energies

Review

Mapping Global Research on Green Energy and Green Investment: A Comprehensive Bibliometric Study

Aleksy Kwilinski [1,2,3]

[1] Department of Management, Faculty of Applied Sciences, WSB University, 41-300 Dabrowa Gornicza, Poland; a.kwilinski@london-asb.co.uk
[2] The London Academy of Science and Business, 120 Baker St., London W1U 6TU, UK
[3] Department of Marketing, Sumy State University, 116, Kharkivska St., 40007 Sumy, Ukraine

Abstract: The spillover effects of climate change require the exploration and implementation of appropriate ways to reduce ecological issues while simultaneously maintaining economic and social well-being. The expansion of green energy allows for a reduction in the negative anthropogenic impact on the environment without restricting economic growth or social welfare. However, the expansion of green energy necessitates additional green investment. This paper aims to provide a comprehensive bibliometric analysis of studies on the interactions between green energy and green investment. The study is based on Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and employs Scopus Tools Analysis and VOSviewer version 1.6.20 software. The metadata for the investigation were compiled from scientific databases in Scopus. The findings allow for the identification of the most prolific countries and authors and their collaborative efforts, which contribute to the theoretical landscape of green energy and green investment. The study also illustrates the evolution of the investigation of the linkages between green energy and green investment. Furthermore, the results enable the identification of core scientific clusters in the analysis of green energy and green investment: the first cluster focuses on renewable energy and sustainable development; the second on government and green energy; and the third on green investment as the catalyst for green energy. The results of the meta-analysis facilitate the identification of new research areas related to the connection between green investment and green energy.

Keywords: renewable energy; sustainable development; green energy; investment

check for updates

Citation: Kwilinski, A. Mapping Global Research on Green Energy and Green Investment: A Comprehensive Bibliometric Study. *Energies* **2024**, *17*, 1119. https://doi.org/10.3390/en17051119

Academic Editors: Frede Blaabjerg and Eugenio Meloni

Received: 21 January 2024
Revised: 19 February 2024
Accepted: 22 February 2024
Published: 26 February 2024

1. Introduction

In the complex array of modern challenges, the focus is on pursuing sustainable development, urging humanity to find a balance between progress and environmental stewardship [1–3]. At the core of this collective endeavor lies a critical issue: the manner in which energy is harnessed and consumed. Sustainable development, which involves the encapsulation of economic prosperity, social equity, and environmental responsibility, compels a confrontation with the pressing need for transformative energy solutions [4–6]. Grappling with the urgency of sustainable development reveals the energy landscape as a linchpin in the quest for a harmonious coexistence of human aspirations and planetary well-being [7–9]. In 2015, as reported by Ritchie et al. [10], the global population lacking access to electricity dropped below one billion for the first time in recent decades. Despite a consistent global increase in the proportion of people with electricity access in recent decades, there are still nations where a majority of the population remains without such access. Unfortunately, the pace of improvement in access is insufficient to achieve the universal access goal by 2030, which is especially apparent in sub-Saharan Africa. This slow progress in energy accessibility highlights a significant disparity that hampers advancements in education, healthcare, and economic empowerment. Moreover, this energy paradox extends beyond access issues to include the environmental consequences associated with conventional energy sources.

According to the International Energy Agency (IEA) [11], global energy demand is projected to increase by nearly 25% by 2040, underscoring the urgency of addressing the challenges associated with this surge. The World Bank reports that air pollution, primarily originating from the combustion of fossil fuels, was inflicted on the global economy in 2019 with a cost of more than USD 8.1 trillion in welfare losses [12]. Air pollution presents an intricate and widespread challenge for individuals worldwide, especially those residing in urban regions characterized by elevated levels of industrial and vehicular activities. The health repercussions linked to polluted air go beyond physical ailments, encompassing heightened healthcare expenses, diminished labor productivity, and increased strain on healthcare systems. In 2019, the impact on human life and well-being was significant, with an estimated 6.4 million premature deaths worldwide attributed to exposure to fine particulate matter, known as PM2.5 [12]. This categorizes air pollution as the fourth leading cause of mortality on a global scale.

In addition to its immediate health effects, air pollution can contribute to long-term environmental issues such as climate change. Many of the pollutants that cause air quality issues, such as carbon dioxide, methane, and other greenhouse gases, also play a role in global warming. The International Energy Agency (IEA) emphasizes the concerning trajectory of global carbon dioxide emissions, a significant contributor to climate change, as they reached a historic high of 36.8 gigatons (Gt) in 2022 [11]. During that year, there was a 0.9% increase, amounting to 321 megatons (Mt), in global energy-related CO_2 emissions. Investment in cleaner, renewable alternatives is not merely an ecological virtue but also an essential commitment to preserving biodiversity, curbing emissions, and ensuring a habitable planet for future generations. This approach amplifies the urgency of pivoting toward sustainable energy practices to mitigate environmental fallout and charting a course toward a more equitable and resilient future. Essentially, the connection between sustainable development and the energy predicament embodies the challenges and opportunities that define this era. The decisions made today regarding energy not only influence the trajectory of the environmental footprint but also mold the contours of societal progress and global stability. Within this context, the investigation of energy consumption assumes significance, requiring innovative solutions, strategic foresight, and a collective commitment to forge a path toward a world where sustainable development and energy harmony converge for the prosperity of all.

The expanding literature on green energy [13–16] defines it as power derived from renewable, environmentally friendly sources. This approach provides a compelling alternative to traditional fossil fuels, which significantly contribute to climate change and environmental degradation. Renewable energy sources, such as solar, wind, hydropower, and geothermal power, lie at the core of green energy initiatives. These sources harness natural processes or cycles, minimizing adverse environmental impacts while providing a reliable and sustainable energy supply. For instance, solar panels convert sunlight into electricity, wind turbines harness wind energy, and hydroelectric power systems generate electricity from flowing water, all of which contribute to the diversification of the energy portfolio [17–20]. Nonetheless, the analysis of the environmental impacts of power plants based on renewable energy sources (RESs) (including solar thermal, solar photovoltaic, wind, biomass, geothermal, hydroelectric, tidal, ocean current, oceanic wave, ocean thermal, and osmotic effects) emphasizes the imperative need for careful selection when implementing RESs in electrical power plants [21]. The inappropriate utilization of RESs could pose significant harm to the environment. The authors conduct a thorough Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis for all RES-based power plants, considering various factors such as human health, noise, pollution, greenhouse gas emissions, ozone layer depletion, toxification, flooding, impact on inhabitants, eutrophication, dried-up rivers, and deforestation. Green investment involves allocating financial resources to projects and initiatives that promote sustainability, environmental conservation, and the development of clean energy solutions [22–24]. Investors increasingly recognize the long-term value and positive societal impact of directing funds toward enterprises that prioritize eco-friendly practices and contribute to a lower carbon footprint.

The rise of green energy and green investment is propelled by several factors. First, the growing awareness of climate change and its far-reaching consequences has prompted a global call for action [25]. Governments, businesses, and individuals alike are seeking viable alternatives to conventional energy sources, driving the demand for cleaner and more sustainable options. Moreover, technological advancements have significantly improved the efficiency and affordability of green energy solutions, increasing their competitiveness with traditional counterparts [26]. This shift is attracting substantial investments in the research, development, and implementation of green technologies, fostering innovation and scalability in the renewable energy sector. From an economic perspective, green investment is not only a moral imperative but also a strategic choice. As governments worldwide set ambitious targets for reducing carbon emissions, businesses that embrace sustainable practices are better positioned for long-term success. Investors recognize the potential for strong returns as green technologies mature and gain wider adoption, creating a virtuous cycle that reinforces the viability of green investments.

Exploring the landscape of research on green energy and green investment is of paramount importance. Recent strides in scientometrics and bibliometric techniques have become indispensable tools in literature reviews, yielding noteworthy achievements [27–30]. A notable example is the work of Mentel G. et al. [31], in which the researchers carried out a bibliometric review following the PRISMA guidance and utilized visualization analysis through VOSviewer version 1.6.20 software. The Web of Science Core Collection (WoS CC) database served as the primary source, and by employing predefined inclusion criteria, the authors curated 1144 records for bibliographic analysis. The findings of this study revealed gaps in the domain of green and renewable energy innovation, leading to the identification of areas for future research and the formulation of corresponding recommendations. Similarly, Bagdi T. et al. [32] utilized VOSviewer in bibliometric methods to explore progress and trends in gender and renewable energy. The study offers a thorough perspective on research within this domain, aiding researchers and stakeholders in recognizing prospective avenues for future investigations into gender considerations related to renewable energy access. This insight proves valuable for formulating effective policies aimed at societal transformation and achieving sustainable development goals. In turn, in their comprehensive study, Qin Y. et al. [33] delve into the adoption of green energy and its determinants, employing a bibliometric analysis to uncover patterns and trends. This research is particularly significant in the context of escalating global environmental challenges, highlighting the urgent need for sustainable energy solutions. By examining the factors that drive the adoption of green energy, the study contributes valuable insights into policy formulation and the promotion of renewable energy sources. The paper [34] consolidates arguments and counterarguments in the scientific discourse regarding the influence of energy-efficient development in advancing the national green brand. The main objective of this research is to offer a comprehensive survey of the scholarly context addressing the correlation between energy efficiency policies and a country's green brand. The aim is to pinpoint potential research gaps and underscore promising avenues for future research endeavors. The authors conducted the study by organizing and analyzing scientific publications available in the Scopus database spanning the period from 2000 to 2020. The analysis was executed using VOSviewer software tools, and based on the outcomes, the authors delineated promising areas for further research exploration. Ziabina Ye. and Pimonenko T. [35] conducted a bibliometric analysis to gauge public awareness of significant shifts in the economic and ecological realms. Their article presents a bibliometric analysis of research pertaining to green deal policies, energy conservation, and the promotion of energy efficiency through the integration of renewable energy sources. The authors meticulously selected 337 papers published between 1999 and 2019 for their study. Using VOSviewer, they visually represented the outcomes of the bibliometric analyses in a definitions map, revealing six clusters encompassing 131 terms. This research revealed a connection between terms such as "renewable energy sources" and "energy saving", elucidated through the constructed bibliographic map. To examine the global landscape of academic publications at the crossroads of corporate social responsibility and renewable energy, Us et al. [36] utilized a systematic approach. The methodology involved (1) conducting a comprehensive search, collection, and preprocessing of articles pertinent to the targeted theme; (2) employing diverse bibliometric techniques, including the use of VOSviewer, to conduct a thorough analysis and visually map the research findings; and (3) integrating the derived results to facilitate a discussion on potential future research directions. The findings elucidate prominent trends within the researched domain; identify influential scholars and their collaborative endeavors; and emphasize the noteworthy contributions of scrutinized journals, affiliations, and countries. These studies underscore the effectiveness of bibliometric analysis tools, particularly VOSviewer, in literature review and analysis.

2. Materials and Methods

Originating from the work of Van Eck N.J. and Waltman, L. [37], VOSviewer is a sophisticated software tool for scientific knowledge mapping analysis. Leveraging these advanced tools augments the current study in two crucial dimensions: (a) Diverging from conventional review methods, the bibliometric approach allows for a more extensive examination of literature databases, resulting in comprehensive analysis results. This approach aligns seamlessly with the study's objective of systematically dissecting the research network to pinpoint hotspots and knowledge frontiers within the realm of green energy and green investment. (b) By integrating with traditional qualitative review analysis methods, the bibliometric approach enhances the reliability and informativeness of the ongoing research review. Moreover, it offers a more intuitive presentation of the future relationship between green energy and green investment. Consequently, the fusion of bibliometrics with traditional literature analysis methods enables a holistic examination of research focus and context in the field. Within this framework, the contributions of this study can be outlined as follows: first, it utilizes a bibliometric approach to depict the evolution and current state of research on green energy and green investment, providing more pertinent and reliable statistical insights; second, the study addresses a notable gap in the literature by undertaking a thorough review and synthesis of the factors influencing green energy and green investment from various perspectives. This thorough effort is uncommon in current research, adding uniqueness to the study. Last, with the field of green energy and green investment research entering a mature stage, a detailed bibliometric review at this juncture enhances the understanding of these subjects. This, in turn, offers valuable insights for scholars as they plan future research endeavors. Significantly, the paper identifies key determinants affecting green energy and green investment from diverse viewpoints, contributes to a robust cognitive framework, and lays the groundwork for future research in this field.

Based on previous published studies [38–42], this study was based on PRISMA guidelines (Figure 1) [43]. In bibliometric analysis, the PRISMA guidelines facilitate a systematic and unbiased approach to literature selection and evaluation. This involves a clear definition of search and selection criteria, including databases, keywords, timeframes, and publication types (Identification). The identified literature is then methodically screened to assess its relevance against specific inclusion and exclusion criteria (Screening), followed by a detailed evaluation of the selected studies for their suitability based on content, methodology, and quality (Eligibility). The final step in the selection process is confirming the studies to be included in the analysis, ensuring a comprehensive dataset representative of the research field (Inclusion). Relevant data, such as authors, publication years, keywords, citations, and affiliations, are extracted from these studies and analyzed to discern patterns, trends, and networks (Data Extraction and Analysis). Finally, a detailed report of the methodology and findings, including the search process, criteria for selection, data extraction methods, and analysis techniques, is provided (Reporting). These steps ensure thoroughness and rigor in bibliometric analyses.

