

## Analysis of publications in ISI and Scopus about Energy Policies in Wind Energy

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### Abstract

The energy planning of the countries has taken relevance for the governments, they must guarantee a stable supply avoiding the emissions of greenhouse gases. Therefore, the development of public policies that allow investment in clean energy has become a topic of discussion among the scientific community. To contribute to the analysis of this issue, this paper shows the status of WoS and Scopus publications on energy and wind power policies. A bibliometric analysis is carried out with 121 WoS documents and 225 Scopus documents between 1992 and 2017. The number of publications, journals, issues and authors with the greatest impact are analyzed and it concludes that policy issues are divided between acceptance public of technology and penetration costs.

**Keywords:** Bibliometric analysis, policies, renewable energy, wind power.

### INTRODUCTION

The development of renewable energy sources is now recognized as an important component in providing integrated solutions for limiting emissions of greenhouse gases and is an opportunity to encourage innovation and promote economic growth in addition, improving access to a safe, clean and affordable energy [1], these characteristics make that energy planning are a complex issue, due to the policies to be implemented interact with other sectors of the economy such as production, demand, technology, fuel safety, affordability and environmental concerns. [2]

The main problems in the successful implementation of policies are of concern for all the socioeconomic institutions of

the countries, since they are responsible for planning in two main areas: the spatial environment and the development of policies that focus on the environment; which are problems that not only concern acceptance by the public, but they involve all interested parties, such as government agencies and institutions that allow an environment conducive to the formation and decision making in energy matters [3]. This takes strength due to an increasing dependence of modern society on energy consumption, which is why innumerable models have been developed that facilitate the energy planning process [2]. However, this problem can be observed to a greater extent in underdeveloped economies, where, for example, the commercialization and setting of the price of energy is difficult due to having small stock markets and the mechanisms of information transfer are incipient. [4]

Therefore, this study makes an analysis of the publications and topics of interest on the part of the scientific community regarding the development of energy policies applied specifically to wind energy; based on a bibliometric study with searches of documents indexed to Web of Science databases - WoS and Scopus. The purpose of this study is to develop a framework that justifies and expresses the importance of the topic for the scientific community, trends in topics addressed by experts and journals with greater impact and interest for the publication of articles on these topics.

This paper presents, first, the conceptual analysis of energy policies focused on wind energy; based on the documents found in the databases analyzed, secondly, the methodology used for the development of the study is presented, then the results are shown and finally, the conclusions reached by this research.

## WIND ENERGY AND ENERGY POLICIES

With the growing concern among scientists and policy makers about the potentially catastrophic consequences of climate change, there is a push in many countries to increase the amount of energy generated from renewable resources. Due to wind turbine technology is the most advanced in technical aspects, this can be used with other renewable energy technologies, and make it more economically profitable, wind turbines have been deployed in matrices with greater frequency; however, it is a subject that has developed controversies in public opinion for the reasons of visual impact and noise, which generate barriers to entry to this technology [5]

For Wolsink [3], the schemes for the introduction of wind energy must consider the public acceptance of the technology; thus, both politicians and researchers present wind energy as a renewable source that confront with climate change, but considers that care must be taken in the location and design. In this case it concludes that the policies for the location should fall on the central governments, but in practice, it is the local governments who finally determine the planning.

Another one of the barriers in which the policies must focus, is the high costs of penetration and investment that the wind energy has, compared with the conventional sources. For example, for Blanco [1] wind energy is a capital-intensive technology, with fixed assets representing up to 80% of the total cost. Operation and maintenance represent another 10% of the expense; although there is uncertainty regarding this category, due to few wind turbines have reached the end of their useful life, which limits the accuracy of any analysis. Therefore, it proposes an appropriate political framework that can undoubtedly reduce the cost of generating wind energy. R & D policies should focus on the optimization of the size of wind turbines, the application of advanced materials, the improvement of prediction and placement techniques, operation and maintenance with remote control devices and the design of intelligent networks that support greater amounts of wind energy.

The above aspects show that regulatory frameworks and energy policies play a key role in the development and implementation of renewable energies. In addition, they would allow the development of a map and ways to solve problems that may result from the expansion of energy networks, adopting wind power as the main source [6].

