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Article

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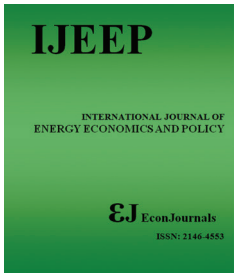

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Mapping the Landscape of Green Energy Integration in Business and Management: A Bibliometric Analysis

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ABSTRACT

The idea of sustainability has gained prominence in the contemporary era and calls for a thorough assessment of our social, economic, and environmental policies. Integrating green energy is one of the key tactics in this sustainability quest as it gives companies a method to match their operations with environmental goals throughout the world and have a positive impact on a more sustainable future. This study seeks to methodically identify and classify important research topics, trends, and publishing patterns in the literature on the integration of green energy into business and management. The study provides a comprehensive bibliometric framework that will direct future research by evaluating the effects of green energy on corporate performance and sustainability.

Keywords: Green Energy Integration, Sustainable Business Practices, Bibliometric Analysis
JEL Classifications: K32, M14, Q01, Q42

1. INTRODUCTION

A complete re-evaluation of our economic, social, and environmental policies is required in light of the recent meteoric rise in the popularity of the concept of sustainability. Fundamentally, sustainability seeks to satisfy current demands without endangering the capacity of future generations to satisfy their own needs (Brundtland Commission, 1987). Among the various strategies, one significant part in the quest for sustainability is the integration of green energy into business operations, a concept that entails incorporating renewable energy sources (Lund, 2007). Incorporating green energy into business models fosters creativity, efficiency, and resilience while simultaneously addressing the pressing need to cut carbon emissions and reliance on fossil fuels (Jacobson and Delucchi, 2011; Bunse et al., 2011; Ahakwa et al., 2024).

Beyond its beneficial effect on the environment, green energy integration offers social and economic implications as well. Businesses may gain a competitive edge by implementing green energy practices given that they can save operating costs profoundly, improve their brand, and comply with regulations (Porter and Kramer, 2006; Abdelaziz, Saidur, & Mekhilef, 2011; Ding, 2024). Additionally, businesses that show a dedication to sustainability may draw in investors and environmentally sensitive customers, strengthening their position in the market and boosting long-term profitability (Hart and Milstein, 2003; Al-Madani et al., 2024).

The integration of green energy also plays a crucial role in achieving the United Nations Sustainable Development Goals (SDGs), particularly Goal 7, which aims to ensure access to affordable, reliable, sustainable, and modern energy for all (UN, 2015). This alignment not only helps businesses comply with international regulations but also positions them as leaders in corporate social responsibility (CSR) (Bansal and Roth, 2000; Basheer et al., 2024).

The increasing relevance of green energy integration and the difficulty of its implementation have led to a significant expansion

of the academic literature on the topic in business and management. Within this corpus of work, important research subjects, trends, and publication patterns may be systematically identified and categorized using bibliometric analysis. Conducting a bibliometric analysis on the topic of green energy integration in business and management is crucial for several reasons. Firstly, it provides a comprehensive overview of existing research, allowing scholars to identify gaps, inconsistencies, and emerging trends in the literature (Erwin & Yang, 2023).

This study will facilitate the identification of influential works and scholars in the field of green energy. The purpose of this study is to enhance comprehension of the intellectual landscape and prominent contributors to the discourse by identifying highly cited papers and prolific authors. The study will aim to map the evolving landscape of green energy integration in business and management, providing valuable insights that can inform research, policy-making, and practical implementation. By understanding the major themes, trends, and contributions in this field, we can better appreciate the critical role of green energy in fostering sustainable business practices and advancing global sustainability goals.

