

## **Bibliometric Assessment of Research on Energy in the World, in the Eastern Europe and in the Republic of Moldova**

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**Abstract.** Society is becoming increasingly dependent on energy. It is a stimulating factor for economic growth and technological change, but also the most significant limiting factor. The analysis of research trends on energy is of great importance because it provides a picture of the development directions of the future. The goal of the paper is to evaluate the performance and tendencies of researches on energy in the World, Eastern Europe region and in the Republic of Moldova. This goal is achieved by using bibliometric methods. Bibliometrics has become standard method for measuring the impact of research, which is accepted as a valid way of ranking scientific performance and tendencies. The novelty of the work consists in the wider geographical and chronological coverage of the study in comparison with similar studies, as well as that the analysis was carried out based on data extracted from two international and one national databases: Scopus Elsevier, Web of Science Core Collection and National Bibliometric Instrument. It was revealed that on global, regional and national levels the number of papers on energy increases quicker than the total number of publications. There is also a growth of the share of publications on energy from total number of documents on global, regional and national levels. The contribution of the Eastern Europe in the global information flow on energy increases slowly but stable. Lower speed of increase of the contribution of the Republic of Moldova in the regional (EE) information flow on energy is detected.

**Keywords:** research on energy, energetical sector, energy research trends, energy research productivity, bibliometric assessment, information flow on energy.

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### **Evaluarea bibliometrică a cercetărilor în domeniul energeticii în lume, în regiunea Europei de Est și în Republica Moldova**

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**Rezumat.** Societatea devine din ce în ce mai dependentă de energie, deoarece energia este atât un factor de stimulare a creșterii economice și al schimbărilor tehnologice, cât și cel mai important factor limitator. Analiza tendințelor cercetării în domeniul energeticii are o importanță deosebită, deoarece oferă o imagine a direcțiilor de dezvoltare pentru viitor. Scopul lucrării constă în evaluarea nivelului de dezvoltare și a tendințelor cercetării în domeniul energeticii în lume, în regiunea Europei de Est și în Republica Moldova. Acest scop este atins prin utilizarea metodelor bibliometrice. Bibliometria a devenit metodă standard pentru măsurarea impactului cercetării, care este acceptată ca o modalitate credibilă de evaluare a performanței științifice. Noutatea lucrării constă în acoperirea mai largă geografică și cronologică a cercetării în comparație cu alte lucrări similare, precum și în faptul că analiza a fost efectuată pe baza datelor extrase din două baze de date internaționale și una națională: Scopus Elsevier, Web of Science Core Collection și Instrumentul Bibliometric Național. S-a constatat că, la nivel global, regional și național, numărul de lucrări privind energetica crește mai rapid decât numărul total de publicații. Se înregistrează de asemenea o creștere a ponderii publicațiilor în domeniul energeticii din numărul total de documente la nivel global, regional și național. Contribuția Europei de Est în fluxul informațional global în domeniul energeticii crește încet, dar stabil. S-a stabilit, că viteza de creștere a contribuției Republicii Moldova în fluxul informațional regional (EE) în domeniul energeticii este mai mică.

**Cuvinte-cheie:** cercetarea în energetică, sectorul energetic, tendințele cercetării în energetică, productivitatea cercetării în energetică, evaluarea bibliometrică, fluxul informațional în energetică.

**Библиометрический анализ исследований в области энергетики в мире, в Восточной Европе  
и в Республике Молдова**

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**Аннотация.** Общество становится все более зависимым от энергии. Энергия является не только стимулирующим фактором экономического роста и технологических изменений, но также и сильнейшим ограничивающим фактором. Анализ тенденций исследований в области энергетики имеет большое значение, поскольку он дает представление о направлениях развития данной отрасли в будущем. Целью работы является оценка продуктивности и тенденций исследований в области энергетики в мире, регионе Восточной Европы и в Республике Молдова. Эта цель достигается с помощью библиометрических методов. Библиометрия стала стандартным методом измерения воздействия исследований, который принят в качестве надежного способа ранжирования научных достижений и тенденций. Новизна работы заключается в более широком географическом и хронологическом охвате исследования по сравнению с аналогичными работами, а также в том, что анализ проводился на основе данных, извлеченных из двух международных и одной национальной баз данных: Scopus Elsevier, Core of Science Core Collection и Национальный Библиометрический Инструмент. Выявлено, что на глобальном, региональном и национальном уровнях количество статей по энергетике увеличивается быстрее, чем общее количество публикаций. Растет, также, и доля публикаций по энергетике в общем количестве документов на глобальном, региональном и национальном уровнях. Вклад Восточной Европы в глобальный информационный поток по энергетике увеличивается медленно, но стабильно. Обнаружена более низкая скорость роста вклада Республики Молдова в региональный информационный поток в области энергетики.

**Ключевые слова:** исследования в энергетике, тенденции исследований в области энергетики, производительность исследований в области энергетики, библиометрическая оценка, информационный поток.

## INTRODUCTION

Energy is fundamental to the economic progress and social development of any country. Human society is increasingly dependent on energy, which is a stimulating factor for economic growth and technological change. Energy use is also a key determinant in ensuring the needs of various fields or branches, populations' needs, as well as increasing the quality of life. Driven by expansion in developing countries, global energy demand is set to increase by 35% over the period 2015–2040 [1]. Primary energy consumption growth averaged 2.2% in 2017, up from 1.2% in 2016 and the fastest since 2013. This compares with the 10-year average of 1.7% per year, contributing significantly to economic growth, as well as of living standards [2]. A number of authors that have investigated the relation between a country energy use and its degree of development have found strong correlations between energy use and living standards [3–6]. However, in the current context of globalization, the energy used by a country is not anymore an adequate indicator for measuring the total energy requirements associated with its level of development; the significant variable is the

energy consumed worldwide to produce the goods and services required by that country [7].

There is a variety of interdisciplinary studies (i.e. chemistry, engineering, environmental science, materials science, economics etc.) that approach the issues of production, distribution and use of energy [8–9]. The analysis of energy research trends is of great importance because it provides a picture of the development directions of the future. At the same time, it is very important to analyse the energy situation in developing countries for sustainable development [10], as well as the contribution of the energy sector to achieve the sustainable development objectives (SDOs) [11]. Multidisciplinary research into economic, social, technical, behavioural, institutional, governance and policy aspects of energy market is of imminent importance, especially because policy-makers need valid and reliable information to support evidence-based decisions in the process of developing policies on energy issues [12].

In the Republic of Moldova (RM), the energy sector is the basic branch for the country's economy, and other segments of the national economy largely depend on it. The evolutions in the global economy, the global financial crisis, the energy impasse in which are the energy-

dependent countries, and the significant dependence of the Republic of Moldova on the import of energy resources, require the development of strategic mechanisms and levers to deal with country's dependence on the energy resources [13]. The dependence on imported energy resources determines a great vulnerability of the country's macroeconomic stability.

In order to develop the energy sector of the Republic of Moldova, it is necessary to implement a series of solutions, such as: increasing energy efficiency, introducing modern and efficient systems for energy consumption management, developing incentive mechanisms for actions to increase energy efficiency and energy conservation, creation of the biofuel use infrastructure, as well as participation of academia in R&D on energy [14].

In this context, it is important to identify the regional and national contribution to researches on energy. Typically, various indicators are used to measure the impact, the visibility or the performance of science, for example, the number of scientific publications, the number of citations, the number of downloads etc. These indicators cannot have a full impact, but they are often viewed as powerful and unequivocal forms of evidence [15] and can be used for evaluation of the science evolution [16, 17].

