ВОПРОСЫ НАУКОМЕТРИИ И БИБЛИОМЕТРИИ

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Mapping Sustainable Energy Technologies for SDG-7: A Bibliometric Analysis of *Dimensions.ai* Data

УДК: [303.6+303.7]:001.8
DOI: 10.24412/2079-0910-2025-4-95-113

This study aims to identify technologies relevant to Sustainable Development Goal 7 on Clean and Affordable Energy by analyzing bibliometric data from the *Dimensions.ai* platform. A total of 15 000 records from 2020–2025, published in 9 journals most relevant to the topic under consideration, were analyzed. The method of determining current research topics based on the co-occurrence of key terms is demonstrated, taking into account the number of citations, average time of publication of papers in which these terms appear. Free programs for bibliometric analysis and visualization — *VOSviewer* and *Scimago Graphica* — were used in the study. The relevance of the study stems from the fact that energy is crucial to the development of manufacturing, especially with the deepening of automation and the introduction of artificial intelligence. The results of text analysis of titles and abstracts of bibliometric records showed the dominance of different aspects of technologies related to renewable energy, wireless energy transmission, hydrogen production and storage, innovations in water electrolysis and the impact of technology on economic development. This study should be viewed as an initial investigation into how sustainable energy technologies effect on job creation and economic opportunities, energy access and equality and other social challenges.

Keywords: sustainable energy technologies, SDG-7, *Dimensions.ai*, topic analysis, bibliometric analysis, visualization.

Acknowledgment

The research was carried out with support from the Ministry of Science and Higher Education of the Russian Federation (State Assignment No. 125021302095-2).

Introduction

Relevance of the research topic in question

Sustainable energy technologies must prioritize equity and justice to ensure inclusiveness, benefit all segments of society and address inequalities in energy access and environmental burdens. Developing and deploying these technologies with social equity in mind promotes equitable development and prevents the exacerbation of existing inequalities.

The following papers provide a more detailed discussion of this assertion.

The authors [*Zaidan, Antoine Ibrahim*, 2024] propose using oversight and compliance mechanisms within global energy-related frameworks, international human rights law, and the 2030 Agenda to achieve energy justice. Energy justice is the fair distribution of energy benefits and burdens among different communities and individuals.

Energy poverty is a global issue affecting households and communities, affecting public health and social equity. It is defined as the lack of access to modern and affordable energy services. Recent research on energy poverty [*Jones, Reyes*, 2023] highlights five themes: definitions and metrics, behavioral aspects, effectiveness of energy assistance programs, efficiency of energy policy, and the energy transition and environmental justice.

Sustainable development implies fairness in the distribution of benefits and resources, such as resources and constraints. The study [*Törnblom et al.*, 2025] provides a list of factors to analyze the relationship between sustainability and social justice from a social psychology perspective, focusing on global food availability and local distribution of renewable energy resources.

The review [*Wang, Lo*, 2021] examines the concept of a just transition away from fossil fuels, highlighting five themes: labor-centeredness, integrated justice, sociotechnical theory of transition, governance strategy, and public perception.

The low-carbon energy transition is critical to mitigating climate change, but it can lead to injustices for marginalized communities. These include increased energy burdens, unaffordability, loss of property values and unequal health benefits. Four main areas of the low-carbon energy transition are discussed in [*Kime et al.*, 2023]: deployment of renewable energy, decommissioning of fossil fuel infrastructure, electrification of transport and decarbonization of residential buildings.

While the focus on equity and justice in sustainable energy technologies is crucial, it is also important to consider the challenges in implementing these principles. To do this, the concept of sustainable technologies needs to be defined in more detail.

The definition of sustainable technologies

Sustainable technologies aim to reduce negative environmental and social impacts while promoting the efficient use of resources. These technologies are designed to promote economic growth and social development without compromising the needs of future generations.

These are the most common publications that contain the term “sustainable technologies” in their titles.

The article [*Dada et al.*, 2025] reviews biogas biodesulfurization technologies for industrial applications with a focus on aerobic and anoxic biofilters, biotrickling filters and bioscrubbers. Biodesulfurization technologies are characterized by high efficiencies of up to

99%. They are cost-effective, but precautions must be taken to avoid the risk of explosion and hydrogen sulphide gas poisoning.

Superhydrophobic surfaces with exceptional water-repellent properties are crucial for various applications. Methods to achieve superhydrophobicity include polymer grafting, dip coating, chemical deposition, and etching [*Shahzadi et al.*, 2024]. The use of nanomolecules, fluorocarbons, silicones, and natural waxes is also discussed.

Through the Sustainable Development Goals (SDGs), the United Nations seeks to address clean water, sanitation and climate issues. Reverse osmosis membrane technology is widely used for water supply [*Nurjanah et al.*, 2024].

A study [*Lowy et al.,* 2024] examines cost-effective electrochemical carbon dioxide reduction (ECO2RR) methods for converting atmospheric CO_2 into fuels, particularly C_2 molecules and $C_{6–8}$ alkanes. The authors found no thermodynamic obstacles to perform CO_2 electroreduction.

Thus, publications with the term "sustainable technologies" in the title usually offer purely technological solutions without analyzing the social aspects of their implementation.

Using the term "sustainable energy technologies" in the title of publications in the *ScienceDirect* abstract database yielded two publications that mention social aspects.

The study [*Eppe et al.*, 2025] analyzing the psychological determinants of sustainable energy technology adoption found that personal norms, attitudes, and perceived behavioral control have the strongest positive associations with adoption outcomes. Environmental concerns and perceived monetary costs increased over time, while other constructs remained stable. This meta-analysis suggests the need for targeted interventions to promote sustainable energy technologies.

New sustainable and renewable energy technologies play a central role in mitigating or adapting to climate change. The authors [*Milani et al.*, 2024] analyzed articles from *Scopus*, *Web of Science* and *PsychInfo* databases. Results showed that beliefs related to context and technology had a greater influence on social acceptance than purely individual (e. g., cognitive) or sociodemographic variables.

The two articles cited above reveal the psychological aspects of the perception of new sustainable energy technologies. However, the socio-economic aspects remain uncovered.