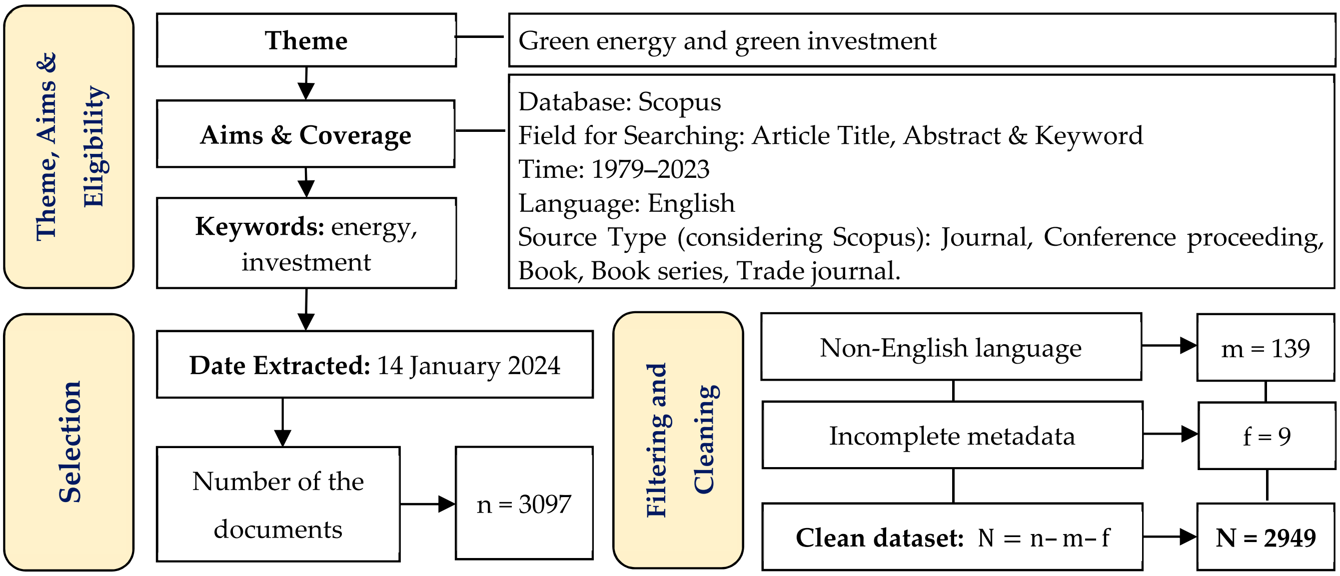


Figure 1. PRISMA guidelines for investigating green energy and green investment.

The metadata for the investigation were compiled from scientific databases in Scopus from 1979 to 2023.

The following limitations were applied when selecting filtered papers:

- Language—English;
- Keywords—energy; investment;
- Time—1979–2023.

Considering the input requirements, 3097 documents were generated in Scopus. After the screening, cleaning, and checking of the metadata, 2949 papers remained for further analysis. Using the methodology from previous studies [44–48], in the next stage, this study employs Scopus Tools Analysis [49] to accomplish the following:

- Analyze the dynamics of publications on green energy and green investment;
- Identify the most prolific authors in the investigation of green energy and green investment;
- Explore the investigation of green energy and green investment within countries;
- Outline organizations that are the principal investors in research on green energy and green investment;
- Explore the most cited documents on green energy and green investment.

VOSviewer, as referenced in [50], is a tool specifically designed for visualizing and analyzing bibliometric networks. This tool is instrumental in mapping out various bibliometric relations such as co-authorship networks within countries, keyword co-occurrence networks, and overlay visualizations. Each of these functionalities plays a unique role in bibliometric analysis: (1) co-authorship networks within countries can visualize the collaboration patterns among authors within specific countries. The tool helps in understanding the extent and nature of research collaborations, revealing important insights into how knowledge networks are structured geographically. The threshold for co-authorship networks is set at 6, meaning that only those connections meeting or exceeding this criterion are visualized; (2) keyword co-occurrence networks are crucial for understanding the thematic and conceptual landscapes of a research field. Keyword co-occurrence networks analyze how often certain terms or keywords appear together in the scientific literature. This analysis can reveal the most prominent and emerging topics in a field. VOSviewer sets a threshold of 10 for this analysis, focusing on the most frequently co-occurring keywords to provide a clearer picture of the dominant themes; (3) the overlay visualization advanced feature of VOSviewer is used to identify the evolution and historical trajectory of research in a particular field. Overlay visualizations can illustrate how certain topics have emerged, evolved, or declined over time, providing a dynamic view of the field's development; (4) co-occurrence analysis, as detailed in studies [51–53], is a method used to discern and examine the relationships between terms or entities based on their joint appearance in a specific context. In bibliometrics, this method is applied to detect patterns and connections between terms (usually keywords or topics) within a collection of documents. It is a powerful way to uncover underlying structures in the scientific literature and to identify areas that are garnering increasing attention or those that are more established.

VOSviewer, with its capabilities for network analysis and visualization, serves as a valuable tool in bibliometric research. It allows for a comprehensive and nuanced understanding of research dynamics, collaborations, and thematic developments in various scientific fields. The thresholds set for different types of analysis ensure that the visualizations are focused and meaningful, highlighting the most significant connections and trends.

3. Results

The data provided in Figure 2 represent the dynamics of publications related to the analysis of publications focusing on green energy and green investment over the years. The figure displays the number of publications for each year, starting from 1979 to 2023.

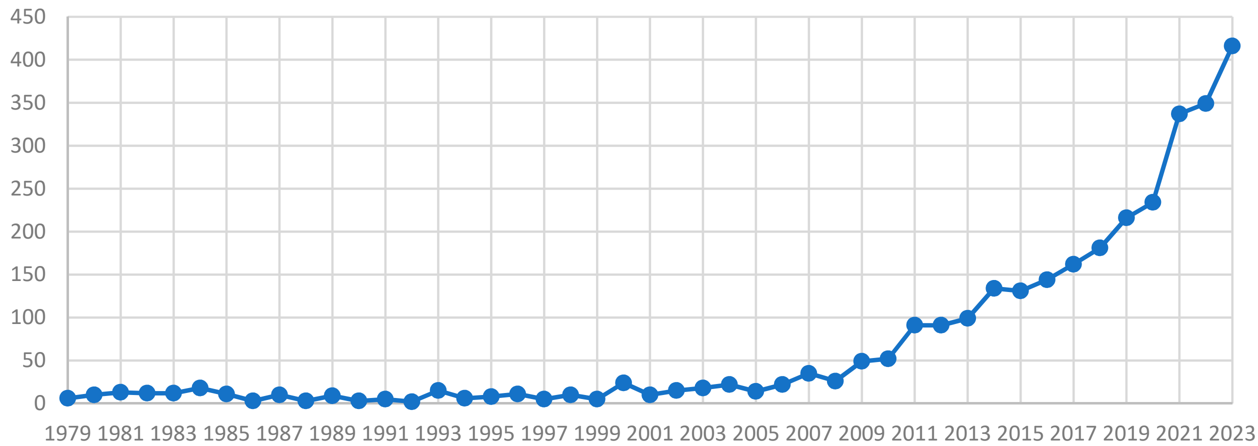


Figure 2. Dynamics of publications that focused on green energy and green investment.

The number of publications during 1979–1990 was relatively low, ranging from 2 to 18 publications per year. The field appeared to be in its early stages of development during this period. In the 1990s to 2000s, there was a noticeable increase in the number of publications starting in the late 1990s and continuing into the 2000s. The field began to gain attention, with the number of publications per year ranging from 5 to 24. A significant surge in publications was observed during 2007–2013, with a notable spike in 2007. The number of publications continued to rise steadily, reaching its peak in 2013. From 2014 onwards, there has been a consistent upward trend in the number of publications. There has been substantial growth in the field, with 100 publications each subsequent year. In recent years (2020–2023), the number of publications has substantially increased, reaching 349 in 2022 and further increasing to 416 in 2023. This finding suggests a continued and accelerating interest in the analysis of publications related to green energy and green investment.

Considering the findings (Table 1), the most prolific authors are Dinçer Hasan and Yüksel Serhat, who have 42 and 40 documents, respectively, that focus on the analysis of green energy and investment.

Table 1. The top 10 prolific authors in the analysis of the links between green energy and investment and their scientific metrics according to Scopus.

Authors	Affiliation	h-Index	Number of Documents		International Collaboration
			Total	On Green Energy and Green Investment	
Dinçer H.	İstanbul Medipol Üniversitesi, Istanbul, Turkey	39	297	42	42.3%
Yüksel S.	Adnan Kassar School of Business, Beirut, Lebanon	39	221	40	54.7%
Hall C.A.S.	SUNY College of Environmental Science and Forestry, Syracuse, United States	42	157	16	19.0%
Bekun F.V.	İstanbul Gelişim Üniversitesi, Istanbul, Turkey	56	213	10	91.7%
Feng L.	China University of Petroleum-Beijing, Beijing, China	21	61	10	60.0%
Murshed M.	North South University, Dhaka, Bangladesh	53	158	10	83.0%
Xiang Y.	Sichuan University, Chengdu, China	31	288	10	29.9%
Liu J.	Sichuan University, Chengdu, China	16	117	9	11.1%
Doukas H.	National Technical University of Athens, Athens, Greece	38	221	8	47.1%
Shahbaz M.	Beijing Institute of Technology, Beijing, China	109	499	8	90.3%

