

Mapping the Nexus between Green Energy, Sustainable Development Goals, and Sustainable Economic Growth: A Bibliometric and Thematic Analysis

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ABSTRACT

The transition towards green energy has become increasingly important for achieving the Sustainable Development Goals (SDGs) while supporting sustainable economic growth. However, the literature connecting these dimensions remains fragmented across energy, environmental, economic, and sustainability research. This study maps the global research landscape at the nexus of green energy, SDGs, and sustainable economic growth using bibliometric and thematic analysis. Bibliographic records were retrieved from Scopus using a structured TITLE-ABS-KEY search. Following relevance screening and data cleaning, 376 documents published between 2017 and 2026 were analysed using Biblioshiny, the web-based interface of the Bibliometrix package in R. The findings reveal rapid growth in scholarly output, particularly in recent years, indicating increasing academic interest in integrating energy transition with sustainability and economic development. Renewable energy emerged as a central concept alongside sustainable development, economic growth, green growth, the SDGs, and green finance. The thematic map identifies renewable energy, economic growth, and carbon emissions as the principal motor theme, while sustainable development, the SDGs, and green development constitute foundational themes. Thematic evolution demonstrates a progression from early emphasis on sustainable development, SDGs, and pollution towards a more diversified research structure incorporating renewable energy, economic growth, green economy, energy transition, environmental policy, and environmental technology. Overall, the study consolidates a fragmented knowledge base and highlights the increasing integration of clean-energy transformation, sustainability objectives, and economic development within the global research agenda.

Keywords: Green Energy; Renewable Energy; Sustainable Development Goals; Sustainable Economic Growth

INTRODUCTION

The global economy has historically depended heavily on fossil energy, particularly coal, oil and natural gas, to support industrialisation, transportation, electricity generation and economic expansion. Although these energy sources have contributed substantially to economic development, their extensive consumption has imposed considerable environmental costs. Fossil-fuel combustion remains closely associated with carbon dioxide (CO₂) emissions, greenhouse gas accumulation and broader environmental degradation. Empirical evidence from major energy-consuming economies reinforces this concern. For example, fossil-energy

consumption has been associated with higher CO₂ emissions in the United States and China, while similar environmental consequences of fossil-energy dependence have been observed in India, Indonesia and Malaysia (Mohamad et al., 2023; Mohamad & Ab-Rahim, 2024; Mohamad et al., 2025a; Mohamad et al., 2026a). These findings demonstrate the continuing tension between conventional energy-dependent economic development and long-term environmental sustainability. The underlying studies specifically report relationships between fossil-energy use and CO₂ emissions across these national contexts.

The consequences of fossil-energy dependence extend beyond environmental degradation to human health and well-being (Yang, 2025). Environmental pollution associated with carbon-intensive energy systems can create substantial health burdens, making the energy transition relevant not only to environmental policy but also to human development. Recent empirical evidence provides support for this relationship. Shaari et al. (2025), for instance, found that higher renewable-energy utilisation was associated with improvements in life expectancy in Malaysia, while emphasising the interconnections among energy consumption, economic development, environmental sustainability and public health. Similarly, Shaari et al. (2026) examined the relationship between marginal CO₂ emissions and life expectancy across ASEAN economies. Taken together, these studies reinforce the importance of considering human well-being when evaluating the sustainability of energy-dependent economic development. Consequently, sustainable development cannot be assessed exclusively through increases in economic output or income but must also account for environmental quality and improvements in human welfare.

Against this background, the transition from fossil-based energy towards green and renewable energy has become an increasingly important component of global sustainability strategies. Renewable-energy sources offer opportunities to reduce dependence on carbon-intensive energy systems while supporting the transition towards cleaner forms of production and consumption. Evidence from the United States and China indicates that increasing renewable-energy consumption can contribute to reducing environmental degradation, supporting the broader objectives of the renewable-energy transition (Mohamad et al., 2023). Evidence from India likewise highlights the importance of diversifying energy systems away from fossil fuels and strengthening clean-energy policies in pursuit of SDG 7 (Mohamad & Ab-Rahim, 2024). Comparable concerns are evident in Indonesia and Malaysia, where growing energy requirements associated with economic development have intensified the need to reconcile energy security, economic expansion and environmental sustainability (Mohamad et al., 2025a; Mohamad et al., 2026a).

Green-energy transition, however, involves more than the substitution of fossil fuels with renewable sources. Technological development and innovation are important enabling mechanisms for improving the efficiency, accessibility, reliability and economic viability of cleaner energy systems (Mishra & Singh, 2023; Ukoba et al., 2024). Advances in renewable-energy technologies, energy storage, smart grids, digital energy management, electrification and other low-carbon technologies can facilitate more efficient utilisation and integration of renewable resources. The growing research landscape surrounding renewable energy and energy markets demonstrates that technological innovation, policy frameworks and economic considerations are increasingly interconnected within contemporary energy-transition research (Mohamad & Ab-Rahim, 2025). The bibliometric evidence from this literature also reveals growing scholarly attention to decentralised and digitally enabled energy systems and the convergence of technological innovation with economic and policy considerations.

The relationship between energy transition and economic development is nevertheless complex. Sustainable economic growth requires economies to improve income, productivity, employment opportunities and living standards without continuously increasing environmental pressures. The Environmental Kuznets Curve literature illustrates that the relationship between economic expansion and environmental degradation may change according to stages of development, energy structures and other economic conditions. Evidence from Japan, for example, indicates a non-linear relationship between economic growth and CO₂ emissions, while low-carbon energy can contribute to environmental improvement (Mohamad & Shaari, 2026). This reinforces the argument that the composition of energy systems is important in determining whether economic development can become progressively less carbon intensive.

The sustainability transition also increasingly extends into corporate and institutional decision-making. Environmental concerns are influencing how organisations evaluate economic performance, accountability and sustainability practices. Ab-Rahim et al. (2025), for example, examined green accounting disclosure among Malaysian publicly listed firms and demonstrated that environmental disclosure may have differentiated implications for corporate financial performance. Although green accounting represents a different dimension of sustainability from green-energy transition, it illustrates the broader integration of environmental considerations into economic and organisational decision-making. Sustainable economic growth therefore involves not only macro-level energy transformation but also institutional and corporate responses to environmental sustainability (Han et al., 2026).

These interconnected environmental, economic, technological and social dimensions are closely aligned with the United Nations Sustainable Development Goals (SDGs). SDG 7, Affordable and Clean Energy, directly emphasises access to affordable, reliable, sustainable and modern energy (Makedon et al., 2025). However, green-energy transition also intersects with several other SDGs, including SDG 3 on Good Health and Well-being (Das et al., 2021), SDG 8 on Decent Work and Economic Growth (Zehri et al., 2024), SDG 9 on Industry, Innovation and Infrastructure (Küfeoğlu, 2022a), SDG 11 on Sustainable Cities and Communities (Nabiyeva et al., 2023), SDG 12 on Responsible Consumption and Production (Küfeoğlu, 2022a), and SDG 13 on Climate Action (Shafik, 2025). Empirical studies connecting renewable-energy transition with SDG 7 further demonstrate that clean-energy development cannot be separated from wider environmental and economic objectives (Mohamad et al., 2023; Mohamad & Ab-Rahim, 2024; Mohamad et al., 2026a). Collectively, these SDGs demonstrate that the green-energy transition extends beyond energy provision and intersects with health, economic development, technological innovation, sustainable production, urban development, and climate action.