## METHODOLOGY

Bibliometrics is the application of mathematical and statistical methods to books and other media. This includes books, monographs, reports, theses, articles in serial publications and periodicals, and today also electronic books and electronic journals, as well as, in the broadest sense, the WEB, to determine advances in a field of science [7]. The analysis of scientific publications is an essential component in the research process, becoming a useful tool to analyze the process of generation and evolution of knowledge, evaluating scientific quality and the impact on the academic world [8].

Data mining techniques, are useful for the development of analysis of a specific investigation, especially when it comes to identifying and visualizing the relationship between keywords, where the correlation metric is the most used to determine them, can be complemented with the collaboration on the part of the authors [9]. Correlation is understood as the measure of impact or joint movement that have two or more variables, [10] this allows to find the qualitative relationship that the subjects have between each other.

For this study, the Web of Science and Scopus databases are specifically used with a search for the keywords: renewable energy, wind energy and policy, which was limited until 2017, and only to articles, which are performs a descriptive analysis of the number of publications, the chronological order in which the keywords appear and the relationship between them. It also makes use of impact indicators to measure the most important journals in the field of renewable energies, finally determining the authors with the highest citation and thus, identifying experts in terms of energy policies and wind energy.

## RESULTS

For the development of this work, we searched the scientific databases WoS and Scopus, with the keywords: renewable energy, wind power and energy policies, to follow up on the theme at an international level. A total of 121 articles were recovered in WoS and 225 in Scopus. Publications related to the development of policies that encourage investment in renewable energy and specifically through wind sources, appear as first publications since 1993 and show a growth in the interest of the scientific community at the end of the 2000s where the greatest amount of publications is evident; what is observed with figures 1 and 2 where the trend line for the number of publications in journals indexed in WoS and Scopus is increasing.

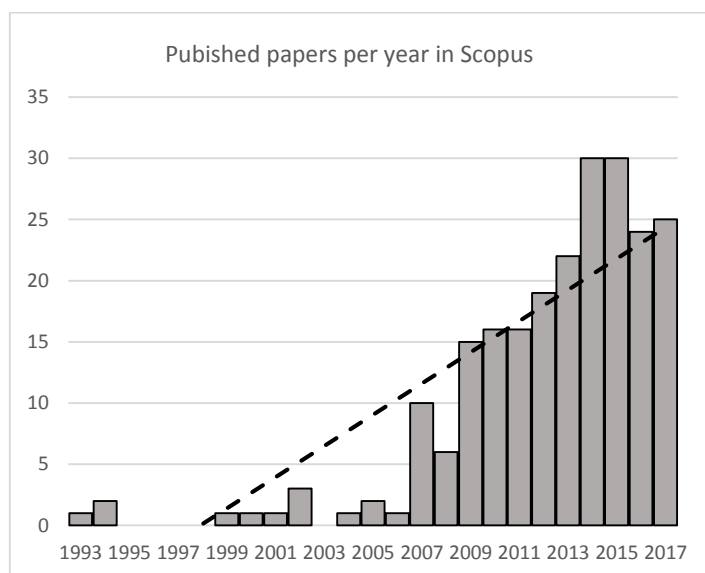
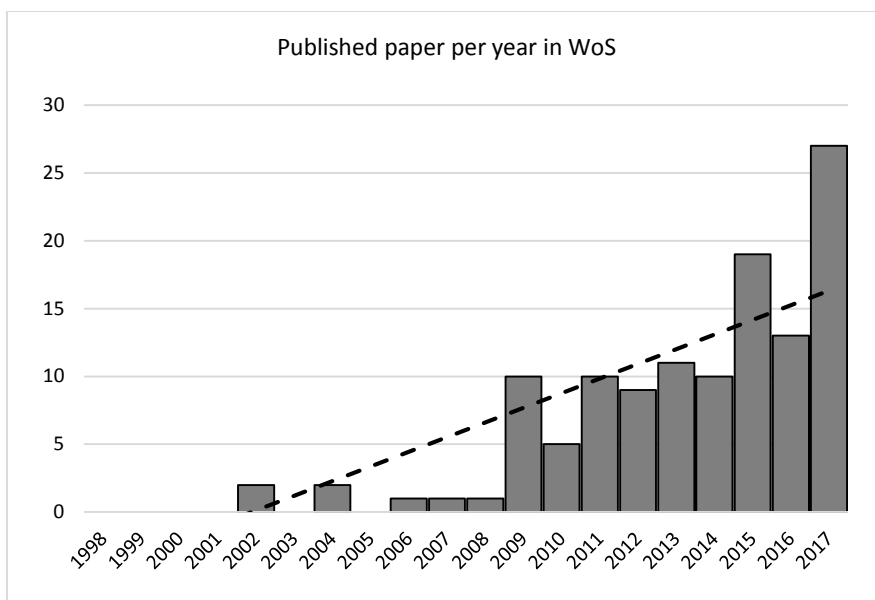


