Social Aspects in Energy Research & Social Science Journal Publications for 2019-2023. Bibliometric Analysis

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Article

Social Aspects in Energy Research & Social Science Journal Publications for 2019–2023: Bibliometric Analysis

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Abstract: The article aims to explore social aspects in the area of energy research by using bibliometrics methods and tools. The study is based on the data of Energy Research & Social Science journal publications exported from ScienceDirect database during 2019-2023. Methodologically, the work included clustering of the bibliometric records under consideration. This allowed to identify the main topics of publications and those in which the research of social problems prevails. This stage of the work was carried out using carrot2, an engine for clustering search results. Next, the analysis of publication topics related to social issues research was carried out using VOSviewer — a software tool for visualizing scientific landscapes. The topics of the four clusters obtained at this stage were described by key terms with the maximum total link strength. For the principal ones, a definition was made on the basis of the texts of publications that most fully disclose the meaning of these terms. The 1537 publications in the journal during the period under review deal with many aspects of energy transition research, renewable energy, energy policy, energy justice and energy systems, but only 78 of them are dominated by social issues. The paper reveals the main social issues in the field of energy research: sociology of energy, socio-technical system, community energy, energy democracy, sociology of the future, energy sovereignty, socio-technical imaginary and shows the insufficient attention to this topic, especially to the investment of such research.

Keywords: subjects of publications; bibliometric analysis; text clustering; energy transition; social issues

Introduction

The social aspects of energy research refer to the study of how the production, distribution and consumption of energy affects society and individuals.

Energy research often overlooks social aspects of energy systems, focusing on technological progress and economic considerations. To create a sustainable energy future, interdisciplinary research must analyze social science data, foster collaboration, and consider diverse perspectives. Social science research can address energy poverty, justice, transitions, democracy, sociology of energy, industrial decarbonization, and socio-technical imagination. It helps develop policies for equitable access to clean energy and develops effective energy policies that consider the social, cultural, and economic context of energy systems. Understanding these dynamics will enable policymakers to develop strategies for a just transition.

The following are some key points about energy research from a social perspective.

Energy policy significantly influences the transition to sustainable, socially equitable energy systems. Prioritizing renewable energy, energy efficiency, and justice encourages clean energy adoption, while policies empowering local communities promote self-reliance. Energy researchers can inform policy-making. [1, 2]

Sociology is crucial in energy research, analyzing social dynamics and power relations that shape energy systems. Studying energy transitions helps identify barriers to sustainable technologies and practices, contributing to inclusive policies and governance structures.[3]

The integration of social sciences and humanities (SSH) in energy studies has gained importance in recent years.[4] Energy studies that utilize disciplines such as sociology, anthropology and political science to understand energy systems and their social impacts, thereby contributing to informed and socially just energy policies and practice.

The sociotechnical imagination in energy research aims to bridge the gap between science and society by recognizing the social and cultural aspects of energy systems and their impact on society, contributing to a comprehensive understanding of them.[5]

Energy justice aims to address unequal distribution of resources and disproportionate impacts on marginalized communities. By examining social, economic, and environmental dimensions, energy researchers can contribute to a more equitable and inclusive energy transition. This involves considering marginalized needs, promoting affordability, and ensuring access to clean, reliable energy sources. Integrating energy justice into research can lead to a more sustainable and just future.[6]

Energy democracy focuses on empowering communities and individuals to shape their futures.[7] Energy researchers can contribute to energy democracy and socio-technical imagination by supporting community initiatives, promoting cooperative energy organizations, and advocating for policy frameworks that ensure community ownership and participation.

Socio-technical energy systems involve the interplay of social, cultural, economic, and technological factors influencing energy production, distribution, and consumption.[8] Understanding these systems helps identify barriers and opportunities for sustainable, socially just energy transitions. This involves examining norms, technology's role, and the social and economic implications of energy sources.

Thus, the subject of the social aspects of energy research is extremely diverse.

To conduct the own bibliometric analysis of the social aspects of energy research, it is recommended to choose a journal/journals that publish articles on the specified subject.

Justification of the selection of journals for bibliometric analyses of social aspects of energy research

Open reference database of publications according to the query: "Scholarly Works = energy; Filters: Year Published = (2019 -); Publication Type = (journal article); Subject = (Social Sciences (miscellaneous), Sociology and Political Science)" (up to date on 15 July 2023) gives 10,847 records. The number of publications in the journal Energy Research & Social Science is about three times the number of publications in the following journal Resources Policy. This fact has led to the interest in the journal Energy Research & Social Science. The bibliometric data of the journal are available in the open database ScienceDirect, which determines not only their availability, but also their high quality.

Also, in the CWTS Journal Indicators system, the query Select subject area → "Energy" AND Search for Title → "Social" gives only one journal: Energy Research & Social Science.

In the list of Scimago Journal & Country Rank in the section "Energy" there are only two journals: Energy Research & Social Science (h-index 94; Q1 in Energy Engineering and Power Technology) and International Journal of Environmental, Cultural, Economic and Social Sustainability out of 563 journals with the term social in the title. But the second journal covers a broader area than the energy sector.

About the journal. Energy Research & Social Science is an international journal that publishes research and review articles on the relationship between energy systems and society, focusing on topics such as energy technologies, fuels and resources, and social processes and impacts.

Therefore, it is reasonable to investigate whether the journal Energy Research & Social Science reflects the given subject and to identify relevant issues by means of bibliometric analysis.