Accordingly, the relationship among green energy, the SDGs and sustainable economic growth represents an interconnected sustainability nexus rather than three independent research domains. Green energy can function as a transition mechanism for reducing dependence on carbon-intensive energy sources, while technological innovation can improve the effectiveness and economic feasibility of this transition. The SDGs provide the broader institutional and developmental framework within which these transformations occur, whereas sustainable economic growth represents the challenge of maintaining improvements in economic and social welfare while progressively reducing environmental pressures. This perspective shifts the debate beyond whether economic growth and environmental sustainability are compatible towards understanding the conditions under which cleaner energy systems can support both objectives.

Scholarly interest in renewable energy, green growth, technological innovation, sustainable development and the SDGs has consequently expanded considerably. Nevertheless, the resulting knowledge base remains fragmented across energy economics, environmental science, sustainability, engineering, development studies, public policy, technology and innovation studies, and business and management (Ar-rahim et al., 2025). Some studies concentrate primarily on environmental degradation and renewable-energy transition, whereas others examine economic growth, technological innovation, carbon emissions, energy policy, corporate sustainability or individual SDGs. Consequently, substantial knowledge has accumulated within individual streams, but the broader structure connecting green energy, SDGs and sustainable economic growth requires systematic consolidation.

Bibliometric analysis provides an appropriate means of addressing this fragmentation because it enables large bodies of scientific literature to be quantitatively evaluated and mapped. Rather than relying exclusively on narrative interpretation, bibliometric methods allow researchers to investigate publication growth, influential sources and authors, institutional and geographical contributions, citation patterns, scientific collaboration and conceptual relationships. The increasing application of bibliometric methods across diverse fields demonstrates their usefulness for identifying the intellectual, social and conceptual organisation of expanding research domains.

Such approaches have been employed in studies of poverty (Mohamad et al., 2024a), housing markets (Mohamad et al., 2024b), behavioural economics (Wei et al., 2025), artificial intelligence and stock markets

(Mohamad et al., 2025b), higher education and the Fourth Industrial Revolution (Shahar et al., 2025), renewable energy and energy markets (Mohamad & Ab-Rahim, 2025), artificial intelligence and education (Mohamad et al., 2026b), and interdisciplinary socio-legal scholarship (Mohamad et al., 2026c). These studies collectively demonstrate the adaptability of bibliometric approaches for examining publication structures, research trends, conceptual clusters and emerging research directions across heterogeneous scholarly domains. For example, the renewable-energy study used bibliometric techniques to investigate keyword patterns, global contributions, thematic development and collaboration. The Islamic family-law study similarly combined Biblioshiny with other science-mapping tools to examine thematic evolution and collaboration across 1,057 publications.

Despite the growing application of bibliometric methods to renewable-energy and sustainability research, the integrated scholarly landscape connecting green energy, the SDGs and sustainable economic growth warrants further systematic investigation. Existing bibliometric research has examined renewable energy in conjunction with energy markets and has identified technological innovation, policy frameworks, economic modelling and regional strategies as important thematic dimensions (Mohamad & Ab-Rahim, 2025). However, the present study adopts a more specific triadic focus by requiring retrieved publications to simultaneously engage with green or renewable energy, the SDGs or 2030 Agenda, and sustainable or green economic growth. This design provides a basis for examining how these three interconnected concepts have developed within a common research domain.

Accordingly, this study conducts a bibliometric and thematic analysis of the global research landscape concerning green energy, the Sustainable Development Goals (SDGs), and sustainable economic growth. An initial 385 records were retrieved from Scopus, of which nine were removed following relevance screening and data cleaning, producing a final analytical corpus of 376 documents covering 2017–2026. Specifically, the study seeks to: (1) examine the growth and citation development of research connecting green energy, SDGs, and sustainable economic growth; (2) identify the principal publication sources, geographical distribution of scientific production, and globally influential documents within the research field; (3) examine patterns of international research collaboration and the relationships among contributing countries, major research themes, and publication sources; (4) identify the thematic structure of the research field; and (5) examine how the major research themes have evolved over time.

The study contributes to the literature by consolidating a fragmented interdisciplinary knowledge base and providing an integrated representation of the performance, relational, and thematic structures of research at the nexus of green energy, SDGs, and sustainable economic growth. In doing so, the analysis provides a systematic basis for understanding how scholarly attention has evolved from concerns surrounding environmental sustainability towards cleaner energy systems, sustainable development, economic growth, and broader sustainability transitions.

METHODOLOGY

Research Design

This study employed a quantitative bibliometric research design to systematically examine the development, scholarly influence, relational structure, and thematic evolution of research at the intersection of green energy, the Sustainable Development Goals (SDGs), and sustainable economic growth. Bibliometric analysis provides a structured quantitative approach for examining large collections of scientific publications and identifying patterns that may be difficult to capture through conventional narrative reviews alone. The application of bibliometric analysis has expanded considerably across academic disciplines. Recent studies have employed bibliometric approaches to investigate poverty (Mohamad et al., 2024a), housing markets (Mohamad et al., 2024b), behavioural economics (Wei et al., 2025), artificial intelligence and stock-market research (Mohamad et al., 2025b), higher education and the Fourth Industrial Revolution (Shahar et al., 2025), renewable energy and energy markets (Mohamad & Ab-Rahim, 2025), artificial intelligence and education (Mohamad et al., 2026b), and Islamic family-law scholarship (Mohamad et al., 2026c). These applications demonstrate the

methodological suitability of bibliometric analysis for examining the development and thematic structure of multidisciplinary research domains.

The bibliometric approach was particularly appropriate for the present investigation because the nexus among green energy, SDGs, and sustainable economic growth spans environmental science, energy studies, economics, sustainability, public policy, technology, and business and management. Accordingly, the analytical framework combined performance analysis and science mapping. Performance analysis was employed to assess publication development and scholarly influence, while science mapping was used to examine relationships among selected bibliographic dimensions and the thematic organisation and evolution of the literature.

Data Source

Bibliographic data were retrieved exclusively from the Scopus database. Scopus was selected because its multidisciplinary coverage is compatible with the interdisciplinary nature of the research topic and because it provides structured bibliographic metadata required for bibliometric analysis, including document titles, abstracts, authors, affiliations, publication years, source titles, author keywords, indexed keywords, citation information, and cited references.

The use of Scopus as a bibliographic source is also consistent with previous bibliometric studies across different research fields. For example, Mohamad et al. (2024a) retrieved Scopus documents for their bibliometric investigation of poverty, while Wei et al. (2025) employed Scopus-indexed publications in their study of behavioural economics. Similarly, Shahar et al. (2025) used Scopus-indexed publications to examine higher education within the context of the Fourth Industrial Revolution. Using a single bibliographic database also facilitated consistency in the metadata structure and reduced complications associated with integrating records from databases employing different indexing and citation systems. The retrieved records were subsequently exported in CSV format for data preparation and bibliometric analysis.

Search Strategy

A structured search strategy was developed to identify publications situated at the intersection of three principal conceptual domains: green and renewable energy, the Sustainable Development Goals and 2030 Agenda, and sustainable economic growth. The search was conducted using the TITLE-ABS-KEY field in Scopus, thereby retrieving terms occurring within publication titles, abstracts, and keywords. The following search string was applied: TITLE-ABS-KEY (("green energy" OR "renewable energy" OR "clean energy" OR "sustainable energy" OR "renewable energy transition" OR "clean energy transition" OR "green energy transition") AND ("sustainable development goal*" OR "SDG*" OR "2030 Agenda" OR "Agenda 2030") AND ("sustainable economic growth" OR "green economic growth" OR "green growth" OR "sustainable growth" OR "inclusive green growth" OR "low-carbon economic growth" OR "low carbon growth"))The search consisted of three Boolean blocks corresponding to the conceptual dimensions of the study. The first represented green and renewable energy, the second represented the SDGs and 2030 Agenda, and the third represented sustainable and green economic growth. The Boolean operator OR connected synonymous or closely related terms within each block, whereas AND connected the three conceptual dimensions. The search was therefore designed to retrieve publications simultaneously associated with the three principal components of the research topic. Wildcard characters were used to accommodate relevant singular and plural variations.