2. METHODOLOGY

On May 23, 2024, a literature review and analysis were conducted using SCOPUS, focusing on the theme of "Green Energy." The search parameters were limited to the time frame of 2011-2023, articles published in English, and the subject area of business management and accounting. The term "Green Energy" is mentioned in the articles' titles of the search result. Figure 1 shows the 288 journal articles pertaining to green energy that were listed in the SCOPUS over the time period. Bibliometrics uses quantitative analysis to study the bibliographic data. It offers effective methods for categorising data from a scientific area (Merigó and Yang, 2014). This analysis was approached from two main perspectives: Firstly, assessing the efficacy and influence of publications through bibliometric indicators such as total number of publications (TP) and number of citations (TC); secondly, investigating multiple facets including sources, authors, countries, co-occurrence, collaborative relationships, and phrase relationships. To facilitate visualization and understanding of the interconnectedness within the research areas, this study employed Vos viewer and R Programming to create visualization networks. These visualizations serve as valuable tools for identifying research trends and relationships within the field of green energy integration in business and management.

3. RESULTS AND DISCUSSION

3.1. Countries with Publication on Green Energy

Over the years 2011-2023, 288 papers worldwide have been made available on the subject of green energy through the Scopus database. Research on sustainability and renewable energy has become increasingly important, as seen by the notable growth in year-wise publications in the field of green energy at the global level in recent years. In the realm of green energy research, Figure 2 shows the leading contributing nations.

China has the most publications (49), followed by India (45) and the United States (35). These three countries are the main contributors. Additional noteworthy contributions are Germany (11), Australia (11), Malaysia (12), Taiwan (15), Italy (16), Romania (16), and the United Kingdom (14). By making up a sizable share of all publications, these top 10 countries demonstrate their dedication to developing green energy policies and technologies.