Although, there is not yet an accepted framework within which to measure societal impact of the research, bibliometrics has become standard methods for measuring the impact of research in science [18] which is accepted as a valid way of ranking scientific performance. The bibliometric analytical technique offers an effective quantitative perspective to assessing the development and growth of research on strategic topics [19]. It is a statistical method of counting to evaluate the growth of literature for a particular subject, which has been widely employed in various disciplines to describe the distribution pattern of articles within a given topic, field, institution and country [20].

There are some advantages in implementing bibliometric analysis that makes it suitable for the assessment of research: (1) it provides an evaluation of the scientific production in a specific research areas over a period of time using indicators for evaluation of research performance [21]; (2) it analyses data, which concerns the essence of scientific work; (3) the bibliometric data can be easily found and assessed for a broad spectrum of disciplines using appropriate databases [22]; (4) it examines

science as a knowledge-generating system [23]; (5) the results of bibliometrics correlate well with other indicators of research quality [24]; (6) it is possible to summarize big amounts of information and establish key characteristics in the research landscape; (7) allows comparison among different scientific disciplines and different countries [25].

Many research areas, scientific disciplines and countries have tried to evaluate their evolution by this method and, nowadays, bibliometric techniques have become an important instrument for measuring scientific progress. The data provided by the bibliometric analyses on the productivity of scientific research help governments, decision-makers in the distribution of public money, in the elaboration of long-term strategic plans, to establish research perspectives directions, or decide to support certain research activities in accordance with the economic and political objectives of a country [26].

#### RELATED WORKS

For the last years, the evaluation of the productivity of scientific research become common practice in energy field. Several bibliometric analyses were carried out to evaluate global scientific production on R&D in the energy sector [27, 28]. The results showed that the United States, Japan, China and India are the countries that published most papers on energy subjects. The USA is the country that has published most of papers in energy field, including both individual production and international collaboration. Studies on energy technology, environmental aspects and global climate changes are among the main topics. Among leading countries, China has demonstrated a stupendous growth rate, specialization in the field, and immense scientific output.

A significant body of research has focused on bibliometric review of various energy related fields of research, such as low-carbon power [29, 30], solar power [31, 32], energy efficiency [33, 34], green energy [35], alternative energy [36] etc. The purpose of those studies was to provide an overview of research activities at the global level on these topics, describing various aspects of research outputs.

Bibliometric indicators have generally been used to evaluate country-wide energy publishing. For the last decade the evaluation of the productivity of scientific research in energy

fields become common practice in various countries: Australia [37], Brazil [38], China [20, 39-41], Germany [42], India [43-45], Norway [46], South Africa [25], Spain [47] etc.

The study regarding visualizing Australia energy and environment research productivity, conducted over the period of 1991-2014, shows a steady increase in Australia's literature output in energy fuels (8.4%). The results show that many of research papers have identified in the field of energy fuels 174 (6.2%) as the scientists are interesting to do their research [37].

The analysis of Brazilian research on high energy physics, indexed by Web of Science from 1983 to 2013 [38], show the increase of the international collaboration in the field under study. Brazilian high energy physics articles accounted for 3% of the total investigated. Brazil occupies the fourteenth position in terms of participation in high energy physics. Also, the results show that the average publications growth in this period in Brazil. In terms of visibility, significant internationalization of research in the field seems to have contributed to the high rate of articles with at least one citation (87.65%).

Bibliometric analysis of Chinese energy research aims to summarize an overview of Chinese research in energy R&D, and trends in research on coal, microbial fuel cells, energy and fuels using comprehensive bibliometric analysis measures based on data extracted from Web of Science databases [20, 39-41]. Thus, China has cooperated with 75 countries in the field of energy and fuels. The USA and Japan have had the highest rates of co-publication with China, much higher than other countries. Also, China showed an exponential increase in its number of published articles. Energy fuels, engineering chemical, environmental sciences were the major subject categories and biomass and biodiesel research was the popular topic, as well as hydrogen and fuel cells, but solar energy was not still „hot”.

Another country's scientometric study on trends in solar energy research has been conducted in Germany [42]. The results of the study have shown that there are increasing trends of papers during the study period 2011-2015.

Over the past 5 years, several studies on the bibliometric and scientometric analysis of literature in various fields of energy in India have been conducted [43-45]. The papers attempt to study the trends in renewable energy, solar energy, green energy and wind energy research in India. Results demonstrate that India

has shown increasing trend in the research output in these emerging areas of energy research. Thus, it is found that after the year 2000, PhD is produced in almost every renewable energy technology which is quite applauding. At the same time research output in solar energy in India almost doubled in 2005-2009 as compared to 2000-2004. Although, the research productivity of renewable energy reveals that a regular growth during the study period 2001-2013, India's contribution on renewable energy output during the study period is 652 only. This number is very low in comparison with other countries.

Social science studies actively contribute to public debate on reducing energy consumption and building effective and socially sustainable energy markets. The international and Norwegian study towards social science research on energy has identified key areas covered by this topic [46]. The energy subject area with the most publications is energy use, followed by carbon capture and storage and wind technology. The analysis indicates that energy, and environmentally friendly energy especially, has increased in importance within social science publishing and also in terms of Norwegian participation in national and international research projects. This heightened research interest reflects a hard focus on environmentally friendly energy, in an international and national context.

The objective of another investigation is to assess the field of energy research in the South Africa [25]. The Thomson Reuters databases were interrogated for the identification of South African authors publishing in the field of „Energy and Fuels” during the period 2003–2013. Analysis of the core energy literature identified that 752 articles with at least one South African address appeared in the database during this period. The South Africa's contribution to core energy literature is showing an increasing trend. However, the South African national research system is producing a relatively small number of research publications in the international energy core literature. Energy research literature constitutes approximately 1% of the national output. Analysis of the specialisation patterns of energy research shows that fossil (31.5%) and renewable energy (28.0%) related research are equally emphasised in the South Africa, albeit by a small number of articles, and topics related to energy efficiency appear to be an ascending trend.

In [47] it is presented the result of the bibliometric study regarding research on energy in Spain carried out using Scopus Elsevier database. The analysis shows the distribution of the 12,532 Spanish energy contributions in the period 1957–2012. Mainly, consisting of journal papers (70.66%) and conference papers (25.85%), other types of publications such as reviews and editorials have a less important weight. The increase in publications during this period has been exponential, especially in the Engineering, Material Science and Chemistry categories. As a result of the keywords analysis the authors have deduced that „Power Quality”, „Hydrogen” and „Modelling” are the three terms most used by researchers. The studies show that the Spanish contribution is significant, that the energy topics produce a big amount of international publications in journals and outstanding conferences, also that Spain collaborates with a relevant number of international institutions.

Regarding the bibliometric and scientometric researches carried out in the Republic of Moldova, some analyses on scientific productivity [48, 49] and on the contribution of the Moldovan researchers in the information process [50, 51], as well as analysis of research outputs in some research areas [52] should be noted.

According to the analysis presented in these papers, there has been the unprecedented growth of contribution of Moldavian scientists on a world-wide information process after 2004. This process is related with new type of science administration due to enactment of „The Code on Science and Innovation” and intensification of international scientific cooperation. Also, articles present the data regarding the Moldovan scholars’ collaboration in academic publishing in different scientific disciplines in the period from 2001 to 2010. In these papers is specified the contribution of researchers and scientific groups to the development of different directions of national science. It is demonstrated that Moldova is among the countries with the mid-level of both the scientific and socio-economic development.

The bibliometric studies carried out at the international level, as well as those in the Republic of Moldova, do not present analysis on

the research output and trends in energy research in Eastern Europe<sup>1</sup> region (EE).

Against this background the objective assessment of scientific productivity on energy of the EE region in general and of the Republic of Moldova in particular acquires special importance. Thus, this study aims to provide an up-to-date bibliometric view and trends of energy R&D in EE region and in the Republic of Moldova.