Data Screening and Eligibility

The Scopus search conducted on 22 June 2026 initially identified 385 records. Following retrieval, the titles and abstracts of all records were screened to assess their substantive relevance to the scope and objectives of the study. The screening focused on whether each publication meaningfully addressed the nexus among the three principal conceptual dimensions: green or renewable energy, the Sustainable Development Goals (SDGs) or 2030 Agenda, and sustainable or green economic growth.

Records were retained when their substantive content addressed the relationships among these dimensions or contributed directly to understanding the role of green or renewable energy in advancing sustainable development and sustainable economic growth. During the screening process, nine records were excluded because, despite being captured by the search strategy, examination of their titles and abstracts showed that their substantive content was not related to the specific focus of the study. In these records, one or more search terms appeared in the bibliographic metadata, but the principal research focus did not address the green energy, SDG and the sustainable economic growth nexus examined in this study. Following the exclusion of these nine out-of-scope records, 376 documents were retained as the final bibliographic corpus for analysis, covering the period 2017–2026.

Data Extraction and Cleaning

The bibliographic records were exported from Scopus in CSV format with the metadata required for subsequent bibliometric analysis. The exported information included, where available, titles, abstracts, authors, affiliations, publication years, source titles, author keywords, indexed keywords, citation information, and cited references. A systematic cleaning and pre-processing procedure was undertaken before the bibliometric analysis. This stage was necessary because inconsistencies in bibliographic metadata can distort publication frequencies and thematic structures.

The records were therefore examined for duplicate or potentially duplicated entries, metadata inconsistencies, and relevance to the predefined research scope. Data preparation and metadata cleaning are similarly evident in previous bibliometric applications. Studies of behavioural economics (Wei et al., 2025), higher education and Industry 4.0 (Shahar et al., 2025), and other bibliometric domains demonstrate the importance of preparing bibliographic metadata before bibliometric and science-mapping analyses. Accordingly, data cleaning constituted a distinct stage before the final analyses.

Keyword Harmonisation

Keyword harmonisation was undertaken before the thematic analyses. Bibliographic databases frequently contain semantically equivalent keywords expressed through different grammatical forms, abbreviations, singular and plural variants, or alternative formatting. If left untreated, these variations can cause bibliometric software to interpret equivalent concepts as separate terms, thereby artificially fragmenting thematic structures. Accordingly, the author-keyword data were reviewed and standardised conservatively. Examples included “Sustainable Development Goal” and “Sustainable Development Goals”; “SDG” and “SDGs”; “Renewable Energy” and “Renewable Energies”; “Economic Growth” and “Economic Growths”; “Green Growth” and “Green Growths”; “Energy Transition” and “Energy Transitions”; and “Green Innovation” and “Green Innovations.” Variations referring to carbon dioxide and CO₂ emissions were similarly reviewed and harmonised where they represented the same underlying concept.

A conservative semantic harmonisation strategy was employed. Keywords were merged only when they represented clear linguistic variants, abbreviations, or substantively equivalent concepts. Related but conceptually distinct constructs were not merged. In particular, “sustainable development” and “Sustainable Development Goals” were retained separately because they represent related but distinct concepts. Sustainable development represents the broader sustainability paradigm, whereas the SDGs constitute the specific institutional framework established under the United Nations 2030 Agenda. Similarly, renewable energy, green energy, energy transition, green economy, and green growth were retained as distinct concepts. This procedure reduced artificial fragmentation while preserving theoretically meaningful distinctions within the research domain.

Bibliometric Software and Analytical Framework

The final corpus of 376 documents was analysed using Biblioshiny, the web-based graphical interface of the Bibliometrix package in R. Bibliometrix provides an integrated framework for bibliometric performance

analysis and science mapping, while Biblioshiny facilitates the implementation and visualisation of these analyses through an interactive interface (Aria & Cuccurullo, 2017; Aria et al., 2026).

The analytical framework comprised two broad components: performance analysis and science mapping. Performance analysis assessed the temporal development, publication-source distribution, and citation influence of the literature. Science mapping complemented these indicators by examining relationships among countries, author keywords, and publication sources through a Three-Field Plot and by evaluating the thematic structure and longitudinal development of the research field through thematic mapping and thematic evolution analysis.

Performance and Citation Analysis

Performance analysis was conducted to evaluate the development, geographical distribution, and scholarly influence of the literature. Annual Scientific Production was examined to identify changes in publication output across the 2017–2026 period and to determine periods of expansion in research concerning green energy, SDGs, and sustainable economic growth. Average citations per year were examined alongside annual scientific production to provide a complementary perspective on the temporal development and scholarly visibility of the literature.

Source analysis was conducted to identify the most relevant publication outlets contributing to the research field. Sources were assessed according to the number of documents represented within the final bibliographic corpus, thereby identifying journals in which research concerning green energy, SDGs, and sustainable economic growth was most frequently disseminated.

Country-level analysis was conducted to examine the geographical distribution of scientific production and patterns of international research collaboration. Country Scientific Production was visualised geographically to identify the distribution and relative concentration of scholarly output across countries. This analysis was complemented by a Country Collaboration Map, in which cross-national connections were used to visualise international scholarly relationships. The two analyses were interpreted jointly to distinguish geographical research productivity from international research connectivity.

Citation analysis was subsequently employed to identify the most globally cited documents within the dataset. Global citation counts were used to assess the broader scholarly visibility and influence of individual publications. Citation counts were interpreted as indicators of scholarly attention and influence rather than direct measures of methodological quality or scientific validity. Differences in publication age were also considered when interpreting citation performance because older publications generally have longer periods in which to accumulate citations.

Three-Field Plot Analysis

A Three-Field Plot was employed to provide an integrated representation of relationships among three bibliographic dimensions: author countries (AU_CO), author keywords (DE), and publication sources (SO). The analysis uses a Sankey-type structure in which connecting flows illustrate relationships among the selected fields, while the relative width of each flow represents the strength of the corresponding association.

The Three-Field Plot was used to examine how major contributing countries were connected with prominent research themes and publication outlets. This approach enabled geographical, conceptual, and publication dimensions of the literature to be examined simultaneously. The analysis was interpreted as a relational visualisation rather than an independent measure of research productivity or influence.

Thematic Map Analysis

A thematic map was generated to evaluate the development and strategic importance of major research themes. The thematic map positions clusters according to two dimensions: centrality and density. Centrality reflects

the extent to which a theme is connected with other themes and therefore indicates its relevance to the broader research field, whereas density reflects the internal development and cohesiveness of a thematic cluster.

Based on these dimensions, themes were classified as motor themes, basic themes, niche themes, or emerging or declining themes. Motor themes exhibit relatively high centrality and density and therefore represent well-developed and influential areas. Basic themes exhibit relatively high centrality but lower density and represent foundational topics connected to the broader field. Niche themes are comparatively well developed internally but less connected to the overall research structure, whereas themes characterised by low centrality and density may represent emerging research directions or areas experiencing declining scholarly attention. The thematic map therefore provided a strategic representation of the maturity, interconnectedness, and relative development of the major themes constituting research on green energy, SDGs, and sustainable economic growth.

Thematic Evolution Analysis

Thematic evolution analysis was conducted to examine how the conceptual structure of the research field developed over time. Unlike the thematic map, which provides a static representation of the thematic structure, thematic evolution offers a longitudinal perspective by examining relationships among themes across successive periods (Mahmood et al., 2018; Mostafa, 2023).