Articles categorized under sustainable technologies and social issues were related to UN sustainable development topics.

The paper [*Corsi et al.*, 2020] reviews literature on technology transfer for sustainable development, focusing on resource depletion, climate change, and social impacts. Results show a lack of social impacts in scientific works, with main impacts being health improvement, quality of life, and poverty alleviation.

The study [*Raman et al.*, 2025] takes an integrative and critical approach to explore how Social Entrepreneurship aligns with the SDGs and promotes inclusive, sustainable and innovative change. A systematic literature review was conducted to ensure rigor and transparency in the selection of studies from 2015 to 2024. The review identified thematic gaps in the existing literature, including under-researched areas such as sector-specific finance, digital innovation, entrepreneurship in emerging sectors, adoption of sustainable technologies, and contextualizing Social Entrepreneurship into SDG-related outcomes. The findings reveal that SEs contribute to SDGs 4, 8, and 9 by using inclusive models and digital tools, such as AI and blockchain technology. SEs also advance SDGs 10, 11, and 12, which are enabled by institutions (SDG 16) and partnerships (SDG 17).

Publications that fulfill the request for the presence of the terms “SDG 7,” “technology,” and “social” in titles and abstracts are mostly from the last three years. Examples are given below.

To achieve Goal 7 of the 2030 Agenda for Sustainable Development, the extraction of fossil fuels remains critical to the transition to low-carbon energy and renewable sources. Efforts to improve oil recovery at low cost are necessary, but environmental conservation must be prioritized [*Quintella et al.*, 2025].

Solar desalination is a sustainable solution to climate change and water scarcity. It contributes to achieving key SDGs, such as *No Poverty*, *Zero Hunger*, *Clean Water and Sanitation*, *Affordable and Clean Energy*, and *Combating Climate Change*. Solar desalination also provides economic and social benefits [*Madhuri et al.*, 2025].

The paper [*Abdelkareem et al.*, 2025] explores the impact of electric vehicles (EVs) on the SDGs and their social, economic, and environmental impacts. It highlights EVs’ significant influence on SDGs such as Affordable and Clean Energy, Industry, Innovation, Infrastructure, Sustainable Cities and Communities, Responsible Consumption and Production, and Climate Action. The paper examines case studies from diverse contexts.

The study [*Obaideen et al.*, 2024] analyzes 19 235 publications on wireless power transmission (WPT) from 2015 to 2023, highlighting its significant contribution to the SDGs SDG 7 (Affordable and Clean Energy) and SDG 3 (Good Health and Wellbeing) in the economic, environmental and social spheres.

In general, the literature review shows that there are publications on the topic of this study, but there are few of them found by direct queries. A solution can be achieved by broadening the search context.

The motivation and objectives of this study are due to the fragmented nature of publications on the topic of interest (as noted in the title) and the low probability of finding a sufficient number of publications comprehensive analysis of topic. Therefore, it was decided to conduct the study in two stages: in the first stage, to identify the topics of publications that can be attributed to the relevant issues of energy technologies for SDG 7. And also, to develop a convenient method for graphical representation of the actual research topics. The second stage involves conducting a separate study revealing the social aspects of sustainable energy technologies identified as relevant in the first stage.

The choice of the *Dimensions.ai* platform as a source of bibliometric data was based on two reasons: open access to the database and the availability of a filter on the SDGs.

Note: the justification of the proposed context expansion is confirmed by the fact that, of the 15 000 bibliometric records analyzed in this paper, 777 contained the term “social.” This is significantly more than could be found using direct queries.

Materials and Methods

The data source for the bibliometric records was *Dimensions.ai*, current as of June 30, 2025.

The export filters were: publication affiliation with the SDG 7 sustainability theme; publication type: “Article”; publication years: 2020–2025 and journals: “Energies,” “Renewable and Sustainable Energy Reviews,” “Energy,” “International Journal of Hydrogen Energy,” “Applied Energy,” “IEEE Access,” “Sustainability,” “Journal of Cleaner Production,” “Renewable Energy”.

For each year, 2 500 of the most relevant records containing the term “technology” in their title were exported. A total of 15 000 bibliometric records were exported.

The following programs were used to analyze and visualize bibliometric data: *VOSviewer* [*Waltman et al.*, 2010] and *Scimago Graphica* [*Hassan-Montero et al.*, 2022].

Results and Discussions

Since the data exported from *Dimensions.ai* does not contain keyword fields, the texts of the title and abstract fields were used in this work.

Using the default *VOSviewer* parameters, the program identified a total of 241 267 terms, 7 032 of which occurred five or more times. By utilizing the recommended 60%, the 4 219 most relevant terms and further 1 000 terms with the highest total link strength were selected to build a term co-occurrence network. Under these conditions, five clusters were obtained.

A disadvantage of the approach with default parameters was the large number of one-word terms of general character, e. g., energy, system. Therefore, only terms consisting of two or more words were retained for further research. Such terms among 1 000 previously selected ones were 662 and the graph of their co-currencies is shown in fig. 1.

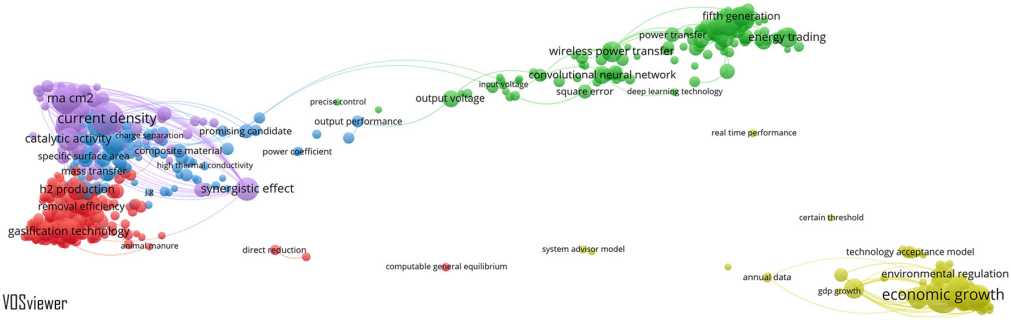

Fig. 1. Five clusters of the network based on the co-occurrence of 662 non-single-word terms from 15 000 bibliometric records

The main purpose of such charts is to identify the dominant topics described by a set of keywords. At the next stage, the selected set of keywords can be used to find publications that are most representative of the topic under consideration.