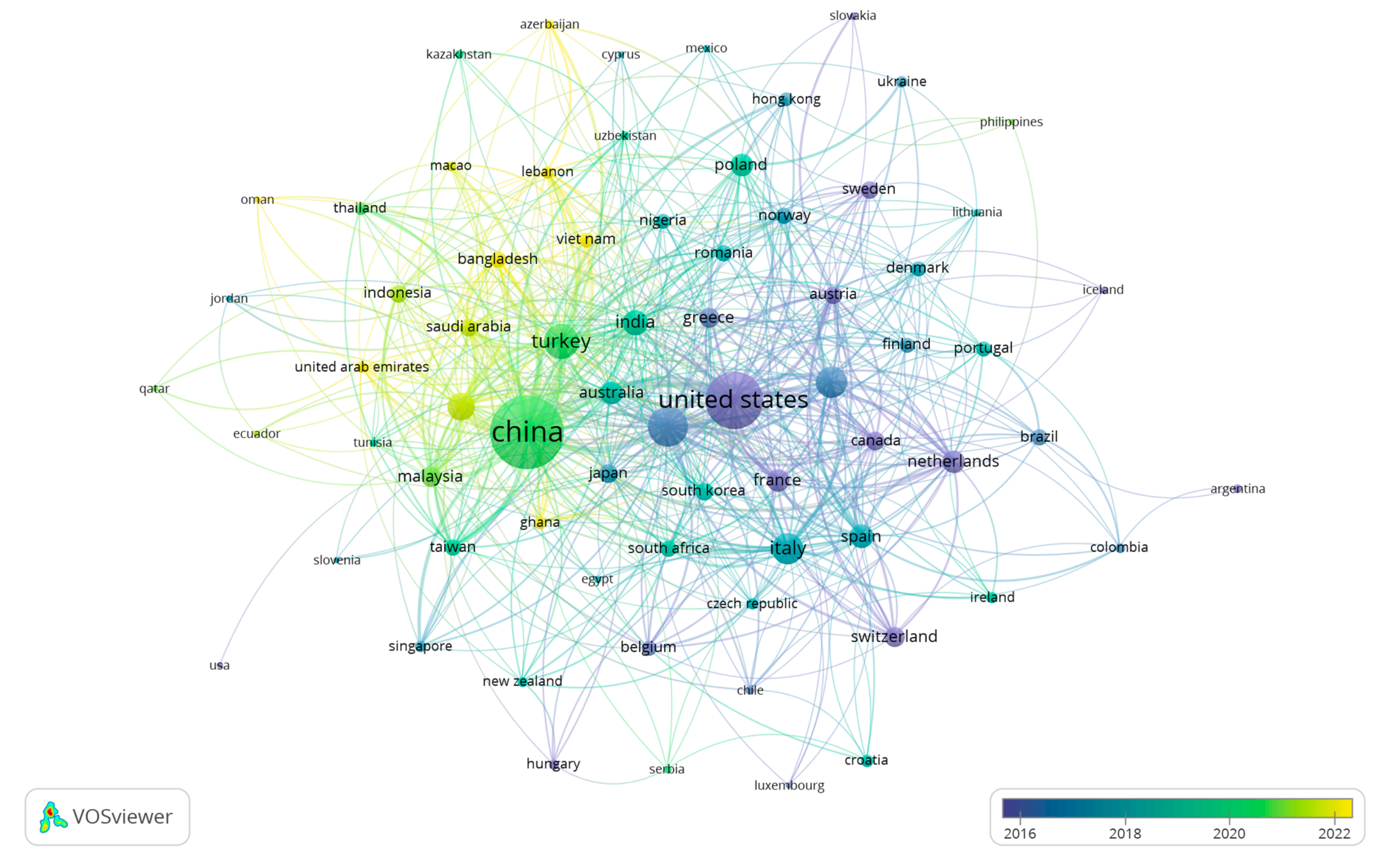
Among the papers on green energy and green investment, the most cited papers (citations—168) of Dinçer Hasan and Yüksel Serhat [54] underscore the vital connection between green energy and investment, specifically addressing carbon emissions within the transportation sector. Acknowledging the environmental impact of fossil fuel use in transport, this research advocates for electric vehicles as a pivotal solution. To overcome these cost barriers, this study proposes integrating solar energy to charge electric vehicles and presents innovative carbon emission reduction strategies for transportation investment projects. The findings [54] emphasize the significance of dynamicity and composite materials in enhancing the effectiveness of solar energy projects, offering valuable insights for mitigating carbon emissions in the transportation industry. Hall C.A.S. from the SUNY College of Environmental Science and Forestry in Syracuse, United States, has an h-index of 42 and 16 documents. However, Hall C.A.S. has a moderate international collaboration rate of 19.0%, which indicates that most of the documents were collaboratively authored by researchers from different countries or regions. Hall C.A.S., in the most cited papers [55–57], focused on the linkage between green energy and investment by focusing on the energy return on investment (EROI). Gagnon et al. [55] focused on the linkage between green energy and investment by focusing on the EROI for oil and gas operations. This finding emphasizes the need for abundant and efficiently exploitable energy resources to sustain successful economies. Gagnon et al. [55] employ a unique approach, converting monetary values into approximate energy values to assess EROIs. The findings reveal a changing landscape, indicating that the EROI at the wellhead was approximately 26:1 in 1992, increased to 35:1 in 1999, and subsequently decreased to 18:1 in 2006. This trend suggests that global petroleum supplies for economic work may be less than gross reserve estimates and that the EROI is declining over time, especially with increased annual drilling levels. Murphy and Hall [56] focused on the crucial link between green energy and investment by examining the potential challenges posed by the depletion of conventional crude oil supplies over the last 40 years. This research highlights the reliance on increasing quantities of fossil fuel energy, especially oil, for economic growth. However, the feasibility of significantly expanding the global supply of conventional crude oil is questioned, leading to concerns about sustained economic growth. Murphy and Hall [56] introduce the concept of an economic growth paradox, explaining that to increase the oil supply for economic growth, high oil prices are needed, which, in turn, may undermine the economic growth it aims to support. The findings of Murphy and Hall [56] suggest that a sustainable long-term economic growth trajectory necessitates a transformative shift in how economies are managed. Guilford et al. [57] underscore the intricate relationship between energy gains, costs, and drilling intensity, emphasizing the need for careful consideration in managing the transition to greener and more sustainable energy sources.

Bekun F.V. from İstanbul Gelişim Üniversitesi in Turkey is a highly influential author with an impressive h-index of 56. By contributing 10 documents on green energy and green investment, Bekun F.V. demonstrated an outstanding international collaboration rate of 91.7%. The most cited papers by Bekun F. [58–60] highlight the complex interplay between economic growth, energy consumption, environmental quality, and the role of renewable and nonrenewable energy sources. The findings underscore the importance of green investment in formulating policies for sustainable development and environmental conservation. A study of Bekun [58] investigated the impact of renewable and nonrenewable energy, economic growth, and energy sector investment on CO_2 emissions in India. Empirical results reveal a negative relation between CO_2 emissions and renewable energy, suggesting its potential as a solution for sustainable development. However, positive relationships are observed between CO_2 emissions and both nonrenewable energy and real GDP growth. The Granger causality analysis indicates one-way causality among renewable energy consumption, CO_2 emissions, economic development, and energy investment, providing valuable policy directions for environmental sustainability in the Indian economy. The second most cited study, Caglar et al. [59], in which the co-authors of Bekun F. were involved, explored the nexus between trade openness, economic complexity, economic growth, natural resources, and public–private partnerships and the environmental quality of BRICS countries. The findings demonstrate that positive changes in trade openness and economic complexity stimulate environmental quality, while economic growth, natural resources, and public–private partnerships contribute to environmental degradation. Policymakers are provided with new insights and recommendations for fostering environmental quality in BRICS economies. The third most cited study, Udemba et al. [60], where Bekun F. is a co-author, focuses on China's high industrial economy and investigates the interaction between pollutant emissions, foreign direct investment, energy consumption, tourism arrivals, and economic growth. Empirical results reveal a positive relationship between pollutant emissions and all variables except economic growth, highlighting environmental degradation. Granger causality analysis revealed two-way causality between CO_2 emissions and energy consumption, as well as one-way causality from growth and FDI to pollutant emissions. This study emphasizes the environmental impact of fossil fuel energy consumption and green investment-induced pollutant emissions in China. The findings (Table 1) underscore a dynamic and collaborative research environment, with scholars worldwide actively contributing to the advancement of knowledge in green energy and green investment.

In general, the findings on the most prolific countries in which researchers explore the link between green energy and green investment (Table 2) showed that researchers from China (692 documents), the U.S. (483 documents), and the U.K. (230 documents) had the highest number of documents on green energy and green investment.

Among the Chinese authors, the most cited paper (353 citations), Shahbaz et al. [61], investigates the relationship between public–private partnership investment in the energy sector and carbon emissions in China, with a focus on the impact of technological innovations. Utilizing bootstrapping autoregressive distributed lag modeling, ref. [61] examined the cointegration between carbon emissions and its determinants. The results indicate that investment in energy contributes to environmental degradation by increasing carbon emissions, while technological innovations exhibit a negative impact on carbon emissions. Additionally, exports are positively associated with carbon emissions, and green investment hinders environmental quality by stimulating CO_2 emissions. The second most cited paper [62] among Chinese scholars (281 citations) introduces the Green Economy Development Index to assess the progress of the green economy using a sample of 150 renewable energy companies in China. Employing a threshold effect model, this study explores the nonlinear relationship between renewable energy investment and the Green Economy Development Index, emphasizing the role of green credit. The results reveal dual threshold effects from green credit, dividing the impact into three stages: promotion, restraint, and successive promotion. He et al. [62] differentiate the impact on large companies, featuring a single threshold from that on green credit, and medium-, small-, and micro-sized enterprises, exhibiting dual threshold effects, with environmental pollution control expenditure and industry structure adjustment identified as contributors to increasing the Green Economy Development Index. It should be noted that after 2020, Chinese authors began their investigations of green energy and investment. At the same time, scholars from the U.S. and U.K. started to analyze the same issue before 2016 (dark blue color in the figure from Table 2). Furthermore, scholars from Lebanon, Ghana, Vietnam, Bangladesh Oman, Macao, and the United Arab Emirates increased their investigations of green energy and investment after 2022.

Table 2. The findings on the most prolific countries in which researchers explore the link between green energy and green investment and co-authorship analysis within these countries considering the historical horizon.



Countries	Documents	Countries	Documents	Countries	Documents
China	692	Turkey	190	Pakistan	101
United States	483	Germany	139	Spain	88
United Kingdom	230	Italy	135	Poland	81
				India	80

The results (Table 3) reveal the top 10 sponsors actively contributing to research on the connection between green energy and green investment. Among these sponsors, the National Natural Science Foundation of China leads with 192 documents, featuring a highly cited study (with 258 citations) [63] revealing that China's green financial development negatively affects bank loan issuance, thereby partially inhibiting the enhancement of renewable energy investment efficiency.

Table 3. The top 10 sponsors that invest in research on the linking between green energy and green investment.

Organizations	Number of Documents	The Most Cited Papers		
		Title	Authors	Citations
National Natural Science Foundation of China	192	Can green financial development promote renewable energy investment efficiency? A consideration of bank credit [63]	He L., Liu R., Zhong Z., Wang D., Xia Y.	258
European Commission	52	Factors influencing energy efficiency investments in existing Swedish residential buildings [64]	Nair G., Gustavsson, L., Mahapatra K.	270
Energimyndigheten	18			
National Office for Philosophy and Social Sciences	50	The impact of government subsidies and enterprises' R&D investment: A panel data study from renewable energy in China [65]	Yu F., Guo Y., Le-Nguyen K., Barnes S.J., Zhang W.	211
Ministry of Education of the People's Republic of China	41			
Fundamental Research Funds for the Central Universities	38	Public–private partnerships investment in energy as new determinant of CO_2 emissions: The role of technological innovations in China [61]	Shahbaz M., Raghutla C., Song M., Zameer H., Jiao Z.	353
Horizon 2020 Framework Programme	23	Energy investment needs for fulfilling the Paris Agreement and achieving the Sustainable Development Goals [66]	McCollum D.L., Zhou W., Bertram C., de Boer H.-S., Bosetti V., Busch S., Després J., Drouet L., Emmerling J., Fay M., Fricko O., Fujimori S., Gidden M., Harmsen M., Huppmann D., Iyer G., Krey V., Kriegler E., Nicolas C., Pachauri S., Parkinson S., Poblete-Cazenave M., Rafaj P., Rao N., Rozenberg J., Schmitz A., Schoepp W., . . . Van Vuuren D., Riahi K.	342
European Regional Development Fund	21	The use of real options approach in energy sector investments [67]	Fernandes B., Cunha J., Ferreira P.	149
Engineering and Physical Sciences Research Council	18	Estimation of global final-stage energy-return-on-investment for fossil fuels with comparison to renewable energy sources [68]	Brockway P.E., Owen A., Brand-Correa L.I., Hardt L.	295
National Key Research and Development Program of China	18	Energy investment risk assessment for nations along China's Belt & Road Initiative [69]	Duan F., Ji Q., Liu B.-Y., Fan Y.	184

The study observes [63] an intermediary effect of bank loans for overinvested renewable energy enterprises, with green financial development curbing overinvestment by reducing bank credit issuance. One paper [63] recommends government intervention in constructing and refining the green financial system, creating financial institutions for innovative green financial products, and reinforcing the internal management and diversification of financing channels for renewable energy enterprises. The European Commission follows closely with 52 documents, showcasing influential research by Nair et al. [64], cited 270 times. Nair et al. [64] outlined that the majority of Swedish homeowners express an interest in reducing household energy consumption, with a preference for noncost measures over investment measures. Nair et al. [64] outlined the necessity of promoting the implementation of investment measures to improve energy efficiency in residential buildings. Other noteworthy sponsors include the National Office for Philosophy and Social Sciences, the Ministry of Education of the People's Republic of China, and the Fundamental Research Funds for the Central Universities. Each of these organizations has made significant contributions to advancing knowledge in the field, as evidenced by their prolific document outputs and impactful research papers. McCollum D.L. et al. [66] outlined that low-carbon investments are crucial for the transformation of the energy system to achieve the goals outlined in the Paris Agreement and Sustainable Development Goals. McCollum D.L. et al. [66] employed six global modeling frameworks to assess the scale and characteristics of these investments under varying technological and policy scenarios. Fernandes et al. [67] outline that the widespread adoption of renewable energy systems faces challenges, primarily related to high investment costs and a lack of comprehensive understanding of their overall benefits compared to traditional technologies. Traditional project evaluation techniques have become insufficient in the face of increased market uncertainty and competitiveness resulting from the deregulation of the energy sector. To address these challenges, sophisticated evaluation techniques, particularly the real options approach, have gained prominence in the broader energy sector, although their application in the field of renewable energy has remained limited. Duan et al. [69] confirm that leading energy-consuming countries are increasingly favoring overseas energy investment to secure energy supply, although such investments entail various risks, including political, regulatory, currency, liquidity, and resource risks. The findings highlight that resource potential and Chinese factors are primary determinants of energy investment risk, with environmental constraints and political risk also playing crucial roles in investment decisions. The study concludes that Saudi Arabia, the United Arab Emirates, Pakistan, and Kazakhstan are the most favorable choices for China's energy investment considering both resource potential and the investment environment [69].

Clustering of the publications' metadata (based on co-occurrence analysis) allowed us to identify seven clusters of investigations that focused on the analysis of green energy and green investment. The visualization of the co-occurrence analysis is shown in Figure 3.