The analysis was used to identify the continuity, transformation, diversification, convergence, and changing prominence of research themes across the study period. This temporal perspective was particularly relevant because scholarship concerning renewable energy, sustainable development, SDGs, and economic growth has evolved alongside wider developments relating to the 2030 Agenda, energy transition, decarbonisation, technological innovation, and low-carbon development. For the present analysis, thematic development was examined across the periods 2017–2019, 2020–2022, 2023–2025, and 2026, corresponding to the periods presented in the thematic evolution analysis. The 2026 period was interpreted cautiously because the Scopus data were extracted on 22 June 2026 and therefore represent an incomplete publication year.

Reliability, Transparency and Reproducibility

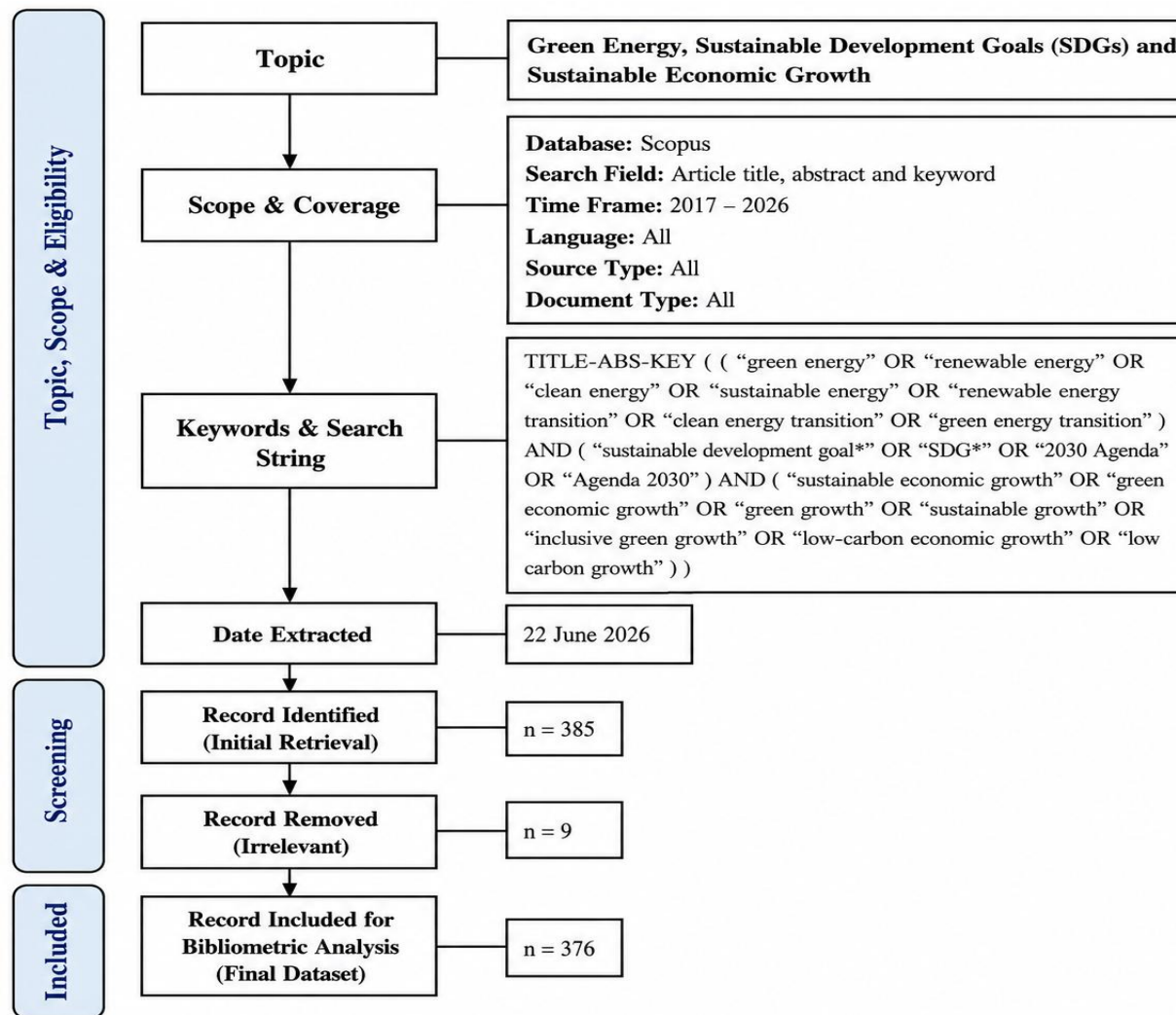
Several procedures were adopted to strengthen the reliability, transparency, and reproducibility of the bibliometric analysis. First, the bibliographic database was explicitly defined as Scopus. Second, the complete Boolean search strategy and TITLE-ABS-KEY search field were documented to facilitate replication of the literature-retrieval procedure. Third, the exact extraction date, 22 June 2026, was recorded because Scopus is continuously updated and identical searches conducted at different times may produce different numbers of records.

Fourth, the screening and cleaning procedures were explicitly documented. The initial search identified 385 records, of which nine were removed following relevance screening and data cleaning, resulting in a final analytical corpus of 376 documents. Fifth, bibliographic metadata were examined before analysis, and conservative keyword harmonisation was undertaken to reduce artificial conceptual fragmentation while preserving theoretically meaningful distinctions (Rossi et al., 2026).

Finally, Biblioshiny and Bibliometrix provided a structured analytical environment for conducting the analyses (Ghorbani, 2024; Marlés-Sáenz et al., 2025). The final analytical procedure comprised annual scientific production and citation analysis, source analysis, country scientific production analysis, international country collaboration analysis, global citation analysis,

Three-Field Plot analysis, thematic mapping, and thematic evolution analysis. These procedures correspond directly to the analyses reported in the Results and Discussion section and provide a transparent framework for examining the development, geographical distribution, scholarly influence, relational structure, and thematic evolution of research at the nexus of green energy, the Sustainable Development Goals, and sustainable economic growth.

Figure 1. Flow Diagram of the search strategy



RESULTS AND DISCUSSION

Annual Scientific Production and Citation Development

Figure 2. Annual scientific production and average citations per year, 2017–2026.

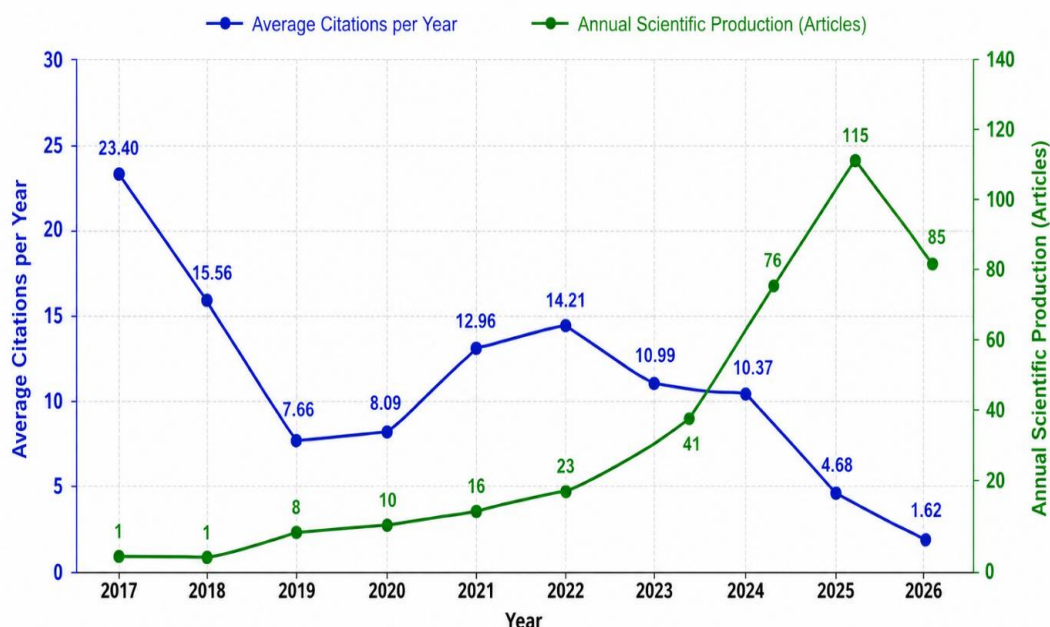


Figure 2 illustrates the temporal development of annual scientific production and average citations per year for the 376 documents published between 2017 and 2026. The findings demonstrate a pronounced expansion in scholarly attention to the nexus between green energy, the Sustainable Development Goals (SDGs), and sustainable economic growth, particularly during the latter part of the study period. Nevertheless, publication output and citation performance exhibit different temporal trajectories, reflecting the distinction between the expansion of a research field and the time required for its publications to accumulate scholarly influence.