There is no single “true” choice of a set of keywords for the subsequent literature search. Therefore, this paper presents two alternatives: in the first case, tables of terms are constructed for each cluster: 10 most frequently occurring terms (Occurrences), 10 with high normalized citations (Avg. norm. citations) and those occurring in newer publications (Avg. pub. year); in the second case, graphs of the network of co-occurrence of key terms for each cluster are constructed in the coordinates average normalized citation — average year of publications in which the key term occurs.

To illustrate that, each table or graph is followed by the article(s) corresponding to that set of key terms, as well as a brief summary of the article abstract.

Table 1. Each of the top ten terms from the first cluster ranked by occurrence, citation, and novelty

Occurrences	Avg. norm. citations	Avg. pub. year
h2 production	circular bioeconomy	catalyst design
gasification technology	animal manure	catalyst stability
microbial fuel cell	microbial fuel cells	reaction pathway
gasification process	bio oil yield	valuable chemical
hydrogen yield	waste biomass	preparation method
lignocellulosic biomass	biomass pyrolysis	main product
bio oil	water gas shift reaction	hydrogen rich syngas
syngas production	methane pyrolysis	environmental remediation
biohydrogen production	bioethanol production	kinetic analysis
food waste	preparation method	efficient conversion

The following key terms were used to find an example article: H_2 production; circular bioeconomy; catalyst design [*Chen et al.*, 2023].

This review examines the design, synthesis and application of waste-based electrocatalysts for clean hydrogen energy with a focus on the circular economy. The cost-effective use of spent catalysts in water electrolysis, following the principle of circular economy, makes a significant contribution to the sustainable development of green hydrogen production.

Table 2. Each of the top ten terms from the second cluster ranked by occurrence, citation, and novelty

Occurrences	Avg. norm. citations	Avg. pub. year
wireless power transfer	higher data rate	precise control
energy trading	high throughput	federated learning
fifth generation	network function virtualization	mode control
communication system	deep learning technology	mean absolute error
base station	massive mimo	deep reinforcement learning
iot device	markov decision process	6g network
convolutional neural network	high data rate	consensus mechanism
wireless communication	6g network	deep deterministic policy gradient
unmanned aerial vehicle	phasor measurement unit	reconfigurable intelligent surface
wireless network	cloud computing	long short term memory

The following key terms were used to find an example article: wireless power transfer; higher data rate; precise control [*Trigui et al.*, 2020]. The paper presents a wireless power and downlink data transfer system for medical implants using a 10 MHz inductive link. The system uses a *Carrier Width Modulation* (CWM) scheme for high-speed communication and efficient power delivery. The system operates under a wide range of data rates, with a maximum data rate of 3.33 Mb/s and a maximum power delivery of 6.1 mW at 1 cm coils separation distance. The system's genericity allows operators to choose the best compromise between power and data rates without reconfiguring the receiver.

Table 3. Each of the top ten terms from the third cluster ranked by occurrence, citation, and novelty

Occurrences	Avg. norm. citations	Avg. pub. year
water splitting	photoelectrochemical water splitting	hydrogen adsorption
surface area	water molecule	catalytic efficiency
activation energy	solid state hydrogen storage	solid state hydrogen storage technology
electrode material	hydrogen adsorption	synergistic interaction
hydrogen production rate	photocatalytic hydrogen production	hydrogen storage material
specific surface area	hydrogen storage material	density functional theory
metal organic framework	hydrogen efficiency	molecular dynamic
reaction kinetic	photocatalytic activity	charge transfer
promising candidate	photocatalytic performance	hydrogen storage capacity
electrochemical performance	liquid organic hydrogen carrier	hydrogen storage application

The following key terms were used to find an example article: water splitting; photoelectrochemical water splitting; hydrogen adsorption [*Fu et al.*, 2024]. Oxygen vacancies enhance charge transfer between active sites and adatoms, reducing the system's work function and enhancing redox capacity. This reduces hydrogen adsorption-free energy for the hydrogen evolution reaction and overpotential for the OER, facilitating photoelectrochemical activity of overall water splitting. Oxygen vacancies also reduce hydrogen adsorption-free energy and overpotential.

Table 4. Each of the top ten terms from the fourth cluster ranked by occurrence, citation, and novelty

Occurrences	Avg. norm. citations	Avg. pub. year
economic growth	load capacity factor	chinese city
panel data	quarterly data	digital infrastructure
renewable energy consumption	ecological sustainability	dual carbon
technology innovation	nonrenewable energy consumption	natural resource rent
green technology innovation	green innovation	policy uncertainty
environmental degradation	empirical finding	threshold effect
environmental regulation	green technological innovation	higher quantile
empirical result	brics country	load capacity factor
long run	negative shock	ecological sustainability
environmental quality	regional heterogeneity	economic policy uncertainty

The following key terms were used to find an example article: economic growth; load capacity factor; Chinese city [*Usman et al.*, 2024]. This study examines the impact of clean energy expansion and natural resource extraction on China's load capacity factor from 1970 to 2018, highlighting the potential for a sustainable decarbonized economy in the country. It emphasizes the need for investment in clean energy sources and efficient use of available natural resources to mitigate the environmental impact of non-renewable energy.

Table 5. Each of the top ten terms from the fifth cluster ranked by occurrence, citation, and novelty

Occurrences	Avg. norm. citations	Avg. pub. year
current density	anion exchange membrane	slow kinetic
oxygen evolution reaction	efficient hydrogen production	alkaline condition
ma cm2	water electrolysis technology	seawater electrolysis
hydrogen evolution reaction	noble metal	catalytic mechanism
synergistic effect	alkaline water electrolysis	alkaline water electrolysis
catalytic activity	water electrolyzer	electrocatalytic water splitting
active site	large scale hydrogen production	electronic structure
catalytic performance	sustainable hydrogen production	m koh
mass transfer	bifunctional electrocatalyst	bifunctional electrocatalyst
hydrogen evolution	proton exchange membrane water electrolysis	oxygen evolution reaction

The following key terms were used to find an example article: current density; anion exchange membrane; slow kinetic [*Serban et al.*, 2025]. The study presents a simple electrodeposition method for a self-supported Ni_4Mo–MoOx catalyst, which is a cost-effective alternative to platinum group metal (PGM) catalysts used in modern AEM water electrolyzers for green hydrogen production. The cooperation between MoOx and Ni_4Mo enhances the Volmer step of HER due to their superior activity.