The largest cluster (Figure 3), shown in red, merged the results of the investigations focused on analyzing the links between energy storage, new technologies, decarbonization, and energy performance. The intersection of energy storage, emerging technologies, decarbonization, and energy performance plays a pivotal role in the framework of green energy and green investment. Energy storage technologies, such as advanced batteries and grid-scale storage solutions, are instrumental in addressing intermittency challenges associated with renewable energy sources. These technologies contribute to enhancing the reliability and stability of green energy systems [70,71]. The integration of new technologies, including artificial intelligence, the Internet of Things (IoT), and advanced control systems, synergizes with energy storage to optimize energy performance [72–75]. These innovations enable real-time monitoring, predictive analytics, and smart grid management, thereby enhancing overall energy efficiency and reducing environmental impact. Decarbonization efforts are inherently linked to the deployment of energy storage and new technologies. By facilitating the efficient utilization of renewable energy and enabling the transition away from fossil fuels, these advancements play a crucial role in achieving carbon reduction goals. This synergy supports the broader objective of creating sustainable and low-carbon energy ecosystems. The studies [76–80] outline that the rapid advancement of information technology and industrial revolutions has triggered digital transformation across various sectors, giving rise to the development of cryptocurrencies. However, the act of cryptocurrency introduces a dilemma. While it contributes to economic development, attracting resources for advancing smart and green technologies and decarbonizing economic growth, it also poses challenges by intensifying energy consumption and increasing greenhouse gas emissions. The findings [77] reveal that increasing crypto trading correlates with heightened GDP, real gross fixed capital formation, and globalization. However, the long-term relationship between crypto trading and the share of renewable energy in total energy consumption remains inconclusive [77]. A similar conclusion on the positive effect of digitalization was obtained by other studies [81,82]. Ref. [83] outlined the necessity of reevaluating energy development strategies, with a focus on smart grids as a key direction. Scholars [83] have developed a comprehensive assessment approach for smart grids that incorporates lessons from the pandemic, offering policymakers precise efficiency indicators to inform energy efficiency programs and policy implementation.

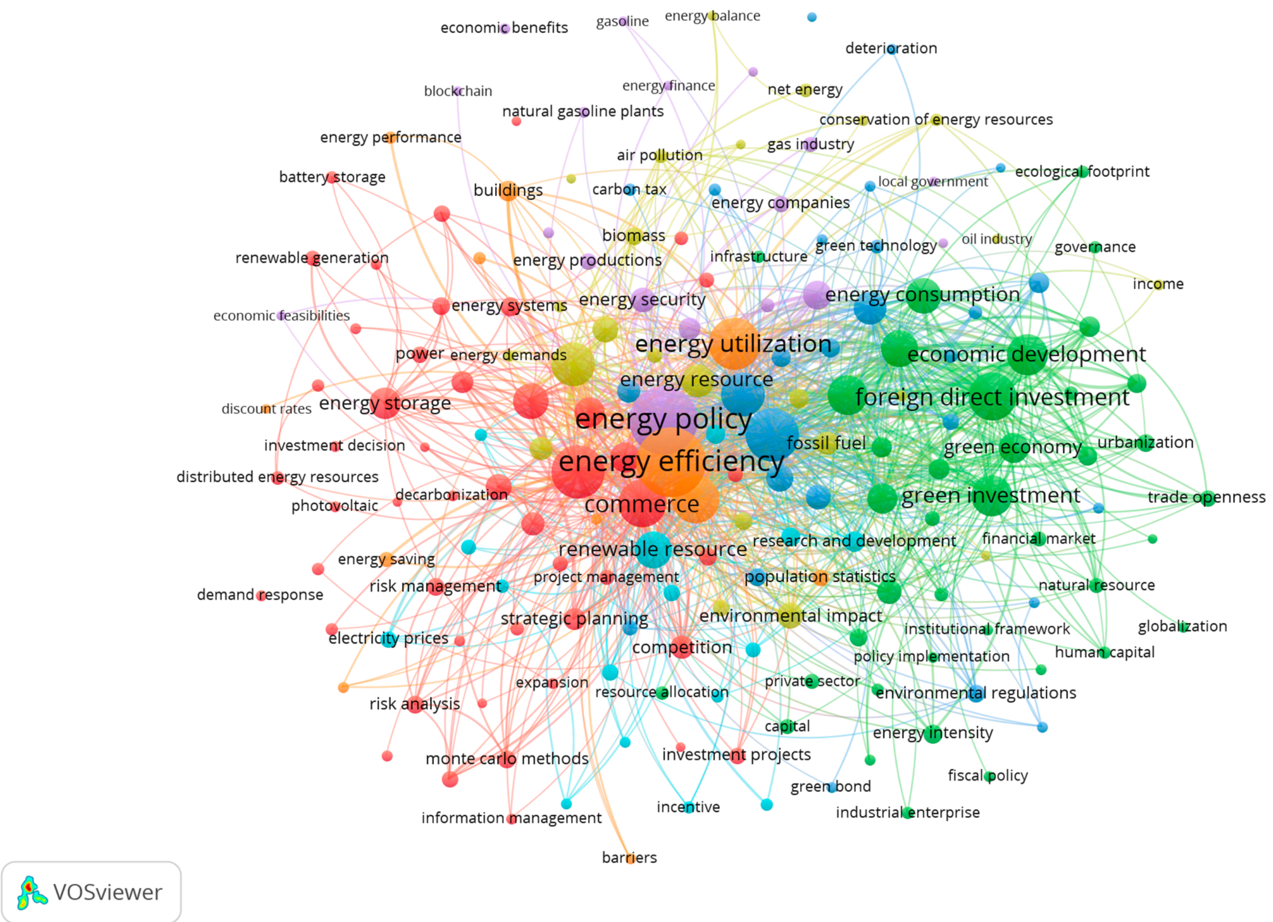


Figure 3. Network visualization of the co-occurrence analysis of the metadata of the documents that focused on green energy and green investment.

The second cluster (green) merged the investigations of the ecological footprint, green investment, and green economy development (Figure 3). Green investment acts as a catalyst for the development and expansion of sustainable energy solutions [84–86]. Allocating financial resources to renewable energy projects, energy-efficient technologies, and eco-friendly initiatives enhances the capacity to transition toward a green economy [87–89]. These investments not only yield positive environmental outcomes but also stimulate economic growth through job creation and technological innovation [90–92]. The studies [93–95] outlined that the development of a green economy involves the integration of sustainable practices across various sectors. Green energy and associated investments are integral components of this transition, fostering a circular economy that prioritizes environmental stewardship. The green economy thrives on sustainable energy practices, creating a harmonious balance between economic prosperity and ecological well-being. The relationships between green energy, the ecological footprint, green investment, and green economy development are symbiotic [96,97]. Green energy acts as a linchpin in reducing the ecological footprint, while green investment fuels the transition toward a sustainable economy, creating a holistic approach that aligns economic development with environmental preservation.

The navy blue cluster focused on analyzing the links between sustainable development, green technology, and energy consumption. Sustainable development, a multidimensional concept, seeks to meet the needs of the present without compromising the ability of future generations to meet their own needs [98–100]. Green technology, encompassing innovations in renewable energy, energy efficiency, and environmentally friendly practices, plays a pivotal role in achieving the objectives of sustainable development. Scholars [101–103] confirm that green technology directly influences energy consumption patterns by offering cleaner and more efficient alternatives. Renewable energy sources, such as solar and wind power, contribute to reducing dependence on finite fossil fuels, leading to lower greenhouse gas emissions and mitigating the impacts of climate change. Energy-efficient technologies further optimize consumption, minimizing waste and environmental impact. Past studies [104–106] outline that the adoption of green technology aligns with the principles of sustainable development by promoting economic growth, social equity, and environmental responsibility. Investments in the research, development, and implementation of green technologies contribute to creating a more resilient and sustainable society.

The next cluster (yellow) focused on investigating biomass and bioenergy as types of green energy. The study [107] investigates how agricultural biogas investments impact Czech farms, with a specific emphasis on their alignment with green energy practices and overall sustainability. This research assessed economic, environmental, and operational dimensions to understand the implications of adopting biogas technology for Czech agricultural practices. Key aspects include financial outcomes, sustainability metrics, and operational changes brought about by integrating biogas systems, contributing to the discourse on green investment in the agricultural sector. The studies [108–113] focused on assessing the social safety of developing countries in the context of meeting sustainable development standards, with a special emphasis on the role of green investments in biogas technologies. By examining indicators, levels, and strategic benchmarks, this study provides a comprehensive analysis of the social safety landscape, incorporating insights into the impact of green investments. The inclusion of a case study on Ukraine adds practical dimensions to the proposed framework, showcasing the potential influence of green initiatives on social safety. The previous study of Shpak et al. [111] explored the challenges and strategies involved in managing the logistic activities of agricultural enterprises within the context of the digital economy, with a focus on the integration of green energy practices. This research investigates how digital technologies impact supply chain logistics, efficiency, and overall operations in the agricultural sector while also considering the implications for green investments. Insights into the evolving landscape of agricultural logistics in the digital economy, coupled with the incorporation of green energy practices, contribute to the broader discourse on sustainable and technologically advanced agricultural practices.

The purple, light blue, and orange clusters (Figure 3) show the results of the investigation that analyzed the general aspects of energy policy, renewable energy, the effects of innovation, digitalization, and energy efficiency. By examining the impact of digital technologies on international perception, economic positioning, and environmental sustainability, Skvarciany et al. [112] outlined the role of green investment and technology in shaping countries' development. Trushkina et al. [114] examined the role of green energy adoption in shaping organizational values. It explores how organizations incorporate eco-friendly practices as part of their cultural transformation in response to the information economy. By examining the intersection of renewable energy, knowledge spillover, innovation, and environmental regulation, studies [115,116] have underscored the significance of green technologies in promoting sustainable practices. The studies [117–119] discuss how environmental regulations influence the capacity for innovation and knowledge transfer in the renewable energy sector. To address the role of environmental regulations, renewable energy adoption, and energy efficiency in achieving green economic growth, scholars [117–119] have explored the interconnected dynamics of these factors. The studies [117–119] discussed how these factors, along with green investments, collectively contribute to steering economies toward environmentally sustainable and economically viable pathways.

The chronological evolution of the research focus reveals a strategic progression in addressing key aspects of the energy landscape (Figure 4). Before 2014, the emphasis on general policy issues surrounding renewable energy underscored the foundational understanding of regulatory frameworks and overarching strategies. The period from 2016 to 2018 marked a shift toward a more application-oriented investigation, delving into energy utilization, commerce dynamics, and the intricacies of enhancing energy efficiency. This phase aimed at translating theoretical insights into practical solutions and optimizing the practical aspects of energy systems. The subsequent span from 2018 to 2022 witnessed an intensified exploration of critical elements in the energy domain, specifically energy consumption patterns and the emerging field of energy storage technologies.

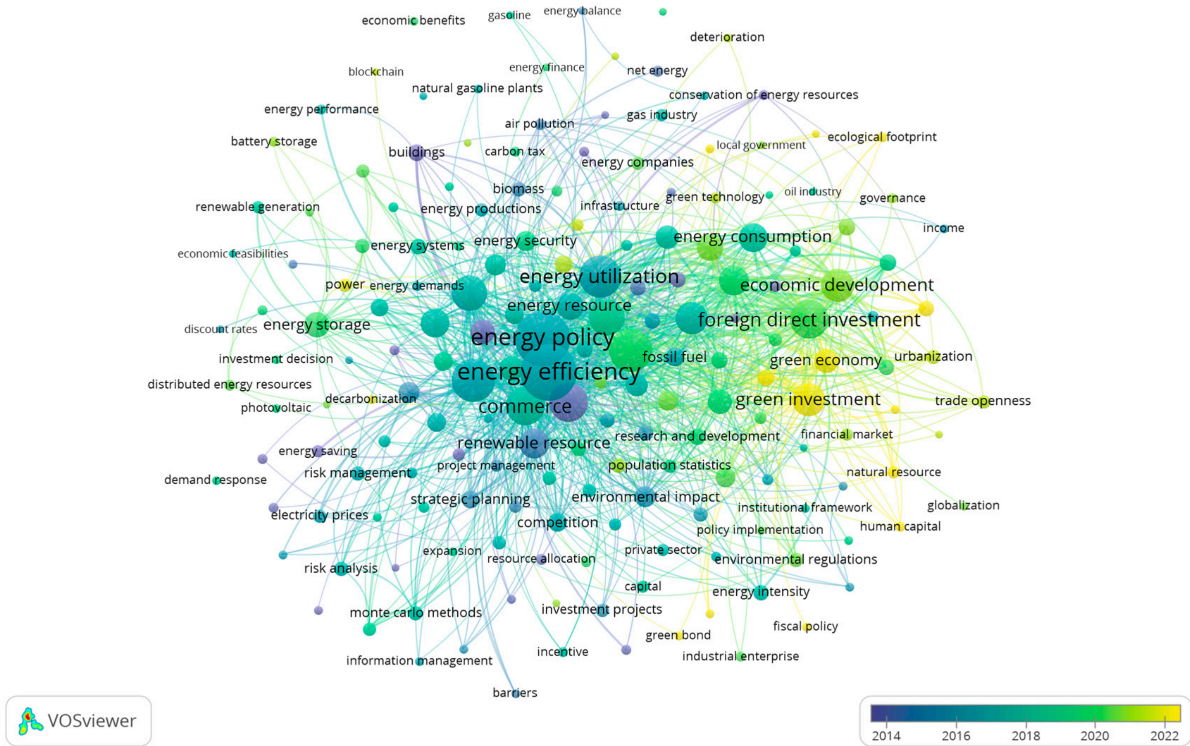


Figure 4. Overlay visualization of the evolution of the theoretical landscape of investigations on green energy and green investment.