Scientific production was initially limited, with only one publication recorded in both 2017 and 2018. Research activity subsequently increased to 8 publications in 2019, 10 in 2020, 16 in 2021, and 23 in 2022, indicating a gradual consolidation of scholarly interest in the interrelationships among green energy, sustainable development, and economic growth. A considerably stronger expansion occurred after 2022, with annual output increasing to 41 publications in 2023 and 76 in 2024, before reaching its highest observed level of 115 publications in 2025. Notably, the 191 documents published during 2024 and 2025 accounted for approximately 50.8% of the entire dataset, demonstrating that more than half of the literature emerged within these two years alone. This pronounced concentration of recent publications indicates that the field has entered a period of rapid scholarly expansion and reinforces the relevance of systematically mapping its increasingly extensive and multidisciplinary knowledge structure.

Although annual scientific production decreased to 85 publications in 2026, this apparent decline should be interpreted with caution. The Scopus search was conducted 22 June 2026, and the 2026 observation therefore represents an incomplete publication year. Accordingly, the lower publication count cannot be interpreted as evidence of a contraction in scholarly interest. Rather, it reflects the temporal boundary of the data collection process, and direct comparison between the partial 2026 output and the complete publication years would potentially underestimate the actual trajectory of research growth.

Citation performance reveals a different temporal pattern. The highest average citation rate was recorded for publications from 2017, with 23.40 citations per year, followed by 15.56 in 2018. The average decreased substantially to 7.66 in 2019, before recovering to 8.09 in 2020, 12.96 in 2021, and 14.21 in 2022. Thereafter, average citation performance moderated to 10.99 in 2023 and 10.37 in 2024, followed by considerably lower values of 4.68 in 2025 and 1.62 in 2026.

Importantly, the declining citation averages observed in the most recent years should not be interpreted as evidence of diminishing research quality or scholarly relevance. Citation accumulation is inherently sensitive to publication age, as earlier publications have had a longer period to diffuse through the scientific community and attract subsequent citations. Conversely, publications from 2025 and particularly 2026 have had substantially shorter citation windows. The low citation average recorded for 2026 is therefore expected given that the bibliographic data were extracted before the completion of the year.

Three-Field Analysis

Figure 3. Three-field plot

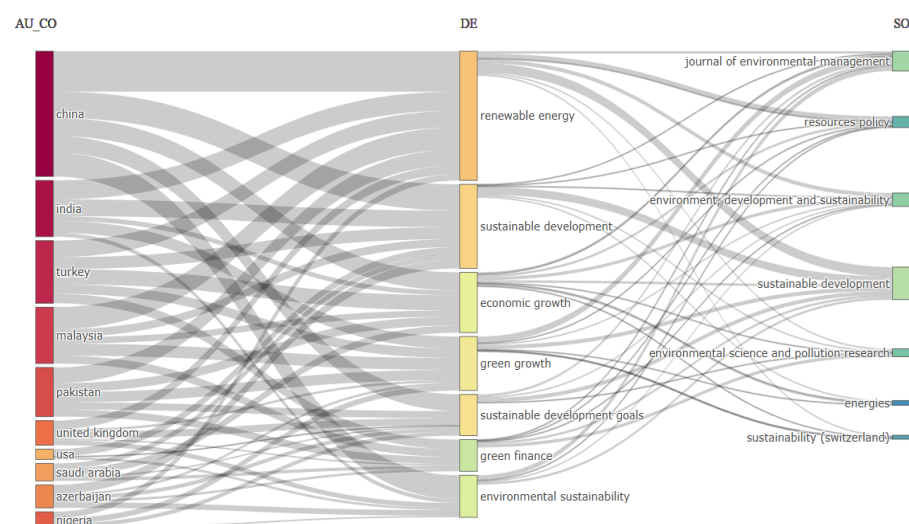


Figure 3 presents the Three-Field Plot linking author countries (AU_CO), author keywords (DE), and publication sources (SO) within the research landscape of green energy, Sustainable Development Goals (SDGs), and sustainable economic growth. The width of the connecting flows represents the relative strength of associations among these three dimensions. Overall, the figure demonstrates a geographically concentrated yet conceptually diverse research landscape, with China and India occupying prominent positions among contributing countries and renewable energy emerging as the dominant thematic component.

From the geographical perspective, China represents the most prominent contributor, exhibiting substantial connections with several major research themes. India also demonstrates a strong presence, followed by Turkey, Malaysia, and Pakistan. Contributions are additionally visible from the United Kingdom, United States, Saudi Arabia, Azerbaijan, and Nigeria. The distribution of flows across multiple themes suggests that the leading countries do not concentrate exclusively on a single dimension of the field but contribute to a broader research agenda encompassing energy transition, sustainability, economic development, and environmental concerns.

At the conceptual level, “renewable energy” emerges as the most prominent author keyword, confirming its central position within the knowledge structure of the field. Other prominent keywords include “sustainable development,” “economic growth,” “green growth,” “sustainable development goals,” “green finance,” and “environmental sustainability.” Collectively, these themes demonstrate that the literature has developed beyond a narrow energy-environment relationship towards a broader research framework incorporating economic, developmental, financial, and institutional dimensions of sustainability.

Importantly, “sustainable development” and “sustainable development goals” appear as separate themes in the Three-Field Plot because they represent related but conceptually distinct constructs rather than interchangeable terms. Sustainable development refers to the broader normative and developmental paradigm concerned with balancing economic development, social well-being, and environmental protection over the long term (Mensah, 2019; Hariram et al., 2023).

In contrast, the Sustainable Development Goals represent a specific institutionalised framework comprising the 17 goals established under the United Nations 2030 Agenda (Krannich & Reiser, 2023). Thus, a publication may investigate sustainable development conceptually without explicitly engaging with the SDGs, whereas another may specifically examine renewable energy in relation to particular SDGs, such as SDG 7 on Affordable and Clean Energy, SDG 8 on Decent Work and Economic Growth, or SDG 13 on Climate Action (Fonseca et al., 2020; Tian et al., 2024).

For this reason, the two keywords were deliberately retained as separate terms during keyword harmonisation. Combining them would imply semantic equivalence and could obscure meaningful differences in the conceptual structure of the literature. The distinction is analytically important because the prominence of “sustainable development” reflects engagement with the broader sustainability paradigm, whereas “sustainable development goals” captures research explicitly situated within the SDG and 2030 Agenda framework. Their simultaneous presence therefore indicates that the field encompasses both a broad conceptual sustainability discourse and a more specific policy-oriented SDG discourse.