Figure 1. Number of published papers in wind energy and incentive policies in Scopus between 1993 and 2017.



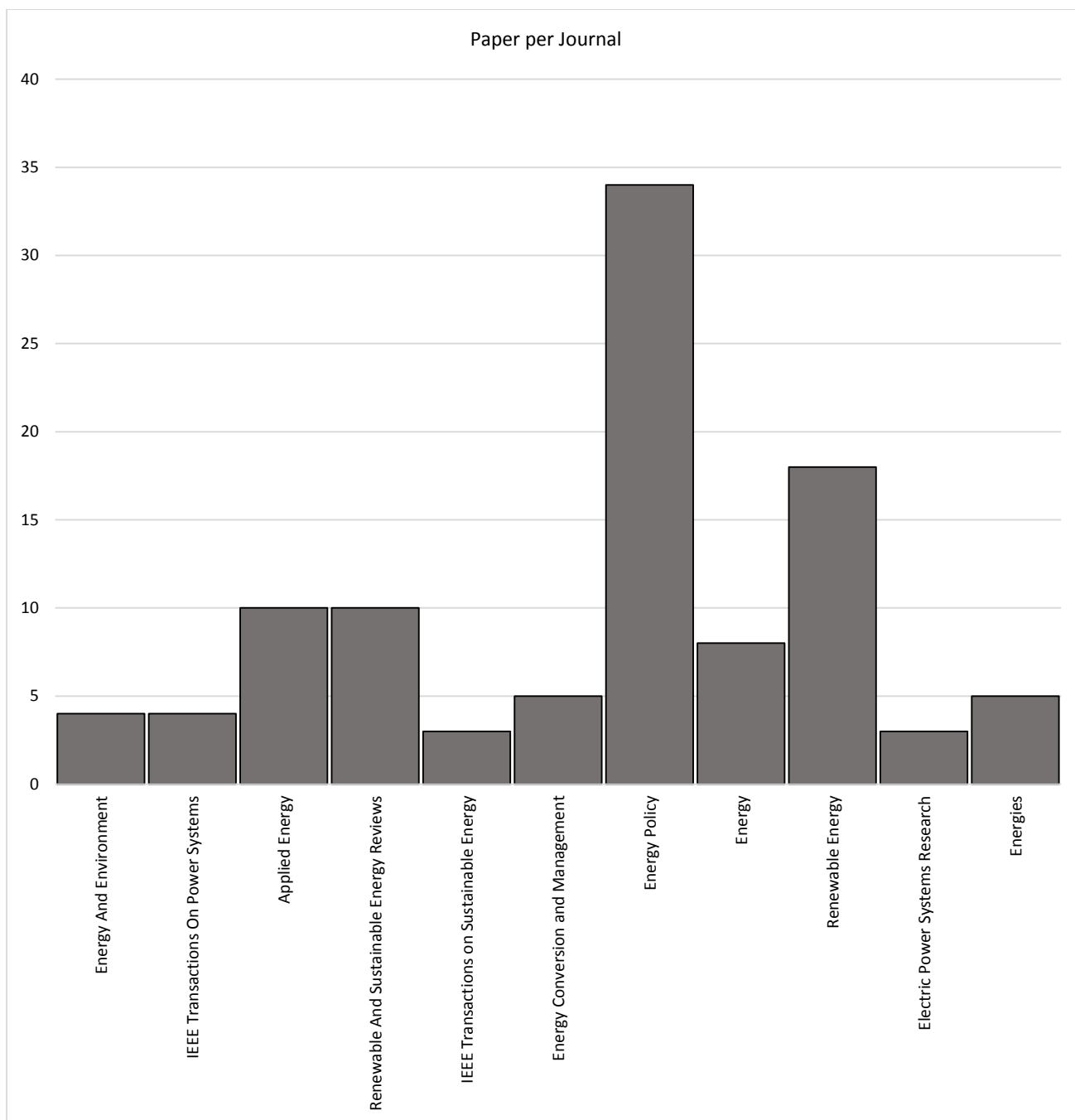
**Figure 2.** Number of published paper in wind energy and incentive policies in WoS between 1993 and 2017.