The challenge of this approach is that terms with high-level characteristics, such as frequent occurrence and high average citation and occurrence in new publications, may rarely appear together in the title and abstract of a single paper. Therefore, few publications can be found, making it difficult to compile a reference list to address the topic in detail.

As an alternative, an approach based on a graphical representation of terms co-occurrence network for each of the five clusters, shown in coordinates of average normalized citation and occurrence in new publications, is considered below. In addition, 4 sub-clusters are formed for each cluster. This grouping increases the visibility of the co-occurrence of terms, which improves the understanding of the subcluster topic and the ability to find a more accurate list of publications by the subtopic. This enables the identification of a relevant topic that meets several parameters at once: average normalized citation, occurrence of terms in new publications, and total link strength of terms. The latter is achieved by setting a threshold for the total link strength parameter. The elegance of this approach lies not only in its visibility, but also in the fact that it can be implemented within a single free program — *Scimago Graphica*.

Each of the five figures (fig. 2–6) consists of two graphs. The upper graph shows the structure of one of the clusters corresponding to fig. 1. The lower graph is plotted on the same data using the *Scimago Graphica* program in coordinates Average normalized number of citations and Average publication year of the documents in which a keyword occurs. The terms of the bottom graph were additionally clustered using the algorithm based on Clauset, Newman and Moore [*Clauset et al.*, 2004], built into the *Scimago Graphica* program. Additional clustering was used to narrow the set of terms reflecting the current topic and, consequently, the set of terms within one community.

Fig. 2 shows the terms co-occurrence graph for the first cluster presented in fig. 1.

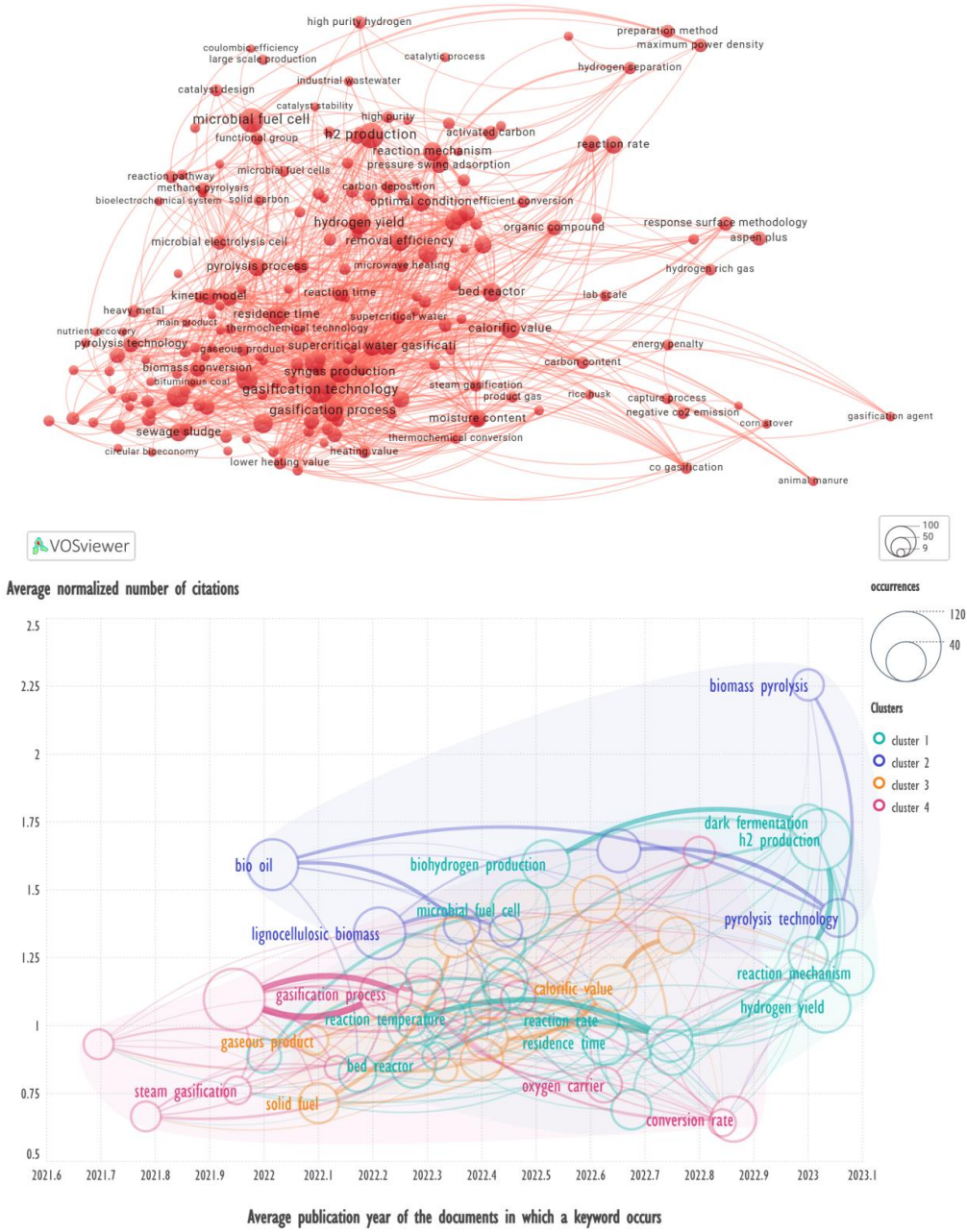

Fig. 2. A graph describing a promising research topic employing terminology from the first cluster

In this case, the topic biomass pyrolysis has a good citation rate and frequently appears in new publications. It has a Total Link Strength of 72 and an occurrence of 25. (The total link strength for a node is the sum of the strength values of all the links connected to that node.)