The source dimension further demonstrates the multidisciplinary character of the field. The Journal of Environmental Management occupies a prominent position among the displayed publication outlets, while Resources Policy, Environment, Development and Sustainability, Sustainable Development, Environmental Science and Pollution Research, Energies, and Sustainability also contribute to the dissemination of research within this domain. The distribution of thematic connections across these sources indicates that scholarship on green energy, SDGs, and sustainable economic growth extends across environmental management, energy studies, development, sustainability, and resource-policy research rather than being concentrated within a single disciplinary outlet.

Most Relevant Sources

Figure 4. Most relevant sources in green energy, Sustainable Development Goals, and sustainable economic growth research.

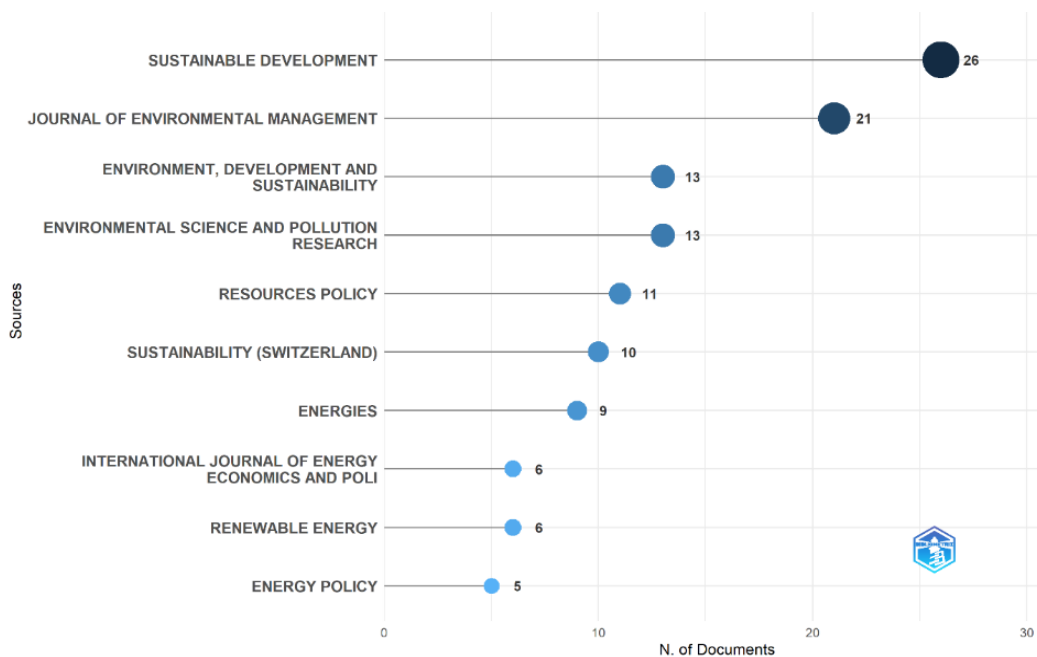


Figure 4 presents the ten most relevant publication sources within the 376-document dataset, ranked according to the number of documents published on the nexus between green energy, Sustainable Development Goals (SDGs), and sustainable economic growth. The distribution indicates that the literature is primarily concentrated in journals specialising in sustainability, environmental management, energy, and resource policy, reflecting the multidisciplinary character of the research domain. Sustainable Development emerged as the most productive source, contributing 26 documents, followed by the Journal of Environmental Management with 21 documents. Together, these two journals accounted for 47 publications, representing approximately 12.5% of the total dataset. Their leading positions suggest that research at the intersection of green energy, sustainability objectives, and economic development is strongly embedded within the broader sustainable-development and environmental-management literature.

The next tier consisted of Environment, Development and Sustainability and Environmental Science and Pollution Research, each contributing 13 documents, followed by Resources Policy with 11 documents. The prominence of these sources further demonstrates that the research domain extends beyond energy-specific scholarship and encompasses broader concerns relating to environmental degradation, sustainable development, natural-resource governance, and policy (Hejnowicz et al., 2022). This distribution is consistent with the inherently interdisciplinary nature of the green energy-SDG-sustainable economic growth nexus, in which energy transitions are increasingly examined alongside environmental, developmental, and institutional considerations (Le et al., 2026).

Several energy journals and sustainability-oriented journals also made notable contributions. Sustainability contributed 10 documents, followed by Energies with 9 documents. The International Journal of Energy Economics and Policy and Renewable Energy each contributed 6 documents, while Energy Policy accounted for 5 documents. The presence of these energy-focused sources highlights the economic and policy dimensions of the literature, particularly regarding renewable-energy deployment, energy transition, energy economics, and the policy mechanisms required to reconcile environmental objectives with economic development.

An important feature of the source distribution is that no single journal overwhelmingly dominates the literature. Even the leading source, Sustainable Development, contributed 26 of the 376 documents, equivalent to approximately 6.9% of the total corpus. This relatively dispersed publication structure indicates that scholarship on green energy, SDGs, and sustainable economic growth is distributed across multiple

disciplinary outlets rather than concentrated within a specialised journal. Such dispersion reflects the conceptual breadth of the field, which integrates sustainability science, environmental management, renewable energy, energy economics, resource governance, and public policy.

Most Globally Cited Documents

Figure 5. Most globally cited documents in the green energy, Sustainable Development Goals, and sustainable economic growth literature.

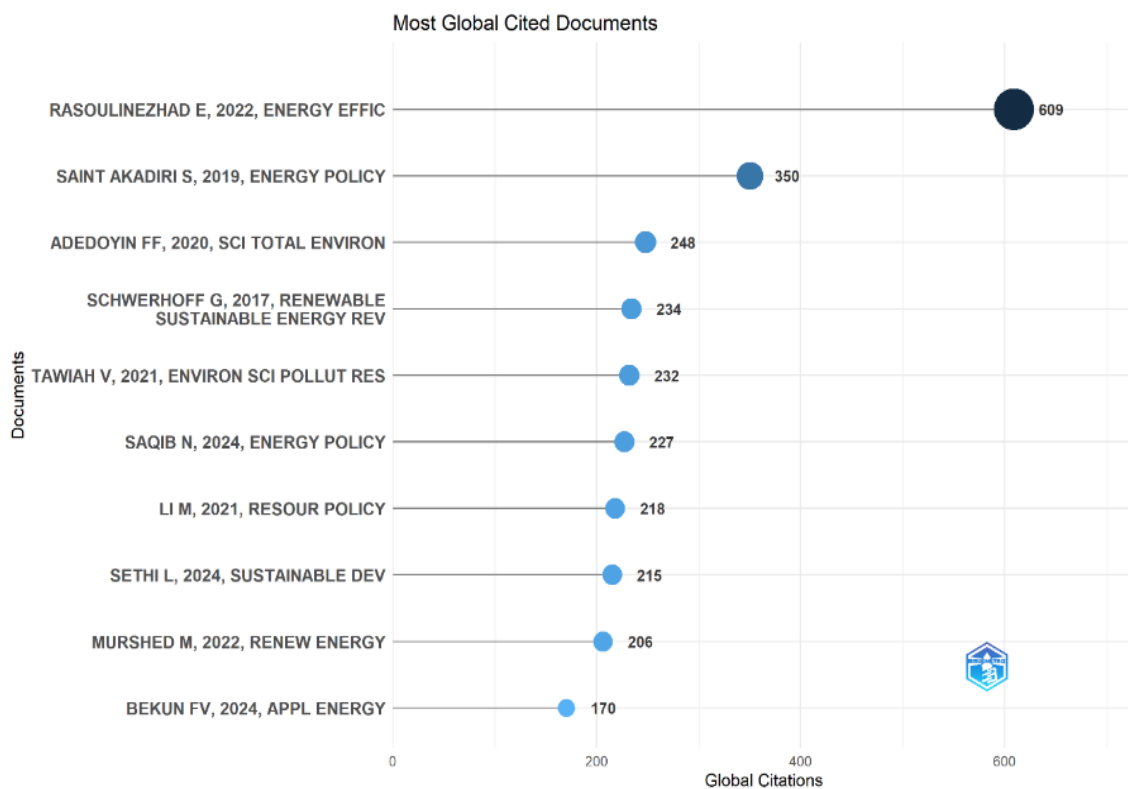


Figure 5 presents the ten most globally cited documents within the 376-document corpus, providing an indication of the publications that have achieved the greatest citation visibility in the broader scholarly literature. The results reveal considerable variation in citation performance among the leading documents, with the most highly cited publication substantially exceeding the citation counts of the remaining studies.