In recent years, two bibliometric studies have been published in the journal Energy Research & Social Science, focusing on social aspects in energy. The article [9] deals with this topic mainly through publications in Renewable & Sustainable Energy Review (9.5% of articles); Renewable Energy (4.1%), International Journal of Greenhouse Gas Control (4.1%) and Applied Energy (3.3%). The article [10] focuses on the energy transition and social innovation. The article notes that the largest number of publications analyzed by the authors were published in Energy Research & Social Science. Both

studies provide a broad bibliometric review of publications, while the social aspects of the topic are only briefly discussed.

In view of the above, the aim of this article can be formulated as follows: to examine the social aspects of energy research within a specific journal by means of bibliometric methods applied to articles published in the last five years, in order to identify topics of interest for additional studies.

Materials and Methods

This paper uses bibliometric data from the open access system ScienceDirect, retrieved from the query "Journal or book title: Energy Research & Social Science, Year: 2019-2023"; Article type: Review articles OR Research articles. Data are current as of 14 July 2023. A total of 1537 records were extracted. In addition to bibliographic data, the exported records contain fields for abstracts and author keywords, making them useful for analysing publication topics.

The data obtained was utilized in the following main stages of the ongoing study:

- Identification of the main research areas in the publications of the Journal of Energy Research & Social Sciences for 2019-2023 based on the clustering of their bibliometric records.
- Identification of the main topics of publications related to social issues in energy research based on co-occurrence keyword clustering.
- Composition of definitions of the main terms on the subject on the basis of the texts of the publications under consideration.
- Identifying in combination with which informative phrases these terms most often appear in the text of article abstracts.

The first stage of the ongoing research was realized using a demo version of the freely distributed software Carrot2[1]. Documents were clustered by title and author keywords fields using the Lingo3G algorithm. DOI was used as the publication index.

Lingo3G is a proprietary algorithm. This algorithm detects the structure of topics in input texts using term-document matrix dimensionality reduction techniques. In this case, a document can belong to more than one cluster (overlapping clusters).

The Carrot2 system has been in development for a sufficiently long time [11], is fully documented, has test and demo versions as well as an open-source edition. It has also reached the stage of commercial implementation. For these reasons, it was chosen for this study.

In the second stage, the identification of the main topics of publications dealing with the social problems of energy research was carried out by clustering keywords based on their co-occurrence using the VOSviewer software. This tool allows researchers to analyze the topics of bibliometric records, track the development of topics and gain insight into the structure and interrelationships of research through the analysis of networks of co-occurring terms using different scientometric datasets.[12]

The final visualization of the bibliometric networks created with VOSviewer was carried out on https://app.vosviewer.com using VOSviewer Online, which allowed additional parameters to be displayed in the figure.

In the next stage of the research, brief explanations of the main concepts (terms) related to the topic under consideration were formulated. This was achieved by analysing the texts of published works. Based on the collected bibliometric data, examples of published works revealing the application of these terms were selected.

The most significant phrases were identified as follows: a corpus of texts was compiled from the abstracts of articles containing the key term in question. Then the most significant word combinations in the given text were identified using the Yake! program. The details of the algorithm used in the program are described in [13], the working demo is available at: http://yake.inesctec.pt.

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[1] https://search.carrotsearch.com/#/workbench — Clustering Workbench. The expert-level Lingo3G application

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Knowing the most significant collocations allows expanding the literature search if there is a need for further study of the subject related to the key term.

Results and Discussion

General characteristics of the sample of bibliometric records

Considering that in this study the author aimed to use open soft and abstract databases, The Lens system was selected for comprehensive evaluation of bibliometric records of Energy Research & Social Science journal, such as research area, author affiliation, citation etc.

Lens.org is an online database that offers access to patent and scholarly literature, including scientific articles, conference papers, and theses, along with advanced features like data visualization and citation analysis.

Figures 1–3 show only the general bibliometric data obtained from this database by querying Filters: Year Published = (2019 - 2023) Source Title = (Energy Research & Social Science), answering the question: who has published in this journal and on what topics.

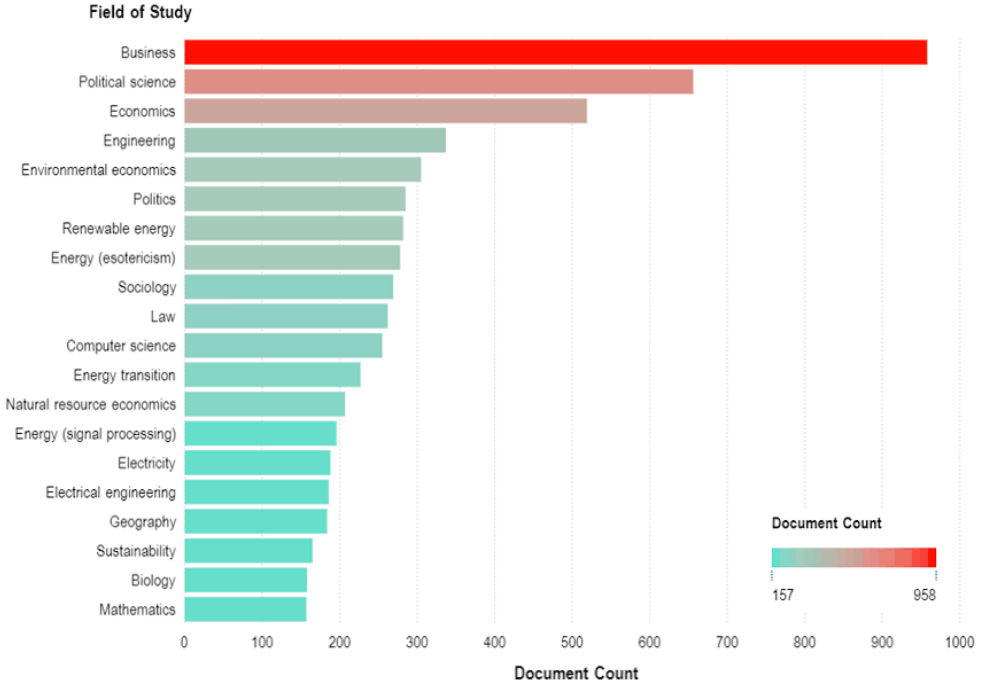

Figure 1. Top 20 fields of study with the highest number of related publications according to The Lens database data version.