From the records found, it was found that 50% of the publications are concentrated in the journals in Table 1, which according to the reports taken from Scimago in its latest evaluation for 2017, shows that the magazine with the highest impact according to the H index and factor SJR is "Energy And

Environment"; However, it is not the magazine with the most publications since "Energy Policy" of the United Kingdom has 15.11% of the total documents found. Figure 3 shows the behavior of the journals analyzed.

**Table 1.** Impact indicators to 2017 of index journals in WoS and Scopus.

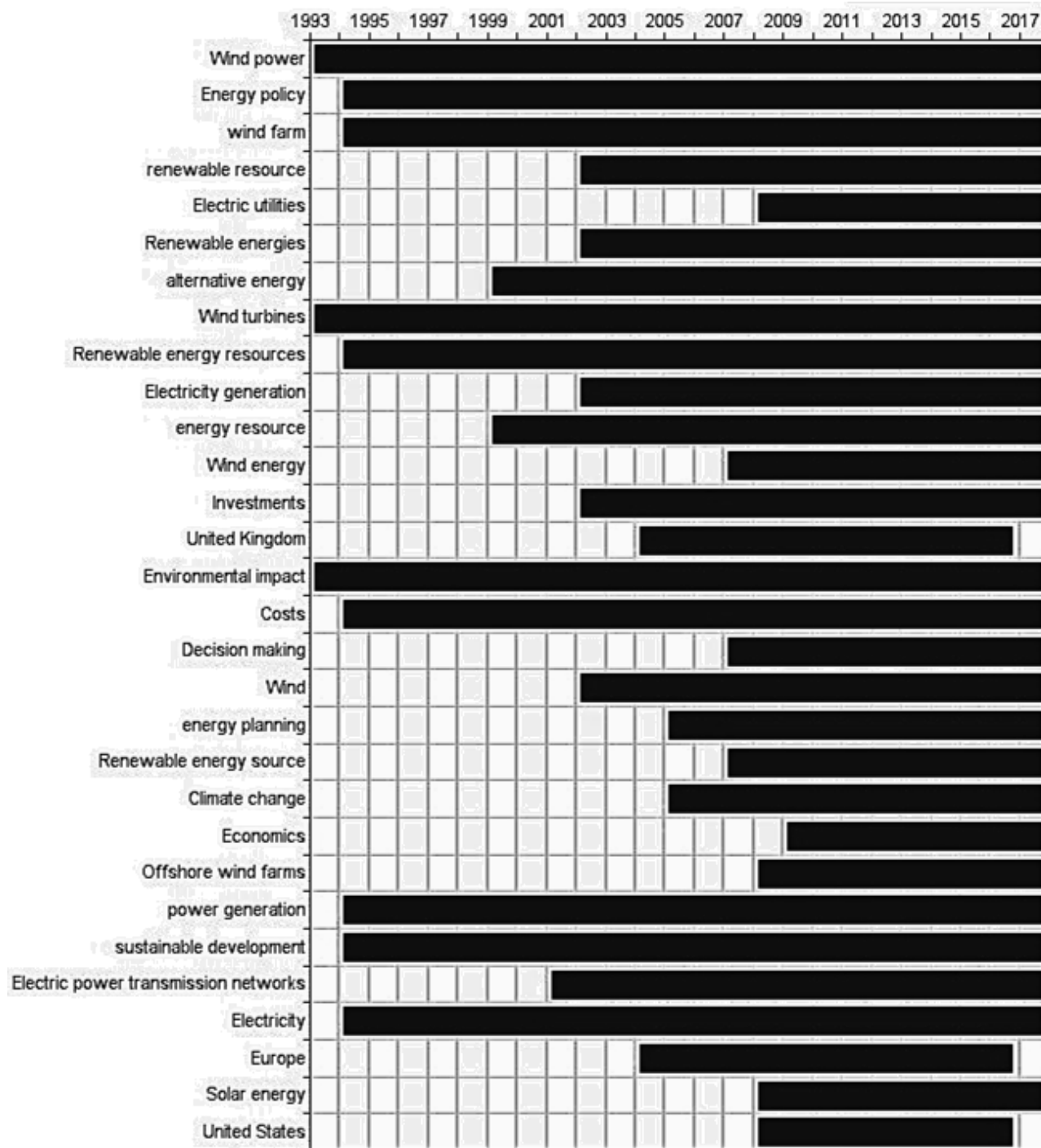
Indicadores a 2016								
Revista	Amount	% over total	SJR	SJR Best Quartile	H index	Total Docs. (3years)	Total Cites (3years)	Country
<i>Energy And Environment</i>	4	1,78%	<u>12,140</u>	Q1	<u>209</u>	1.097	<u>28.861</u>	United Kingdom
<i>IEEE Transactions On Power Systems</i>	4	1,78%	3,757	Q1	194	1.509	10.249	United States
<i>Applied Energy</i>	10	4,44%	3,058	Q1	125	3.494	26.677	United Kingdom
<i>Renewable And Sustainable Energy Reviews</i>	10	4,44%	3,051	Q1	176	2.716	25.093	Netherlands
<i>IEEE Transactions on Sustainable Energy</i>	3	2,48%	2,636	Q1	61	544	3.566	United States
<i>Energy Conversion and Management</i>	5	4,13%	2,287	Q1	139	2.736	16.277	United Kingdom
<i>Energy Policy</i>	34	<u>15,11%</u>	2,197	Q1	146	<u>3.642</u>	9.362	United Kingdom
<i>Energy</i>	8	3,56%	1,999	Q1	134	2.119	18.256	United Kingdom
<i>Renewable Energy</i>	18	8,00%	1,697	Q1	134	2.231	10.491	United Kingdom
<i>Electric Power Systems Research</i>	3	2,48%	1,167	Q1	89	889	2.812	Netherlands
<i>Energies</i>	5	2,22%	0,691	Q1	48	Dato no reporta	3.810	Switzerland