These years were pivotal in understanding the dynamics of energy demand and the technological innovations shaping the storage landscape. It should be noted that scholars [120–122] have underlined the necessity of restructuring the available infrastructure and management systems [123–126] and enhancing green knowledge and competencies. In the aftermath of 2022, the research trajectory expanded further to encompass pressing issues integral to sustainable development [127,128]. Green investment became a prominent theme, highlighting the importance of financial strategies aligning with environmentally conscious initiatives [129–134]. The exploration of the green economy emphasized the integration of ecological considerations into economic frameworks, aiming for a harmonious balance between growth and environmental stewardship. The research focused on post-2022 years (Figure 5) and delved into the realm of green knowledge, underlining the significance of knowledge dissemination and acquisition in fostering sustainable practices.

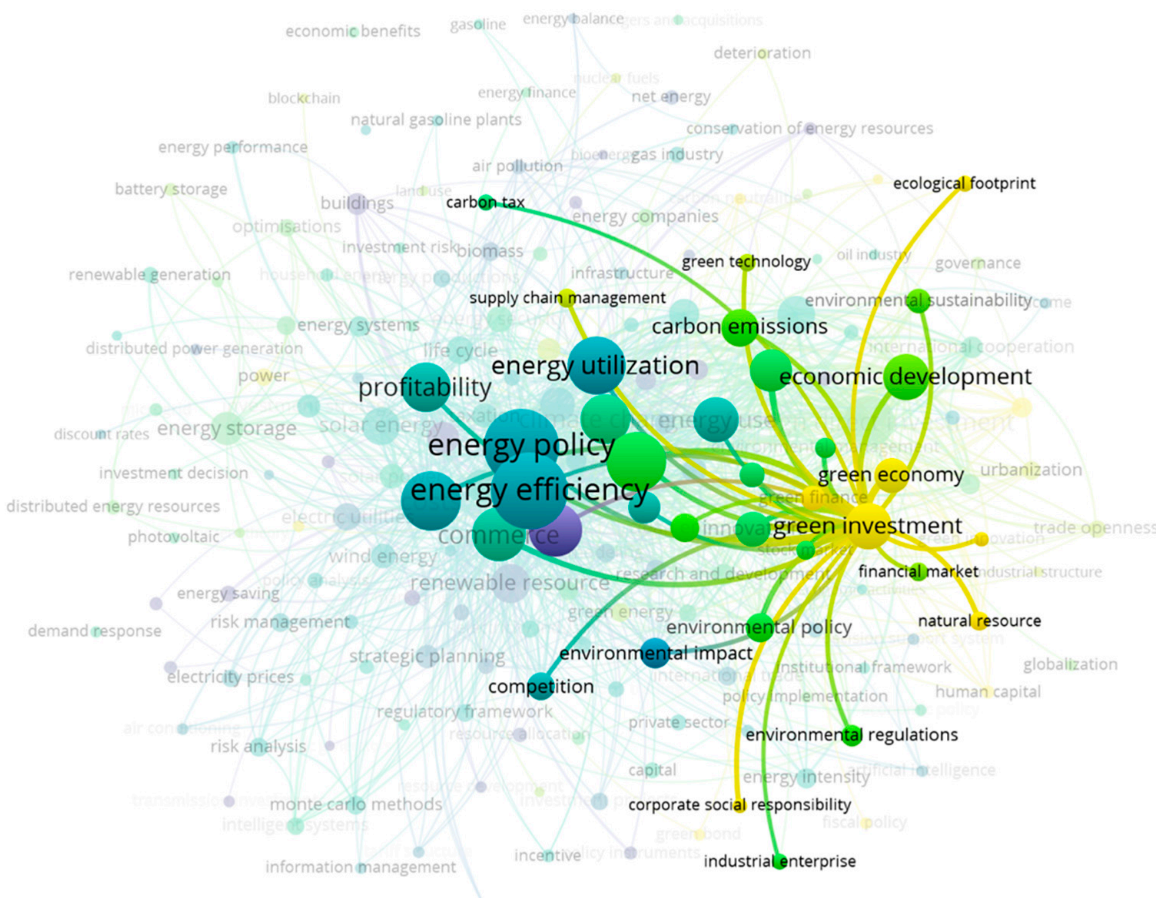


Figure 5. The overlay visualization of green investment cluster links with others.

Moreover, the increasing role of digitalization in the energy sector has emerged as a critical area of study, reflecting the ongoing transformation fueled by technological advancements. Past studies [135], through empirical analysis and data-driven insights, have uncovered the interplay between digitalization and energy efficiency in the context of EU nations. Scholars [136–139] have identified patterns, trends, and key themes that illuminate the intersection of sustainability and the ongoing digital revolution. In the contemporary global landscape, characterized by the forces of globalization and the pervasive influence of information technology (IT), nations find themselves at the crossroads of innovation and sustainability.

The imperative to restructure and adapt arises not only from the need to remain competitive in a rapidly changing world but also from a broader commitment to environmental responsibility. As countries embrace new knowledge and competences [140–143], they are compelled to explore novel approaches to governance and policy making that prioritize green energy and green investment. The nexus between new knowledge and competences becomes particularly crucial in navigating the complexities of a globalized market [144–146]. Nations are challenged to stay abreast of emerging technologies, international trends, and the ever-evolving landscape of sustainability practices. This requires a strategic rethinking of competences within the workforce, fostering a culture of continuous learning and adaptability.

Moreover, the imperative for green energy and sustainable practices places environmental considerations at the forefront of national decisions [147–151]. The integration of renewable energy sources, eco-friendly technologies, and sustainable investment strategies is no longer just an environmental commitment; it is a strategic necessity for national development. Countries recognize that aligning their policies with green principles not only mitigates environmental impact but also enhances global reputation and resilience in the face of changing international dynamics [152–154].

In terms of governance approaches, the shift toward green energy and investment necessitates a departure from traditional models. Forward-thinking leaders at the country level are exploring innovative strategies that prioritize sustainability, circular economies, and responsible resource utilization. This transition demands a holistic view of the national ecosystem, incorporating environmental, social, and governance (ESG) factors into policy-making processes.

4. Discussion

This research systematically reviews and examines a variety of existing studies pertaining to green energy and green investment. The application of quantitative methods has been employed to guarantee an impartial and objective analysis of the scientific underpinnings of the discourse. The trend toward publication sharply increased after 2007. One significant factor contributing to the notable increase in publications in 2007 could be the growing global awareness of environmental issues and the urgency of addressing climate change. The Intergovernmental Panel on Climate Change (IPCC) released its Fourth Assessment Report in 2007 [155], emphasizing the need for immediate action to mitigate the impacts of climate change. This heightened awareness likely prompted a surge in research and publications related to green energy and sustainable investment practices. Furthermore, 2007 marked a turning point in international discussions on climate change with the United Nations Climate Change Conference (COP13) in Bali [156]. The conference laid the groundwork for future climate agreements, and the heightened focus on sustainability and green initiatives likely stimulated academic and scientific interest in the years that followed. Additionally, governments and businesses worldwide began to recognize the economic potential of green energy and sustainable investments. Policies supporting renewable energy and environmentally friendly practices gained traction, leading to increased funding and research opportunities in these areas. The financial crisis of 2007–2008 may have also played a role, as governments sought new avenues for economic growth, and green industries presented viable opportunities.

5. Conclusions

In the process of identifying the most influential countries actively investigating the intersection of green energy and green investment, a thorough analysis was undertaken. This comprehensive assessment considered both individual research contributions and their interconnectedness with sponsors in the field. Chinese authors have emerged prominently at the forefront of research endeavors in this domain, with a noticeable surge in their investigations post-2020, setting them apart from earlier initiatives by researchers from the United States and the United Kingdom. An examination of the top 10 sponsors in this research domain highlighted the National Natural Science Foundation of China as the leading contributor. A pivotal study originating from this foundation delves into the intricate dynamics of China's green financial development, revealing a detrimental impact on bank loan issuance. Consequently, this study partially constrains the enhancement of efficiency in renewable energy investments. This underscores China's pivotal role in shaping the discourse surrounding the integration of green energy and investment practices, both on a national and global scale. The country's ambitious policies, including emission reduction targets and a commitment to sustainable practices, position China as a policy leader in the global effort against climate change [157]. Additionally, China's significant contributions to technological innovation in green technologies, coupled with its influence on the global supply chain for renewable energy products, have far-reaching effects on the adoption and diffusion of sustainable practices worldwide [3,117,158,159]. Engaging in international collaboration and actively participating in global initiatives further solidify China's impact on the global narrative regarding the best practices for achieving sustainable development goals. The sheer size and dynamics of China's market also play a crucial role in influencing the global supply and demand for green technologies and shaping investment strategies on a global scale.

A co-occurrence analysis of green energy and green investment revealed the identification of seven formative research streams. The first major cluster consolidates investigations focused on the interconnected dynamics of energy storage, new technologies, decarbonization, and energy performance. This nexus plays a pivotal role in the framework of green energy and investment, with energy storage technologies addressing challenges associated with renewable energy intermittency and innovative technologies optimizing overall energy performance. Innovative technologies, including artificial intelligence, the Internet of Things (IoT), and advanced control systems, synergistically collaborate with energy storage to optimize the overall performance of energy systems. This amalgamation enables real-time monitoring, predictive analytics, and efficient smart grid management, contributing to heightened energy efficiency and a consequential reduction in environmental impact. Furthermore, the cluster delves into the broader spectrum of decarbonization, emphasizing the integral connection between the deployment of energy storage and new technologies. The second cluster integrates research on the ecological footprint, green investment, and green economy development. At the heart of this cluster is the pivotal role of green investment as a catalyst for ushering in sustainable energy solutions. By allocating financial resources to renewable energy projects, energy-efficient technologies, and eco-friendly initiatives, green investment not only stimulates positive environmental outcomes but also serves as a driving force behind economic growth. This financial commitment fosters a transition toward a green economy, where the intertwining of economic prosperity and ecological well-being becomes manifest. The studies within this cluster underscore the integral components of this transition, emphasizing how green energy and associated investments contribute to the development of a circular economy that prioritizes environmental stewardship. Through a symbiotic relationship, green energy acts as a linchpin in reducing the ecological footprint, aligning seamlessly with green investment strategies that fuel the transition toward a sustainable economy. At the core of the third cluster lies the exploration of green technology, a broad domain encompassing innovations in renewable energy and energy-efficient practices. This technology has proven to be a linchpin in realizing sustainable development goals by exerting a significant influence on energy consumption patterns. The studies within this cluster collectively affirm that green technology, ranging from renewable energy sources such as solar and wind power to energy-efficient technologies, directly impacts the consumption of energy by offering cleaner, more efficient alternatives. As a result, the adoption of these green technologies contributes substantially to reducing dependence on finite fossil fuels, leading to lower greenhouse gas emissions and mitigating the adverse impacts of climate change. Furthermore, the research underscores the multifaceted benefits of green technology adoption, not only by optimizing energy consumption but also by promoting economic growth, social equity, and environmental responsibility. The investments in the research, development, and implementation of green technologies outlined in this cluster become instrumental in fostering a resilient and sustainable society, aligning with the principles of sustainable development that seek to meet present needs without compromising the ability of future generations to meet their own. The fourth cluster reveals the multifaceted role of biomass and bioenergy in influencing agricultural landscapes, fostering social safety in developing countries, and shaping the logistics domain within the digital economy. The research within this cluster serves as a pivotal contributor to the evolving understanding of the diverse impacts and potential of biomass and bioenergy in driving sustainable development across interconnected sectors. Clusters five, six, and seven form a comprehensive exploration of critical dimensions in the realm of energy policy and sustainability. Cluster five concentrates on dissecting energy policies and governance structures, analyzing their impact on fostering green investments and innovation, and navigating environmental regulations. Cluster six delves into the intersection of renewable energy and innovation, assessing the role of cutting-edge technologies in advancing sustainable practices and their implications for economic growth. Moreover, cluster seven investigates the transformative impact of digitalization on energy efficiency, emphasizing the role of smart technologies in optimizing energy use and contributing to both economic and environmental objectives. Together, these clusters provide a nuanced understanding of the multifaceted impact of green energy initiatives on international perceptions, organizational strategies, and the broader landscape of sustainable economic growth. The research within these clusters serves as a valuable guide for policymakers, businesses, and stakeholders in navigating the complex dynamics of the energy landscape toward a more sustainable and environmentally conscious future.

