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The research on energy in spain: A scientometric approach

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ABSTRACT

This work describes the features of the contributions made by the Spanish institutions to the specialized literature in the energy field in the period 1957–2012. The source considered has been the Scopus Elsevier database, together with bibliometric analysis techniques. All items provided by Scopus have been taken into account in the analysis (journal papers, conference proceedings, etc.). The results of this work show that the Spanish contribution is more that significant in the light of the obtained data, being the keywords power, energy, system, wind and solar the most used terms. Different aspects of the publications are analyzed, such as publication type, field, language, subcategory and journal type, as well as the keyword occurrence frequency. The contributions are geographically and institutionally broken down, with Madrid and Catalonia the main researching regions. At an international level, Spain mainly works jointly with France, USA, Germany and the United Kingdom. The most active categories in the Energy field are Engineering, Materials Science and Chemistry. It can be stated that the Spanish research enjoys good health and is an important and relevant player in the international scientific scene.

Contents

1. Introduction

Energy in all its facets is a very interesting field of study for the scientific community [1]. Both the generation and the distribution or its final use are the topic of numerous studies in diverse disciplines such as engineering, material sciences and chemistry [2–7]. In general, the economic and industrial development make use of energy resources [8,9] in order to cover the growing needs of world population. So, the energy related research trends analysis is of paramount importance, because it provides a detailed view about the advances and future work lines [10–12].

The Spanish specific case deserves special attention given to the innate scarceness of energy resources that the country suffers [13]. Traditionally, Spain has had very little gas and liquid hydrocarbons, or they have been of low quality [14]. The national coal is a similar example [15] with the additional problem that it is

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obtained at a higher cost than other third countries coals. Recently, renewable energies have turned up to slightly lessen this situation. Thanks to the latest Governments support, the wind and solar energy take off has been clear [16–23], generating great activity in the energy auxiliary sectors.

Lately, the study of the marine energy resources in Spain has pointed out that they can be of help to improve this situation, mainly in the Atlantic coast [24–26] and in the Canary Islands [27–29], as well as the seasonal biomass use [1,30–33]. Even though, Spain still is a relatively poor country regarding energy self-provision, this does not prevent its institutions and researchers publications and research from playing a relevant role in the international scene [34–38].

The state of the Spanish research analysis reveals a growing interest from its beginnings back in the 50s with the creation of the Junta de Energia Nuclear, JEN (Nuclear Energy Board) [39], mainly focused on atomic research. Later on, and thanks to the creation of different institutes and public centers, the diversification into other disciplines, such as wind or solar energy, started [40]. Nowadays, there are four great public research centers: Centro Superior de Investigaciones Científicas, CSIC (Scientific Research Higher Center), Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas, CIEMAT (Energy, Environment and Technology Research Center), Instituto Nacional de Tecnología Aeroespacial, INTA (Aerospace Technology National Institute) and the Instituto Geológico y Minero, IGME (Geology and Mine Institute). Among these centers, only the first one is in the top twenty of world institutions with highest number of publications about biomass as energy resource [1]. Certainly, besides these great public units, a great amount of Spanish research is based on research groups belonging to different universities of the country, up to 71 universities [41].

Then, knowing the distribution of the Spanish scientific scene regarding the energy research is of special interest. The main objective of this work lies in analyzing the research state and trends in the energy field during the last 50 years in Spain in order to help the research community understand the current situation and future trends, as well as predict the dynamic changes that could appear in the work lines.

The Scopus database has been chosen in this work as information source for the analyzed data, given that it counts with a more than 49 millions records catalog from nearly 20,500 titles and 5000 publishing houses. Scopus is accepted by the international scientific community as one of the two biggest data sources for the analysis of scientific publications [42].

2. Materials and methods

A complete search in the Scopus database has been carried out using sub-fields *subjarea* and *affilcountry* to find publications about the energy topic in which any Spanish researcher or research center has taken part. The search range goes from 1957 to 2012 (included). The different energy research sub-fields comprise all the spectrum related to any type of energy use.

The retrieved records have been treated using spread sheets and a specific open source tool, OpenRefine (http://openrefine.org/). This app is a standalone desktop application initially developed by Google for data cleanup and transformation to other formats. In this way, the messy, conflicting or disorganized text analysis is greatly eased, obtaining very satisfactory results that could be nearly impossible to get due to the extent of the working database otherwise. Each record obtained from Scopus follows Table 1 structure. The personalized export option, that the database provides, has been used.

As can be seen, more than enough information is available so rates and statistics about many field of interest can be computed.

3. Results and discussion

3.1. Type of publications and languages of publications

Fig. 1 shows the distribution of the 12,532 Spanish energy contributions in the period 1957–2012. Mainly, consisting of journal papers (8858/70.66%) and conference papers (3241/25.85%). Reviews (322/2.57%) and editorials (42/0.34%) have a less important weight.

Table 1
Structure of each record exported from the Scopus database.

Field	Value
Authors	Serrano Gonzalez J., Burgos Payan M., Riquelme Santos J.
Title	Optimum design of transmissions systems for offshore wind farms including decision making under risk
Year	2013
Source title	Renewable Energy
Volume	59
Issue	
Art. no.	
Page start	115
Page end	127
Page count	
Cited by	
Link	http://www.scopus.com/inward/record.url?eid=2-s2.0-84876721373&partnerID=40&md5=7c537f3664b7e0d1732b0d6f19fc2dc2
Affiliations	Department of Electrical Engineering, University of Seville, Seville, Spain
Authors with affiliations	Serrano Gonzalez, J., Department of Electrical Engineering, University of Seville, Seville, Spain Burgos Payan, M., Department of Electrical Engineering, University of Seville, Seville, Spain Riquelme Santos, J., Department of Electrical Engineering, University of Seville, Seville, Spain
Author keywords	Cost-benefits optimization; Decision making under risk; HV transmission system; HVDC-VSC; Offshore wind farms
Index keywords	
References	Complete list of references
ISSN	9601481
ISBN	
CODEN	
DOI	10.1016/j.renene.2013.03.024
Document type	Article
Source	Scopus