**Figure 3.** Number of published papers in journals indexed in WoS and Scopus.

due to the increase of interest in renewable energy sources from wind energy, the evolution of the concepts used as key words in the publications from 1993 to 2017 was analyzed; With the support of the Thomson Data Analyzer (TDA) software, the timeline shown in Figure 4 was created, where it was found that the first concepts to appear in 1993 are related to the development of turbines, the generation of energy and the

environmental impact. Subsequently, the concept of energy policies, wind farms, sustainable development and costs begins to take hold; what indicates the relationship between the development of clean energies and the impact on the economy is still a potential current issue for new research. However, in this analysis it is not clear what is the frequency of use and, therefore, how much research is focused on these issues.



**Figure 4.** Timeline of keywords in papers between 1993 and 2017 in Scopus.

To answer the previous question, Figure 5 is presented where the concepts and topics that were developed most frequently in the investigations are indicated. Within the analysis conducted with TDA, from the search in Scopus, figure 5 was obtained of frequencies where it is observed that again the words, renewable sources of energy, wind energy, wind farms and

energy policies increase with the passage of time and that they are used with increasing tendency in the last years, which supposes that they would be current topics.

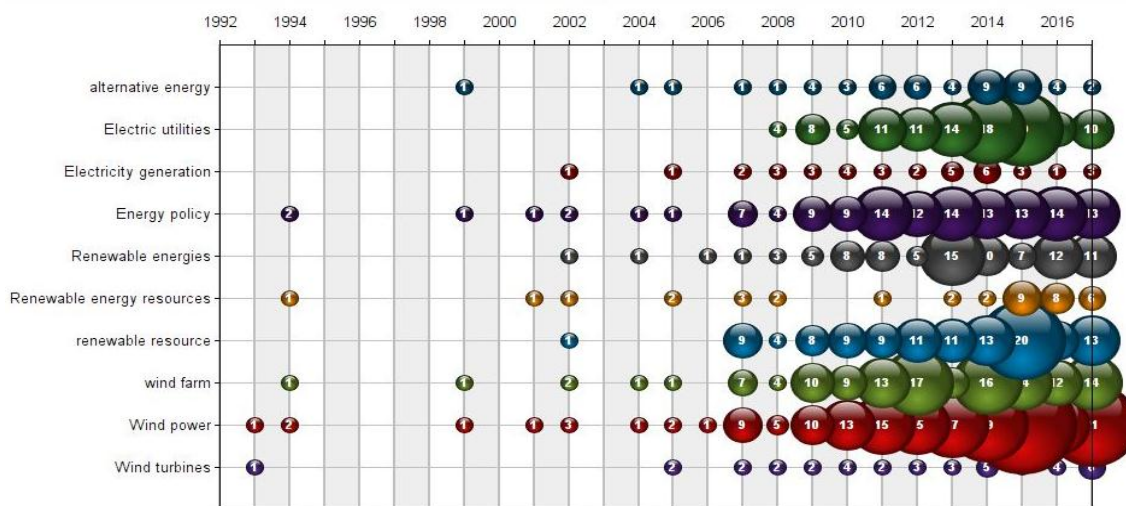


Figure 5. Frequency of ten keywords more used since 1992 until 2017.

High frequency keywords also have a relation between them, figure 6 shows with thick lines and a correlation coefficient higher than 75%, those words that are found more often in the same publication, in this way it is identified that Publications on renewable energy sources and specifically on wind energy,

are related to energy policies. In addition, it was found that the keyword "companies of the energy sector" (Electric Utilities), has a strong relationship with wind energy and energy policies, so it can infer an interest of these entities for the development of research on these issues.

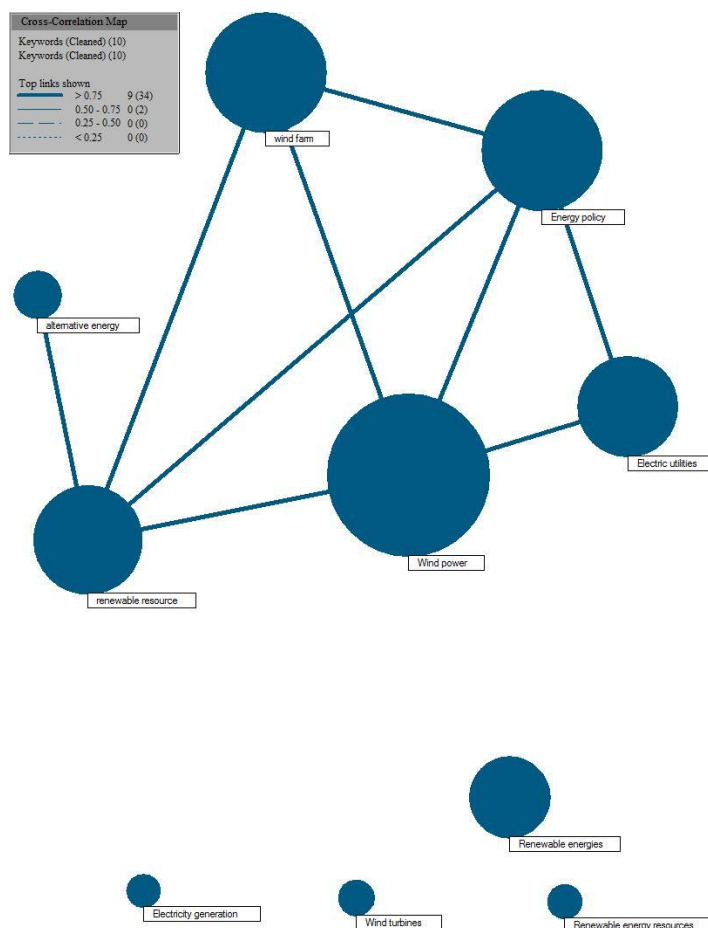
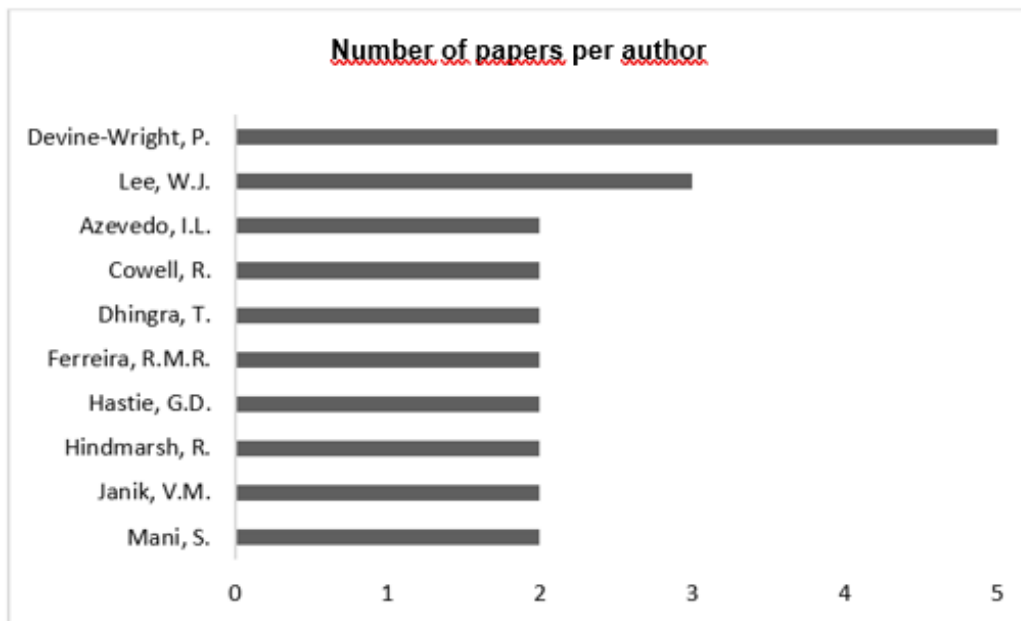