### OBJECTIVES OF THE STUDY

The main objective of this study is to evaluate the trends in research performance in the field of energy research in the world, Eastern Europe region and, as a case study, in the Republic of Moldova, for the period of 15 years (2003-2017).

Specific objectives of the paper are:

- To perform bibliometric analysis of research papers on energy with authors from all over the world, from the Eastern Europe countries and from the Republic of Moldova;
- To find out and compare the growth rate of the number of publications on energy on global, regional and national level;
- To compare the share of papers on energy form total number of publications on global, regional and national level;
- To identify and compare regional contribution in the worldwide and national contribution in the regional information flow on energy;
- To detect main trends in R&D on energy in the world, in the region and in the Republic of Moldova;
- To identify top researchers, top research organizations and top countries in research on energy on global, regional and national levels.

## METHODOLOGY, RESULTS, DISCUSSIONS

### METHODOLOGY

This study was performed based on data from three databases: 1) Web of Science (WoS – Core collection), 2) Scopus, 3) National Bibliometric Instrument (IBN) [53], and covers the period of 15 years (2003-2017). Data were gathered in the period of 16-20 February 2019.

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<sup>1</sup> Eastern Europe countries according to Worldometers: Russia, Ukraine, Poland, Romania, Czech Republic, Hungary, Belarus, Bulgaria, Slovakia, Moldova  
<http://www.worldometers.info/population/europe/eastern-europe/>.

It should be noted that IBN was used to extract data only on national level.

The following data were extracted:

- Total number of papers, and publications on energy registered in databases;
- Total number of papers, and publications on energy with authors from EE region;
- Total number of papers, and publications on energy with authors from RM;
- Authors with the most papers on energy on global, regional (EE) and national (RM) levels;
- Affiliated organizations to authors with the most papers on energy from all over the world, EE region and RM;
- Most productive countries in research on energy on global and regional level;
- Countries with which the Republic of Moldova in research on energy collaborates.

Obtained data on publications were processed in order to identify:

- Growth rate of the total number of publications and of papers on energy on global level;
- Growth rate of the total number of publications and of papers on energy with authors from Eastern Europe;
- Growth rate of the total number of publications and of papers on energy with authors from the Republic of Moldova;
- Share of research papers on energy with authors from all countries of total number of publications;
- Share of papers on energy on regional level of total number of publications with authors from EE;
- Share of papers on energy on national level of total number of publications with authors from RM;
- Contribution of EE authors to world information flow on energy research;
- Contribution of RM authors to regional information flow on energy research;
- Global, regional and national trends in energy research;
- Five top authors and authors' affiliations of papers on energy in the World, in EE region and in RM;
- Five top more productive countries in research on energy on global and regional level;
- Five top countries with which academia from the Republic of Moldova in research on energy collaborates.

## RESULTS

One of the main bibliometric indicators is the dynamics of the number of papers written by authors located in a given geographical area in a specific subject during a certain period. But this indicator cannot be used for comparison of dynamics on global, regional and national level. In this case the growth rate of the number of publications can be used, a certain year for all geographical areas being considered as 100% or 1.

According to data collected from Web of Science and Scopus the growth rate of research papers on energy is bigger than the growth rate of the total number of publications. Thus, on global level, in 15 years the number of papers on energy increased about 2 times, while the number of papers on energy in the same period has increased 4.7 times in WoS and 3.9 times in Scopus (tab. 1).

According to data presented in table 2, on EE level the total number of publications increased 2.9 times in WoS and 1.7 times in Scopus, while the number of papers on energy increased 6.5 times and 4 times correspondingly.

As about the Republic of Moldova, according to international sources the growth rate of the total number of publications is comparable with that of the world and global: 1.9 in WoS and 2.4 in Scopus. At the same time, the number of papers on energy with authors from the Republic of Moldova increased 12.3 times in WoS and 14 times in Scopus in 15 years (tab.3). Together, data obtained from national database (IBN) show that the growth rate of total number of publications with authors from RM (22.7) and papers on energy with Moldovan authors (21.0) increased considerably, but are very close.

The phenomenon of a bigger growth rate of papers on energy in comparison with the growth rate of the total number of papers can be related to the increasing interest in the world, region and especially in Moldova for solving the energy problem. Taking into consideration obtained data it can be concluded that although the growth rate increased so much, research on energy is a less priority on national level and more on international one.

The number of publications with at least one author from the Republic of Moldova reveals that there are about three times as many papers on a national level (according to IBN), as on international one (based on Web of Science and Scopus) (tab. 4).

Table 1.

Growth rate of total number of publications and papers on energy in 15 years on global level

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
	<b>Web of Science</b>														
<b>Total on global level</b>	1.0	1.1	1.1	1.2	1.3	1.4	1.4	1.5	1.6	1.7	1.7	1.8	2.0	2.1	2.1
<b>On energy on global level</b>	1.0	0.9	0.9	1.1	1.3	1.5	1.8	1.9	2.1	2.6	3.2	3.5	3.7	4.1	4.7
	<b>Scopus</b>														
<b>Total on global level</b>	1.0	1.1	1.2	1.3	1.4	1.4	1.8	1.7	1.6	1.5	1.8	1.9	1.8	1.9	2.0
<b>On energy on global level</b>	1.0	1.0	1.2	1.2	2.2	2.2	2.5	2.0	2.0	1.7	1.6	2.7	2.9	3.3	3.9

Table 2.

Growth rate of total number of publications and papers on energy in 15 years with authors from EE

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
	<b>Web of Science</b>														
<b>Total of EE</b>	1.0	1.1	1.1	1.2	1.3	1.4	1.5	1.6	1.6	1.7	1.8	2.0	2.6	2.8	2.9
<b>On energy of EE</b>	1.0	0.8	0.9	0.9	1.7	1.7	1.9	2.0	2.0	2.4	2.6	3.2	3.8	4.7	6.5
	<b>Scopus</b>														
<b>Total of EE</b>	1.0	0.8	0.9	0.8	0.9	0.9	1.1	1.0	1.1	1.0	1.1	1.1	1.3	1.4	1.7
<b>On energy of EE</b>	1.0	0.9	1.0	0.9	1.1	1.2	1.5	1.4	1.6	1.7	2.0	2.1	2.6	3.1	4.0

Table 3.

Growth rate of total number of publications and papers on energy in 15 years with authors from RM

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
	<b>Web of Science</b>														
<b>Total of RM</b>	1.0	0.8	1.2	1.1	1.3	1.5	1.5	1.7	1.1	1.3	1.1	1.0	1.4	2.1	1.9
<b>On energy of RM</b>	1.0	0.3	0.5	0.5	1.3	1.0	4.0	3.3	1.5	1.0	1.3	4.3	2.8	8.5	14.0
	<b>Scopus</b>														
<b>Total of RM</b>	1.0	0.9	1.2	1.2	1.1	1.3	1.6	1.4	1.6	1.6	1.7	1.8	2.5	2.9	2.4
<b>On energy of RM</b>	1.0	0.0	0.3	0.5	0.8	1.3	1.0	0.8	0.3	1.5	0.5	1.8	6.3	6.5	12.3
	<b>IBN</b>														
<b>Total of RM</b>	1.0	1.3	2.2	4.3	8.2	9.5	12.1	13.1	14.7	16.5	15.5	16.6	16.0	17.6	22.7
<b>On energy of RM</b>	1.0	0.5	22.5	4.5	6.0	9.0	15.5	11.5	15.5	38.5	11.0	10.0	22.5	43.5	21.0

It is obvious, because international requirements to research papers are more drastic. According to figure 1, a moderate growth is observed during all period, with three distinguished peaks, in 2005, 2012 and 2016, when International Conference „Energy of Moldova. Regional Aspects of Development”

was organized by the Institute of Power Engineering. It should be emphasized, that in 2017 there are more papers on energy in the international databases than in the national one.