The document by Rasoulinezhad & Taghizadeh-Hesary (2022) published in Energy Efficiency occupies the leading position with 609 global citations, making it the most globally cited publication in the dataset by a considerable margin. This is followed by Saint Akadiri et al. (2019) in Energy Policy, with 350 citations. The substantial citation counts of these two documents indicate their high visibility within the wider literature related to energy, sustainability, and economic development.

The next group of influential publications demonstrates a comparatively narrower citation range. Adedoyin & Zakari. (2020), published in Science of the Total Environment, received 248 citations, followed by Schwerhoff and Sy (2017) in Renewable and Sustainable Energy Reviews with 234 citations and Tawiah et al. (2021) in Environmental Science and Pollution Research with 232 citations. These results indicate that highly cited contributions to this research domain are distributed across environmental science, renewable energy, and sustainability-oriented outlets rather than being concentrated exclusively within energy economics journals.

More recent publications also demonstrate substantial citation visibility. Saqib et al. (2024) in Energy Policy accumulated 227 citations, while Sethi et al. (2024) in Sustainable Development received 215 citations. Their inclusion among the most globally cited documents is particularly noteworthy given their relatively recent publication dates, suggesting comparatively rapid citation uptake. However, such differences should be interpreted cautiously because citation accumulation is affected by publication age as well as disciplinary citation practices and the visibility of individual research topics.

The remaining highly cited publications include Li et al. (2021) in *Resources Policy* with 218 citations, Murshed et al. (2022) in *Renewable Energy* with 206 citations, and Bekun (2024) in *Applied Energy* with 170 citations. Collectively, the ten leading documents demonstrate that influential scholarship within this research landscape is disseminated through a diverse range of energy, environmental, sustainability, and resource-policy journals.

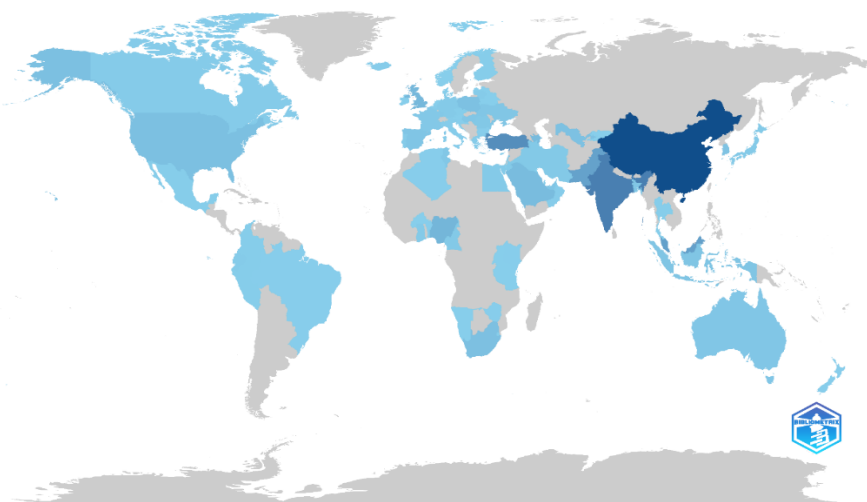
A notable pattern is the strong representation of energy- and sustainability-oriented publication outlets among the most globally cited documents. *Energy Policy* appears twice among the ten leading publications, while other prominent sources include *Energy Efficiency*, *Renewable and Sustainable Energy Reviews*, *Renewable Energy*, and *Applied Energy*. This pattern suggests that the intellectual influence of the field is strongly associated with research addressing energy transition and its environmental, economic, and policy implications. At the same time, the presence of *Science of the Total Environment*, *Environmental Science and Pollution Research*, *Resources Policy*, and *Sustainable Development* demonstrates the interdisciplinary character of the field.

Overall, the global citation analysis indicates that the intellectual influence of research at the nexus of green energy, SDGs, and sustainable economic growth is distributed across multiple disciplinary domains but anchored strongly in energy and sustainability scholarship. The exceptionally high citation count of the leading document, together with the substantial citation performance of several recent studies, highlights the growing scholarly relevance of research integrating energy transition with environmental and sustainable-development concerns. Nevertheless, global citation counts should be interpreted as indicators of scholarly visibility and influence rather than direct measures of research quality, particularly because citation opportunities vary according to publication year, disciplinary practices, and the length of the citation window.

Country Scientific Production and International Collaboration

The geographical distribution of scientific production provides insight into the international development of research concerning green energy, SDGs, and sustainable economic growth. Figure 6 illustrates the distribution of scientific production across countries, while Figure 7 presents the corresponding international collaboration structure. Considered together, these analyses reveal both the geographical concentration of research activity and the cross-national connections underpinning the development of the field.

Figure 6. Country Scientific Production



Note: Darker shading represents greater scientific production. The analysis is based on the final Scopus dataset of 376 documents published between 2017 and 2026. Data were extracted on 22 June 2026.

Figure 6 demonstrates that scientific production is geographically distributed across multiple regions, including Asia, Europe, North America, South America, Africa, the Middle East, and Oceania. Nevertheless, substantial variation is evident in the intensity of research production across countries. China displays the strongest concentration of scientific production, as indicated by the darkest shading on the map, while India

also demonstrates a comparatively high level of research activity. This pattern indicates a particularly strong Asian contribution to scholarship at the intersection of green energy, sustainable development, and economic growth.

Research activity is also visible across several countries in Southeast Asia and the Middle East, as well as throughout Europe. North America contributes to the geographical coverage of the field, particularly through the United States and Canada, while contributions are additionally evident from Australia and countries in South America and Africa. The overall geographical distribution therefore demonstrates that the research domain extends beyond a small group of countries and has attracted scholarly attention across both developed and developing regions.

The geographical concentration of scientific production also has implications for the development of the field. The prominence of China and India suggests that the research agenda is being shaped substantially by economies simultaneously confronting rapid energy-demand growth, decarbonisation pressures, and sustainable-development priorities (Hassan et al., 2024). However, comparatively lower research visibility across several developing regions may limit the geographical diversity of the evidence base. This is particularly important because sustainable development pathways are highly context-dependent, with differences in institutional capacity, resource endowments, investment conditions, and economic structures influencing countries' ability to achieve sustainable economic growth and SDG objectives (Itangishaka et al., 2026). Future studies should therefore extend empirical and collaborative research towards underrepresented economies, particularly where energy access, financing constraints, institutional capacity, and development priorities differ substantially from those of the dominant research-producing countries. From a policy perspective, a geographically broader evidence base would facilitate more context-sensitive strategies for aligning renewable-energy transitions with the SDGs and sustainable economic growth.