The following two publications may be considered as examples:

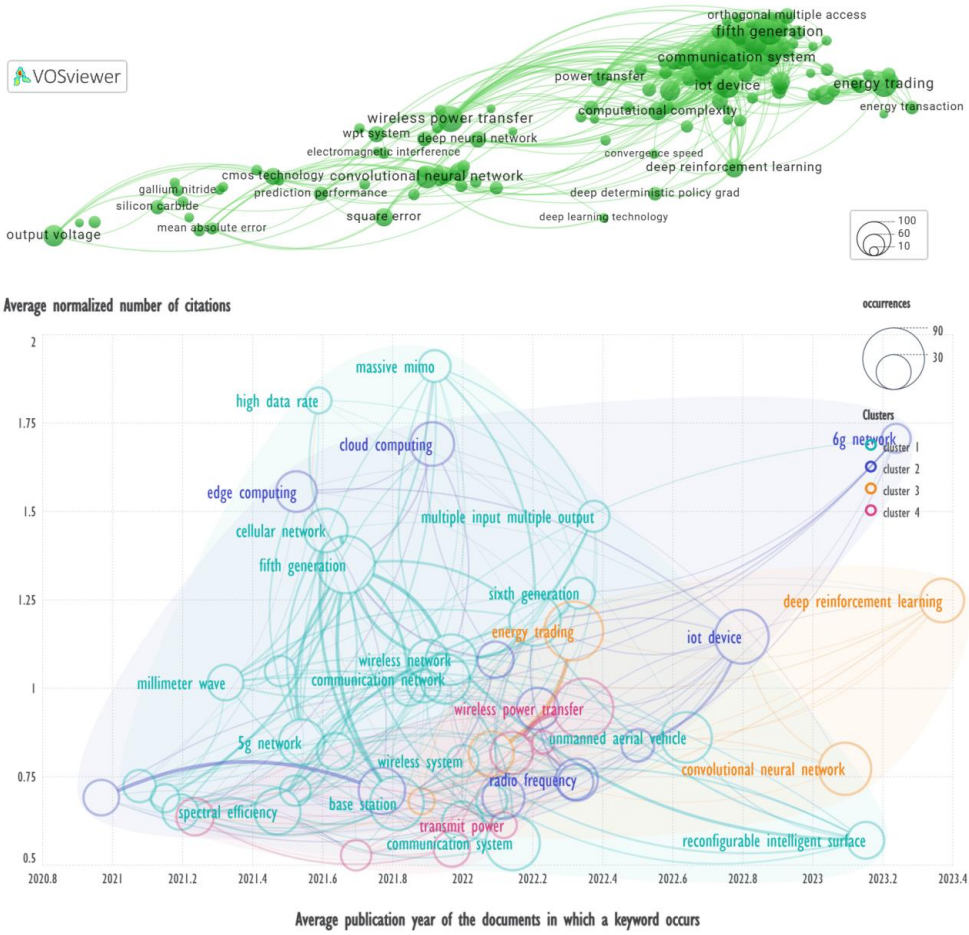

Fig. 3. A graph describing a promising research topic employing terminology from the second cluster

The study [*Al-Rumaihi et al.*, 2022] reviews pyrolysis techniques, reactor types, and parameters to optimize biochar production from co-pyrolysis of plastic and biomass feedstock. It identifies temperature, heating rate, reactor bed height, residence time, pressure, feedstock type, and blending ratio as determinants affecting yield, stability, and carbon content of biochar (2022 / 371→Year / Cited).

The increasing energy consumption and environmental concerns highlight the need for renewable and clean energy sources, particularly hydrogen. The paper [*Nguyen et al.*, 2024] reviews recent advancements in biomass pyrolysis and gasification, focusing on technical problems, efficiency, and mechanisms (2024 / 124).

Fig. 3 shows the terms co-occurrence graph for the second cluster presented in fig. 1.

In this case, the topic 6g network has a good citation rate and frequently appears in new publications. It has a Total Link Strength of 71 and an occurrence of 21. The topic is quite extensive, so let's add the term *iote device*, which occurs 69 times and has a Total Link Strength — 171.

The following two publications may be considered as examples:

The *6G Internet of Things* (IoT) has gained considerable attention with the advent of 5G networks. To address issues such as information transmission, data aggregation and power supply. A variance-based integration model is proposed for the 6G IoT approach, which considers energy, communication, and computation and integrates the optimization of transmission beams via the improved ant colony optimization model to balance system performance, energy consumption, and computational complexity [*Ramamoorthy et al.*, 2023] (2023 / 11).

The paper [*Sefati et al.*, 2024] provides a literature review on IoT resource management in 6G cellular networks. A comparative study of IoT resource management techniques, an overview of how resources are managed in LTE, 5G and 6G networks, an analysis of applications such as *Intelligent Transportation Systems* (ITS), *Industrial IoT* (IIoT) and *Mobile Crowdsensing* (MCS), and a discussion of upcoming challenges (2024 / 16).

Fig. 4 shows the terms co-occurrence graph for the third cluster presented in fig. 1.