Figure 6. Correlation between keywords.

When analyzing the documents found in Scopus, the list of the ten authors with the largest number of published articles was determined. In Figure 7, it is evident that Devine-Wright P. has 5 articles and Lee, W.J. with 3 items. However, it is noteworthy that the second author does not correspond to the most cited,

while Devine-Wright P. has the articles with the highest number of citations which outlines it as a mainstream.



**Figure 7.** Author with more scientific production indexed in Scopus

To determine the authors with the greatest impact on the subject, the results were organized according to the descending order of citations for both Scopus and WoS. Table 2 shows that the article most used in Scopus as reference when studying issues related to wind energy and energy policies is "Beyond NIMBYism: Towards an integrated framework for understanding public perceptions of wind energy" by Devine-Wright in 2005 [11]. article in which the conceptual framework in which public perceptions about wind energy based on the concept "Not In My Back Yard - NIMBY" can be evidenced, this type of research trends, give way to investigations like the Wolsink in 2007 [12] that makes a planning of renewable energy schemes taking into account the intervention of wind

power equipment in landscaping. It can be identified that the research indexed to Scopus in energy and wind energy policies, are focused on the acceptance of this technology and its impact on natural spaces and environments, that is, landscaping. However, with a smaller number of citations, there is the research of Green R. and Vasilakos in 2011[13] that shows the importance of overseas wind energy in the economy and Lema A. and Ruby K in 2007 [14] that show as policies of state can affect an energy market based on wind energy, at this point the investigations turn to economic policy issues and not infrastructure.

**Table 2.** Papers indexed in Scopus with highest number of citations.

Authors	Paper Title	Year	Citations
Devine-Wright P.	"Beyond NIMBYism: Towards an integrated framework for understanding public perceptions of wind energy"	2005 [11]	481
Devine-Wright P. Howes Y.	"Rethinking NIMBYism: The role of place attachment and place identity in explaining place-protective action"	2009 [15]	383
Devine-Wright P. Howes Y.	"Disruption to place attachment and the protection of restorative environments: A wind energy case study"	2010 [16]	265
Wolsink M.	"Planning of renewables schemes: Deliberative and fair decision-making on landscape issues instead of reproachful accusations of non-cooperation"	2007 [12]	242

