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Review

A Scoping Review of Renewable Energy, Sustainability and the Environment

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Abstract: The article aims to identify the latest trends in research on renewable energy, sustainability and the environment. A total of 92,873 publications from 123 Scopus sources for 2020–2021 are compared using the scoping review method. The results show that the most cited works in this sample are those by authors from the Asian region. The research of these authors focuses on the security, efficiency and reliability of separate elements in energy systems. Besides, the paper considers the problems regarding COVID disease along with the renewable energy sources, perovskite and organic solar panels, nanostructured materials and high energy density. Finally, the paper analyses applications of computer science methods in research on renewable energy, sustainability and the environment. The findings evidently show that recent advancements in computer science methods were not extensively used in the discussed research domain and give a great room for novel strategies of prognosing, simulation and processes optimisation.

Keywords: clean energy innovation; environmental sustainability; renewable energy

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1. Introduction

Researchers have been significantly interested in renewable energy, sustainable development and environmental protection in recent years. Constant changes in energy markets to increase green energy consumption stimulate studies and publication activity globally [1,2]. Governments of all countries face ambitious challenges for the goals of 2030 and the demands to counteract climate changes [3,4] and reduce greenhouse gas emissions [5,6]. The environmental component is an integral part of sustainable development, the impact of which is greatly enhanced due to the extensive use of fossil resources and insufficient environmental protection. Uncontrolled pollution of territories can lead to economic consequences and negatively impact the environment [7,8], causing ecological disasters and migration of the working population [9,10]. At the same time, the Paris Agreement 2015 contains regulated requirements that disturb the transformation of energy balances in terms of reducing the share of coal [11,12] and expanding green energy production in the energy sector [13]. Given this and considering the fluctuations of generating power based on most green energy sources [14,15], it does not seem strange to find ways to balance the growing share of renewable energy sources in conventional energy systems [16,17]. Unfortunately, the existing solutions have drawbacks.

The scientific community conducts discussions and studies of economic efficiency regarding renewable energy sources [18,19]. Given the criticism of the current approach to assessing economic efficiency, the criteria and methods for measuring it are widely discussed [20,21]. However, not all countries have been able to achieve certain efficiency targets so far. There is a gap between potential and actual energy generation from renewable energy sources [22,23] and indicators of its productivity [24,25]. A possible solution,

in this case, will be to expand the use of green innovations, smart grids [26,27], promising energy storage technologies [28,29]. The accelerated consumption of renewable energy resources is stimulated in the interested communities [30]. In the real world, citizen energy communities and renewable energy communities are formed, where changes are adapted, and the green innovation diffusion processes occur [31,32]. The existing infrastructure is used, and a new one, which can cope with the load when using renewable energy [33,34], is built to support and function such communities. The deployment of microgrids and virtual power plants is among the many innovations needed to integrate renewable energy sources [35,36]. In addition, the transition to sustainable business models [37,38] requires updating the requirements for flexibility, security [39,40], management of energy systems [41,42]. On the part of the state, such an update can be stimulated via institutions quality standards [43], environmental taxes [44,45], environmental responsibility strategies [46], security [47,48] and ecological standards [49,50], the requirements for industry safety indicators [51,52] and the introduction of comprehensive training programs [53,54]. Therefore, new research topics are rapidly emerging, driven by current changes and technologies in the energy sector. It is possible to name new technologies for the production and storage of energy [55,56], new requirements for the provision of basic functions in the COVID-19 pandemic [57,58]. Such topics require detailed study [59], determining the role and directions of the transition to sustainable green energy, the main factors in combating irreversible climate change, identifying drivers to ensure a green energy breakthrough, which is the purpose of this study.

This article consists of four sections. In the next section, the authors describe the research methodology and the main stages of the scoping review. The third section presents the results and issues related to the analysis of new topics and clusters, research results of institutions and leading authors in the subject area 'Renewable energy, sustainability and the environment' for 2020–2021. The conclusions complete this article.

2. Materials and Methods

The concept of the study was based on an adapted approach to the scoping review, considering the methodologies outlined in several works [60,61]. Given the potential and comprehensive coverage of the scientific literature on renewable energy, the authors ask the following research question: 'What are the latest trends in research in the subject area, Renewable energy, sustainability and the environment?' The scoping review in this work was performed to analyse the scientific literature from the Scopus database as of 7 April 2021, and to maximise the coverage of promising research for 2015–2021. For the general estimation of tendencies in the chosen subject area, 363,255 publications were found by All Science Journal Classification Codes (ASJC) subject area: 'Renewable energy, sustainability and the environment', among which 270,382 units were excluded (by date and type of publications). During 2020–2021, the authors selected a total of 78,126 articles and 14,747 conference papers. The final database of the study contained 92,873 publications by 302,587 authors. Figure 1 shows the general methodology of the study.

Content analysis of publications was performed using analytical applications for data visualisation of scientific publications: SciVal (scival.com, Copyright © 2021 Elsevier B.V.; accessed on 7 April 2021) and VOSviewer 1.6.16 (vosviewer.com, Copyright © 2021 Centre for Science and Technology Studies, Leiden University, Leiden, The Netherlands; downloaded on 7 April 2021). Performance indicators, research of topics and topic clusters, works of authors and institutions in publications were analysed using the analytical solution SciVal. Network analysis of the observed topics and authors was performed applying VOSviewer 1.6.16.

Citation maps were built for the top 5 leading publications (by the number of citations). About 1548 works cite the top 5 leading publications. For these publications, VOSviewer 1.6.16 network maps of joint citation and topics of research networks of the authors of the works were formed. When constructing the maps, the association strength normalisation method was used. The authors merged small clusters using the min cluster size filter.