This study has certain limitations that merit consideration. First, the adequacy of the dataset hinges on the selection of search terms and the chosen data source. Different search terms could have resulted in more or fewer articles, leading to disparate outcomes. In parallel with the search term selection, the inclusion of additional databases could have altered the results. The choice to utilize the Scopus database was driven by its extensive coverage, its ability to serve as a quality indicator for publications, and its unique ability to extract literature references. It is noteworthy that not all databases offer the same functionality in this regard. The Web of Science Core Collection provides a comparable alternative for bibliometric analysis. It is important to note that the dataset exclusively comprises peer-reviewed articles, excluding working papers, reports, or books. While this selection ensures article quality, it comes at the expense of potentially omitting recent and pertinent scientific findings. Although significant results emerge from identifying factors, the inability to consistently rank individual variables within these factors limits interpretative possibilities. A more definitive categorization could be achieved with repeated analysis in the future based on a larger dataset that includes more peer-reviewed publications on the intersection of green energy and green investment. For subsequent studies with expanded datasets, it would be intriguing to explore publication data inclusive and exclusive of review and survey articles. This approach could further enrich the understanding of the subject matter and contribute to a more comprehensive analysis.

Funding: This research received no external funding.

Conflicts of Interest: The author declares no conflicts of interest.

References

1. Zhang, M.; Chen, Y.; Lyulyov, O.; Pimonenko, T. Interactions between economic growth and environmental degradation toward sustainable development. *Systems* **2023**, *11*, 13. [CrossRef]
2. Konovalyuk, I.; Brych, V.; Borysiak, O.; Mucha-Kus, K.; Pavlenchyk, N. Monitoring the integration of environmentally friendly technologies in business structures in the context of climate security. *Forum Sci. Oeconomia* **2023**, *11*, 161–174.
3. Gavkalova, N.; Lola, Y.; Prokopovych, S.; Akimov, O.; Smalskys, V.; Akimova, L. Innovative Development of Renewable Energy during the Crisis Period and Its Impact on the Environment. *Virtual Econ.* **2022**, *5*, 65–77. [CrossRef] [PubMed]
4. Kolosok, S.; Saher, L.; Kovalenko, Y.; Delibasic, M. Renewable Energy and Energy Innovations: Examining Relationships Using Markov Switching Regression Model. *Mark. Manag. Innov.* **2022**, *2*, 151–160. [CrossRef]
5. Ziabina, Y.; Navickas, V. Innovations in Energy Efficiency Management: Role of Public Governance. *Mark. Manag. Innov.* **2022**, *4*, 218–227. [CrossRef]
6. Chygryn, O.; Lyulyov, O.; Pimonenko, T.; Myronenko, N. Key indicators of green competitiveness: The EU and Ukraine's performance. *E3S Web Conf.* **2021**, *307*, 03003. [CrossRef]
7. Pan, X.; Shao, T.; Zheng, X.; Zhang, Y.; Ma, X.; Zhang, Q. Energy and sustainable development nexus: A review. *Energy Strategy Rev.* **2023**, *47*, 101078. [CrossRef]
8. Liu, F.; Su, C.W.; Qin, M.; Umar, M. Is renewable energy a path toward sustainable development? *Sustain. Dev.* **2023**, *31*, 3869–3880. [CrossRef]

9. Manigandan, P.; Alam, M.S.; Alagirisamy, K.; Pachiyappan, D.; Murshed, M.; Mahmood, H. Realizing the Sustainable Development Goals through technological innovation: Juxtaposing the economic and environmental effects of financial development and energy use. *Environ. Sci. Pollut. Res.* **2023**, *30*, 8239–8256. [CrossRef]
10. Ritchie, H.; Rosado, P.; Roser, M. Access to Energy. Our World in Data. 2024. Available online: https://ourworldindata.org/energy-access (accessed on 14 January 2024).
11. International Energy Agency. *World Energy Outlook*; IEA: Paris, France, 2022. Available online: https://iea.blob.core.windows.net/assets/830fe099-5530-48f2-a7c1-11f35d510983/WorldEnergyOutlook2022.pdf (accessed on 3 September 2023).
12. Sanchez-Triana, E. Fighting Air Pollution: A Deadly Killer and a Core Development Challenge. 2023. Available online: https://blogs.worldbank.org/health/fighting-air-pollution-deadly-killer-and-core-development-challenge (accessed on 14 January 2024).
13. Midilli, A.; Dincer, I.; Ay, M. Green energy strategies for sustainable development. *Energy Policy* **2006**, *34*, 3623–3633. [CrossRef]
14. Omer, A.M. Green energies and the environment. *Renew. Sustain. Energy Rev.* **2008**, *12*, 1789–1821. [CrossRef]
15. Androniceanu, A.; Sabie, O.M. Overview of green energy as a real strategic option for sustainable development. *Energies* **2022**, *15*, 8573. [CrossRef]
16. Chau, K.Y.; Moslehpour, M.; Tu, Y.T.; Tai, N.T.; Tien, N.H.; Huy, P.Q. Exploring the impact of green energy and consumption on the sustainability of natural resources: Empirical evidence from G7 countries. *Renew. Energy* **2022**, *196*, 1241–1249. [CrossRef]
17. Thompson, E.P.; Bombelli, E.L.; Shubham, S.; Watson, H.; Everard, A.; D'Ardes, V.; Schievano, A.; Bocchi, S.; Zand, N.; Howe, C.J.; et al. Tinted semi-transparent solar panels allow concurrent production of crops and electricity on the same cropland. *Adv. Energy Mater.* **2020**, *10*, 2001189. [CrossRef]
18. McKuin, B.; Zumkehr, A.; Ta, J.; Bales, R.; Viers, J.H.; Pathak, T.; Campbell, J.E. Energy and water cobenefits from covering canals with solar panels. *Nat. Sustain.* **2021**, *4*, 609–617. [CrossRef]
19. Hao, S.; Kuah, A.T.; Rudd, C.D.; Wong, K.H.; Lai, N.Y.G.; Mao, J.; Liu, X. A circular economy approach to green energy: Wind turbine, waste, and material recovery. *Sci. Total Environ.* **2020**, *702*, 135054. [CrossRef] [PubMed]
20. Nazir, M.S.; Ali, N.; Bilal, M.; Iqbal, H.M. Potential environmental impacts of wind energy development: A global perspective. *Curr. Opin. Environ. Sci. Health* **2020**, *13*, 85–90. [CrossRef]
21. Rahman, A.; Farrok, O.; Haque, M.M. Environmental impact of renewable energy source based electrical power plants: Solar, wind, hydroelectric, biomass, geothermal, tidal, ocean, and osmotic. *Renew. Sustain. Energy Rev.* **2022**, *161*, 112279. [CrossRef]
22. Ren, S.; Hao, Y.; Wu, H. How does green investment affect environmental pollution? Evidence from China. *Environ. Resour. Econ.* **2022**, *81*, 25–51. [CrossRef]
23. Chen, Y.; Ma, Y. Does green investment improve energy firm performance? *Energy Policy* **2021**, *153*, 112252. [CrossRef]
24. Zhang, X.; Chen, T.; Shen, C. Green investment choice in a duopoly market with quality competition. *J. Clean. Prod.* **2020**, *276*, 124032. [CrossRef]
25. Taghizadeh-Hesary, F.; Yoshino, N. Sustainable solutions for green financing and investment in renewable energy projects. *Energies* **2020**, *13*, 788. [CrossRef]
26. Zhao, L.; Zhang, Y.; Sadiq, M.; Hieu, V.M.; Ngo, T.Q. Testing green fiscal policies for green investment, innovation and green productivity amid the COVID-19 era. *Econ. Chang. Restruct.* **2023**, *56*, 2943–2964. [CrossRef]
27. Sulich, A.; Zema, T. The green energy transition in Germany: A bibliometric study. *Forum Sci. Oeconomia* **2023**, *11*, 175–195.
28. Owusu, E.; Arthur, J.L.; Amofah, K. Cross-Cultural Communication Strategies in the Digital Era: A Bibliometric Analysis. *Virtual Econ.* **2023**, *6*, 55–71. [CrossRef]
29. Miskiewicz, R. Internet of things in marketing: Bibliometric analysis. *Mark. Manag. Innov.* **2020**, *3*, 371–381.
30. Kwilinski, A. The Relationship between Sustainable Development and Digital Transformation: Bibliometric Analysis. *Virtual Econ.* **2023**, *6*, 56–69. [CrossRef]
31. Mentel, G.; Lewandowska, A.; Berniak-Woźny, J.; Tarczyński, W. Green and Renewable Energy Innovations: A Comprehensive Bibliometric Analysis. *Energies* **2023**, *16*, 1428. [CrossRef]
32. Bagdi, T.; Ghosh, S.; Sarkar, A.; Hazra, A.K.; Balachandran, S.; Chaudhury, S. Evaluation of research progress and trends on gender and renewable energy: A bibliometric analysis. *J. Clean. Prod.* **2023**, *423*, 138654. [CrossRef]
33. Qin, Y.; Xu, Z.; Wang, X.; Škare, M. Green energy adoption and its determinants: A bibliometric analysis. *Renew. Sustain. Energy Rev.* **2022**, *153*, 111780. [CrossRef]
34. Us, Y.; Pimonenko, T.; Lyulyov, O. The impact of energy efficiency policy on Ukraine's green brand: A bibliometrics analysis. *Polityka Energetyczna* **2021**, *24*, 5–18. [CrossRef]
35. Ziabina, Y.; Pimonenko, T. The Green Deal Policy for renewable energy: A bibliometric analysis. *Virtual Econ.* **2020**, *3*, 147–168. [CrossRef]
36. Us, Y.; Pimonenko, T.; Lyulyov, O. Corporate Social Responsibility and Renewable Energy Development for the Green Brand within SDGs: A Meta-Analytic Review. *Energies* **2023**, *16*, 2335. [CrossRef]
37. Van Eck, N.J.; Waltman, L. Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics* **2010**, *84*, 523–538. [CrossRef]
38. Us, Y.; Pimonenko, T.; Lyulyov, O.; Chen, Y.; Tambovceva, T. Promoting Green Brand of University in Social Media: Text Mining and Sentiment Analysis. *Virtual Econ.* **2022**, *5*, 24–42. [CrossRef]