It is noteworthy that according to the publication systematization adopted by The Lens, the main "Field of Study" are business, political science and economics, rather than energy and social sciences, as could be expected from the title of the journal.

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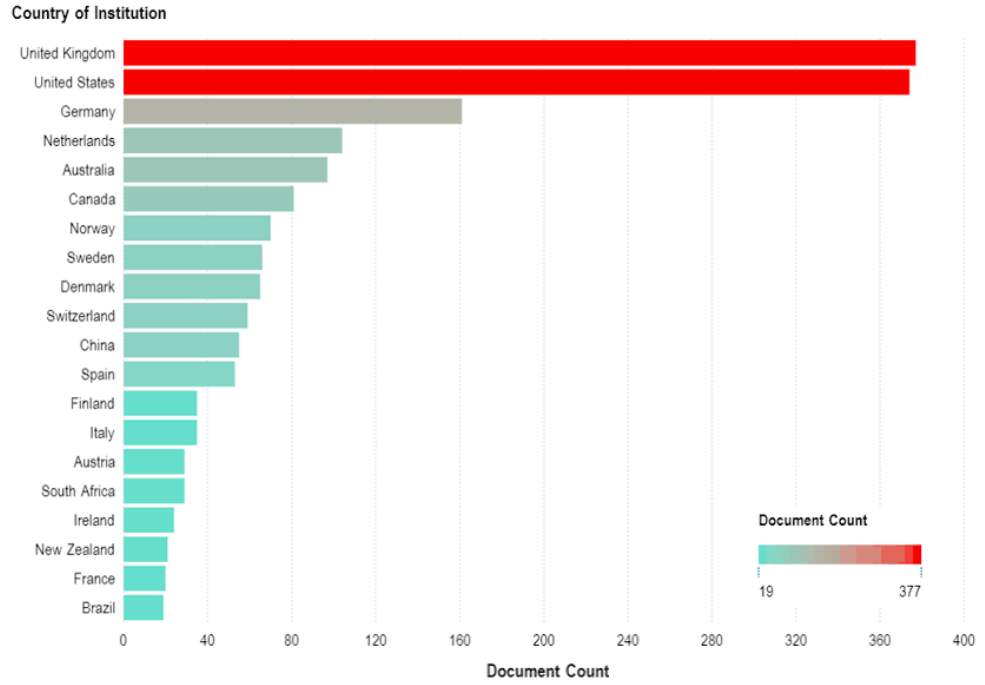

Figure 2. Top 20 countries whose institutions have published the most papers in Energy Research & Social Sciences for 2019-2023

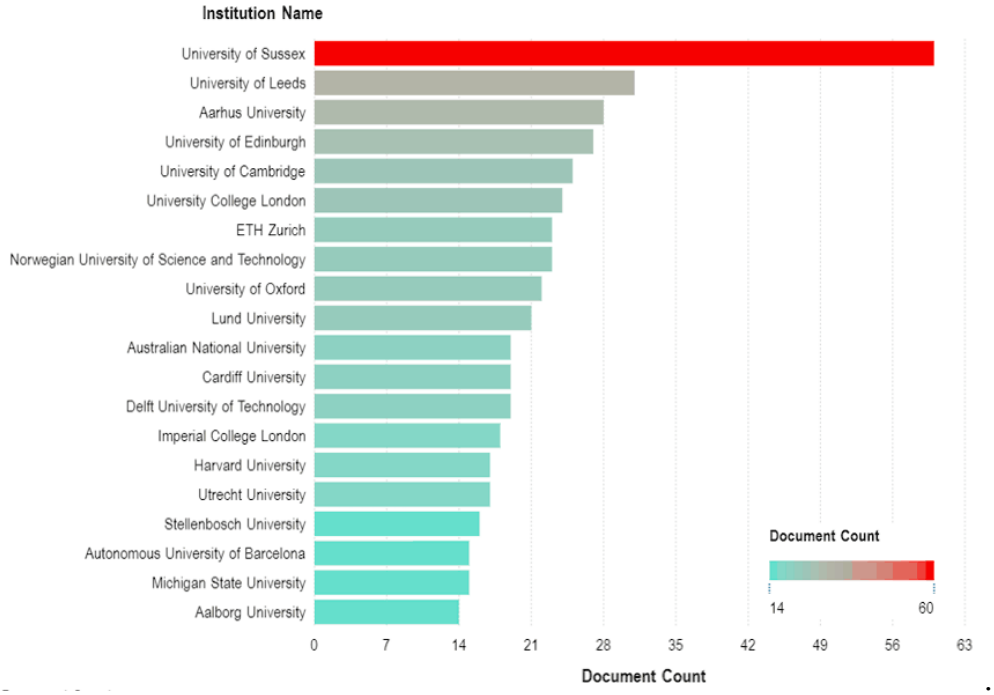

Figure 3. Top 20 institutions publishing the most papers in Energy Research & Social Sciences for 2019-2023.