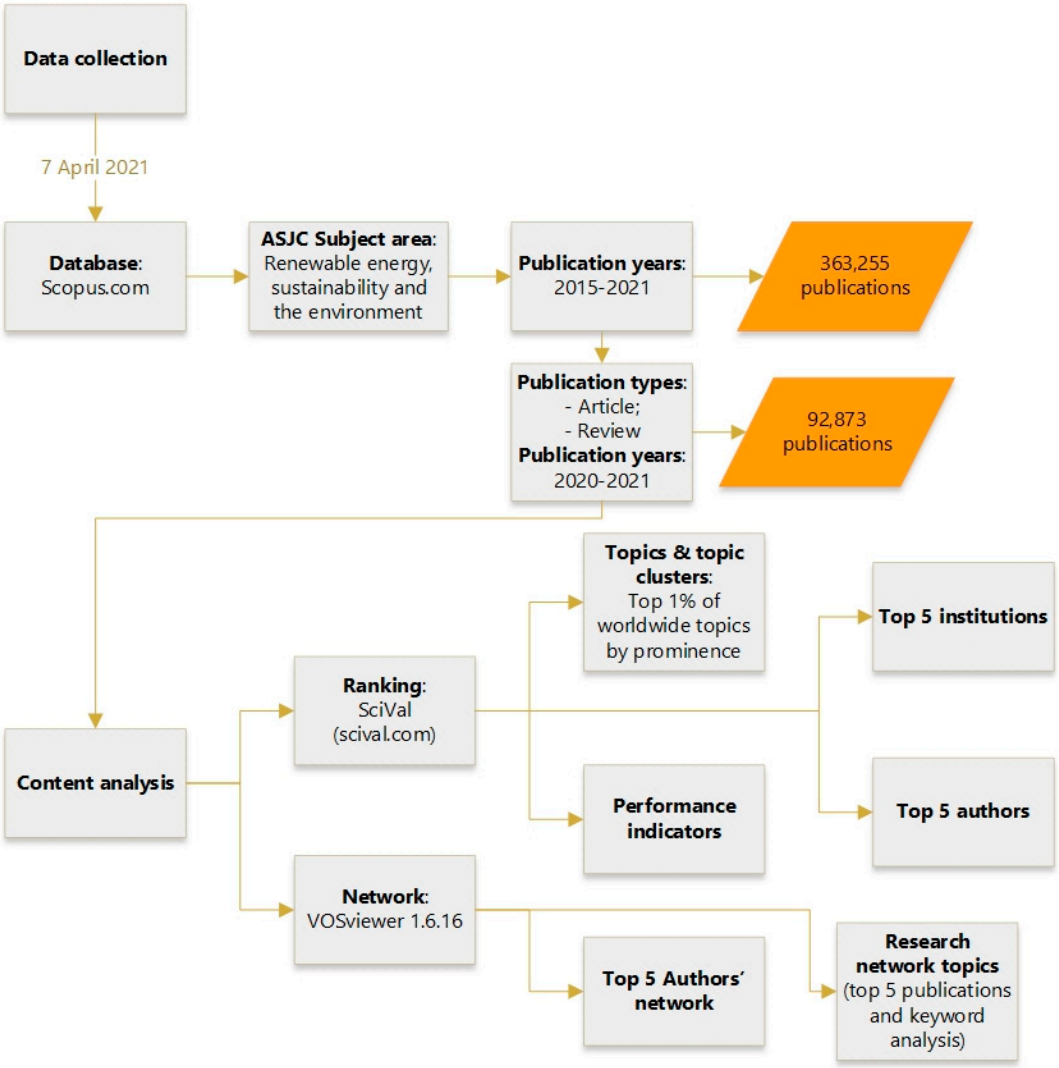


Figure 1. Diagram of the general research methodology.

3. Results and Discussion

3.1. The Cluster Analysis

The authors analysed the clusters and topics included in the subject area 'Renewable Energy, Sustainability and the Environment' for works published in 2020–2021. All publications during this period can be grouped into 20 clusters, three of which belonged to the top 1% of worldwide clusters by prominence in the Scopus database. These are such ASJC topic clusters (TC) as TC.30, TC.28, TC.81 (Table 1). The TC.30 contains 52 topics, the most important in terms of prominence percentile are topics (T) T.4025, T.1727, T.6, T.350 and T.5899. In the TC.28, topics T.257, T.200, T.5522 should be distinguished by prominence, and in the TC.81-topics T.5457, T.2456, T.3285. It is clear that the subject of these publications mainly relates to such areas as energy, materials science, chemistry. Although research within these clusters is being conducted worldwide, scientists from China and the United States have made the most significant progress.

Table 1. Top 1% of worldwide clusters by prominence that appear within renewable energy, sustainability and the environment, 2020–2021.

Topic Cluster	Scholarly Output	Publication Share (%)	Field-Weighted Citation Impact	Prominence Percentile
Secondary Batteries; Electric Batteries; Lithium Alloys (TC.30)	7891	6.90	1.96	100.000
Electric Power Transmission Networks; Wind Power; Electric Power Distribution (TC.28)	6251	7.23	1.00	99.398
Electricity; Energy; Economics (TC.81)	3728	7.40	1.60	99.264

Based on the SciVal database (www.scival.com, accessed on 7 April 2021); data source: Scopus (downloaded on 7 April 2021); copyright: Elsevier B.V.

According to the analytical platform SciVal, this sample of publications contained a total of 825 ASJC topics, 135 topics of which were in the top 1% of worldwide topics by prominence. Among the topics in the sample, one topic had 100% prominence (Figure 2, Table 2). This is T.20 (TC.8), which is related to the study of perovskite photovoltaic cells for solar panels. This topic is prospective and developing rapidly.

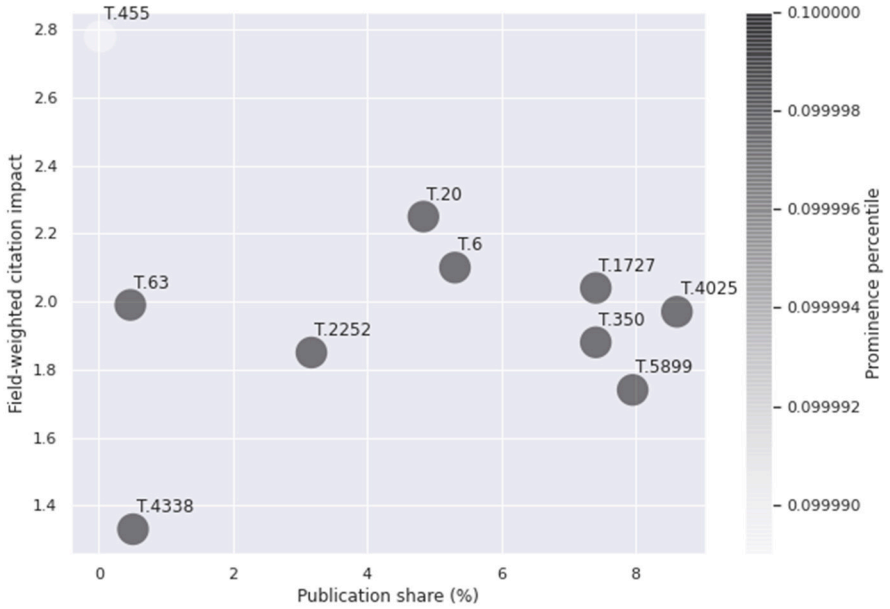


Figure 2. Top 10 topics by prominence that appear within renewable energy, sustainability and the environment, 2020–2021 (Based on the SciVal database (www.scival.com, accessed on 7 April 2021); data source: Scopus (downloaded on 7 April 2021); copyright: Elsevier B.V.).

Table 2. Top 10 topics by prominence ranking that appear within renewable energy, sustainability and the environment, 2020–2021.