39. Polcyn, J.; Us, Y.; Lyulyov, O.; Pimonenko, T.; Kwilinski, A. Factors Influencing the Renewable Energy Consumption in Selected European Countries. *Energies* **2022**, *15*, 108. [CrossRef]
40. Us, Y.; Pimonenko, T.; Lyulyov, O. Energy Efficiency Profiles in Developing the Free-Carbon Economy: On the Example of Ukraine and the V4 Countries. *Polityka Energetyczna* **2020**, *23*, 49–66. [CrossRef]
41. Bilan, Y.; Pimonenko, T.; Starchenko, L. Sustainable business models for innovation and success: Bibliometric analysis. *E3S Web Conf.* **2020**, *159*, 04037. [CrossRef]
42. Soliman, M.; Lyulyov, O.; Shvindina, H.; Figueiredo, R.; Pimonenko, T. Scientific output of the European Journal of Tourism Research: A bibliometric overview and visualization. *Eur. J. Tour. Res.* **2021**, *28*, 2801. [CrossRef]
43. PRISMA Guidelines. Available online: http://www.prisma-statement.org/?AspxAutoDetectCookieSupport=1 (accessed on 14 January 2024).
44. Letunovska, N.; Lyuolyov, O.; Pimonenko, T.; Aleksandrov, V. Environmental management and social marketing: A bibliometric analysis. *E3S Web Conf.* **2021**, *234*, 00008. [CrossRef]
45. Pimonenko, T.; Us, Y.; Lyulyova, L.; Kotenko, N. The impact of the macroeconomic stability on the energy-efficiency of the European countries: A bibliometric analysis. *E3S Web Conf.* **2021**, *234*, 00013. [CrossRef]
46. Soliman, M.; Gulvady, S.; Lyulyov, O.; Pimonenko, T. Research Trends and Themes in the Top-Tier Tourism, Leisure and Hospitality Journals: A Bibliometric and Network Analysis Before and During the COVID-19 Era. *Int. J. Hosp. Tour. Syst.* **2023**, *16*, 58.
47. Dubina, O.; Us, Y.; Pimonenko, T.; Lyulyov, O. Customer loyalty to bank services: The bibliometric analysis. *Virtual Econ.* **2020**, *3*, 53–66. [CrossRef]
48. Acheampong, S.; Pimonenko, T.; Lyulyov, O. Sustainable Marketing Performance of Banks in the Digital Economy: The Role of Customer Relationship Management. *Virtual Econ.* **2023**, *6*, 19–37. [CrossRef] [PubMed]
49. Scopus. Available online: https://www.scopus.com/search/form.uri?display=basic&zone=header&origin=AuthorProfile#basic (accessed on 14 January 2024).
50. VOSviewer. Available online: https://www.vosviewer.com (accessed on 14 January 2024).
51. Tongjing, W.; Meijers, E.; Wang, H. The multiplex relations between cities: A lexicon-based approach to detect urban systems. *Reg. Stud.* **2023**, *57*, 1592–1604. [CrossRef]
52. Wan, X.; Yang, J.; Marinov, S.; Calliess, J.P.; Zohren, S.; Dong, X. Sentiment correlation in financial news networks and associated market movements. *Sci. Rep.* **2021**, *11*, 3062. [CrossRef]
53. Schober, A.; Kittel, C.; Baumgartner, R.J.; Füllsack, M. Identifying dominant topics appearing in the Journal of Cleaner Production. *J. Clean. Prod.* **2018**, *190*, 160–168. [CrossRef]
54. Kou, G.; Yüksel, S.; Dinçer, H. Inventive problem-solving map of innovative carbon emission strategies for solar energy-based transportation investment projects. *Appl. Energy* **2022**, *311*, 118680. [CrossRef]
55. Gagnon, N.; Hall, C.A.S.; Brinker, L. A Preliminary Investigation of Energy Return on Energy Investment for Global Oil and Gas Production. *Energies* **2009**, *2*, 490–503. [CrossRef]
56. Murphy, D.J.; Hall, C.A. Energy return on investment, peak oil, and the end of economic growth. *Ann. N. Y. Acad. Sci.* **2011**, *1219*, 52–72. [CrossRef]
57. Guilford, M.C.; Hall, C.A.S.; O'Connor, P.; Cleveland, C.J. A New Long Term Assessment of Energy Return on Investment (EROI) for U.S. Oil and Gas Discovery and Production. *Sustainability* **2011**, *3*, 1866–1887. [CrossRef]
58. Bekun, F. Mitigating Emissions in India: Accounting for the Role of Real Income, Renewable Energy Consumption and Investment in Energy. *Int. J. Energy Econ. Policy* **2022**, *12*, 188–192. [CrossRef]
59. Caglar, A.E.; Zafar, M.W.; Bekun, F.V.; Mert, M. Determinants of CO_2 emissions in the BRICS economies: The role of partnerships investment in energy and economic complexity. *Sustain. Energy Technol. Assess.* **2022**, *51*, 101907. [CrossRef]
60. Udemba, E.N.; Magazzino, C.; Bekun, F.V. Modeling the nexus between pollutant emission, energy consumption, foreign direct investment, and economic growth: New insights from China. *Environ. Sci. Pollut. Res.* **2020**, *27*, 17831–17842. [CrossRef] [PubMed]
61. Shahbaz, M.; Raghutla, C.; Song, M.; Zameer, H.; Jiao, Z. Public–private partnerships investment in energy as new determinant of CO_2 emissions: The role of technological innovations in China. *Energy Econ.* **2020**, *86*, 104664. [CrossRef]
62. He, L.; Zhang, L.; Zhong, Z.; Wang, D.; Wang, F. Green credit, renewable energy investment and green economy development: Empirical analysis based on 150 listed companies of China. *J. Clean. Prod.* **2019**, *208*, 363–372. [CrossRef]
63. He, L.; Liu, R.; Zhong, Z.; Wang, D.; Xia, Y. Can green financial development promote renewable energy investment efficiency? A consideration of bank credit. *Renew. Energy* **2019**, *143*, 974–984. [CrossRef]
64. Nair, G.; Gustavsson, L.; Mahapatra, K. Factors influencing energy efficiency investments in existing Swedish residential buildings. *Energy Policy* **2010**, *38*, 2956–2963. [CrossRef]
65. Yu, F.; Guo, Y.; Le-Nguyen, K.; Barnes, S.J.; Zhang, W. The impact of government subsidies and enterprises' R&D investment: A panel data study from renewable energy in China. *Energy Policy* **2016**, *89*, 106–113.
66. McCollum, D.L.; Zhou, W.; Bertram, C.; De Boer, H.S.; Bosetti, V.; Busch, S.; Riahi, K. Energy investment needs for fulfilling the Paris Agreement and achieving the Sustainable Development Goals. *Nat. Energy* **2018**, *3*, 589–599. [CrossRef]
67. Fernandes, B.; Cunha, J.; Ferreira, P. The use of real options approach in energy sector investments. *Renew. Sustain. Energy Rev.* **2011**, *15*, 4491–4497. [CrossRef]

68. Brockway, P.E.; Owen, A.; Brand-Correa, L.I.; Hardt, L. Estimation of global final-stage energy-return-on-investment for fossil fuels with comparison to renewable energy sources. *Nat. Energy* **2019**, *4*, 612–621. [CrossRef]
69. Duan, F.; Ji, Q.; Liu, B.Y.; Fan, Y. Energy investment risk assessment for nations along China's Belt & Road Initiative. *J. Clean. Prod.* **2018**, *170*, 535–547.
70. Castillo, A.; Gayme, D.F. Grid-scale energy storage applications in renewable energy integration: A survey. *Energy Convers. Manag.* **2014**, *87*, 885–894. [CrossRef]
71. Byrne, R.H.; Nguyen, T.A.; Copp, D.A.; Chalamala, B.R.; Gyuk, I. Energy management and optimization methods for grid energy storage systems. *IEEE Access* **2017**, *6*, 13231–13260. [CrossRef]
72. Trzeciak, M.; Kopec, T.P.; Kwilinski, A. Constructs of Project Programme Management Supporting Open Innovation at the Strategic Level of the Organization. *J. Open Innov. Technol. Mark. Complex.* **2022**, *8*, 58. [CrossRef]
73. Dementyev, V.; Dalevska, N.; Kwilinski, A. Innovation and Information Aspects of the Structural Organization of the World Political and Economic Space. *Virtual Econ.* **2021**, *4*, 54–76. [CrossRef]
74. Dacko-Pikiewicz, Z. Building a family business brand in the context of the concept of stakeholder-oriented value. *Forum Sci. Oeconomia* **2019**, *7*, 37–51. [CrossRef]
75. Szczepańska-Woszczyna, K.; Gatnar, S. Key Competences of Research and Development Project Managers in High Technology Sector. *Forum Sci. Oeconomia* **2022**, *10*, 107–130. [CrossRef]
76. Kimani, D.; Adams, K.; Attah-Boakye, R.; Ullah, S.; Frecknall-Hughes, J.; Kim, J. Blockchain, business and the fourth industrial revolution: Whence, whither, wherefore and how? *Technol. Forecast. Soc. Chang.* **2020**, *161*, 120254. [CrossRef]
77. Mohsin, M.; Naseem, S.; Zia-ur-Rehman, M.; Baig, S.A.; Salamat, S. The crypto-trade volume, GDP, energy use, and environmental degradation sustainability: An analysis of the top 20 crypto-trader countries. *Int. J. Financ. Econ.* **2023**, *28*, 651–667. [CrossRef]
78. Rymarczyk, J. Technologies, opportunities and challenges of the industrial revolution 4.0: Theoretical considerations. *Entrep. Bus. Econ. Rev.* **2020**, *8*, 185–198. [CrossRef]
79. Su, C.W.; Qin, M.; Tao, R.; Umar, M. Financial implications of fourth industrial revolution: Can bitcoin improve prospects of energy investment? *Technol. Forecast. Soc. Chang.* **2020**, *158*, 120178. [CrossRef] [PubMed]
80. Rymarczyk, J. The impact of industrial revolution 4.0 on international trade. *Entrep. Bus. Econ. Rev.* **2021**, *9*, 105–117. [CrossRef]
81. Kwilinski, A.; Lyulyov, O.; Pimonenko, T. Environmental Sustainability within Attaining Sustainable Development Goals: The Role of Digitalization and the Transport Sector. *Sustainability* **2023**, *15*, 11282. [CrossRef]
82. Kwilinski, A.; Lyulyov, O.; Pimonenko, T. The Effects of Urbanization on Green Growth within Sustainable Development Goals. *Land* **2023**, *12*, 511. [CrossRef]
83. Kwilinski, A.; Lyulyov, O.; Dźwigoł, H.; Vakulenko, I.; Pimonenko, T. Integrative Smart Grids' Assessment System. *Energies* **2022**, *15*, 545. [CrossRef]
84. Majid, M. Renewable energy for sustainable development in India: Current status, future prospects, challenges, employment, and investment opportunities. *Energy Sustain. Soc.* **2020**, *10*, 2.
85. Kwilinski, A.; Lyulyov, O.; Pimonenko, T. Greenfield Investment as a Catalyst of Green Economic Growth. *Energies* **2023**, *16*, 2372. [CrossRef]
86. Kwilinski, A.; Lyulyov, O.; Pimonenko, T. Spillover Effects of Green Finance on Attaining Sustainable Development: Spatial Durbin Model. *Computation* **2023**, *11*, 199. [CrossRef]
87. Sun, G.; Li, G.; Dilanchiev, A.; Kazimova, A. Promotion of green financing: Role of renewable energy and energy transition in China. *Renew. Energy* **2023**, *210*, 769–775. [CrossRef]
88. Nguyen, H.T. The role of human capital in the relationship between foreign direct investment and exports in the Association of Southeast Asian Nations. *Forum Sci. Oeconomia* **2023**, *11*, 149–164. [CrossRef]
89. Sotnyk, I.; Shvets, I.; Momotiuk, L.; Chortok, Y. Management of renewable energy innovative development in Ukrainian households: Problems of financial support. *Mark. Manag. Innov.* **2018**, *4*, 150–160. [CrossRef]
90. Saleem, H.; Khan, M.B.; Mahdavian, S.M. The role of green growth, green financing, and eco-friendly technology in achieving environmental quality: Evidence from selected Asian economies. *Environ. Sci. Pollut. Res.* **2022**, *29*, 57720–57739. [CrossRef] [PubMed]
91. Zhao, L.; Chau, K.Y.; Tran, T.K.; Sadiq, M.; Xuyen, N.T.M.; Phan, T.T.H. Enhancing green economic recovery through green bonds financing and energy efficiency investments. *Econ. Anal. Policy* **2022**, *76*, 488–501. [CrossRef]
92. Wang, Z.; Peng, M.Y.P.; Anser, M.K.; Chen, Z. Research on the impact of green finance and renewable energy on energy efficiency: The case study E−7 economies. *Renew. Energy* **2023**, *205*, 166–173. [CrossRef]
93. He, J.; Iqbal, W.; Su, F. Nexus between renewable energy investment, green finance, and sustainable development: Role of industrial structure and technical innovations. *Renew. Energy* **2023**, *210*, 715–724. [CrossRef]
94. Moskalenko, B.; Lyulyov, O.; Pimonenko, T.; Kwilinski, A.; Dzwigol, H. Investment Attractiveness of the Country: Social, Ecological, Economic Dimension. *Int. J. Environ. Pollut.* **2022**, *69*, 80–98. [CrossRef]
95. Bilal, M.J.; Shaheen, W.A. Toward sustainable development: Investigating the effect of green financial indicators on renewable energy via the mediating variable. *Renew. Energy* **2023**, *221*, 119819. [CrossRef]
96. Hussain, H.I.; Haseeb, M.; Kamarudin, F.; Dacko-Pikiewicz, Z.; Szczepańska-Woszczyna, K. The role of globalization, economic growth and natural resources on the ecological footprint in Thailand: Evidence from nonlinear causal estimations. *Processes* **2021**, *9*, 1103. [CrossRef]