Figures 2 and 3 show that Western Europe, the USA, and Australia have the highest number of publications in the journal, while the big developing countries such as China, South Africa, and Brazil are less represented.

India ranks 26th in terms of publications in this periodical, following the Czech Republic, which also shows the lack of presence of developing countries in this journal.

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The above data overlaps to a substantial extent with the data presented in Figure 1. This is because the transition to clean and sustainable energy sources, as well as concerns about climate change, are attracting a great deal of attention from policymakers in both the European Union and the United States.

Hence, it can be concluded that it is worthwhile to undertake a separate study of the challenges faced by emerging economies with respect to the social aspects in energy research, while referring to alternative sources of literature.

Identification of the main research areas in the publications of the Journal of Energy Research & Social Sciences for 2019-2023 based on the clustering of their bibliometric records

The clustering of articles carried out using Carrot2 allowed us to identify the overall picture of the topics of publications in Research & Social Sciences for 2019-2023 and to identify those that are relevant to social aspects in energy research. The overall view of the topics of the main 6 clusters is shown in Figure 4.

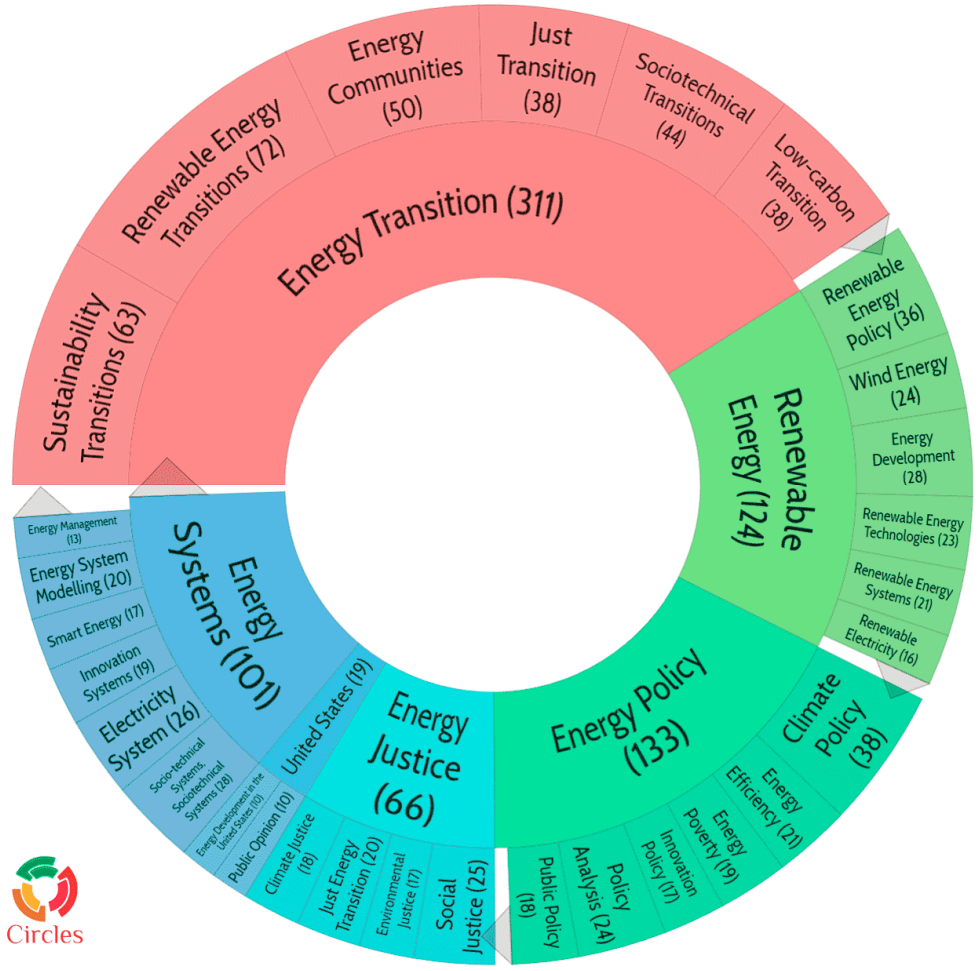

Figure 4. Subjects of publications from the six main clusters and their sub-clusters.

The presented clustering of publications provides a good overview of renewable energy topics, but does not fully address clean energy issues in line with UN Sustainable Development Goal 7. In addition, there is no cluster or sub-cluster dedicated to investment in the social aspects of energy research.

The journal's publications prominently focus on energy transition, energy policy, and renewable energy.[14] These topics are of great significance in the current global discourse surrounding sustainable development and combating climate change.

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The first three clusters are closely related to each other, as energy policy is largely associated with the transition to renewable energy. The concept of energy justice is predominantly realised through energy system solutions, which is reflected in the Energy Justice and Energy Systems clusters.

Given that the aim of this paper is to analyze the topics of publications reflecting social aspects in energy research, publications belonging to sub-clusters containing the term "social" were selected for further consideration: Sociotechnical Transitions (44 records), Social Justice (25 records), Sociotechnical Systems, Sociotechnical Systems (28 records).

Noting that Carrot2 can attribute publications to more than one cluster at a time, only 78 of the 97 entries were unique.

To show the consistency of the overall landscape of research published in this journal, Figure 5 presents a clustering of bibliometric records made up of the 50 most cited for each year. There are 250 records in total. As in the previous case, clustering was performed using the title and author keyword fields. The citations were determined using data from The Lens database. The DOI field was used as the main key for data merging.