Another representative indicator that shows the performance of researchers in a specific field

is the share of papers in this area in the total number of publications.

Based on data from two international sources that are presented in table 5 and figure 2, the share of papers on energy on global level increased slightly during 15 years: from 1% to 2.1% in Web of Science and from 2.2% to 4.4% in Scopus.

At regional level this share also increased slightly in 15 years: from 0.9% to 2.0% in WoS and from 2.8% to 4.7% in Scopus.

The share of papers on energy with authors from Moldova in two international sources increased significantly: from 1.6% to 8.1% in WoS and from 1.4% to 10.5% in Scopus. Significant growth can be seen after 2014. This phenomenon can be related to the increasing interest for research on energy of the Republic of Moldova on international level. Also, it can be a result of intensifying collaboration of researchers on energy from the Republic of Moldova with academia from other countries due to two facts: 1) visa-free regime for Moldova’s citizens that

has entered into force in 2014 and thus the exclusion of many previous bureaucratic procedures related with participation in international conferences, 2) the association in 2014 of the Republic of Moldova to the Seventh Research Framework Programme.

At the same time, according to national database (IBN), the share of papers on energy with authors from the Republic of Moldova did not increase (tab.5, fig.2). Only in 2005 there is a share of 7.7%. This 2005<sup>th</sup> pick appears due to the fact that the total number of papers published in this year and registered in IBN is comparatively smaller.

Another important bibliometric indicator is the contribution in information flow of a specific geographical area. In this context, a key research question is the identification of the contribution of the EE region in the global information flow on energy and of the Republic of Moldova in the regional information flow on energy research. These data are presented in table 6, figure 3.

Table 4.

Research papers on power engineering with authors from the Republic of Moldova

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	total
<b>IBN</b>	2	1	45	9	12	18	31	23	31	77	22	20	45	87	42	465
<b>WoS</b>	4	0	1	2	3	5	4	3	1	6	2	7	25	26	49	138
<b>Scopus</b>	4	1	2	2	5	4	16	13	6	4	5	17	11	34	56	180

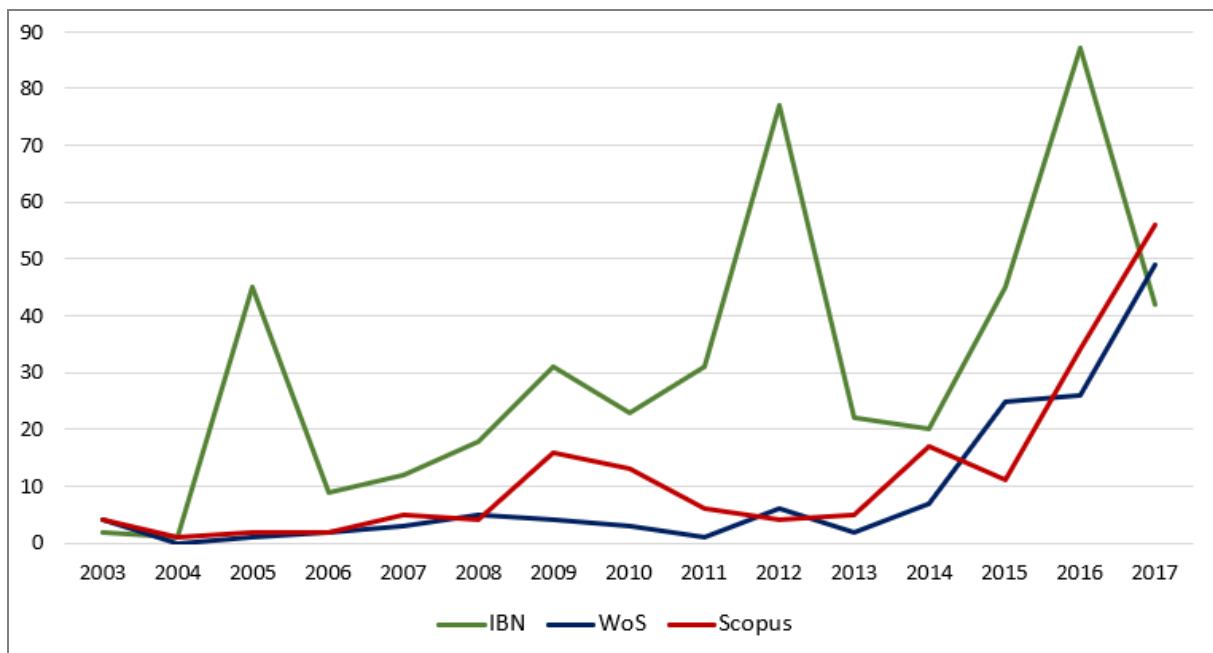


Figure 1. Number of research papers on energy with at least one Moldovan author.



Table 5.

Share of papers on energy from total number of papers (%)

Year	All countries		EE		RM		
	WoS	Scopus	WoS	Scopus	WoS	Scopus	IBN
2003	1.0	2.2	0.9	2.8	1.6	1.4	0.8
2004	0.9	2.2	0.7	2.2	0.0	0.4	0.3
2005	0.8	2.3	0.7	2.5	0.3	0.6	7.7
2006	0.9	2.2	0.6	2.2	0.7	0.7	0.8
2007	1.0	3.6	1.2	2.6	1.1	1.3	0.6
2008	1.1	3.4	1.1	2.6	1.5	0.9	0.7
2009	1.2	3.2	1.1	3.1	1.0	3.8	1.0
2010	1.2	2.7	1.1	2.8	0.9	2.7	0.7
2011	1.3	2.8	1.1	2.9	0.3	1.9	0.8
2012	1.5	2.6	1.2	2.9	1.5	1.1	1.8
2013	1.8	1.9	1.2	3.1	0.5	1.6	0.5
2014	1.9	3.3	1.4	3.0	1.6	5.8	0.5
2015	1.8	3.5	1.3	3.5	4.1	2.7	1.1
2016	1.9	3.9	1.5	3.8	3.6	5.7	1.9
2017	2.1	4.4	2.0	4.7	8.1	10.5	0.7

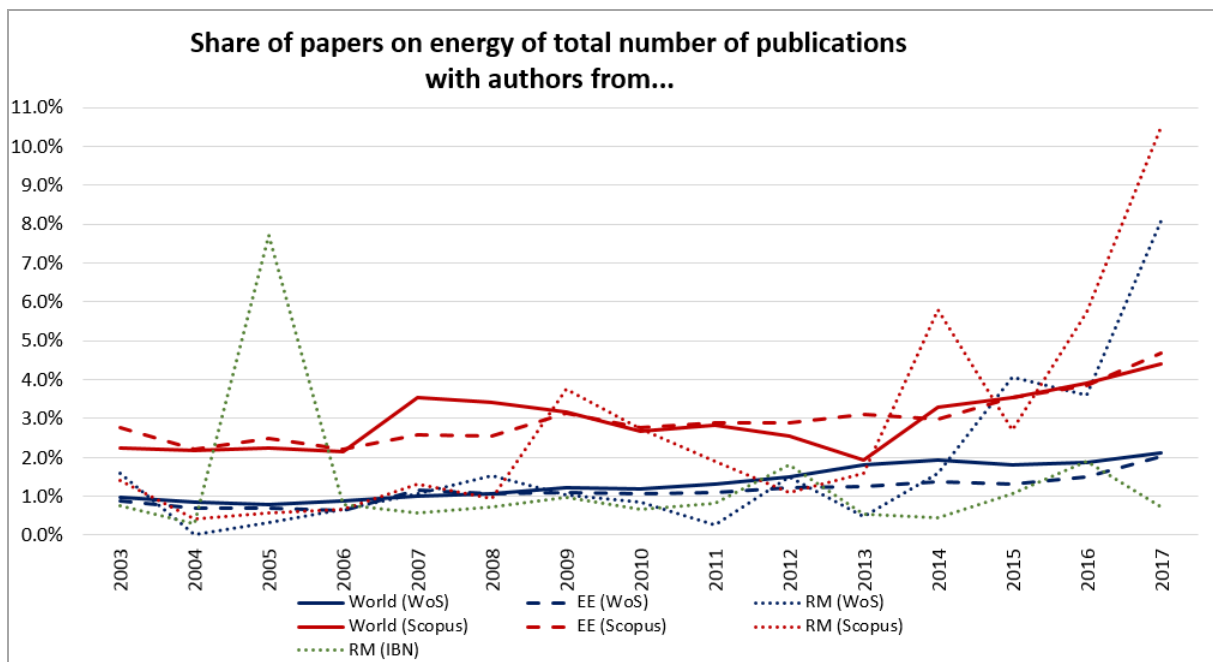


Figure 2. The share of research papers on energy.

