top 20 countries with the highest number of publications.

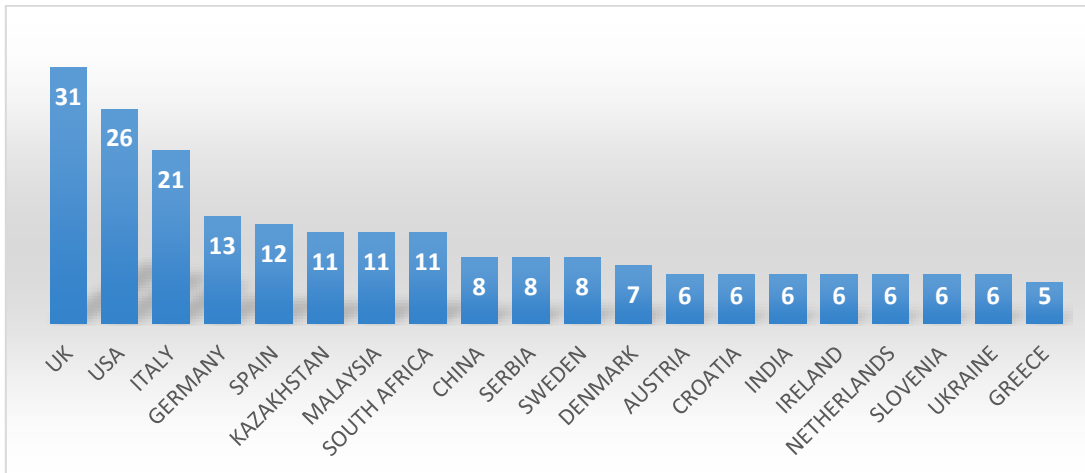


Figure 10. Academic production by country

Productivity indicators: Production at the author level is considered low, as can be seen in Figure # 12, the number of the maximum contributions for each of the first 20 is 2 documents.

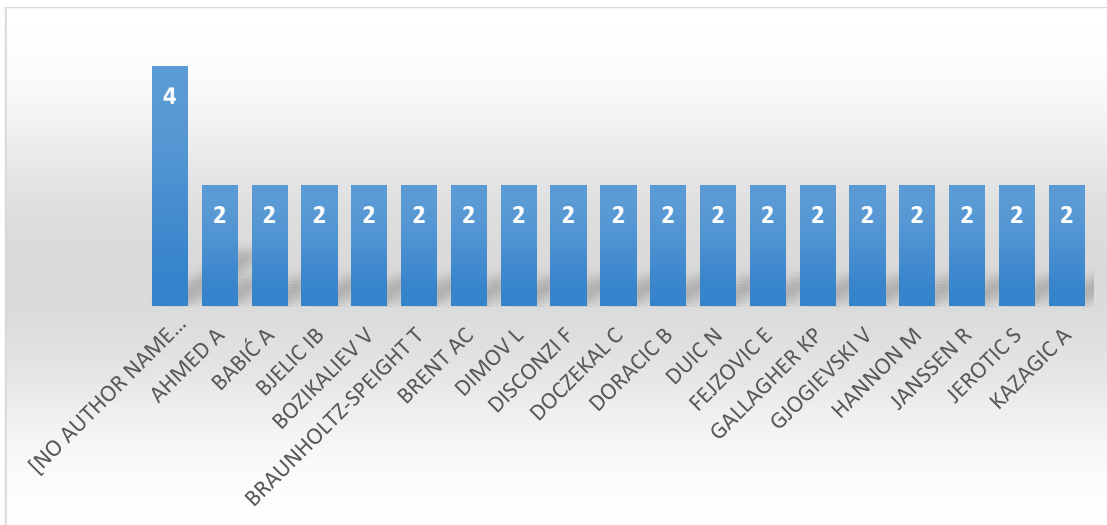


Figure 11. Most productive authors

On the other hand, 135 entities with disclosures on the energy financing subject were identified. Of these, the first 20 concentrates 32.31% of the work carried out. In Figure # 12, the most productive organisms in the area are revealed. The five with the highest productivity are the University of Manchester, and the Plekhanov Russian University of Economics, and University Sultan ZainulAbidin, and Department of Electrical and KTH Royal Institute of Technology, correspondingly.