3.2. Main Information

Figure 1: Search result

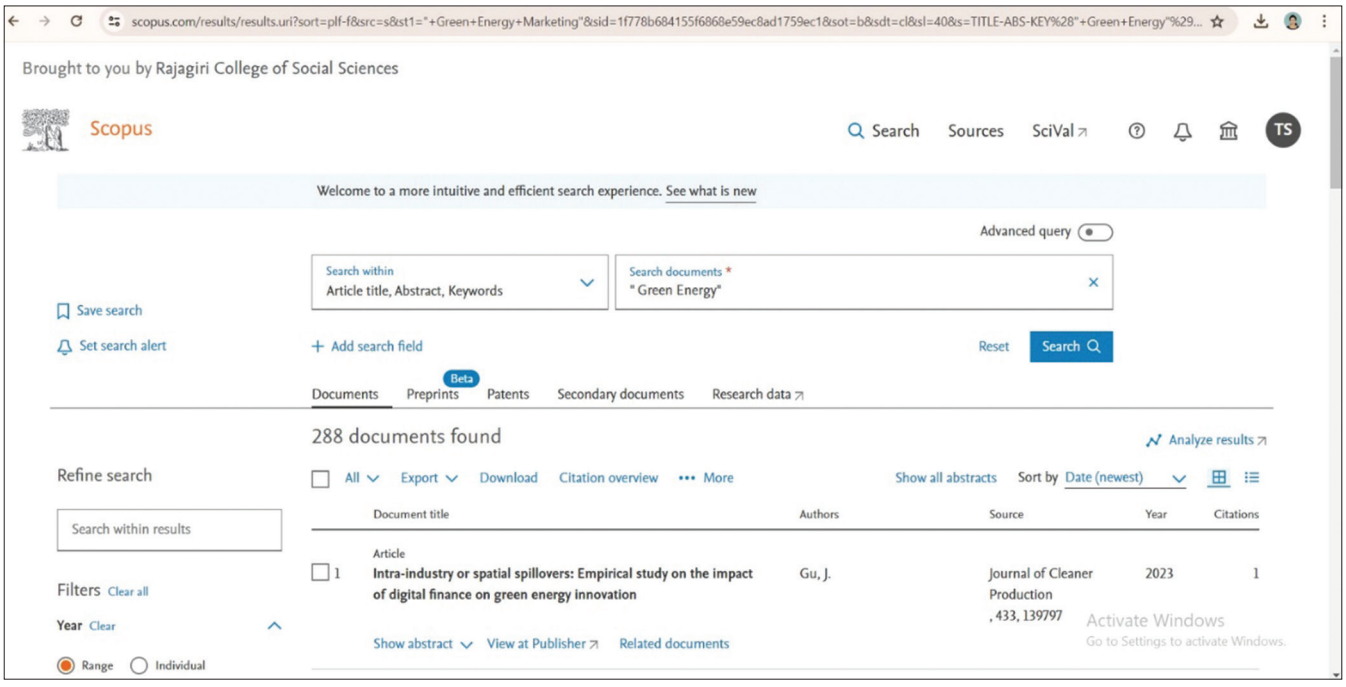


Table 1: Publications between 2011 and 2023

Description	Results
Timespan	2011:2023
Sources (Journals, Books, etc.)	152
Documents	288
Annual growth rate (%)	18.76
Document average age	4.59
Average citations per doc	15.74
References	13,164
Keywords plus (ID)	1493
Author's keywords (DE)	1118
Authors	835
Authors of single-authored docs	50
Single-authored docs	51
Co-authors per doc	3.12
International co-authorships (%)	25.69

There are 288 published documents in the field of green energy research as on May 23rd, 2023, globally. Table 1 indicates the summary data of publications between the timespan 2011 and 2023. These papers are published in 152 different sources. The average annual growth rate and average citation per publication is 18.76% and 4.59% respectively. 1118 keywords were used by authors in 288 documents. There are a total of 835 authors in this area and co-authors per document is 3.12 and international co-authorship per doc is 25.69%.

3.3. Popular Journals

Table 2 highlights the top 10 journals in the list of articles that were taken into consideration for the purpose of the study. Elsevier has the highest number of publication (66) in the journal of cleaner production and followed by 11 publications by SRAC in the journal of quality- access and success. The journal of cleaner productions has the greatest impact factor (11.1) of all the eminent journals on the list. Elsevier journals publish the majority of the papers, followed by Springer. Technological forecasting and social change has the highest SJR (3.12) among the journals, while International Journal of Supply Chain Management has the lowest SJR.

3.4. Yearly Trend

The number of publications on green energy published annually between 2011 and 2023 is shown in the Figure 3. There is a discernible variance in the annual number of publications during this time. With about 65 documents, 2023 has the most publications, suggesting a recent uptick in research activity.

After peaking, the number of publications rapidly declined, with fewer than 10 publications at a low point in 2017. 2019 sees another modest uptick, and then the trend continues to decline. The general pattern reflects the shifting interest in and emphasis on green energy research across time, with periods of both notable drop and brief growth.

3.5. Major Contributing Authors Based on Citation Analysis

The Table 3 represents the most cited papers on green energy, highlighting the authors, paper titles, year of publication, publication sources and total citations. It showcases the papers with the highest impact and influence in the realm of green energy, reflecting their significance within the field based on the number

Figure 2: Major countries with publication

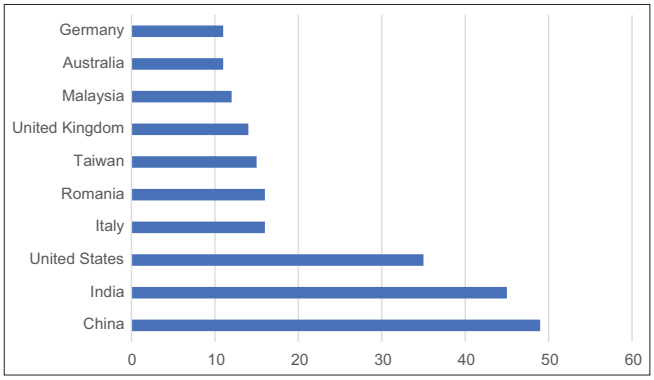
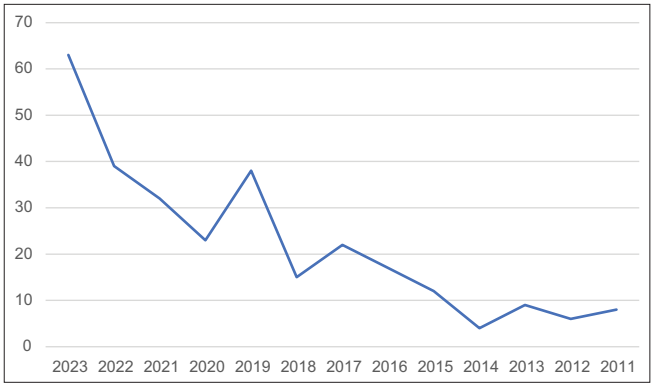