Rank	Topic	Prominence Percentile	Top First Authors by Citations	Top First Source by Citations
1	Perovskite Solar Cells; Lead Bromide; Formamidine [T.20]	100.000	Zheng, X., Hou, Y., Bao, C. and 27 more	Nature Energy
2	Object Detection; CNN; IOU [T.4338]	99.999	Rashid, M., Khan, M.A., Alhaisoni, M. and 4 more	Sustainability (Switzerland)
3	Oxygen Production; Electrocatalysts; Water Splitting [T.4025]	99.997	Liang, C., Zou, P., Nairan, A. and 7 more	Energy and Environmental Science
4	Cyanogen; Heptazine; Photocatalysts [T.2252]	99.996	Che, H., Liu, C., Che, G. and 5 more	Nano Energy
5	Molybdenum Disulfide; Rhenium Sulfide; Van Der Waals [T.63]	99.995	Bafekry, A., Obeid, M.M., Nguyen, C.V. and 2 more	Journal of Materials Chemistry A
6	Sodium-ion Batteries; Nati2(Po4)3; Ion Storage [T.1727]	99.994	Guo, R., Lv, C., Xu, W. and 7 more	Advanced Energy Materials
7	Electrochemical Capacitors; Cobaltous Sulfide; Electrode Materials [T.6]	99.993	Wulan Septiani, N.L., Kaneti, Y.V., Fathoni, K.B. and 9 more	Nano Energy
8	Intestine Flora; Ruminococcaceae; Dysbiosis [T.455]	99.992	Tashiro, A., Shaw, R.	Sustainability (Switzerland)
9	Zinc Air Batteries; Electrocatalysts; Chemical Reduction [T.350]	99.991	Zhu, Y., Sokolowski, J., Song, X. and 3 more	Advanced Energy Materials
10	Electrocatalysts; Cobalt Phosphide; Water Splitting [T.5899]	99.989	Wu, Q., Luo, M., Han, J. and 7 more	ACS Energy Letters

Based on the SciVal database (www.scival.com, accessed on 7 April 2021); data source: Scopus (downloaded on 7 April 2021); copyright: Elsevier B.V.

In general, the most cited publications in the research topics (Table 2) were prepared by both small teams and quite powerful ones, consisting of 30 people. Moreover, about 27% of all teams were international (Figure 3). However, at the same time, only 3% of co-authors had both an academic and a corporate affiliation, which may be a symptom of some slowdown in the commercialisation of innovations.

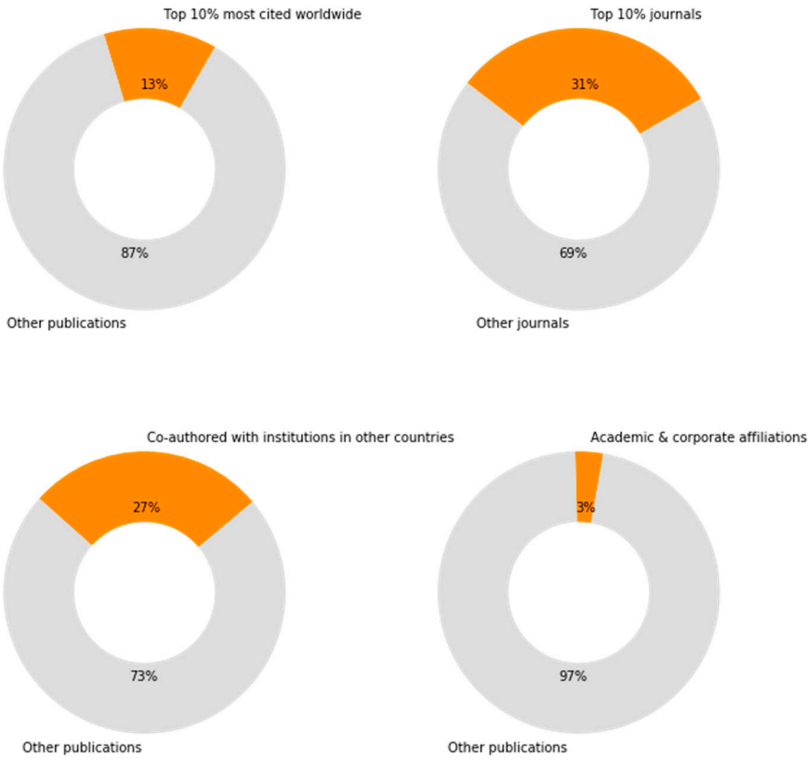


Figure 3. Performance indicators within renewable energy, sustainability and the environment, 2020–2021 (Based on the SciVal database (www.scival.com, accessed on 7 April 2021); data source: Scopus (downloaded on 7 April 2021); copyright: Elsevier B.V.).

At the same time, 31% of publications in the sample belonged to the top 10% of journals. Most publications were published in 5 journals (Table 3): Sustainability (13,340 publications), Journal of Cleaner Production (7021), Energies (5368), International Journal of Hydrogen Energy (4382), Renewable Energy (3353). However, the most cited were publications published in the journals Nature Energy (14.3 citations per publication in the set), Energy and Environmental Science (11.4), Advanced Energy Materials (8.1), Energy Storage Materials (8.1). It is clear that the journals Nature Energy and Energy and Environmental Science have the highest score on the 2019 index CiteScore ™ (Appendix A, Table A1).

Table 3. Top 10 Scopus sources by publications on renewable energy, sustainability and the environment in 2020–2021.

Scopus Source	Publications	Citations Per Publication	2019 CiteScore™
Sustainability	13,340	1.4	3.2
Journal of Cleaner Production	7021	4.2	10.9
Energies	5368	1.5	3.8
International Journal of Hydrogen Energy	4382	2.9	8.0
Renewable Energy	3353	4.5	11.2
Journal of Materials Chemistry A	2594	4.1	17.1
ACS Sustainable Chemistry and Engineering	2152	2.9	9.7
Bioresource Technology	2085	4.1	12.8
Journal of Power Sources	1934	3.4	14.4
Journal of the Electrochemical Society	1813	1.5	5.8

Based on the SciVal database (www.scival.com, accessed on 7 April 2021); data source: Scopus (downloaded on 7 April 2021); copyright: Elsevier B.V.

3.2. Institutions' Research Performance

In terms of quantitative indicators of institutions for scientific publications in this area, the absolute leaders are Chinese institutions, which in the top ten occupy nine places in terms of the number of publications. The top 10 institutions by scientific result (scholarly output) are headed by the Ministry of Education of China, with affiliation of which 3377 publications were published in 2020–2021. Among the 9062 authors affiliated with the Ministry of Education of China, the largest number of publications was in Liao Q. (27 publications), Zhu X. (22) and Wang G. (15).