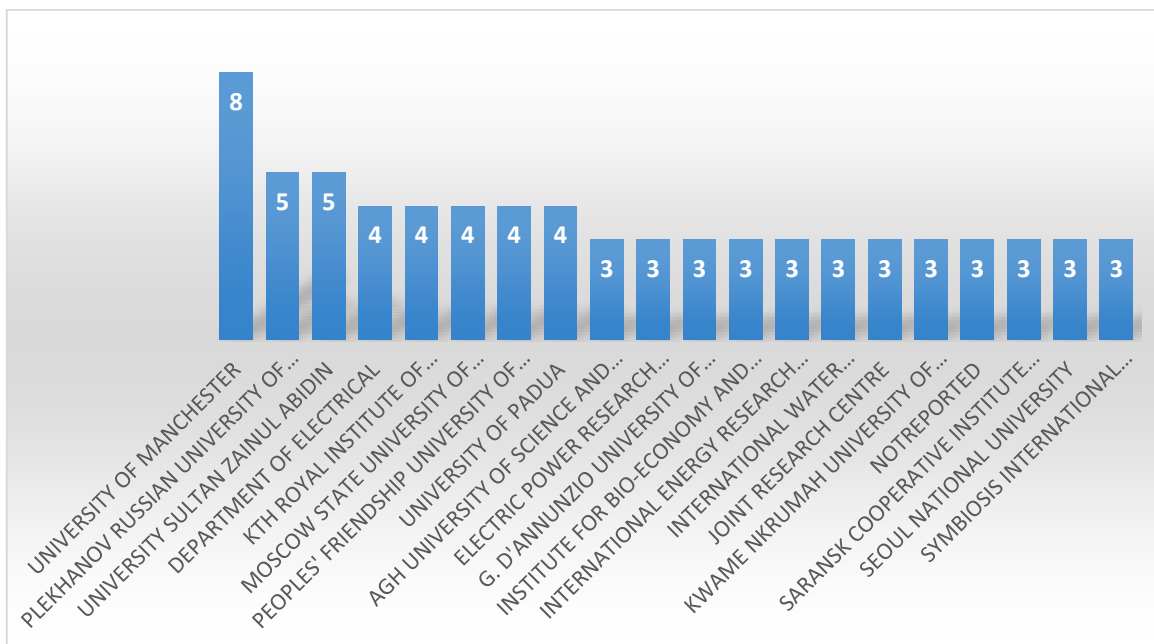


Figure 12. Most productive institutions

Dispersion indicators: From the 119 publications analyzed, the first 20 have been cited 779 times and are listed below in Table #7. “However, it is important to note that the most recently published articles require a longer maturation period before entering the group of the most cited. For example, when the 20 most cited articles of this item are analyzed, only 5 of them belong to the last five years of the study period”.

Table 7. Most cited documents

DOCUMENTS	DOI	CITATIONS
Shahbaz M., 2016, energy policy	10.1016/j.enpol.2016.09.002	143
Yildiz O., 2014, renew energy	10.1016/j.renene.2014.02.038	133
Criscuolo C., 2015, energy policy	10.1016/j.enpol.2015.03.023	62
Hochstetler K., 2015, global environpolit	10.1162/glep_a_00312	50
Tao J.Y., 2016, energy policy	10.1016/j.enpol.2016.03.021	43
Moner-Girona M., 2018, renewable sustainable energy	10.1016/j.rser.2018.04.018	32
Boyd W., 2014, ucla law rev		31
Kolk A., 2012, corpgov	10.1108/14720701211267865	30
LimayeDr, 2011, energyeffic	10.1007/s12053-011-9119-5	29
Roshchanka V., 2016, j clean prod	10.1016/j.jclepro.2015.05.078	24
Blyth W., 2015, energy policy	10.1016/j.enpol.2015.08.028	23