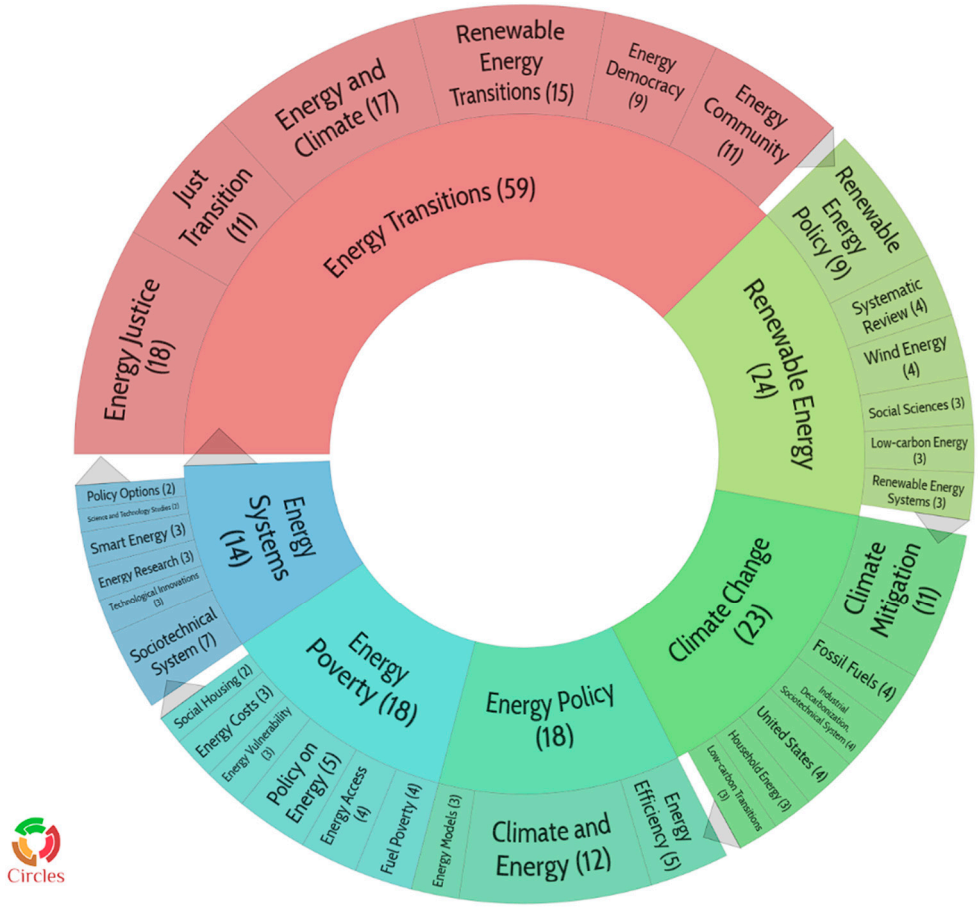

Figure 5. Subjects of publications from the six main clusters and their sub-clusters for 250 most cited records.

The comparison of Figures 4 and 5 shows that the overall research landscape is of a similar nature, indicating the stability of publication topics in the journal under review when the number of entries in the sample and the citation rate of publications change.

It should be noted that the more cited publications are characterised by a separate cluster related to climate change research. Given that climate change issues are widely discussed in Western Europe and the USA, it can be assumed that this affects the citation rate of publications related to this topic. This statement is consistent with the results presented in Figures 2 and 3. A detailed study of the difference in the discourse on this issue in the publications of developed and developing economies is beyond the scope of this paper and deserves a separate study.

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Identification of the main topics of publications related to social issues in energy research using clustering of keywords by their co-occurrence

This section presents the results of a thematic analysis of 78 bibliometric data records of articles dealing with social aspects in energy research using VOSviewer software.

The clustering of author keywords shown in Figure 6 is obtained using the following parameters in VOSviewer: min cluster size 35 and 27 substitutions in keywords that have the same meaning but different spelling, e.g. socio-technical → sociotechnical, SSH → Social Sciences and Humanities, etc. Four clusters were identified, a more detailed discussion of the findings from the content analysis is given below.