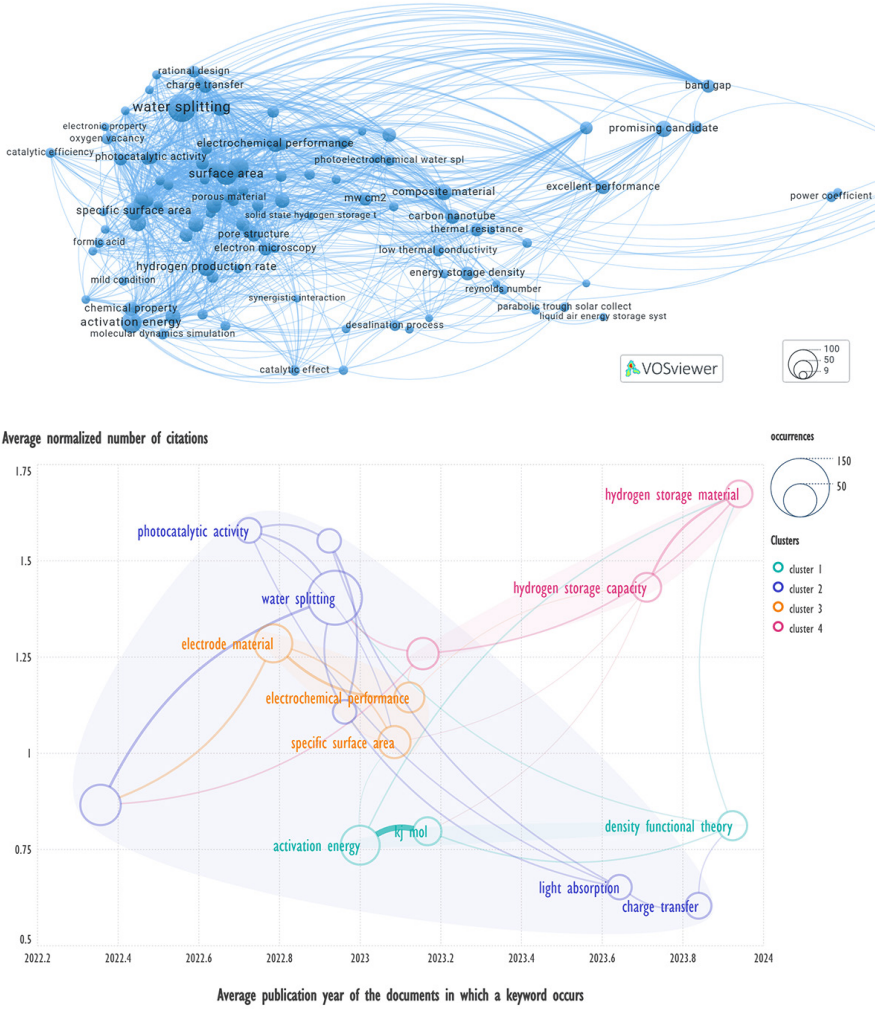

Fig. 4. A graph describing a promising research top ic employing terminology from the third cluster

In this case, the topic hydrogen storage material has a good citation rate and frequently appears in new publications. It has a *Total Link Strenth* of 92 and an occurrence of 33.

The following two publications may be considered as examples:

Efficient and safe hydrogen storage is one of the main challenges for large-scale hydrogen energy. Solid hydrogen storage materials that perform well under ambient conditions are promising for future hydrogen storage technologies. In this study [*Bao et al.*, 2023], structural controllability and physicochemical parameters are analyzed to theoretically justify strategies for the synthesis of metal-organic frameworks (2023 / 41).

The article [*Shu et al.*, 2025] presents an analysis of hydrogen production strategies, storage and transportation technologies, and a wide range of applications. Particular attention is paid to hydrogen storage technologies, which are rapidly evolving and critical for sustainable development. The article also discusses hydrogen storage material selection, cost-effectiveness, safety, and future development trends. In addition, the article discusses hydrogen transportation methods, fuel cell technology, hydrogen combustion and its potential in low-carbon transportation (2025 / 24).

Fig. 5 shows the terms co-occurrence graph for the fourth cluster presented in fig. 1.

In this case, the topic green technological innovation has a good citation rate and frequently appears in new publications. It has a Total Link Strenth of 104 and an occurrence of 22.

Note: In addition to the term green technological innovation, the graph also uses the term green technology innovation. When conducting a study like ours, it is reasonable to use *VOSviewer* to analyze texts in two stages. The first stage is the usual procedure. The second stage involves correcting selected keywords. When using *VOSviewer* for index or author keywords, it is possible to perform lemmatization beforehand to exclude similar spellings of terms. However, this is not possible when using *VOSviewer* for texts because key terms are extracted based on linguistic analysis. For example, the ending may be important. One possible solution is to use *thesaurus_terms* files in the second pass.

The following two publications may be considered as examples:

The study [*Jiakui et al.*, 2023] explores the impact of green financing, financial development, and green technology innovation on green total factor productivity in 28 Chinese provinces from 2011–2021. Results show that green financing significantly enhances green productivity, and legislation can accelerate its growth (2023 / 459).

The study [*Fang*, 2023] examines the effects of economic complexity index, energy sector investment, green technical innovation and industrial structure growth on carbon dioxide emissions in 32 provinces in China from 2005 to 2019. The results show that the economic complexity index is responsible for the worsening trends in China's carbon dioxide emissions, while renewable energy investment, green technical innovation and industrial structure contribute to their reduction (2023 / 151).

It should be emphasized that the selected articles not only have a high citation rate, but also have a relevance to the other clusters in this fig. that is expressed in terms: green finance, green technology innovation, empirical finding, Chinese city (close in meaning to Empirical insights from China, case study of China).

The top part of the fig. 5 shows that the overall cluster topic is relevant to the economic growth theme.

Given the high citation rate of the selected publications, the frequent co-occurrence of many key terms, and the direct relevance to economic growth, it is appropriate to examine this subtopic in more detail in subsequent studies.