However, if we study the number of citations per one publication, the picture will be completely different. According to this metric, the top five institutions include Fluxim AG (Switzerland), International Union for Conservation of Nature and Natural Resources (Switzerland), Royal Swedish Academy of Sciences (Sweden), Valparaiso University (USA), Cag University (Turkey). These institutions belong to different countries and regions, and to different sectors. The top five includes government, corporate and academic institutions. It is worth noting that according to this metric, only institutions with a few highly cited works were in the top (Table 4).

Table 4. Top 5 institutions by number of citations per publication in Scopus on renewable energy, sustainability and the environment in 2020–2021.

Institution	Citations	Authors	Citations Per Publication	Field-Weighted Citation Impact (SciVal)
Fluxim AG	130	6	43.3	16.52
International Union for Conservation of Nature and Natural Resources	86	3	28.7	16.45
Royal Swedish Academy of Sciences	92	4	23.0	12.97
Valparaiso University	107	3	21.4	8.12
Cag University	108	3	18.0	6.96

Based on the SciVal database (www.scival.com, accessed on 7 April 2021); data source: Scopus (downloaded on 7 April 2021); copyright: Elsevier B.V.

Assessing the level of international cooperation in writing scientific publications, it is clear that Chinese institutions prevail. Two Chinese institutions (Chinese Academy of Sciences, and Ministry of Education, China) and one French institution (Center national de la recherche scientifique, CNRS) had the largest number of publications co-authored with employees of foreign institutions in 2020–2021. The Sankey chart provides information on the affiliation of the leading foreign co-authors of these institutions (Figure 4). One can see several directions of geographical orientation: Asian (besides China, you can also name Hong Kong, Singapore, Japan), American (USA and Canada), European (except France, also Great Britain, Denmark, Spain), Australian and African (Tunisia).

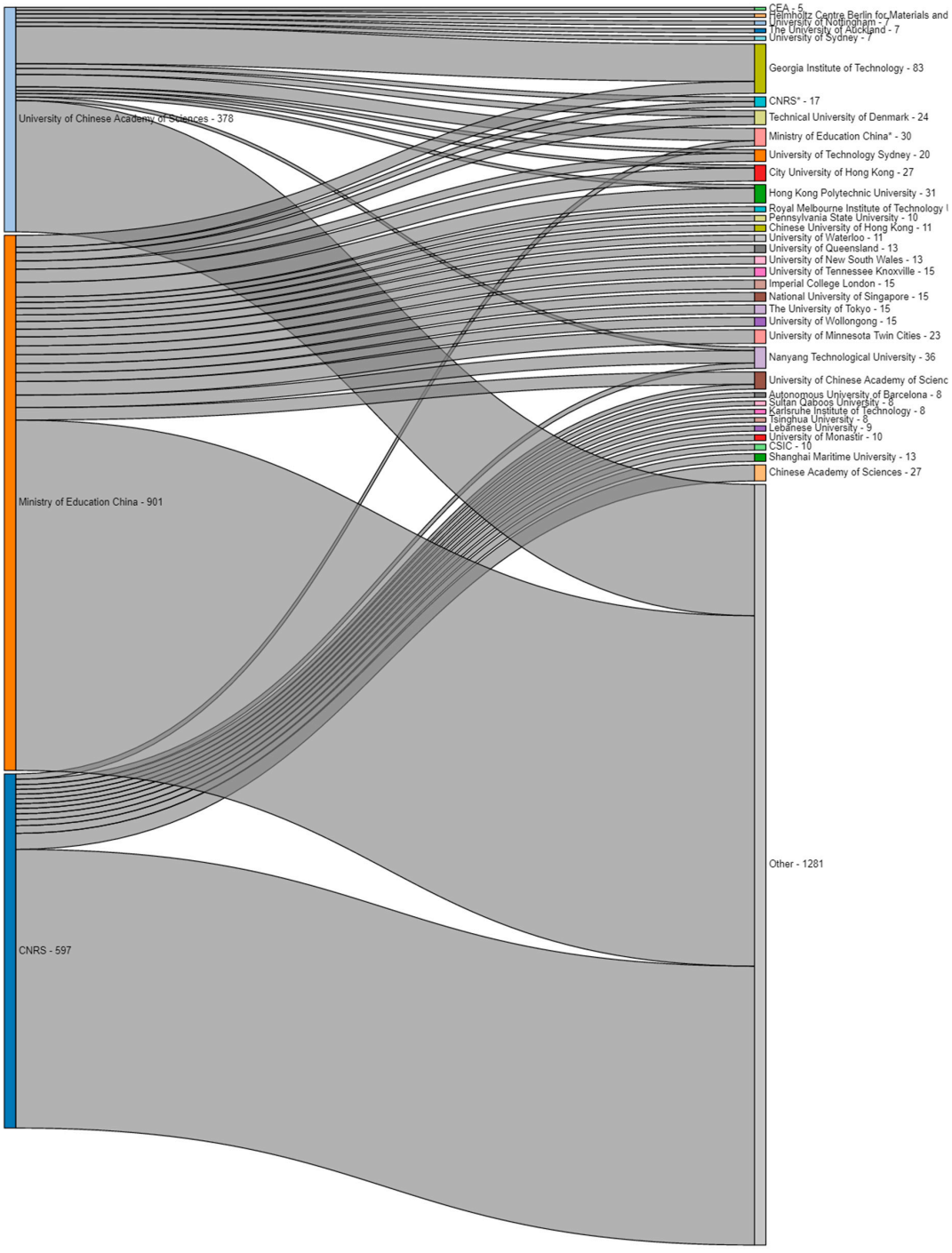


Figure 4. Top networks that appear within renewable energy, sustainability and the environment, 2020–2021 (Based on the SciVal database (www.scival.com, accessed on 7 April 2021); data source: Scopus (downloaded on 7 April 2021); copyright: Elsevier B.V.).

3.3. Authors' Topic Research

In the context of the scientific achievements in the subject area 'Renewable Energy, Sustainability and the Environment' it is also reasonable to analyse the authors' contribution. If we observe the top 10 most cited publications in this field in 2020, it is possible to see the geographical distribution of the relationship between publications (Figure 5). According to the results of spatial clustering, five clusters of countries were identified, the researchers of which have joint publications. The first cluster consisted of 15 countries, and related to assessing the stability of perovskite solar cells. The second cluster included studies of solar cells and modules, but included scientists from 4 countries: Australia, Germany, Italy and Japan. The third cluster of countries included researchers from the United States who had the largest number of links with foreign partners (22 links in this sample of publications). The fourth and fifth clusters included two countries each, China and Hong Kong in the fourth cluster, and India and Turkey in the fifth.