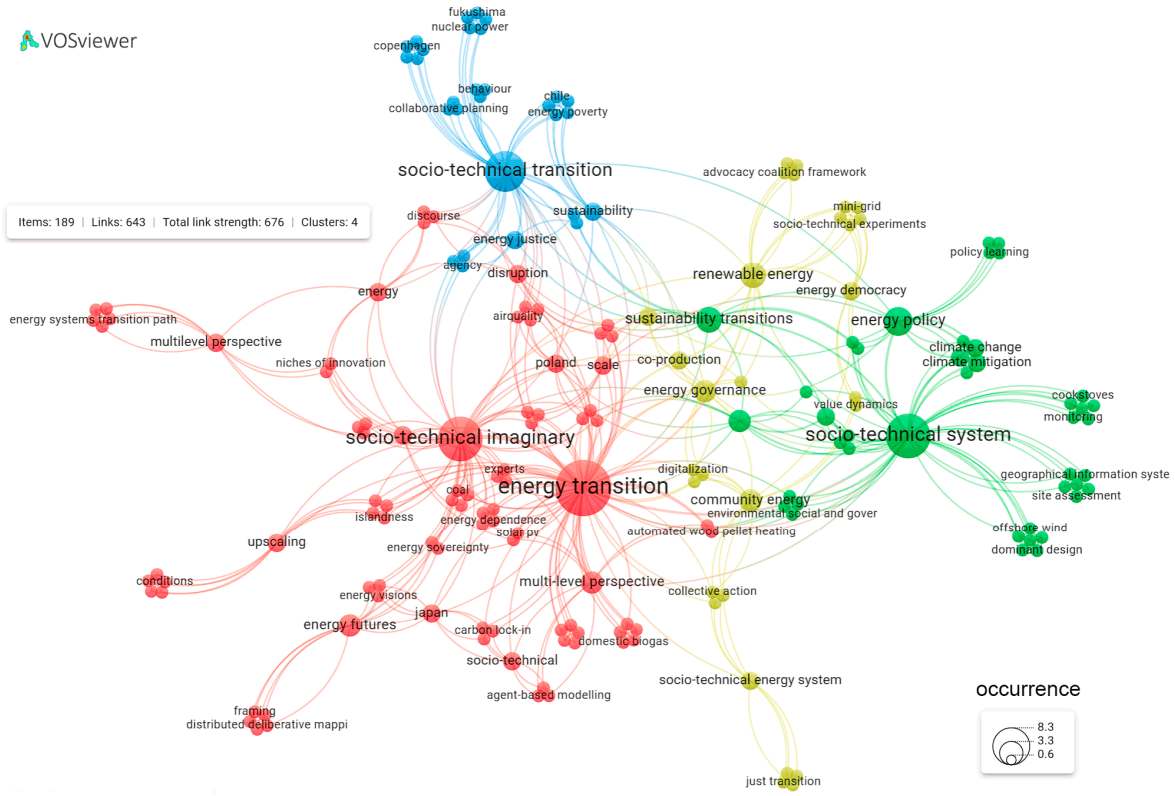

Figure 6. Clustering of author's keywords obtained on the basis of their co-occurrence.

In the simplest case, the clusters can be described by the most common terms within them: energy transition (red), socio-technical system (green), socio-technical transition (blue) and renewable energy + energy governance (khaki). A more detailed analysis of the terms included in the clusters is presented in the next section.

Results of the analysis of author's keywords describing the topics of each of the four clusters

For each cluster, this section presents:

- Tables of the 20 author's keywords with the highest Total link strength.
- Definitions of the main key terms on the topic of each cluster.
- Articles selected from a list of reviewed publications reflecting the corresponding term.
- Informative phrases with which these terms most frequently appear in the text of article abstracts.

Tables 1–4 present 20 author keywords for each of the clusters with the highest total link strength values between terms (weight<Total link strength> is a designation used in the VOSviewer program, TLS is an abbreviation in the table headings). Other fields in the tables: AKWs - author keywords or label in the software, respectively Occ - term occurrence or weight<Occurrences> in the software.

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Note: The strength of a link indicates the number of publications in which two terms occur together.

Cluster 1. The total number of records belonging to the first cluster in their exported VOSviewer program is 94.

Table 1. Top 20 author's keywords of the first cluster with the highest TLS value.

AKWs	TLS	Occ
socio-technical system	59	12
renewable energy	40	8
energy democracy	21	5
sustainability transitions	21	5
science and technology studies	20	4
community energy	19	4
energy governance	14	3
energy poverty	11	2
sustainability	11	2
upscaling	11	2
co-production	10	2
actor-network theory	9	2
energy community	9	2
science technology and society	9	2
social justice	8	2
social science	8	2
chile	6	1
cookstoves	6	1
data and evidence	6	1
dominant design	6	1

Definitions of key terms on the topic of the **first cluster**, phrases related to these terms in the abstract texts and examples of scientific articles from the dataset analyzed in this paper that are related to this term.

Socio-technical systems (STS) are an approach to organizational work design that considers the interaction between people and technology in workplaces. Success is determined by the connections between subsystems, such as socio-psychological, technological, and economic dimensions. The following phrases related to **Socio-technical systems** are the most common in the abstract texts → energy social science; wind project development; social science; wind power development; energy social; wind innovation system; social science research; energy system; energy research; social science energy.

Articles selected from a list of reviewed publications reflecting the STS issue. [15, 16]

Energy democracy seeks to democratize the energy system through the empowerment of individuals to engage in decisions regarding energy production, distribution, and consumption. It encompasses political activism against pollution, resistance against fossil fuel companies, and the encouragement of community-based renewable energy systems.

The following phrases related to **Energy democracy** are the most common in the abstract texts → eliminate fossil fuel; energy transition pathways; energy transition; renewable energy; social movement; energy communities; social impact; democratic energy; energy futures; potential energy futures; transition pathways; eliminate fossil.

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Articles selected from a list of reviewed publications reflecting the energy democracy issue. [17, 18]

Sustainability transitions are long-term, multi-dimensional transformations in established socio-technical systems, aiming to address persistent problems in contemporary societies.

The following phrases related to **Sustainability transitions** are the most common in the abstract texts → capacity remuneration mechanisms; energy transitions; sociotechnical perspectives; remuneration mechanisms; focusing on Britain; energy research; introduction of capacity; capacity remuneration; social movement; electricity system decarbonisation; energy social science; electricity system.

Articles selected from a list of reviewed publications reflecting the sustainability transitions issue. [19, 20]

Energy poverty refers to the lack of access to modern energy services and products, affecting 759 million people in developing and some developed countries.

The following phrases related to **Energy poverty** are the most common in the abstract texts → provide clean energy; clean energy access; overcome energy poverty; income inequality; renewable energy support; renewable energy; rural communities; contribute to overcome; energy support levies; appealing alternative; alternative to provide; provide clean; access to rural; sustainability; energy support; micro-grid.