Thus, the contribution of regional research on energy in the global one increased slightly in 15 years, with some ups and downs, from 4.2% to 5.9% in WoS and from 6.9% to 7.2% in Scopus.

The contribution of the Republic of Moldova in the regional information flow on energy increased in 15 years by only 0.6% in Web of Science and by only 0.4% in Scopus. So, the regional contribution in global information flow

on energy research is higher than of the Republic of Moldova in the regional one.

One more bibliometric indicator is the identification of top authors, organizations and countries of papers in a certain domain. According to data obtained from databases and presented in table 7, on global level 5 top authors of papers on energy in Scopus is represented mostly by United States, while in WoS by China.

Table 6.

Contribution of the Eastern Europe and the Republic of Moldova in information flow on energy (%)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
of EE in the global (WoS)	4.2	3.8	4.0	3.4	5.5	4.9	4.6	4.5	4.1	3.9	3.4	3.8	4.3	4.9	5.9
of EE in the global (Scopus)	6.9	5.6	5.8	5.8	5.0	3.6	3.7	4.3	4.9	5.5	6.8	8.6	5.2	6.2	7.2
of RM in EE (WoS)	0.7	0.0	0.2	0.4	0.3	0.5	0.4	0.3	0.1	0.4	0.1	0.4	1.1	0.9	1.3
of RM in EE (Scopus)	0.2	0.0	0.1	0.1	0.2	0.1	0.4	0.4	0.2	0.1	0.1	0.3	0.2	0.5	0.6

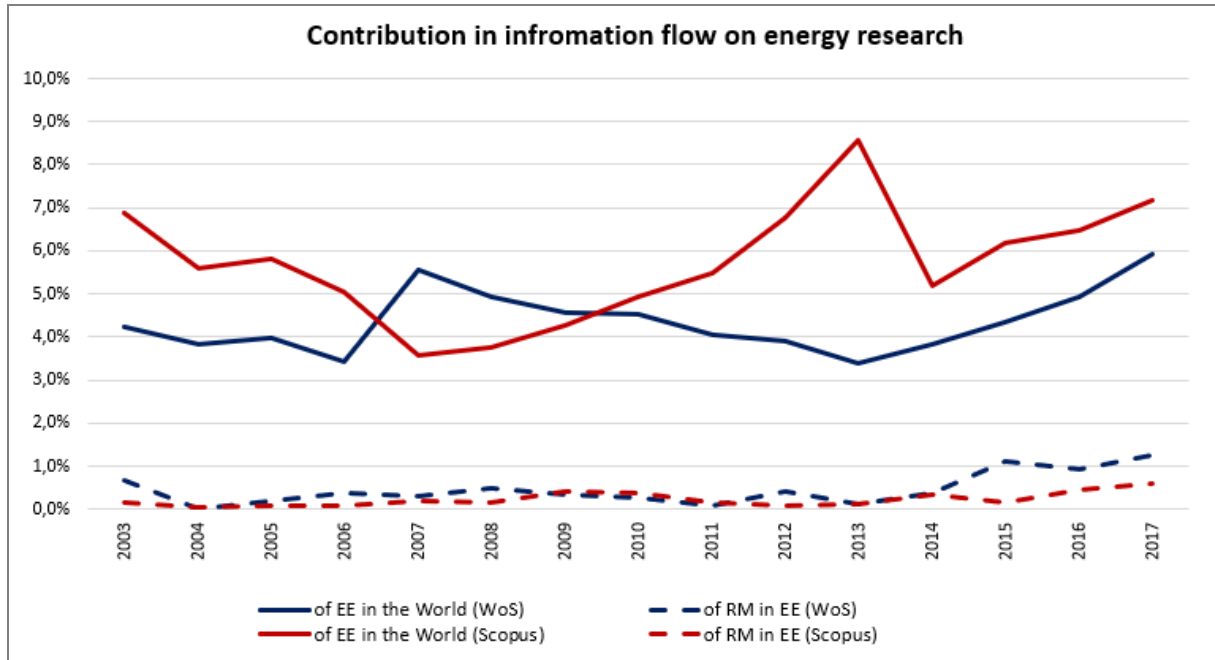


Figure 3. The contribution of EE region in the global and of the Republic of Moldova in the regional information flow on energy research.

At the same time, the number of publications of the 5 top authors in WoS is 3 times greater than in Scopus. Snow N. from United States is in the 5 top authors of papers on energy in both international databases.

On regional level, in five top authors Russian contribution is more visible: about 300

publications in Scopus and about 250 in WoS. Five top authors is also represented by Czech authors, with almost 250 publications in Scopus and almost 90 in WoS. It should be mentioned Khadziev S.N. from Russia, which is in top of both international databases (tab. 8).

Table 7.

Five top authors of papers on energy on global level, regional and national level

Top	Scopus	No of papers	WoS	No of papers
1	Jackson, K.M., USA	738	Snow N, USA	2568
2	Thinnes, B., USA	707	Wang Y, China	2312
3	Snow, N, USA	694	Zhang Y, China	1924
4	Dincer, I, Canada	601	Li Y, China	1832
5	Blaabjerg, F, Denmark	568	Li J, China	1636

Table 8.

**Five top authors of papers on energy on regional level**

Top	Scopus	No of papers	WoS	No of papers
1	Makrlík, E., Czech Rep.	125	Khadzhev SN, Russia	103
2	Vaňura, P., Czech Rep.	124	Misak S, Czech Rep.	87
3	Khisamov, R.S., Russia	119	Korobeinichev OP, Russia	79
4	Khadzhev, S.N., Lapidus, A.L., Russia	106	Fedorov AV, Russia	73
5	Strizhak, P.A., Russia	93	Badescu V, Romania	69

Table 9.

**Five top authors of papers on national level**

Top	Scopus	No of papers	WoS	No of papers	IBN	No of papers
1	Oleschuk, V.	27	Berzan V	16	Postolati Vitali	31
2	Penin, A.	15	Oleschuk V	15	Bícova Elena	29
3	Ermuratskii, V.	10	Postolaty V	11	Berzan Vladimir	25
4	Palii, A.	9	Suslov V, Sit ML	8	Tîrşu Mihai	24
5	Arushanov, E., Berzan, V., Klokishner, S.	8	Ermuratskii V, Tirsu M.	7	Popescu Victor	21

The 5 top Moldovan authors of papers on energy, show that Berzan V. appears in the top of all 3 databases. Other 4 authors appear in two databases: Ermuratsky V., Oleschuk, V. Postolati V. and Tirsu M. (tab. 9).

The five top authors' affiliations of papers on energy on global level are represented exclusively by Chinese institutions in Scopus and by two of them (Chinese Academy of Sciences and Tsinghua University) in WoS. It is surprising to see an Indian organisation in this top (tab. 10).