Authors	Paper Title	Year	Citations
Cowell R. Bristow G. Munday M.	"Acceptanceacceptability and environmental justice:The role of community benefits in wind energy development"	2011 [17]	107
Cass N. Walker G.	"Emotion and rationality: The characterisation and evaluation of opposition to renewable energy projects"	2009 [18]	90
Green R. Vasilakos N.	"The economics of offshore wind"	2011 [13]	76
Lema A. Ruby K.	"Between fragmented authoritarianism and policy coordination: Creating a Chinese market for wind energy"	2007 [14]	67
Bidwell D.	"The role of values in public beliefs and attitudes towards commercial wind energy"	2013 [19]	63
Cowell R.	"Wind power landscape and strategic spatial planning-The construction of 'acceptable locations' in Wales"	2010 [20]	63
Alnaser W.E. Alnaser N.W.	"The status of renewable energy in the GCC countries"	2011 [21]	61
Chen G.Q. Yang Q. Zhao Y.H.	"Renewability of wind power in China: A case study of nonrenewable energy cost and greenhouse gas emission by a plant in Guangxi"	2011 [22]	58

On the other hand, in the results found in WoS, it is highlighted that the articles with the greatest impact according to the number of citations, are focused on economic issues and energy markets. In addition, the importance of the penetration of this renewable source of energy, for The countries, according to the search carried out in WoS, in table 3 it is evidenced the most cited article: "The economics of wind energy" of Blanco [1], which presents the costs in the generation of wind energy projects in European countries, the factors that most influence them, the reasons for the increase and the evolution of them. The article by Bueno y Carta [23] is the second most cited, in which it is sought for the penetration of renewable energy

sources in the Canary Islands, in compliance with the European Union's objectives of maximizing clean technologies for generation of energy. Another issue that worries researchers about the inclusion of wind energy is what corresponds to landscaping and alteration of visual spaces; as can be seen in the articles by Ladenburg and Dubgaard [24], Meyerhoff, Ohl and Hartje [25], and Ladenburg [26]. The above agrees with the results of Scopus where the environmental impact of the insertion of wind energy in the electric power networks becomes a central issue when making decisions on energy policies.

**Table 3.** Papers indexed in WoS with highest number of citations.

Authors	Paper Title	Year	Citations
Blanco, Maria	The economics of wind energy	2009 [1]	211
Bueno, C; Carta, JA	Wind powered pumped hydro storage systems, a means of increasing the penetration of renewable energy in the Canary Islands	2006 [23]	167
Liew, SN; Strbac, G	Maximizing penetration of wind generation in existing distribution networks	2002 [27]	131
Ladenburg, Jacob; Dubgaard, Alex	Willingness to pay for reduced visual disamenities from offshore wind farms in Denmark	2007 [24]	94
Tian, Zhigang; Jin, Tongdan; Wu, Bairong; Ding, Fangfang	Condition based maintenance optimization for wind power generation systems under continuous monitoring	2011 [28]	91
Boccard, Nicolas	Capacity factor of wind power realized values vs. estimates	2009 [29]	81
Meyerhoff, Juergen; Ohl, Cornelia; Hartje, Volkmar	Landscape externalities from onshore wind power	2010 [25]	73
Ladenburg, Jacob	Visual impact assessment of offshore wind farms and prior experience	2009 [26]	64
Dalton, G. J.; Lockington, D. A.; Baldock, T. E.	A survey of tourist attitudes to renewable energy supply in Australian hotel accommodation	2008 [30]	61
Hall, N.; Ashworth, P.; Devine-Wright, P.	Societal acceptance of wind farms: Analysis of four common themes across Australian case studies	2013 [31]	58



## CONCLUSIONS

The issues surrounding renewable energy and energy policies begin their appearance in the databases since 1992, and take force as the decade of 2000 progresses, this, analyzed from the 121 articles indexed to WoS and the 225 belonging to Scopus that they were found until the year 2017, which indicates the recent interest of the scientific community for the development of energy under a sustainable system.

The development of this work allowed us to identify the trends in the number of publications, journals with the greatest impact and relationship among the topics addressed, according to which, it is highlighted that the publication trend in the topic is growing and with potential development in the next years; the journals with the greatest impact are mostly concentrated in the United Kingdom; however, there are also magazines belonging to the United States, the Netherlands and Switzerland. The topics of the searches carried out are strongly related to each other, given that the frequency with which the key words are wind energy, energy policies and renewable energy sources in the same publication is high; that is, the correlation is greater than 75%.

Of the most important authors measured by the number of publications and citations they possess are Devine-Wright Patrick, Wolsink Maarten, Blanco Maria and Bueno C. Carta. In these articles reference is made both to the energy policies that influence the geographical space and, also refer to the costs of investment and penetration of wind energy in the economies.

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