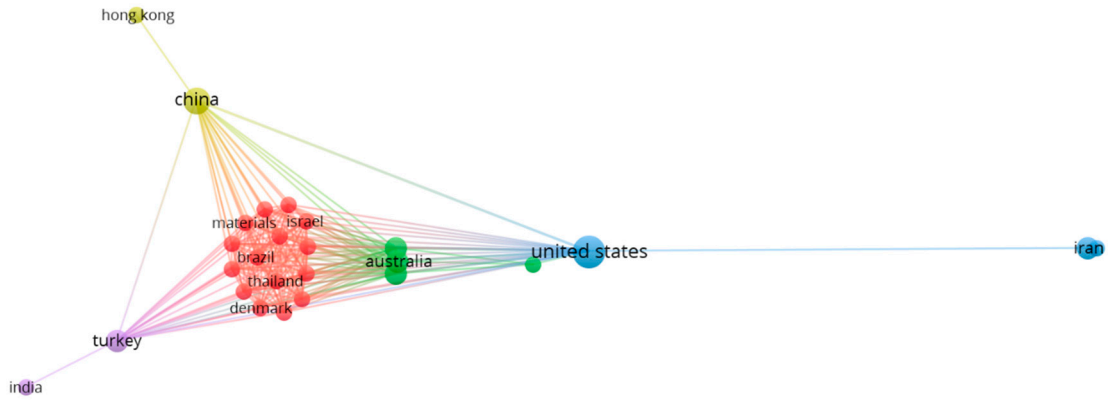


Figure 5. Network map for spatial measurement of research top 10 publications on renewable energy, sustainability and the environment, 2020 (Based on the SciVal database (www.scival.com, accessed on 7 April 2021); data source: Scopus (downloaded on 7 April 2021); copyright: Elsevier B.V.).

In general, the most cited works dealt with the security, efficiency and reliability of separate elements of energy systems in 2020–2021. Most works of the different areas studied energy storage issues, solar cells and their components (Table 5). It can be seen in more detail by looking at the topics of research networks.

Table 5. Top 5 authors by the number of citations in Scopus on renewable energy, sustainability and the environment in 2020–2021.

Name	Country	Citations (2020/21)	Scholarly Output (2020/21)	Most Cited Publication (2020/21)
Wang, Zhonglin	China, USA	601	41	On the first principle theory of nanogenerators from Maxwell's equations
Sun, Andy Xueliang	Canada	511	43	Design of a mixed conductive garnet/Li interface for dendrite-free solid lithium metal batteries
Jermsittiparsert, Kittisak	Thailand	399	46	An IGDT-based risk-involved optimal bidding strategy for hydrogen storage-based intelligent parking lot of electric vehicles
Shafee, Ahmad	Viet Nam	379	12	Acceleration of discharge process of clean energy storage unit with insertion of porous foam considering nanoparticle enhanced paraffin
Lü, Xinhui	Hong Kong	362	16	Over 17% efficiency ternary organic solar cells enabled by two non-fullerene acceptors working in an alloy-like model

Based on the SciVal database (www.scival.com, accessed on 7 April 2021); data source: Scopus (downloaded on 7 April 2021); copyright: Elsevier B.V.

To this end, the authors identified 1548 works citing the top 5 leading publications. For these publications, VOSviewer 1.6.16 network maps of joint citation (Figure 6) and topics of research networks of the authors of the works (Figure 7) were formed. The online citation map visually shows 59 authors who cited the top 5 leading publications more than 15 times in 2020–2021. The most prominent author in this regard was the Chinese scientist Li Y., who had a binding force of 118 for 54 documents. The author's network focused on collaboration with colleagues from the College of Materials Science and Engineering, Hunan University (China), studying high-density potassium ion batteries.

Figure 6. Network citation map of top 5 publications on renewable energy, sustainability and the environment, 2020–2021 (Based on the SciVal database (www.scival.com, accessed on 7 April 2021); data source: Scopus (downloaded on 7 April 2021); copyright: Elsevier B.V.).

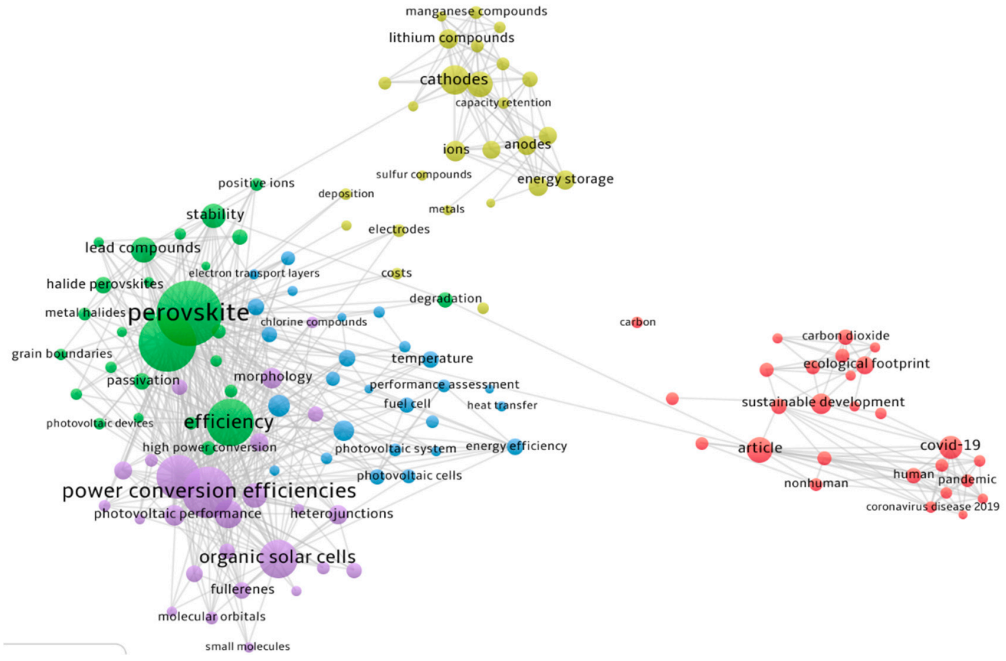


Figure 7. Network map of research topics for the top 5 publications on renewable energy, sustainability and the environment, 2020–2021 (Based on the SciVal database (www.scival.com, accessed on 7 April 2021); data source: Scopus (downloaded on 7 April 2021); copyright: Elsevier B.V.).

As a result of the contextual analysis (Figure 7), a separate research direction in the first cluster was identified. Some works included in the first cluster observed the causes (SARS-CoV-2), results and consequences of coronavirus disease (COVID-19) along with the use of renewable energy sources. In combination with the sustainable development goals research, scientists tried to find an ecological footprint of the pandemic, better to manage waste and to form new trends in ecological research.