On regional level, the 5 top authors' affiliations of papers on energy in both international databases are represented mostly by Russia (tab. 11). Accordingly, the first place in

both databases is occupied by the Russian Academy of Sciences, but also the top is represented by one Ukrainian and one Romanian institutions in Scopus and by two Czech and one Romanian organization in WoS. In both cases Romanian organisation is represented by Polytechnic University of Bucharest.

The 5 top Moldovan institutions in research on energy is presented in table 12. These data denote that 4 organizations appear both in national and international databases: Institute of Power Engineering, Technical University of Moldova, Institute of Applied Physics, Moldova State University. State Agrarian University of Moldova.

Table 10.

**Five top authors' affiliations of publications on energy on global level**

Top	Scopus	No	WoS	No
1	Chinese Academy of Sciences	22015	Chinese Academy of Sciences	12753
2	Ministry of Education of China	15497	United States Department of Energy	11077
3	Tsinghua University, China	13098	Centre National De La Recherche Scientifique, France	6231
4	Xi'an Jiaotong University	8001	Indian Institute of Technology System IIT System	6122
5	China University of Petroleum - Beijing	7664	Tsinghua University, China	5231

Table 11.

**Five top authors' affiliations of publications on energy on EE level**

Top	Scopus	No	WoS	No
1	Russian Academy of Sciences	4308	Russian Academy of Sciences	3469
2	Siberian Branch, Russian Academy of Sciences	2081	VSB – Technical University of Ostrava, Czech Rep.	777
3	National Research Centre Kurchatov Institute, Russia	1251	Polytechnic University of Bucharest, Romania	653
4	National Science Center Kharkov, Institute of Physics and Technology, Ukraine	1237	Brno University of Technology, Czech Rep.	605
5	Polytechnic University of Bucharest, Romania	1143	Tomsk Polytechnic University, Russia	603

Table 12.

**Five top authors' affiliations of publications on energy on national level (Republic of Moldova)**

Top	Scopus	No	WoS	No	IBN	No
1	Institute of Power Engineering	50	Institute of Power Engineering	69	Institute of Power Engineering	129
2	Technical University of Moldova	32	Technical University of Moldova	22	Technical University of Moldova	92
3	Institute of Applied Physics	23	Institute of Applied Physics; Moldova State University	9	State Agrarian University of Moldova	52
4	Institute of Electronic Engineering and Nanotechnologies	14	Informinstrument S.A.; State Agrarian University of Moldova	3	Moldova State University	42
5	Moldova State University	9	National Agency on Energy Regulation	2	Institute of Applied Physics; Free International University of Moldova	19

As about contribution of countries in research on energy, on global level the same 5 countries entered the top in both international databases: China, USA, Japan, Germany, India (tab. 13). Even though, the number of publications on energy by five top countries in Scopus is about 2.5-3 times greater than in Web of Science.

On regional level again, the same 5 states represent the top countries in both databases: Russia, Poland, Ukraine, Czech Republic and Romania, and, again, the number of publications on energy per country is greater in Scopus than in Web of Science (tab. 14).

Table 13.

**Five top countries with papers on energy on global level**

Top	Scopus	Docs	WoS	Docs
1	China	250153	China	110128
2	USA	204755	USA	77516
3	Japan	57954	India	22970
4	Germany	51954	Germany	22442
5	India	50383	Japan	20303

Table 14.

**Five top countries with papers on energy on EE level**

Top	Scopus	Docs	WoS	Docs
1	Russia	30847	Russia	8029
2	Poland	10187	Poland	4974
3	Ukraine	6258	Czech Rep.	3176
4	Czech Republic	6106	Romania	2528
5	Romania	4894	Slovakia; Ukraine	963

In the era of science globalization, international co-authoring represents an important indicator. Thus, data on international co-authoring of papers on energy registered in Scopus and Web of Science reveal that Moldovan researchers collaborate more actively with their colleagues from Romania,

United States, Germany, Italy, Russia, Spain, France, Estonia. Unfortunately, there is weaker international collaboration within national publishing. As a rule, papers in national repository are co-authored internationally by researchers from Moldova's neighbours: Romania, Ukraine, Russia (tab. 15).

Table 15.

**Five top countries with which collaborate academia from the Republic of Moldova**

Top	Scopus	Docs	WoS	Docs	IBN	Docs
1	Germany	19	Romania	16	Romania	7
2	Romania; USA	16	USA	13	Ukraine; Russia	4
3	Italy	13	Italy	9	United Kingdom	2
4	Spain	12	Germany	6	France; Israel	1
5	France; Russia	9	Estonia; Russia	4		

## DISCUSSIONS

The results of the study presented in this work show that according to international databases on global, regional and national levels the number of publications on energy increases quicker than the total number of publications. This is due to the growing interest in the issue of energy. Based on national source, the growth rate of the total number of publications and papers on energy with authors from Moldova is almost the same. Hence, research on energy on national level is not a priority.

The analysis of the number of papers on energy with authors from Moldova obtained from international databases shows that Moldovan research on energy is at its initial stage of development, but the growth in the last years of the number of papers on energy inspire an optimism.

The dynamics of the share of papers on energy from total number of documents based on international sources denote that there is a slight but sure growth of this share on global and regional level.

At the same time, the dynamics of the share of papers on energy from total number of

documents with authors from Moldova indicates that after 2014 this share have begun to grow more rapidly.

The contribution of the Eastern Europe in the global information flow on energy shows that it increases slowly but stable. Lower speed of increase of the contribution of the Republic of Moldova in the regional (EE) information flow on energy is detected.

The five top authors on global level show that research on energy in Scopus is more represented by USA researchers, while in WOS Chinese scholars are more visible.

On regional level most visible in research on energy are Russian and Czech scholars.

As for the Republic of Moldova, a pleasant surprise is that 5 top authors in research on energy are present in two or even in all databases.

On global institutional level Chinese organizations are the most visible in research on energy, while on regional level Russian affiliations are the most representative in Scopus but share the top in WoS with Czech organizations.

On national level more competitive in research on energy are Institute of Power Engineering, Technical University of

Moldova, Institute of Applied Physics and Moldova State University that are present in five top institutions of all three databases.

The contribution of countries in research on energy denote that on global level the same five states represent the top of two international sources: China, USA, Japan, Germany and India.

On regional level again, the same 5 states represent the top countries in both international databases: Russia, Poland, Ukraine, Czech Republic and Romania.

In international co-authoring Moldovan researchers collaborate actively with their colleagues from Romania, United States, Germany, Italy, Russia, Spain, France, and Estonia. There is weaker international collaboration within national publishing. Papers in national repository are oftener co-authored internationally by researchers from