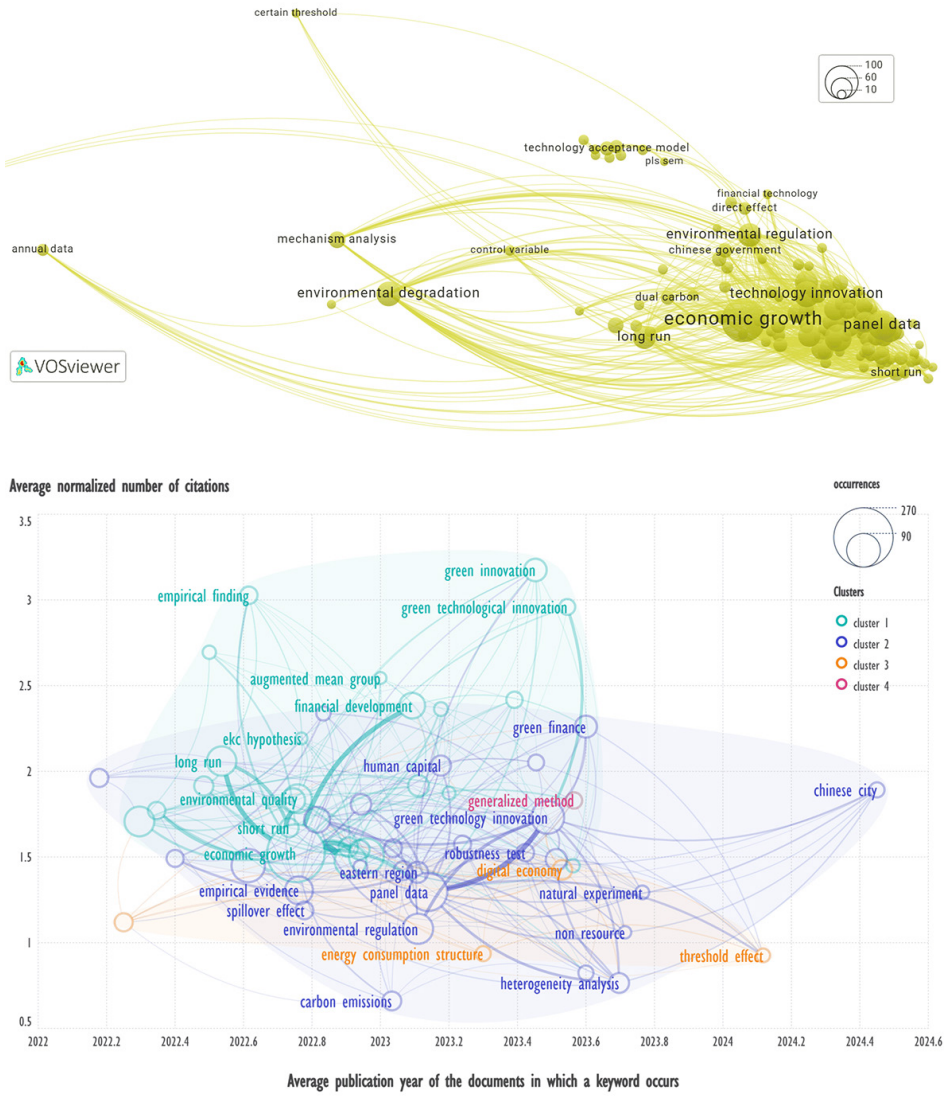

Fig. 5. A graph describing a promising research topic employing terminology from the fourth cluster

Fig. 6 shows the terms co-occurrence graph for the fifth cluster presented in fig. 1.

In this case, the topic alkaline water electrolysis has a good citation rate and frequently appears in new publications. It has a Total Link Strength of 72 and an occurrence of 36.

The following two publications may be considered as examples:

The review [*Maier et al.*, 2022] discusses advances in alkaline water electrolysis with polymer electrolyte membranes for hydrogen production, with emphasis on cost, efficiency, and durability. In addition, the current understanding of mass transfer and its characterization/diagnosis in water electrolyzers with polymer electrolyte membranes is reviewed, with emphasis on the flow channels, liquid-gas diffusion layer, and polymer electrolyte membrane (2022 / 157).

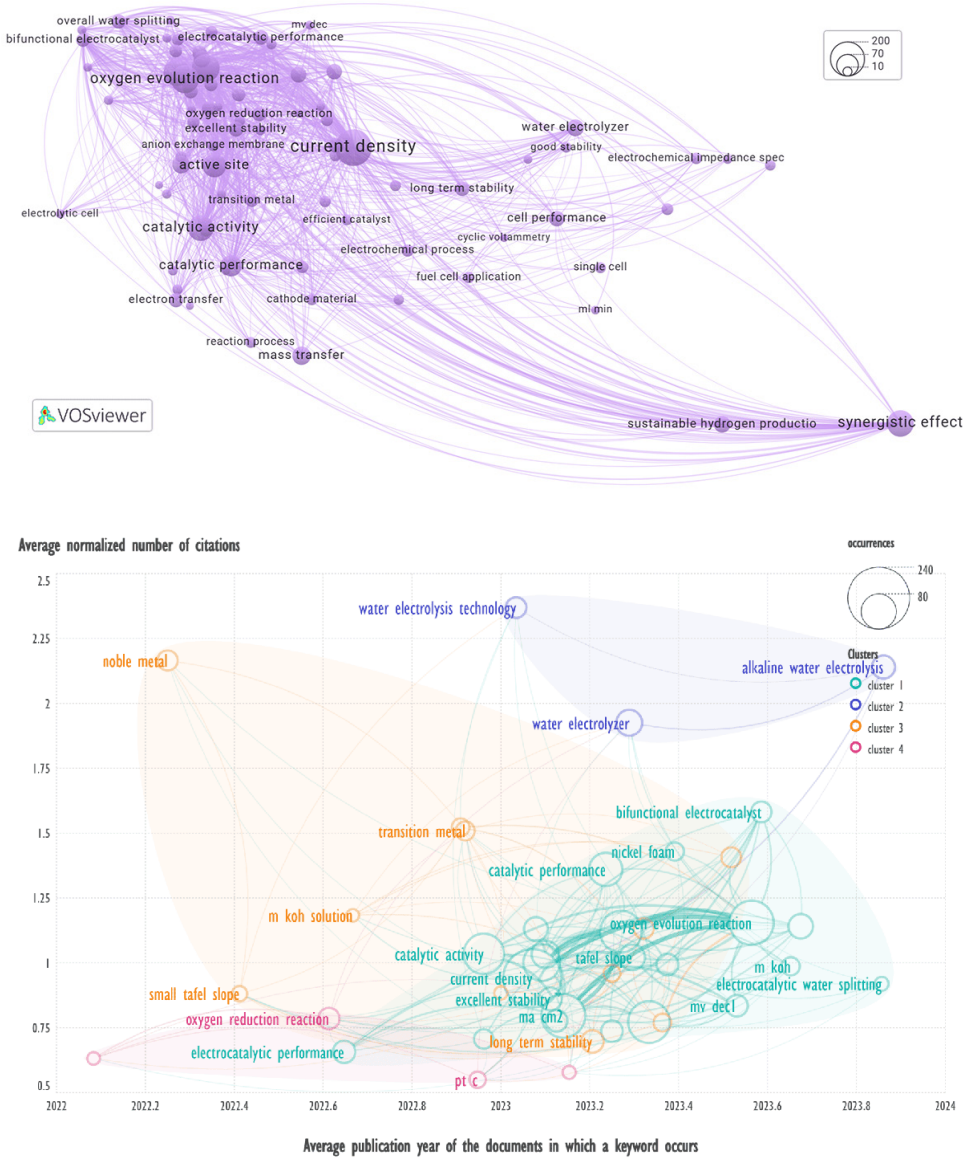

Fig. 6. A graph describing a promising research topic employing terminology from the fifth cluster