The terms included in the research of perovskite solar panels are concentrated in the second cluster. These terms had the most significant impact on the sample (total link strength was 2458 units). In combination with the main topic, the scientist paid attention to efficiency, measurement of degradation, defects and limitations of solar panels. The topics of long-term and operational stability of elements, photovoltaic devices, optoelectronic technologies [62,63] were also studied.

The third cluster contained works focusing on the study of semiconductors, silicone, nanostructured materials, nanofluidics. Performance assessments for green energy transformation were evaluated.

The fourth cluster considered various technologies to use batteries and accumulators of clean energy, capacity retention, assessment and ensuring the stability of space in the management of high-energy densities.

The fifth cluster included studies of energy gaps that the authors tried to bridge with efficient energy conversion technologies. Most works in the cluster were related to the development of organic solar panels.

3.4. Computer Science Research Domain in Renewable Energy, Sustainability and the Environment

Emerging research on renewable energy, sustainability and the environment coincide with a dynamic development of information technologies and computer science methods, which support the conducted research by modelling, prognosis, optimisation and computer simulations solutions. According to SCOPUS sources, for the last two years (2020–2021), only a very selected number (443) of documents covered simultaneously all the aspects, namely renewable energy, sustainability and the environment, with the aid of computer science techniques. On the other hand, bilateral correlations between computer science and individual subdomains: renewable energy, sustainability and the environment, respectively, have a much greater representation, reaching tens of thousands of scholarly outputs, in the last two years.

Considering synergy between renewable energy and computer science research domains, the most cited scholarly outputs, considering this research field, investigate photovoltaic cells parameters optimisation. The power system frequency stabilisation subdomain was the most cited [64]. Another research subdomain, second in citation order, covers renewable energy smart grid systems [65]. The most extensively exploited computer science methods encompass machine learning techniques, blockchain technology and edge computing, which increase the intelligence of smart grid nodes, support the security of energy systems and reduce a transferred data stream.

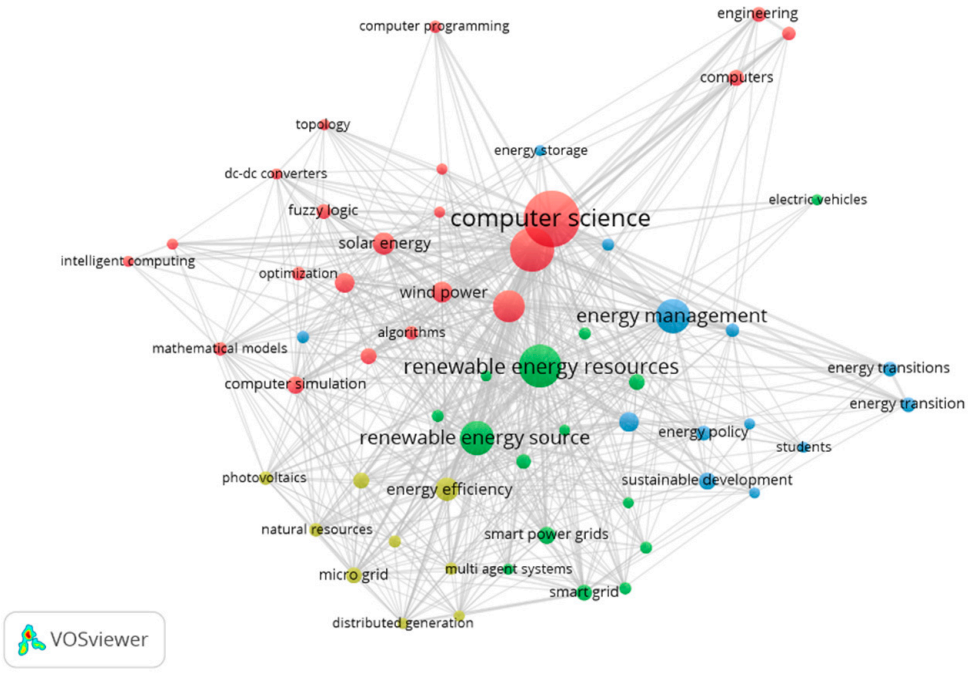
Analogically, the computer science research domain, in the context of sustainability, encompasses thousands of scholarly outputs. The most cited prevailing problems regard blockchain and machine learning techniques in sustainable supply chains and transportation policies [66–68]. The research subdomain also puts a particular interest in the exploitation of big data techniques and Edge-IoT systems for ecosystems monitoring [69], damage detection [70] and livestock or crops monitoring [71]. Surprisingly, sustainable human-centric healthcare and distant education systems [72,73], which intuitively may inspire scientists, due to the recent pandemic situation, in the last two years, give way to the logistics-related problems. Data science techniques and artificial intelligence can support ecological design, which accelerates the transition towards a regenerative approach [74] or can support energy management and sharing among base stations [75].

According to the SCOPUS sources, the most extensive scope of scholarly outputs regards exploiting computer science techniques and methods in environmental engineering-

related problems. The dominating research subdomain considers wireless networks [76]. It might be caused by the growing importance of the 5G/6G technologies in communication and IoT distributed [77,78], covering edge computing and industrial sensors clouds. Second, in citation rate, research problems concern computer science techniques in autonomous vehicles software [79]. Besides widely explored aspects of roads static vicinity (i.e., signposts) analysis [80], geo-localisation and route planning [81], the most challenging and at the same time revealing great room for research-based impact refers to predicting the behaviour of a dynamic, unpredictably changing environment [82].

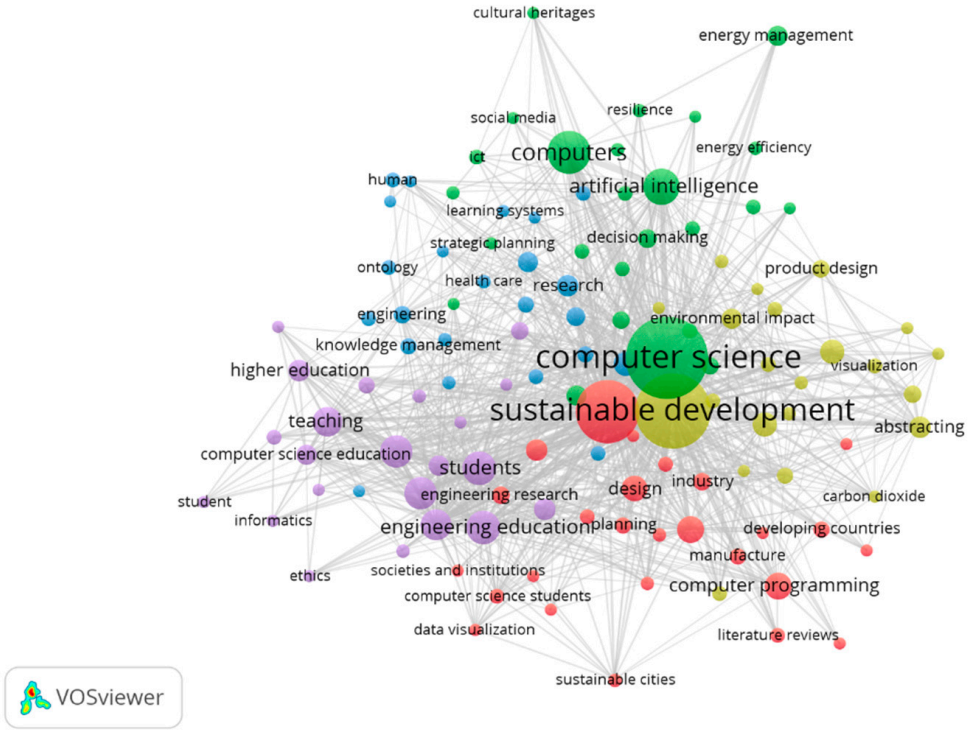
Artificial intelligence techniques for energy consumption or savings prediction [83] are among the most cited problems in the renewable energy engineering research domains. They are almost as much investigated as the aspects of robust grid energy management or optimal deployment of zero-net-energy systems [84,85].