#### REFERENCES

- [1] Organization of the Petroleum Exporting Countries. 2017 OPEC World Oil Outlook. October 2017. Available at: <https://woo.opec.org/> (accessed 19.07.2018)
- [2] BP Statistical Review of World Energy 2108. 67th edition. 2018, June. Available at: <https://www.bp.com/content/dam/bp/en/corporate/pdf/energy-economics/statistical-review/bp-stats-review-2018-full-report.pdf> (accessed 19.07.2018)
- [3] Lambert Jessica G., Hall Charles A.S., Balogh Stephen, Gupta Ajay, Arnold Michelle. Energy, EROI and quality of life. *Energy Policy*, 2014, vol. 64, pp. 153–167. doi: 10.1016/j.enpol.2013.07.001
- [4] Liua Li, Chena Tie, Yin Yanhong. Energy Consumption and Quality of Life: Energy Efficiency Index. *Energy Procedia*, 2016, vol. 88, pp. 224-229. doi: 10.1016/j.egypro.2016.06.152
- [5] Nadimi Reza, Tokimatsu Koji, Yoshikawa Kunio. Sustainable energy policy options in the presence of quality of life, poverty, and CO2 emission. *Energy Procedia*, 2017, vol. 142, pp. 2959-2964. doi: 10.1016/j.egypro.2017.12.314
- [6] Pasten Cesar, Santamarina Juan Carlos. Energy and quality of life. *Energy Policy*, 2012, vol. 49 pp. 468-476. doi: 10.1016/j.enpol.2012.06.051
- [7] Arto Iñaki, Capellán-Pérez Iñigo, Lago Rosa, Bueno Gorka, Bermejo Roberto. The energy requirements of a developed world, *Energy for Sustainable Development*, 2016, vol. 33, pp. 1-13. doi: 10.1016/j.esd.2016.04.001
- [8] Abate Salvatore, Centi Gabriele, Lanzafame Paola, Perathoner Siglinda. The energy-chemistry nexus: A vision of the future from sustainability perspective. *Journal of Energy Chemistry*, 2015, vol. 24, no. 5, pp. 535-547. doi: 10.1016/j.jechem.2015.08.005
- [9] Yao Lixia, Shi Xunpeng, Andrews-Speed Philip. Conceptualization of energy security in resource-poor economies: The role of the nature of economy. *Energy Policy*, 2018, vol. 114, pp. 394-402. doi: 10.1016/j.enpol.2017.12.029
- [10] Kaygusuz Kamil. Energy for sustainable development: A case of developing countries. *Renewable and Sustainable Energy Reviews*, 2012, vol. 16, no. 2, pp. 1116-1126. doi: 10.1016/j.rser.2011.11.013
- [11] Urmee Tania, Md Anisuzzaman. Social, cultural and political dimensions of off-grid renewable energy programs in developing countries. *Renewable Energy*, 2016, vol. 93, pp. 159-167. doi: 10.1016/j.renene.2016.02.040
- [12] Hoppe Thomas, Coenen Frans, Van den Berg Maya. Illustrating the use of concepts from the discipline of policy studies in energy research: An explorative literature review. *Energy Research & Social Science*, 2016, vol. 21, pp. 12-32. doi: 10.1016/j.erss.2016.06.006
- [13] Baltag Alexandru, Baltag Dorina. Securitatea energetică a Republicii Moldova: alternative viabile. *Politici Publice*, 2009, no. 3, pp. 3-55. Available at: <http://www.viitorul.org/ro/content/securitatea-energeticC483-republicii-moldova-alternative-viabile> (accessed 19.07.2018)
- [14] Canțer Valeriu. Sectorul energetic al Republicii Moldova. *Akademos*, 2009, no. 1(12), pp. 49-51.
- [15] Penfield Teresa, Baker Matthew J., Scoble Rosa., Wykes Michael C. Assessment, evaluations, and definitions of research impact: A review. *Research Evaluation*, 2014, vol. 23, no. 1, pp. 21-32. doi: 10.1093/reseval/rvt021
- [16] Nalimov V. V., Mul'chenko Z. M. *Naukometriya. Izuchenie nauki kak informatsionnogo protsessa [Scientometrics. The study of science as an information process.]*. Moscow: Nauka, 1969.

Moldova's neighbours: Romania, Ukraine, and Russia.

The final conclusion of the study is that as result of the high interest for solving energy problems, the number of papers on energy increases on all levels. On global level the biggest contributors in research on energy are China, USA, Japan, Germany and India, while on regional level there should be mentened Russia and Czech Republic.

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- [17] Scharnhorst Andrea, Garfield Eugene. Tracing Scientific Influence. *Dynamics of Socio-Economic Systems*, 2010, vol. 2, no. 1, pp. 1-33. Available at: <http://garfield.library.upenn.edu/papers/tracingscientificinfluence2010.pdf> (accessed 19.07.2018)
- [18] Bornmann Lutz. Do altmetrics point to the broader impact of research? An overview of benefits and disadvantages of altmetrics. *Journal of Informetrics*, 2014, vol. 8, no. 4, pp. 895-903. doi: 10.1016/j.joi.2014.09.005.
- [19] Dua Huibin, Lia Na, Brown Marilyn A., Pengd Yuenuan, Shua Yong. A bibliographic analysis of recent solar energy literatures: The expansion and evolution of a research field. *Renewable Energy*, 2014, vol. 66, pp. 696-706. doi: 10.1016/j.renene.2014.01.018
- [20] Peng Beihua, Guo Danning, Qiao Han, Yang Qing, Zhang Bo, Hayat Tasawar, Alsaedi Ahmed, Ahmad Bashir. Bibliometric and visualized analysis of China's coal research 2000-2015. *Journal of Cleaner Production*, 2018, vol. 197, part 1, pp. 1177-1189. doi: 10.1016/j.jclepro.2018.06.283
- [21] Garfield E. Is citation analysis a legitimate evaluation tool? *Scientometrics*, 1979, vol. 1, no. 4, pp 359-375. doi: 10.1007/BF02019306
- [22] Bornmann Lutz, Leydesdorff Loet. Scientometrics in a changing research landscape: Bibliometrics has become an integral part of research quality evaluation and has been changing the practice of research. *EMBO Rep.* 2014, vol. 15, no. 12, pp. 1228-1232. doi: 10.15252/embr.201439608
- [23] Van R. For your citations only? Hot topics in bibliometric analysis. *Measurement: Interdisciplinary Research and Perspectives*, 2005, vol. 3, no. 1, pp. 50-62. doi: 10.1207/s15366359mea0301\_7
- [24] Diekmann A, Naf M, Schubiger M. The impact of (Thyssen)-awarded articles in the scientific community. *Köln Zeitschrift für Soziologie und Sozialpsychologie*, 2012, vol. 64, no. 3, pp. 563-581.
- [25] Pouris Anastassios. A bibliometric assessment of energy research in South Africa. *South African Journal of Science*, 2016, vol. 112, no 11/12, pp. 1-8. doi: 10.17159/sajs.2016/20160054
- [26] Matcharashvili Teimuraz, Tsveraidze Zurab, Sborshchikovi Aleksandre, Matcharashvili Tamar. Bibliometric indicators for the analysis of research performance in Georgia. *Trames: Journal of the Humanities and Social Sciences*, 2014, vol. 18, no. 4, pp. 345-356. doi: 10.3176/tr.2014.4.03
- [27] Araújo D. F. A., Costa A. P. C. S. Bibliometric analysis of R&D in the energy sector. *IEEE Latin America Transactions*, 2016, vol. 14, no. 3, pp. 1221-1226. doi: 10.1109/TLA.2016.7459602
- [28] Archambault, Éric Caruso Julie, Côté Grégoire, Larivière Vincent Bibliometric analysis of leading countries in energy research, 2009. Available at: [www.science-metrix.com/pdf/ISSI\\_2009\\_Archambault\\_et\\_al\\_Energy\\_RD.pdf](http://www.science-metrix.com/pdf/ISSI_2009_Archambault_et_al_Energy_RD.pdf) (accessed 19.07.2018)
- [29] Wang Lu, Wei Yi-Ming, Marilyn A. Brown. Global transition to low-carbon electricity: A bibliometric analysis. *Applied Energy*, 2017, vol. 2015, pp. 57-68. doi: 10.1016/j.apenergy.2017.07.107
- [30] Yu, Hao Wei Yi-Ming, Tang Bao-Jun, Mi Zhifu, Pan Su-Yan. Assessment on the research trend of low-carbon energy technology investment: A bibliometric analysis. *Applied Energy*, 2016, vol. 184, pp. 960-970. doi: 10.1016/j.apenergy.2016.07.129
- [31] De Paulo Alex Fabianne, Porto Geciane Silveira. Solar energy technologies and open innovation: A study based on bibliometric and social network analysis. *Energy Policy*, 2017, vol. 108, pp. 228-238. doi: 10.1016/j.enpol.2017.06.007
- [32] Dong Bensi, Xu Guoqiang, Luo Xiang, Cai Yi, Gao Wei. A bibliometric analysis of solar power research from 1991 to 2010. *Scientometrics*, 2012, vol. 93, no. 3, pp. 1101-1117. doi: 10.1007/s11192-012-0730-9
- [33] Du, Huibin Wei Linxue, Brown Marilyn A., Wang Yangyang, Shi Zheng. A bibliometric analysis of recent energy efficiency literatures: an expanding and shifting focus. *Energy Efficiency*, 2013, vol. 6, no. 1, pp. 177-190. doi: 10.1007/s12053-012-9171-9
- [34] Cristino Talita Mariane, Neto Antonio Faria, Costa Antonio Fernando Branco. Energy efficiency in buildings: analysis of scientific literature and identification of data analysis techniques from a bibliometric study. *Scientometrics*, 2018, vol. 114, no. 3, pp. 1275-1326. doi: 10.1007/s11192-017-2615-4
- [35] Arenas A. D., Valencia G. E., Duarte J. E. Bibliometric analysis of green energy research from 2011 to 2017. *Indian Journal of Science and Technology*, 2018, vol. 11, no. 18. doi: 10.17485/ijst/2018/v11i18/122604
- [36] Mao Guozhu, Liu Xi, Du Huibin, Zuo Jian, Wang Linyuan. Way forward for alternative energy research: A bibliometric analysis during 1994-2013. *Renewable and Sustainable Energy Reviews*, 2015, vol. 48, pp. 276-86. doi: doi.org/10.1016/j.rser.2015.03.094
- [37] Velmurugan C., Radhakrishnan N. Visualizing Energy and Environment Research Productivity in Australia: A Scientometric Profile. *Asia Pacific Journal of Energy and Environment*, 2015, vol. 2, no. 3, pp. 145-160. Available at: <https://journals.abc.us.org/index.php/apjee/article/view/738/610> (accessed 25.07.2018).
- [38] Alvarez Gonzalo R., Vanz Samile A.S., Barbosa Marcia C. Scientometric indicators for Brazilian research on High Energy Physics, 1983-2013. *Annals of the Brazilian Academy of Sciences*, 2017, vol. 89, no. 3, pp. 2525-2543. doi: 10.1590/0001-3765201720160620.
- [39] Liping Duan. Analysis of the relationship between international cooperation and scientific publications in energy R&D in China. *Applied Energy*, 2011, vol. 88, no. 12, pp. 4229-4238. doi: 10.1016/j.apenergy.2011.02.045.