Articles selected from a list of reviewed publications reflecting the energy poverty issue. [21, 22]

Cluster 2. The total number of records belonging to the second cluster in the exported records from VOSviewer is equal to 74.

Table 2. Top 20 authors' keywords of the second cluster with the highest TLS value.

AKWs	TLS	Occ
energy justice	69	16
multilevel perspective	22	5
energy	17	3
transition	15	3
energy futures	14	3
germany	12	2
disruption	10	2
japan	10	2
hydrogen	9	2
place attachment	9	2
social practices	9	2
socio-technical	9	2
socio-technical regime	9	2
china	8	2
action research	7	1
diversity	7	1
identity	7	1
justice	7	1
social psychology	7	1
asia	5	1

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Definitions of key terms on the topic of the **second cluster**, phrases related to these terms in the abstract texts and examples of scientific articles from the dataset analyzed in this paper that are related to this term.

Energy justice aims to achieve equality in social and economic participation in the energy system, eliminating disproportionate impacts on marginalized communities. It aims to make energy accessible, affordable, clean, and democratically managed for all, regardless of socioeconomic status or where they live.

The following phrases related to **energy justice** are the most common in the abstract texts → energy transitions; social justice; energy systems; solar energy adoption; solar power; energy decisions; energy poverty; solar energy; energy technologies; energy transition policies; energy justice frameworks; energy justice approaches; energy justice based.

Articles selected from a list of reviewed publications reflecting the energy justice issue. [23, 24]

The **multilevel perspective** (MLP) is a conceptual framework for understanding sustainability transitions in socio-technical systems, recognizing their complexity and application in fields like energy, agriculture, and transportation.

The following phrases related to **multilevel perspective** are the most common in the abstract texts → public policy discourses; policy discourses; public policy; worlds energy future; contemporary world; energy transition; socio-technical; socio-technical transitions; socio-technical systems transitions; socio-technical transition pathways; worlds energy; energy transition addressing; sociotechnical imaginaries; sociotechnical imaginaries reflected.

Article selected from a list of reviewed publications reflecting the multilevel perspective issue.[25]

Energy futures are financial instruments allowing investors to buy or sell energy commodities at predetermined prices, influenced by geopolitical events, supply and demand, and weather patterns.

The following phrases related to **energy futures** are the most common in the abstract texts → technological innovation strategies; devoting increasing attention; propelling technological innovation; materialising desirable energy; desirable energy futures; energy systems; socio-technical imaginaries play; innovation strategies; devoting increasing; increasing attention; role that socio-technical; play in materialising; materialising desirable; inspiring and propelling; propelling technological; technological innovation.

Article selected from a list of reviewed publications reflecting the energy futures issue. [26]

A **socio-technical regime** is the social and institutional routines and technical solutions within a system, influencing its stability and organizing activities and relationships between actors and institutions.

The following phrases related to **socio-technical regime** are the most common in the abstract texts → explores methodological implications; examines a variety; variety of theories; theories bearing; explores methodological; methodological implications; paper examines; solar pv uptake; municipalities; policy instruments; systematic general approach; energy transition

Article selected from a list of reviewed publications reflecting the socio-technical regime issue. [27]

Cluster 3. The total number of records belonging to the second cluster in the exported records from VOSviewer is equal to 65.

Table 3. Top 20 authors' keywords of the third cluster with the highest TLS value.

AKWs	TLS	Occ
energy policy	34	7
social acceptance	25	5
just transition	20	4
climate change	16	3
scale	14	3

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climate justice	11	2
climate mitigation	10	2
climate policy	10	2
industrial decarbonization	10	2
environmental justice	9	2
indigenous communities	9	2
socio-technical energy system	9	2
inclusive transition policies	7	1
inequality	7	1
low-carbon transitions	7	1
social outcomes	7	1
coal mining	6	1
contested transition	6	1
"powder river basin, wyoming"	6	1
capability approach	5	1

Definitions of key terms on the topic of the **third cluster**, phrases related to these terms in the abstract texts and examples of scientific articles from the dataset analyzed in this paper that are related to this term.

Energy policy involves regulations, laws, and initiatives to manage energy resources, aiming to reduce emissions, enhance security, and promote economic development, influenced by socio-technical transitions.

The following phrases related to **energy policy** are the most common in the abstract texts → energy transition; chemical industry; transition policies; renewable energy; steel industry; energy transition dynamics; energy transition policies; low-carbon transition policies; transition dynamics; energy transition global; global energy transitions

Articles selected from a list of reviewed publications reflecting the energy policy issue. [28, 29]

Social acceptance of renewable energy projects is crucial for their success, influenced by climate change awareness and technology knowledge. Governments should involve local communities in decision-making, provide relevant information, and address public concerns.

The following phrases related to **social acceptance** are the most common in the abstract texts → wind power; wind energy; low social acceptance; wind energy projects; onshore wind power; energy justice; capability approach; community wind energy; affecting community acceptance; wind power policy; energy technologies; community acceptance; wind power policies.

Articles selected from a list of reviewed publications reflecting the social acceptance issue. [30, 31]

A **just transition** is a framework aiming to transition from a depleting to a renewing economy, ensuring impartiality and parity for all. Recognized by the Paris Agreement, it includes energy democracy, communal transportation expansion, and food self-determination.

The following phrases related to **just transition** are the most common in the abstract texts → energy transition; low-carbon energy transition; transition policies; low-carbon transition policies; renewable energy; potential energy futures; energy transition pathways; energy system; low-carbon transition; renewable energy industries; energy transition varied; democratic energy; Energy workers; energy industries; potential energy; energy futures.