97. Moskalenko, B.; Lyulyov, O.; Pimonenko, T. The investment attractiveness of countries: Coupling between core dimensions. *Forum Sci. Oeconomia* **2022**, *10*, 153–172. [CrossRef]
98. Pudryk, D.; Kwilinski, A.; Lyulyov, O.; Pimonenko, T. Toward Achieving Sustainable Development: Interactions between Migration and Education. *Forum Sci. Oeconomia* **2023**, *11*, 113–132. [CrossRef]
99. Us, Y.; Pimonenko, T.; Lyulyov, O.; Kwilinski, A. Mapping the nexus between digital transformation and the green brand in the context of achieving SDGs. *E3S Web Conf.* **2023**, *456*, 02003. [CrossRef]
100. Acheampong, S.; Lyulyov, O.; Pimonenko, T. Digital Marketing and Sustainable Economic Development Trends in Developed and Underdeveloped Countries: A Bibliometric Analysis. *E3S Web Conf.* **2023**, *456*, 02002. [CrossRef]
101. Dzwigol, H. The Uncertainty Factor in the Market Economic System: The Microeconomic Aspect of Sustainable Development. *Virtual Econ.* **2021**, *4*, 98–117. [CrossRef] [PubMed]
102. Letunovska, N.; Offei, F.A.; Junior, P.A.; Lyulyov, O.; Pimonenko, T.; Kwilinski, A. Green Supply Chain Management: The Effect of Procurement Sustainability on Reverse Logistics. *Logistics* **2023**, *7*, 47. [CrossRef]
103. Kolosok, S.; Pimonenko, T.; Yevdokymova, A.; Nazim, O.H.; Palienko, M.; Prasol, L. Energy efficiency policy: Impact of green innovations. *Mark. Manag. Innov.* **2020**, *4*, 50–60. [CrossRef]
104. Khalatur, S.; Dubovych, O. Financial Engineering of Green Finance as an Element of Environmental Innovation Management. *Mark. Manag. Innov.* **2022**, *1*, 232–246. [CrossRef]
105. Alagpuria, M. Sustainable Financing for the Entrepreneurship Continual Growth: A Gap Analysis on Small and Medium Enterprises in India. *Virtual Econ.* **2021**, *4*, 105–119. [CrossRef] [PubMed]
106. Kwilinski, A.; Lyulyov, O.; Pimonenko, T.; Dźwigoł, H.; Abazov, R.; Pudryk, D. International Migration Drivers: Economic, Environmental, Social, and Political Effects. *Sustainability* **2022**, *14*, 6413. [CrossRef]
107. Moskalenko, B.; Lyulyov, O.; Pimonenko, T.; Kobushko, I. Institutions' Effect on a Country's Investment Attractiveness within Sustainable Development. *Virtual Econ.* **2022**, *5*, 50–64. [CrossRef]
108. Letunovska, N.; Abazov, R.; Chen, Y. Framing a Regional Spatial Development Perspective: The Relation between Health and Regional Performance. *Virtual Econ.* **2022**, *5*, 87–99. [CrossRef] [PubMed]
109. Cebula, J.; Pimonenko, T. Comparison financing conditions of the development biogas sector in Poland and Ukraine. *Int. J. Ecol. Dev.* **2015**, *30*, 20–30.
110. Yevdokimov, Y.; Chygryn, O.; Pimonenko, T.; Lyulyov, O. Biogas as an Alternative Energy Resource for Ukrainian Companies: EU Experience. *Innov. Mark.* **2018**, *14*, 7–15. [CrossRef]
111. Shpak, N.; Melnyk, O.; Horbal, N.; Ruda, M.; Sroka, W. Assessing the implementation of the circular economy in the EU countries. *Forum Sci. Oeconomia* **2021**, *9*, 25–39. [CrossRef]
112. Skvarciany, V.; Jurevičienë, D. An approach to the measurement of the digital economy. *Forum Sci. Oeconomia* **2021**, *9*, 89–102. [CrossRef]
113. Zhanibek, A.; Abazov, R.; Khazbulatov, A. Digital Transformation of a Country's Image: The Case of the Astana International Finance Centre in Kazakhstan. *Virtual Econ.* **2022**, *5*, 71–94. [CrossRef]
114. Trushkina, N.; Abazov, R.; Rynkevych, N.; Bakhautdinova, G. Digital Transformation of Organizational Culture under Conditions of the Information Economy. *Virtual Econ.* **2020**, *3*, 7–38. [CrossRef]
115. Kwilinski, A. Implementation of Blockchain Technology in Accounting Sphere. *Acad. Account. Financ. Stud. J.* **2019**, *23*, 1–6.
116. Pietruszka-Ortyl, A. Determinants of the knowledge diffusion process among professionals in the IT sector. *Forum Sci. Oeconomia* **2020**, *8*, 73–97. [CrossRef]
117. Chen, Y.; Lyulyov, O.; Pimonenko, T.; Kwilinski, A. Green development of the country: Role of macroeconomic stability. *Energy Environ.* **2023**, 1–23. [CrossRef]
118. Lesniak, A.; Surma, T.; Szczepanska-Woszczyna, K.; Zamasz, K. The Recent Development of High-Efficiency Cogeneration Units in Poland. *Forum Sci. Oeconomia* **2023**, *11*, 123–143. [CrossRef]
119. Hakimova, Y.; Samusevych, Y.; Alijanova, S.; Guluzade, E. Eco-innovation vs. environmental taxation: What is more effective for state budget? *Mark. Manag. Innov.* **2021**, *1*, 312–323. [CrossRef]
120. Dzwigol, H. Research Methods and Techniques in New Management Trends: Research Results. *Virtual Econ.* **2019**, *2*, 31–48. [CrossRef]
121. Dzwigol, H. The Concept of the System Approach of the Enterprise Restructuring Process. *Virtual Econ.* **2019**, *2*, 46–70. [CrossRef] [PubMed]
122. Podhorska, I.; Vrbka, J.; Lazaroiu, G.; Kovacova, M. Innovations in financial management: Recursive prediction model based on decision trees. *Mark. Manag. Innov.* **2020**, *3*, 276–292. [CrossRef]
123. Vochozka, M.; Horak, J.; Krulicky, T. Innovations in management forecast: Time development of stock prices with neural networks. *Mark. Manag. Innov.* **2020**, *2*, 324–339. [CrossRef]
124. Sadigov, R. Impact of Digitalization on Entrepreneurship Development in the Context of Business Innovation Management. *Mark. Manag. Innov.* **2022**, *1*, 167–175. [CrossRef]
125. Dzwigol, H. Methodological Approach in Management and Quality Sciences. *E3S Web Conf.* **2020**, *307*, 01002. [CrossRef]
126. Vanickova, R. Innovation corporate energy management: Efficiency of green investment. *Mark. Manag. Innov.* **2020**, *2*, 56–67. [CrossRef]

127. Kwilinski, A.; Lyulyov, O.; Pimonenko, T. The Coupling and Coordination Degree of Digital Business and Digital Governance in the Context of Sustainable Development. *Information* **2023**, *14*, 651. [CrossRef]
128. Kwilinski, A.; Lyulyov, O.; Pimonenko, T. Unlocking Sustainable Value through Digital Transformation: An Examination of ESG Performance. *Information* **2023**, *14*, 444. [CrossRef]
129. Agrawal, R.; Agrawal, S.; Samadhiya, A.; Kumar, A.; Luthra, S.; Jain, V. Adoption of green finance and green innovation for achieving circularity: An exploratory review and future directions. *Geosci. Front.* **2023**, 101669. [CrossRef]
130. Chygryn, O.; Pimonenko, T.; Luylyov, O.; Goncharova, A. Green bonds like the incentive instrument for cleaner production at the government and corporate levels: Experience from EU to Ukraine. *J. Environ. Manag. Tour.* **2019**, *9*, 1443–1456. [CrossRef] [PubMed]
131. Hung, N.T. Green investment, financial development, digitalization and economic sustainability in Vietnam: Evidence from a quantile-on-quantile regression and wavelet coherence. *Technol. Forecast. Soc. Chang.* **2023**, *186*, 12218. [CrossRef]
132. Shahzad, M.A.; Jianguo, D.; Junaid, M. Impact of green HRM practices on sustainable performance: Mediating role of green innovation, green culture, and green employees' behavior. *Environ. Sci. Pollut. Res.* **2023**, *30*, 88524–88547. [CrossRef]
133. Madkhali, A.; Sithole, S.T.M. Exploring the Role of Information Technology in Supporting Sustainability Efforts in Saudi Arabia. *Sustainability* **2023**, *15*, 12375. [CrossRef]
134. Kwong, R.; Kwok, M.L.J.; Wong, H.S.M. Green FinTech Innovation as a Future Research Direction: A Bibliometric Analysis on Green Finance and FinTech. *Sustainability* **2023**, *15*, 14683. [CrossRef]
135. Kwilinski, A.; Lyulyov, O.; Pimonenko, T. The Impact of Digital Business on Energy Efficiency in EU Countries. *Information* **2023**, *14*, 480. [CrossRef]
136. Chen, Y.; Kwilinski, A.; Chygryn, O.; Lyulyov, O.; Pimonenko, T. The Green Competitiveness of Enterprises: Justifying the Quality Criteria of Digital Marketing Communication Channels. *Sustainability* **2021**, *13*, 13679. [CrossRef]
137. Trushkina, N. Development of the information economy under the conditions of global economic transformations: Features, factors and prospects. *Virtual Econ.* **2019**, *2*, 7–25. [CrossRef]
138. Kwilinski, A. E-Commerce and Sustainable Development in the European Union: A Comprehensive Analysis of SDG2, SDG12, and SDG13. *Forum Sci. Oeconomia* **2023**, *11*, 87–107. [CrossRef]
139. Kwilinski, A.; Lyulyov, O.; Pimonenko, T. Inclusive Economic Growth: Relationship between Energy and Governance Efficiency. *Energies* **2023**, *16*, 2511. [CrossRef]
140. Conroy, K.M.; Jacobs, S.; Liu, Y. The dual knowledge role of open innovation intermediaries: Internal weaving and external filtering for MNE subsidiaries. *Technovation* **2023**, *123*, 102721. [CrossRef]
141. Daradkeh, M. Navigating the Complexity of Entrepreneurial Ethics: A Systematic Review and Future Research Agenda. *Sustainability* **2023**, *15*, 11099. [CrossRef]
142. Ogutu, H.; Adol, G.F.C.; Bujdosó, Z.; Andrea, B.; Fekete-Farkas, M.; Dávid, L.D. Theoretical Nexus of Knowledge Management and Tourism Business Enterprise Competitiveness: An Integrated Overview. *Sustainability* **2023**, *15*, 1948. [CrossRef]
143. Sworowska-Baranowska, A. Knowledge pluralisation in for-common-good science: Cross-disciplinary, cross-institutional and cross-sectoral research in Environmental Conservation in Poland. *Forum Sci. Oeconomia* **2022**, *10*, 45–72. [CrossRef]
144. Dźwigoł, H.; Trzeciak, M. Pragmatic Methodology in Management Science. *Forum Sci. Oeconomia* **2023**, *11*, 67–90. [CrossRef]
145. Dzwigol, H. Comparing Idiographic and Nomothetic Approaches in Management Sciences Research. *Virtual Econ.* **2022**, *5*, 27–49. [CrossRef] [PubMed]
146. Dzwigol, H. The Quality Determinants of the Research Process in Management Sciences. *Virtual Econ.* **2023**, *6*, 35–55. [CrossRef] [PubMed]
147. Ratajczak, S. Digital leadership at universities—A systematic literature review. *Forum Sci. Oeconomia* **2022**, *10*, 133–150. [CrossRef]
148. Kharazishvili, Y.; Kwilinski, A. Methodology for Determining the Limit Values of National Security Indicators Using Artificial Intelligence Methods. *Virtual Econ.* **2022**, *5*, 7–26. [CrossRef] [PubMed]
149. Szczepańska-Woszczyna, K.; Gedvilaitė, D.; Nazarko, J.; Stasiukynas, A.; Rubina, A. Assessment of Economic Convergence among Countries in the European Union. *Technol. Econ. Dev. Econ.* **2022**, *28*, 1572–1588. [CrossRef]
150. Melnychenko, O. Application of artificial intelligence in control systems of economic activity. *Virtual Econ.* **2019**, *2*, 30–40. [CrossRef]
151. Mazurkiewicz, J.; Lis, P. Diversification of energy poverty in Central and Eastern European countries. *Virtual Econ.* **2018**, *1*, 26–41. [CrossRef]
152. Miśkiewicz, R. Challenges facing management practice in the light of Industry 4.0: The example of Poland. *Virtual Econ.* **2019**, *2*, 37–47. [CrossRef]
153. Dzwigol, H. Research Methodology in Management Science: Triangulation. *Virtual Econ.* **2022**, *5*, 78–93. [CrossRef]
154. Tkachenko, V.; Klymchuk, M.; Ivakhnenko, I. Scientific prediction of the balanced energy saving development strategy of the construction projects. *Virtual Econ.* **2019**, *2*, 70–84. [CrossRef]
155. Pachauri, R.K.; Reisinger, A. *IPCC Fourth Assessment Report*; IPCC: Geneva, Switzerland, 2007; Volume 2007, p. 044023.
156. Burleson, E. The Bali climate change conference. *Am. Soc. Int. Law Insights* **2008**, *12*, 1–8. Available online: https://ssrn.com/abstract=1107667 (accessed on 14 January 2024).
157. Rui, L.; Sineviciene, L.; Melnyk, L.; Kubatko, O.; Karintseva, O.; Lyulyov, O. Economic and environmental convergence of transformation economy: The case of China. *Probl. Perspect. Manag.* **2019**, *17*, 233–241. [CrossRef]

158. Wang, Q.; Chen, Y.; Guan, H.; Lyulyov, O.; Pimonenko, T. Technological innovation efficiency in China: Dynamic evaluation and driving factors. *Sustainability* **2022**, *14*, 8321. [CrossRef]
159. Xu, S.; Chen, Y.; Lyulyov, O.; Pimonenko, T. Green technology innovation and high-quality economic development: Spatial spillover effect. *Prague Econ. Pap.* **2023**, *32*, 292–319. [CrossRef]