The maps of pairwise research topics, encompassing computer science methods in selected subdomains are presented in Figure 8. Although individual research subdomains are developing very dynamically, their interdependences are relatively limited. Based on this, it can be concluded that the application of IT methods in the field of green energy and sustainability will steadily increase in the coming years.



(**a**)

Figure 8. *Cont.*



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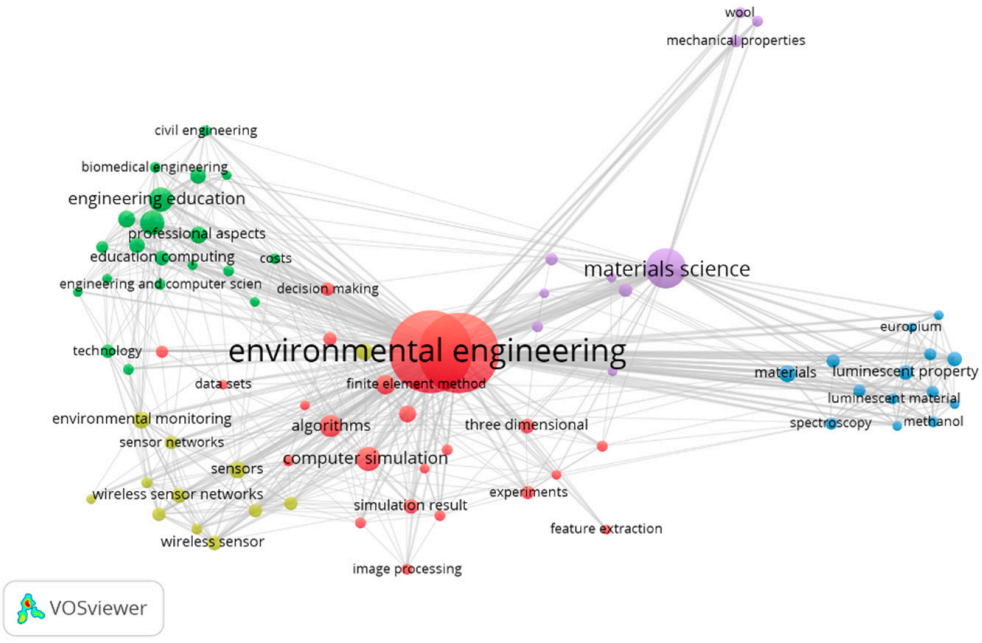

(**c**)

Figure 8. Network map covering computer science and (**a**) renewable energy, (**b**) sustainability, (**c**) the environmental engineering research subdomains, 2020–2021 (data source: Scopus (downloaded on 7 April 2021); copyright: Elsevier B.V.; graphics according to Kamada-Kawai layout).

4. Conclusions

The study aimed to identify the general trends in research in the subject area 'Renewable energy, sustainability and the environment'. The general research question is answered

by exploring the scientific publications for 2020–2021. To this end, 92,873 publications by 302,587 authors, published in 123 sources and indexed by the Scopus database as of 7 April 2021, were analysed. Applications of visualisation of scientific publications data-SciVal and VOSviewer were used for the analysis of the newest subjects and clusters, research of establishments and the leading authors of analytical works.

The data showed that all publications during this period were grouped into 20 clusters (ASJC), three of which belonged to the top 1% of the world's clusters by popularity: TC.30, TC.28, TC.81. Among the topics in the sample, one topic had the 100% prominence, related to the study of perovskite photovoltaic cells for solar panels (T.20). About 31% of publications in the sample belonged to the top 10% of journals. However, at the same time, only 3% of co-authors had both an academic and a corporate affiliation, which may be a symptom of some slowdown in the commercialisation of innovations.

In terms of the number of scientific publications in this field, the absolute leaders are Chinese institutions. They take nine places in the top ten in terms of the number of published works for 2020–2021. The largest number of publications co-authored with employees from foreign institutions in 2020–2021 had two Chinese institutions (Chinese Academy of Sciences, and Ministry of Education, China) and one French (CNRS).

In general, in 2020–2021, the most cited works were those mainly by authors from the Asian region, which were devoted to security, efficiency and reliability of individual elements in the energy systems, the study of COVID disease along with the renewable energy sources, perovskite and organic solar panels, nanostructured materials and high energy density.

The review is enhanced by a contextual analysis of areas of collaboration between two rapidly growing disciplines: computer science and the fields of renewable energy, sustainability and environmental engineering. Its results clearly show that the undeveloped space of cooperation between the disciplines will be a stimulator of their mutual development and a source of many new solutions in the coming years.

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Appendix A

Table A1. Top 100 Scopus sources by publications on renewable energy, sustainability and the environment in 2020–2021.