Ragosa G., 2019, j clean prod	10.1016/j.jclepro.2019.06.166	23
Haselip J., 2014, energy policy	10.1016/j.enpol.2013.10.013	21
Leurent M., 2017, energy policy	10.1016/j.enpol.2017.04.025	21
Lee C.W., 2014, renew energy	10.1016/j.renene.2014.03.015	21
Muchunku C., 2018, wiley interdiscip rev energy	10.1002/wene.282	21
Dixon R.K., 2011, mitigation adapt strateg global ch	10.1007/s11027-010-9253-y	20
Khatoon A., 2019, energies	10.3390/en12173317	19
Borge-Diez D., 2015, energy	10.1016/j.energy.2015.07.005	17
Bergman N., 2020, energy res socsci	10.1016/j.erss.2019.101386	16

3.2.3 Analysis of the relationship and collaboration between authors

The characterization of the relationships among the most prestigious authors will increase the importance of this study. To this result, it was derived to elaborate through the "Bibliometrix of R statistical software" package, "the construction of the relationship and collaboration map, taking as reference the database" that contains 119 documents retrieved from the Scopus database, for this, the study recognized as "Co-authorship" was used as an example of study, which considers the authors as units of analysis, through the 'Full counting' method.

Figure #13 shows the co-occurrence projection of keywords, it allowed the characterization of 4 clusters that involve the 119 documents analyzed, in the first cluster a set of words is grouped where the most relevant are investments, commerce, and economics among others; in the second cluster we find that the most relevant words are: energy efficiency, energy conservation, sustainable development, etc; in the third cluster words such as energy policy, finance, renewable resource, etc; and in the last cluster words like investment, energy market, etc.

Taking into account figure #14, it is possible to observe that the relationship analysis carried out yielded 4 groups or clusters, the first group is made up of 6 authors, Brown, Bird, Rosenow, Bertoldi, Wilson, and Joskow; the second group is made up of 10 authors, Zhang, Lee, Hall, Wang, Liu, Mazzucato, Sovacool, Kim, Shahhaz, and Lerner; the third group is made up of 2 authors, Vine, Singh; and the last cluster is made up of Lewis and other unknown authors.

4. CONCLUSION

4.1 First search

The scientific elaboration in high impact sources regarding the energy financing worldwide study in the first phase search, evidence that it has had a stable growth in the years (2011-2022), where it is important to highlight a slight increase in scientific production in the last 4 years (2018-2021), which had an increase of 28% compared to the previous 7 years (2011-2017).

The general procedure in relation to the sources characteristics of published documents shows a high preference (55.3%) to publish mainly in the type of articles, followed by products presented at conferences (24.45%) and book chapters (8.75%).

Authors with high relevance in the research topic are not presented, 98% of those who contribute the most have a maximum of 2 publications, the other 2% have from 3 to a maximum of 13 contributions.

There is no strong relevance in the keywords related to the research topic, there is a lot of dispersion in the terms.

4.2 Second search

It can be concluded in the first place that 89.5% of the recognized authors have made only one contribution to the field of publication and the remaining 10.5% maximum 2 contributions, that is, "although Loftka's law is fulfilled", exploration in this area of study is identified by a large increase in momentary authors and few scientists.

Second, it is determined that, for this study of 119 of the analyzed publications, 34.45% are concentrated in only 14 journals.

A slightly increasing distribution is observed from 2011 to 2022, with some peaks of lower performance without these representing an extended decrease in scientific elaboration on the subject under study. As of 2018, there was a significant increase in the number of annual publications.

The frequent procedure in relation to the sources characteristics of disclosed writings shows a high preference (53.78%) to disclose especially in the typology of sections, followed by effects exhibited in conferences (20.17%) and book chapters (14.29%).

Authors with high relevance in the research topic are not presented, 100% of those who contribute have a maximum of 2 publications.

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