Articles selected from a list of reviewed publications reflecting the just transition issue. [18, 32]

Climate justice aims to distribute the benefits and disadvantages of climate change fairly, focusing on low-income and communities of color. It acknowledges the link between climate change and social, racial, and environmental injustices.

The following phrases related to **climate justice** are the most common in the abstract texts → low-carbon transition policies; energy transitions; low-carbon transition; inexhaustible number; past

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few decades; decades to seek; seek to explain; explain the interlinked; social outcomes; transition policies; negative social outcomes; climate and low-carbon

Articles selected from a list of reviewed publications reflecting the climate justice issue. [33, 34]

Cluster 4. The total number of records belonging to the second cluster in the exported records from VOSviewer is equal to 52.

Table 4. Tor-20 author's keywords of the fourth cluster with the highest TLS value.

AKWs	TLS	Occ
energy transition	115	23
socio-technical imaginary	58	12
socio-technical transition	46	10
poland	12	2
airquality	6	1
co-benefits	6	1
energy social sciences and humanities	6	1
households	6	1
sociology of energy	6	1
sociology of the future	6	1
solid fuels	6	1
agency	5	1
coal	5	1
coalscape	5	1
copenhagen	5	1
district heating	5	1
domestic biogas	5	1
energy dependence	5	1
energy models	5	1
energy plans	5	1

Definitions of key terms on the topic of the **fourth cluster**, phrases related to these terms in the abstract texts and examples of scientific articles from the dataset analyzed in this paper that are related to this term.

The **energy transition** is a shift towards sustainable, renewable energy sources to combat climate change. This is driven by technological advancements like solar, wind, and hydropower. Electrification is a key driver, and progressive policies and regulations are needed to facilitate this transition.

The following phrases related to **energy transition** are the most common in the abstract texts → energy systems; renewable energy; renewable energy systems; energy security; renewable energy support; social energy research; shared energy systems; energy futures; energy poverty; energy policy; energy transition dynamics.

Articles selected from a list of reviewed publications reflecting the energy transition issue. [32, 22]

A **sociotechnical imaginary** is a collective belief system about technology's potential use by social groups, impacting policy and understanding co-production. These imaginaries vary across cultures and are valuable for scholars studying the interplay between scientific and technological advancements and social life.

The following phrases related to **sociotechnical imaginary** are the most common in the abstract texts → energy transition; renewable energy; energy security; sustainable energy transitions; energy

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system; energy futures; global energy transition; European energy transitions; shaping energy transitions; renewable energy initiatives; renewable energy future; energy policy; energy sovereignty

Articles selected from a list of reviewed publications reflecting the sociotechnical imaginary issue. [35, 36]

Socio-technical transitions involve significant changes in various aspects of socio-technical systems, lasting over 50 years. These transitions involve technological and non-technical innovations, driven by sustainability, and involve a multidimensional transition from one system to another.

The following phrases related to **socio-technical transitions** are the most common in the abstract texts → energy transitions; energy system transitions; energy system; low-carbon energy transition; energy systems analysis; energy system model; socio-technical energy transition; energy transitions literature; socio-technical systems forms; low-carbon transitions; complex energy system

Articles selected from a list of reviewed publications reflecting the socio-technical transitions issue. [37, 21]

Conclusion

The results of this paper show that the largest number of publications in Energy Research & Social Science for 2019-2023 is represented by authors from institutions in Western Europe, the United States, and Australia. Accordingly, the topics reflect the efforts of these countries to advance the energy transition and combat climate change.

Works directly related to the topic of social aspects in energy research account for a smaller share of the total number of publications - 78 out of 1537.

The rationality of using clustering of bibliometric records using Carrot2, an engine for clustering search results, is shown. The results obtained describe well the main issues of energy transition, renewable energy, energy policy and energy justice and energy systems. This approach also allowed us to identify topics directly related to the social aspects of energy research such as: social justice, sociotechnical transitions, sociotechnical systems and the publications related to them.

The themes listed above were analyzed in detail on the basis of keywords co-occurrence using VOSviewer software. Four clusters were identified, which can be summarized by the terms presented in Figure 6: energy transition (red cluster), socio-technical system (green), socio-technical transition (blue) and renewable energy + energy governance (khaki).

The key terms describing the topic of social aspects of energy research are defined, the main of which are: socio-technical systems, energy democracy, sustainability transitions, energy poverty, energy justice, energy futures, socio-technical regime, energy policy, social acceptance, just transition, climate justice, energy transition, sociotechnical imaginary and socio-technical transitions.

To facilitate further exploration of the social aspects in energy research, this paper identifies the phrases most commonly occurring with key terms in abstract texts and examples of research articles associated with these terms.

Remark: it should be noted that neither clustering of records using Carrot2 software nor clustering of authors' keywords using VOSviewer identified tasks related to investing in social problems in energy research.

A direct search for the keyword 'investment' showed its low occurrence in both keywords and article titles.

The term 'investment' occurred 14 times in the authors' keywords and 18 times in article titles out of all, 1537 records.

In 78 records categorized as social problems: once in authors' keywords and none in titles.

The author believes that it is problematic to address the social problems associated with energy research without targeted investment in such research. That is why this remark was made.

Future prospects for the study

Considering that the main subject of the journal is related to the issues of energy transition to renewable energy sources and that most of the publications are from institutions from Europe and the USA, the author of this paper considers it appropriate to conduct a study that will identify other

sources of scientific publications that reflect the interests of authors from developing countries in analysing current social issues related to energy transition important for their countries.

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