Figure 3: Yearly trend



of citations received. The article titled "Consumer attitude and purchase intention toward green energy brands: The roles of psychological benefits and environmental concern" by Hartmann; Apaolaza-Ibáñez was the most cited, with 658 citations (Hartmann & Apaolaza-Ibáñez, 2012).

Another significant contribution is by Bórawski et al., titled "Development of renewable energy sources market and biofuels in The European Union," which garnered 178 citations since its publication in 2019 in the Journal of Cleaner Production (Bórawski et al., 2019). In 2017, Sangroya and Nayak explored the "Factors influencing buying behaviour of green energy consumer," which received 140 citations in the journal of cleaner production (Sangroya & Nayak, 2017). Stucki published a study in Research Policy that analyzed the impact of energy costs and the firms that benefit from investments in renewable energy technologies, resulting in 130 citations (Stucki, 2019). The next major contribution was an investigation into the service quality of green hotels in the International Journal of Hospitality Management, which obtained 99 citations (Lee and Cheng, 2018). The study conducted on the antecedents of general-purpose technologies in the green energy sector, which was published in the Journal of Engineering and Technology Management which garnered 93 citations (Ardito et al., 2016). In 2017, a study on the issue of greenwashing among Chinese energy companies, with a particular emphasis on brand legitimacy and loyalty. Their findings were published in the Journal of Business Ethics, with 91 citations (Guo et al., 2017). A study published in the Journal of Cleaner Production on Scenedesmus obliquus for the purpose of effluent remediation and CO2 biofixation in green energy. The study has been cited 82 times (Ferreira et al., 2017). A

Table 2: Popular journals that published articles on green energy

Sources	Articles	Publisher	h index value	Impact factor	Quality	SJR
Journal of Cleaner Production	66	Elsevier	309	11.1	Q1	2.06
Quality - Access To Success	11	SRAC	26	0.88	Q4	0.18
Utilities Policy	10	Elsevier	63	4	Q1	0.89
Technological Forecasting and Social Change	6	Elsevier	179	12	Q1	3.12
Clean Technologies and Environmental Policy	4	Springer Nature	75	4.3	Q1	0.87
International Journal of Supply Chain Management	4	ExcelingTech	25	8.8	NA	0
International Journal of Precision Engineering and Manufacturing - Green Technology	3	Springer Nature	53	4.2	Q1	0.95