- [40] Sanz-Casado Elías, Serrano-López Antonio, De Filippo Daniela, Lascurain-Sánchez María Luisa. Bibliometric analysis of Chinese-Spanish collaboration in renewable energy research. Project: Scientometric studies over sustainable energies, January 2014. Available at: [https://www.researchgate.net/publication/293440323\\_Bibliometric\\_analysis\\_of\\_Chinese-Spanish\\_collaboration\\_in\\_renewable\\_energy\\_research](https://www.researchgate.net/publication/293440323_Bibliometric_analysis_of_Chinese-Spanish_collaboration_in_renewable_energy_research) (accessed 25.07.2018).
- [41] Chen Hua-Qi, Wang Xiuping, He Li, Chen Ping, Wand Yuehua, Yang Lingyun, Jiang Shuian. Chinese energy and fuels research priorities and trend: A bibliometric analysis. *Renewable and Sustainable Energy Reviews*, 2016, vol. 58, pp. 966-975. doi: 10.1016/j.rser.2015.12.239.
- [42] Rangasamy V., Umadev L. N. Scientometric Analysis of Solar Energy Research Publications in Germany. *Journal of Advances in Library and Information Science*, 2017, vol. 6, no. 1, pp. 7-11. Available at: <http://jalis.in/pdf/6-1/Ranga.pdf> (accessed 25.07.2018).
- [43] Goel Malti, Maurya Vandana, Desai Pranav N. R & D indicators and mapping of solar energy research output in India. *Journal of Scientometric Research*, 2013, vol. 2, no. 1, pp. 52-58. doi: 10.4103/2320-0057.115889.
- [44] Sivasekaran K. India's Contribution on Renewable Energy Research Output: A Scientometric Study. *Journal of Advances in Library and Information Science*, 2015, vol. 4, no.4, pp. 311-316. Available at: [www.jalis.in/pdf/4-4/Siva.pdf](http://www.jalis.in/pdf/4-4/Siva.pdf) (accessed 25.07.2018).
- [45] Kumar Vipin, Sapna Arora Narula. Social Networking Analysis of Renewable Energy Research in India. *Journal of Scientometric Research*, 2017, vol. 6, no. 2, pp. 102-108. doi: 10.5530/jscires.6.2.15.
- [46] Klitkou Antje, Pedersen Trond Einar, Schwach Vera, Scordato Lisa. Social science research on energy: International and Norwegian studies: Rapport 4/2010. Oslo, 2010. Available at: <https://brage.bibsys.no/xmlui/bitstream/handle/11250/279095/NIFUrappport2010-4.pdf?sequence=1> (accessed 25.07.2018).
- [47] Montoya Francisco G., Montoya Maria G., Gómez Julio, Manzano-Agugliaro Francisco, Alameda-Hernández Enrique. The research on energy in Spain: A scientometric approach. *Renewable and Sustainable Energy Reviews*, 2014, vol. 29, pp. 173-183. doi: 10.1016/j.rser.2013.08.094
- [48] Turcan Nelly. Estimarea productivității științifice a savanților din Republica Moldova. *Studia Universitatis. Seria Științe Sociale*, 2011, nr. 8 (48), pp. 206-212. Available at: <http://studiamsu.eu/wp-content/uploads/27.-p.206-212.pdf> (accessed 25.07.2018).
- [49] Turcan Nelly. Evaluarea statistică a publicațiilor științifice ale Moldovei în revistele ISI. *Intellectus*, 2011, nr. 3, pp. 72-76. Available at: [https://ibn.idsi.md/ro/vizualizare\\_articol/15134](https://ibn.idsi.md/ro/vizualizare_articol/15134) (accessed 25.07.2018).
- [50] Dicusar A.I. Mesto issledovatelej Moldovy v mirovom informatsionnom protsesse: Naykometricheskij analiz. [The place of Moldovan researchers in the world innovation process. The scientometric analysis]. *Akados*, 2011, nr. 2(21), pp. 28-35. Available at: [https://ibn.idsi.md/ro/vizualizare\\_articol/30878](https://ibn.idsi.md/ro/vizualizare_articol/30878) (accessed 25.07.2018).
- [51] Dicusar A.I., Kravtsov V.H. Dinamika uchastiya moldavskih issledovatelej v mirovom informatsionnom protsesse: Naykometricheskij analiz. [Evolution of involvement of Moldavian scientists on a world-wide information process: Scientometric analysis]. *Akados*, 2010, nr. 1(16), pp. 11-16. Available at: [https://ibn.idsi.md/ro/vizualizare\\_articol/2040](https://ibn.idsi.md/ro/vizualizare_articol/2040) (accessed 25.07.2018).
- [52] Dicusar A.I. Naykometricheskij analiz biologicheskikh issledovanij v Moldove. *Studia Universitatis. Seria Științe ale naturii*, 2008, nr. 7(17), pp. 117-121. Available at: <http://studiamsu.eu/wp-content/uploads/24-p117-121.pdf> (accessed 25.07.2018).
- [53] National Bibliometric Instrument. Available at: <https://ibn.idsi.md/> (access 02.08.2018).

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