Scopus Source	Publications	Citations Per Publication	2019 CiteScore™
Sustainability	13,340	1.4	3.2
Journal of Cleaner Production	7021	4.2	10.9
Energies	5368	1.5	3.8
International Journal of Hydrogen Energy	4382	2.9	8.0
Renewable Energy	3353	4.5	11.2
Journal of Materials Chemistry A	2594	4.1	17.1
ACS Sustainable Chemistry and Engineering	2152	2.9	9.7
Bioresource Technology	2085	4.1	12.8
Journal of Power Sources	1934	3.4	14.4
Journal of the Electrochemical Society	1813	1.5	5.8
International Journal of Energy Research	1627	1.6	4.2
Nano Energy	1490	6.0	23.1
Energy Conversion and Management	1446	4.5	13.6
Solar Energy	1354	2.6	8.1
Journal of Energy Storage	1187	2.8	5.2
Energy Sources, Part A: Recovery, Utilization and Environmental Effects	1088	1.5	2.1
Sustainable Cities and Society	1000	4.6	7.5
Waste and Biomass Valorization	966	1.7	3.6
Environmental Research Letters	928	1.7	8.9
Biomass Conversion and Biorefinery	860	1.4	3.3
2020 IEEE 4th Conference on Energy Internet and Energy System Integration: Connecting the Grids Towards a Low-Carbon High-Efficiency Energy System, EI2 2020	808	0	0
Advanced Energy Materials	755	8.1	35.4
Taiyangneng Xuebao/Acta Energiae Solaris Sinica	741	0.1	0.4
Solar Energy Materials and Solar Cells	653	3.0	11.6
Renewable and Sustainable Energy Reviews	641	3.6	25.5
IEEE Power and Energy Society General Meeting	639	0.1	0
Sustainable Energy and Fuels	639	2.2	5.4
Energy Storage Materials	613	8.1	16.8
2020 International Multi-Conference on Industrial Engineering and Modern Technologies, FarEastCon 2020	576	0	0
International Journal of Ambient Energy	544	2.9	2.7
Proceedings of 2020 IEEE 4th Information Technology, Networking, Electronic and Automation Control Conference, ITNEC 2020	531	0.3	0
Sustainable Energy Technologies and Assessments	516	2.4	5.4
Journal of Chemical Technology and Biotechnology	488	1.5	4.8
Energy Research and Social Science	472	2.5	9
Thermal Science	469	1.0	2.5
IET Renewable Power Generation	464	1.0	7.6
IEEE Transactions on Sustainable Energy	437	3.6	15.7
Biomass and Bioenergy	434	1.5	6.6
Journal of Wind Engineering and Industrial Aerodynamics	434	1.6	4.9
ACS Energy Letters	432	6.6	23.4
iSPEC 2020-Proceedings: IEEE Sustainable Power and Energy Conference: Energy Transition and Energy Internet	381	0	0
Frontiers in Energy Research	371	0.7	2.5

Table A1. *Cont.*

Scopus Source	Publications	Citations Per Publication	2019 CiteScore™
Proceedings-2020 IEEE International Conference on Environment and Electrical Engineering and 2020 IEEE Industrial and Commercial Power Systems Europe, EEEIC/I and CPS Europe 2020	349	0.3	0
SPE/AAPG/SEG Unconventional Resources Technology Conference 2020, URTeC 2020	349	0.2	0
Proceedings of the 15th IEEE Conference on Industrial Electronics and Applications, ICIEA 2020	343	0.1	0
Environmental Progress and Sustainable Energy	341	1.2	2.8
Research Journal of Chemistry and Environment	331	0.1	0.2
Journal of the Energy Institute	308	3.3	6.5
2020 IEEE International Conference on Power Electronics, Smart Grid and Renewable Energy, PESGRE 2020	298	0.6	0
Bioresource Technology Reports	296	1.6	1.7
Energy and Environmental Science	293	11.4	56
2020 IEEE/IAS Industrial and Commercial Power System Asia, I and CPS Asia 2020	289	0.1	0
Geothermics	288	1.5	7
Sustainable Production and Consumption	277	2.1	5.1
Materials Today Energy	277	2.6	6.2
Proceedings of the ISES Solar World Congress 2019 and IEA SHC International Conference on Solar Heating and Cooling for Buildings and Industry 2019	276	0.1	0
Nature Environment and Pollution Technology	275	0.1	0.5
Proceedings of the 3rd International Conference on Intelligent Sustainable Systems, ICISS 2020	273	0	0
Biotechnology for Biofuels	266	1.9	8.9
Asia-Pacific Journal of Chemical Engineering	245	0.8	2.4
Journal of Energy Resources Technology, Transactions of the ASME	239	1.3	4.4
2020 Advances in Science and Engineering Technology International Conferences, ASET 2020	231	0.3	0
ChemNanoMat	221	1.5	5
European Biomass Conference and Exhibition Proceedings	210	0	0
Wind Energy	209	1.7	6.4
Proceedings of the International Conference on Electronics and Sustainable Communication Systems, ICESC 2020	209	0.4	0
Proceedings-2020 2nd International Conference on Control Systems, Mathematical Modeling, Automation and Energy Efficiency, SUMMA 2020	204	0	0
Bioenergy Research	201	1.1	4.6
2020 IEEE PES/IAS PowerAfrica, PowerAfrica 2020	198	0.1	0
International Journal of Precision Engineering and Manufacturing-Green Technology	195	2.2	7.5
2020 Asia Energy and Electrical Engineering Symposium, AEEES 2020	192	0.1	0
Sustainable Development	190	3.7	4.9
6th IEEE International Energy Conference, ENERGYCon 2020	190	0.1	0
Green Energy and Environment	180	1.2	9.8
Journal of Renewable and Sustainable Energy	179	0.8	3.2
Journal of King Saud University, Engineering Sciences	174	2.4	6.8
Journal of Security and Sustainability Issues	174	0.5	3.9

Table A1. *Cont.*

Scopus Source	Publications	Citations Per Publication	2019 CiteScore™
Progress in Photovoltaics: Research and Applications	173	5.0	16.3
Biofuels	170	2.3	3
Nature Sustainability	169	7.6	6.8
International Journal of Renewable Energy Research	168	0.8	4.4
Journal of Modern Power Systems and Clean Energy	166	1.2	6.4
IEEE Transactions on Green Communications and Networking	166	1.0	5.5
Proceedings-2020 23rd IEEE International Multi-Topic Conference, INMIC 2020	166	0	0
Energy Exploration and Exploitation	164	1.2	2.9
2020 11th Power Electronics, Drive Systems, and Technologies Conference, PEDSTC 2020	164	0.5	0
Carbon Letters	160	0.9	2.8
International Journal of Sustainable Transportation	155	1.9	5.6
Energy and Environment	152	1.4	2.4
2020 5th International Conference on Smart and Sustainable Technologies, SpliTech 2020	151	0.1	0
International Journal of Green Energy	150	0.9	2.8
Dianli Jianshe/Electric Power Construction	149	0.2	1.2
2020 7th International Conference on Energy Efficiency and Agricultural Engineering, EE and AE 2020-Proceedings	146	0	0
Sustainable Water Resources Management	143	0.7	0
Proceedings of the World Conference on Smart Trends in Systems, Security and Sustainability, WS4 2020	143	0.1	0
International Journal of Sustainable Development and Planning	142	0.5	1.4
Proceedings of 2020 13th International Conference Management of Large-Scale System Development, MLSD 2020	140	0	0
Journal of Applied Engineering Science	138	0.3	1.1
Environmental Innovation and Societal Transitions	138	3.9	11.3
Nature Energy	137	14.3	71.2

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