NA: Not available

Figure 4: Co-occurrence analysis

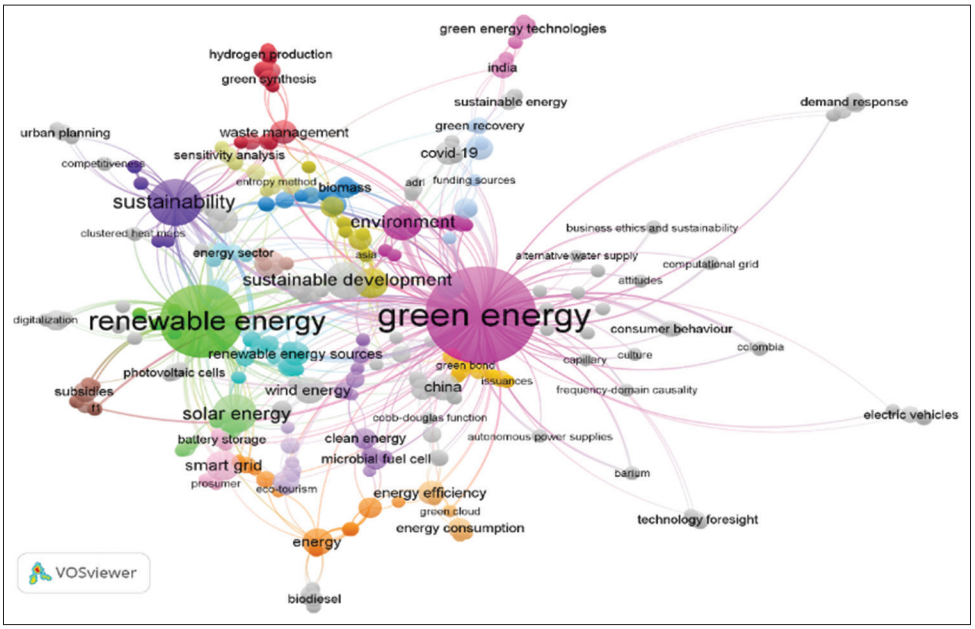


Figure 5: Country collaboration map

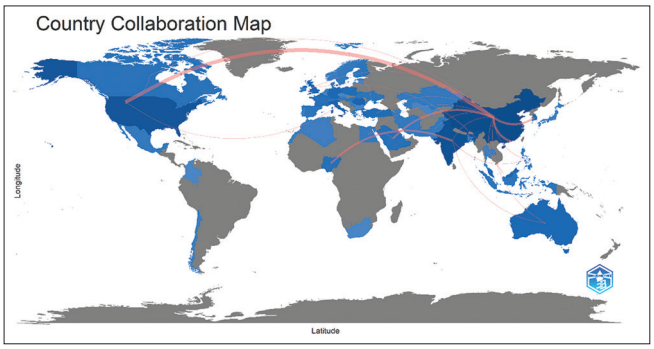


Figure 6: Word cloud

study on ANN model for predicting the direct normal irradiance and the global radiation for a solar application to a residential building that was published in the Journal of Cleaner Production generated a total of 79 citations (Renno et al., 2016). Lastly the study Profiling potential green electricity tariff adopters: Green consumerism as an environmental policy tool? in the journal Business Strategy and the Environment journal was also cited 79 times (Diaz-Rainey & Ashton, 2011).

3.6. Co-occurrence analysis

Co-occurrence analysis is a technique that allows researchers to identify and visualize the relationships between key terms in a corpus of literature, thereby providing valuable insights into research trends and thematic connections (Van Eck and Waltman, 2010). The co-occurrence analysis (Figure 4) map of "green energy" research highlights important themes and their interconnections.

With 57 occurrences and a total link strength of 276 (Cluster 6), the major term, "green energy," is highly connected to a wide range of themes, highlighting its fundamental role in the literature. Other major clusters are renewable energy (33 occurrences and 129 total

Table 3: List of major contributing authors and sources based on citation analysis