The review [*Emam et al.*, 2024] explores alkaline water electrolysis, a technology for producing hydrogen, and offers insights for achieving sustainable growth. Focusing on large-scale systems and industrial applications, it highlights the technology's economic feasibility, cost considerations, and transformational impact. Key discoveries, critical assessments, and areas for future research are highlighted, including electrode materials, safety standards, scaling efficiencies, operational flexibility, and surface modification techniques (2024 / 93).

To achieve a better view of the graphs generated by the *Scimago Graphica* program additional constraints were used: Average normalized number of citations (avg.norm.ci-

tations) > = 0.5. The number of nodes displayed on the graph was controlled by the *total_link_strength* filter (~60–70). This parameter can be considered an additional relevance criterion for topics — terms with significant connections to other terms better reflect the topic of publications.

It is worth noting that while using the terms from the tables required searching for publications in general-purpose search engines such as *Semantic Scholar*, the terms presented in figures 2–6 made it possible to find suitable publications in the source files exported from dimensins.ai and used in this study.

Publications found using the key terms presented in the graphs are often of a review nature and are more suitable for identifying general trends in research on the topic under study. The combination of three terms from the tables, strongly narrows the search result, so it may be more suitable for identifying rather specific problems relevant at the given time.

Conclusion

The text analysis of 15 000 bibliometric records concerning technologies related to the SDG-7 theme allowed to identify 5 clusters of topical problems mainly related to renewable energy, wireless energy transmission, water electrolysis, hydrogen production and storage, especially in solid materials and problems related to economic growth.

The most relevant research topics characteristic of the first cluster can be described by the following key terms: H_2 production, gasification technology, microbial fuel cell, gasification process, circular bioeconomy, catalyst design, catalyst stability, reaction pathway, biomass pyrolysis. According to fig. 2, biomass pyrolysis can serve as a promising research topic.

The most relevant research topics characteristic of the second cluster can be described by the following key terms: wireless power transfer, energy trading, precise control, federated learning, mode control, mean absolute error, deep reinforcement learning, 6g network, higher data rate. According to fig. 3, 6g network and deep reinforcement learning can serve as promising research topics.

The most relevant research topics characteristic of the third cluster can be described by the following key terms: water splitting, hydrogen adsorption, catalytic efficiency, solid state hydrogen storage technology, synergistic interaction, hydrogen storage material, photoelectrochemical water splitting. According to fig. 4, hydrogen storage material can serve as a promising research topic.

The most relevant research topics characteristic of the fourth cluster can be described by the following key terms: economic growth, load capacity factor, Chinese city, quarterly data, ecological sustainability, digital infrastructure, non-renewable energy consumption, natural resource rent. According to fig. 5, green innovation can serve as a promising research topic.

The most relevant research topics characteristic of the fifth cluster can be described by the following key terms: current density, oxygen evolution reaction, anion exchange membrane, efficient hydrogen production, water electrolysis technology, slow kinetic, alkaline condition, seawater electrolysis. According to fig. 6, alkaline water electrolysis can serve as a promising research topic.

Limitations and Future Research: The analysis showed that nuclear and hydro power are not present as relevant topics in the collected bibliometric data. However, they belong to the clean energy and SDG 7. Thus, it seems reasonable to examine how the SDG-7 topic

affiliation filter query is organized and expand it. It also makes sense to broaden the list of quality energy-related journals.

In bibliometric records exported from *Dimensions.ai*, there is no "Keywords" field. Therefore, *VOSviewer* was used to work with the text fields of titles and abstracts. A preliminary morphological analysis was conducted, and noun phrases were selected. It is reasonable to carry out this work in several stages. First, perform morphological analysis and identify noun groups. Then, add key terms that reflect the subject of study, select them in text fields, and normalize them. Finally, carry out clustering, as is done for keywords.

The results showed that the most promising research topics are often purely technological in nature. It would be useful to conduct a separate study reflecting the social aspects of energy transition and sustainable energy technologies using terms such as "affordable energy" and "energy equity". Then find areas where technology and society intersect.

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Ландшафт устойчивых энергетических технологий для ЦУР-7. Библиометрический анализ данных *Dimensions.ai*

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Исследование направлено на выявление технологий, имеющих отношение к Цели устойчивого развития 7 — «Чистая и доступная энергия», путем анализа библиометрических данных платформы *Dimensions.ai*. Всего было проанализировано 15 000 записей за период 2020–2025 гг., опубликованных в девяти журналах, наиболее релевантных рассматриваемой теме. Показан метод определения актуальных тем исследований на основе совместной встречаемости ключевых терминов с учетом цитирования и среднего времени публикации статей, в которых эти термины встречаются. В исследовании использовались бесплатные программы для библиометрического анализа и визуализации — *VOSviewer* и *Scimago Graphica*. Актуальность исследования обусловлена тем, что энергетика имеет решающее значение для развития производства, особенно в условиях углубления автоматизации и внедрения искусственного интеллекта. Результаты текстового анализа заголовков и аннотаций библиометрических записей показали доминирование различных аспектов технологий, связанных с возобнов-

ляемыми источниками энергии, беспроводной передачей энергии, производством и хранением водорода, инновациями в электролизе воды и влиянием технологий на экономическое развитие. Данное исследование следует рассматривать как предварительное изучение того, как развитие технологии устойчивой энергетики могут повлиять на создание рабочих мест, реализацию экономических возможностей, энергетическое равенство и другие социальные проблемы.

Ключевые слова: устойчивые энергетические технологии, SDG-7, *Dimensions.ai*, тематический анализ, библиометрический анализ, визуализация.