Authors	Title	Year	Source title	Cited by
Hartmann P; Apaolaza-Ibáñez V	Consumer attitude and purchase intention toward green energy brands: The roles of psychological benefits and environmental concern	2012	*Journal of Business Research*	658
Bórawski P; Bełdycka-Bórawska A; Szymańska E.J; Jankowski K.J; Dubis B; Dunn J.W	Development of renewable energy sources market and biofuels in The European Union	2019	*Journal of Cleaner Production*	178
Sangroya D; Nayak J.K	Factors influencing buying behaviour of green energy consumer	2017	*Journal of Cleaner Production*	140
Stucki T	Which firms benefit from investments in green energy technologies? - The effect of energy costs	2019	*Research Policy*	130
Lee W.-H; Cheng C.-C	Less is more: A new insight for measuring service quality of green hotels	2018	*International Journal of Hospitality Management*	99
Ardito L; Messeni Petruzzelli A; Albino V	Investigating the antecedents of general purpose technologies: A patent perspective in the green energy field	2016	*Journal of Engineering and Technology Management - JET-M*	93
Guo R; Tao L; Li C.B; Wang T	A Path Analysis of Greenwashing in a Trust Crisis Among Chinese Energy Companies: The Role of Brand Legitimacy and Brand Loyalty	2017	*Journal of Business Ethics*	91
Ferreira A; Ribeiro B; Marques P.A.S.S; Ferreira A.F; Dias A.P; Pinheiro H.M; Reis A; Gouveia L	Scenedesmus obliquus mediated brewery wastewater remediation and CO_2 biofixation for green energy purposes	2017	*Journal of Cleaner Production*	82
Renno C; Petito F; Gatto A	ANN model for predicting the direct normal irradiance and the global radiation for a solar application to a residential building	2016	*Journal of Cleaner Production*	79
Diaz-Rainey I; Ashton J.K	Profiling potential green electricity tariff adopters: Green consumerism as an environmental policy tool?	2011	*Business Strategy and the Environment*	79

link strengths; Cluster 27), sustainability (14 occurrences and 80 total link strengths; Cluster 24) and solar energy (11 occurrences and 41 total link strengths; Cluster 10). The recent changes in research focus are also reflected in the analysis, which emphasizes the impact of COVID-19 on green recovery and funding sources. Overall, the map demonstrates the interdisciplinary nature and emerging trends in renewable energy research.

3.7. Country Collaboration Map

The Country Collaboration Map (Figure 5) depicts international research collaborations, emphasizing critical partnerships. The map demonstrates that the most significant collaboration is between the United States and China, as evidenced by the six collaborative publications and the prominent line connecting the two countries.

China has collaborated with Hong Kong, South Korea, and Saudi Arabia on three publications, as indicated by the lines connecting these regions to China. Furthermore, the map suggests a substantial partnership between Nigeria and India, as evidenced by the three joint publications. This map emphasises China's extensive global partnerships, particularly with major economies and strategic regions, which reflect its prominent role in international cooperation. An essential South-South partnership is also underscored by the collaborative connection between India and Nigeria, which contributes to a diverse and interconnected global research and development network.

3.8. Word Cloud/Key Word Analysis

The most prominent terms in the study domain of business and management were shown in the Figure 6. Considering the data set the term "green energy" appears most frequently by 38 times. Additionally, the word "energy policy" occurs 36 times follows after it. Within the data set "energy policy" appears 36 times in total. There are 26 and 19 instances of the usage of terms "sustainable development" and "energy utilisation."

4. CONCLUSION

Green energy plays a crucial role in the integration and transformation of business and management practices for the attainment of sustainability. Green energy is progressively acting as a cornerstone in the strategic planning and operational frameworks of modern businesses. Management strategies and business activities are being revolutionised by the inclusion of renewable energy sources, as the business firms are striving towards sustainability and minimising their carbon foot prints. This move not only comply with the international environmental standards but also offer economic advantages, reduced energy expenditures, enhanced corporate reputation and regulatory compliance. The adoption of green energy also stimulates innovation, where novel products and corporate strategies can lead to take advantage over rivals. In an eco-conscious market employing green energy would enhance long term resilience and profitability of the business firm. Now a day, larger number of customers are being attracted towards the products and services that upheld sustainability. Emphasising the commitment to sustainable energy, business firms can themselves foster consumer loyalty. As business firms' priority focus on sustainability and green energy increases, this will foster a sense of belonging and engagement among employees, which in turn will create a productive work environment.

The bibliometric analysis in the area of green energy presents a comprehensive overview of its integration in business and management. There is a noticeable gap in the field of green Energy, which highlights the importance of deeper investigation into its various facets and its implementation in less fortunate nations to improve their green efficacy. This study mainly focuses on the publication from SCOPUS database within the domain of business and management, however there remains much more scope to explore how the integration of green energy impacts other academic disciplines.

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