Figure 7. International Research Collaboration

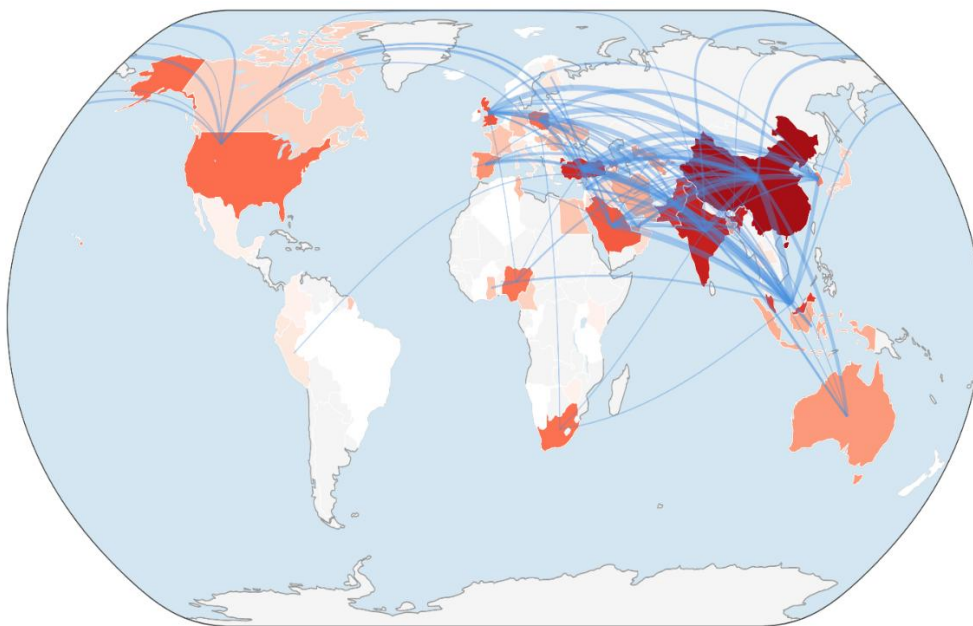


Figure 7 extends the geographical analysis by illustrating international research collaboration among contributing countries. In contrast to the scientific-production map, which reflects the geographical concentration of research output, the collaboration map depicts cross-national scholarly connections through the lines linking individual countries. The resulting network demonstrates that research at the nexus of green energy, SDGs, and sustainable economic growth involves a substantial international dimension, with collaborative relationships extending across Asia, Europe, North America, the Middle East, Africa, and Oceania.

A particularly dense concentration of collaborative connections is visible across Asia, with China occupying a prominent position within the international collaboration structure. Strong connectivity is also apparent

among countries in South and Southeast Asia and between Asian countries and research partners in Europe, North America, the Middle East, and Oceania. The visual prominence of these connections is consistent with the substantial scientific production observed among several Asian countries in the preceding geographical analysis.

The collaboration map also demonstrates extensive connections between European and Asian countries, indicating that knowledge production within this research domain crosses regional boundaries. North American participation is similarly evident, with international connections linking the United States and Canada to research partners in other regions. Australia also participates in the broader international network, while collaborative links involving countries in Africa and the Middle East further demonstrate the geographical breadth of the research field.

Taken together, the two geographical analyses reveal an important distinction between research productivity and research connectivity. A country's scientific production represents its contribution to the volume of scholarship, whereas the collaboration map captures its cross-national research relationships. Consequently, countries with substantial publication output are not necessarily equivalent to countries with the greatest international connectivity. The two indicators should therefore be interpreted as complementary rather than interchangeable dimensions of the global research landscape.

Overall, the collaboration structure indicates that research concerning green energy, SDGs, and sustainable economic growth has developed through an increasingly interconnected international scholarly network. The geographical breadth of these connections is particularly relevant because energy transition, climate change, sustainable development, and economic transformation are inherently transboundary challenges. These collaboration patterns also suggest that international research networks can play a strategic role in transferring technological knowledge, policy experience, and methodological capacity across countries. Future collaboration should increasingly connect highly productive research systems with countries that remain comparatively peripheral in the network. Such partnerships may be particularly valuable for addressing context-specific barriers to renewable-energy deployment and for developing policy frameworks that recognise differences in institutional capacity, financing conditions, energy resources, and stages of economic development.

Thematic Map Analysis

Figure 8. Thematic Map Analysis in the green energy, Sustainable Development Goals, and sustainable economic growth literature.

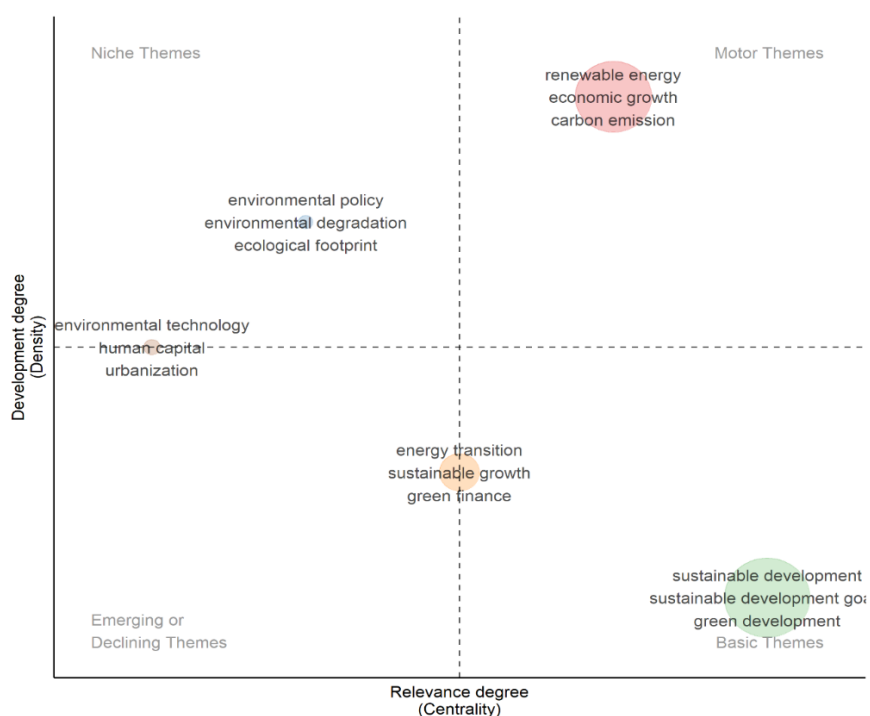


Figure 8 presents the thematic map of research on green energy, Sustainable Development Goals (SDGs), and sustainable economic growth. The map positions thematic clusters according to centrality, which reflects their relevance and connectivity to the overall research field, and density, which indicates their degree of internal development. Accordingly, the four quadrants distinguish motor themes, niche themes, emerging or declining themes, and basic themes. The size of each bubble reflects the relative prominence of the corresponding thematic cluster.

The motor-theme quadrant is dominated by the cluster comprising “renewable energy,” “economic growth,” and “carbon emission.” Its position in the upper-right quadrant indicates both high centrality and high density, suggesting that this cluster is simultaneously well developed internally and strongly connected to the broader intellectual structure of the field. This finding is particularly important because it identifies the energy-growth-environment relationship as a principal research axis. The close association among renewable energy, economic growth, and carbon emissions reflects sustained scholarly interest in determining whether cleaner energy systems can support economic expansion while mitigating the environmental consequences traditionally associated with fossil-fuel-dependent development (Wang et al., 2025).

The basic-theme quadrant contains a prominent cluster centred on “sustainable development,” “sustainable development goals,” and “green development.” Its high centrality but comparatively low density indicates that these concepts are fundamental to the overall research field and strongly connected to other themes, although their internal thematic development is comparatively less specialised. This positioning suggests that sustainable development and the SDGs provide an overarching conceptual and policy foundation linking different streams of green-energy and sustainable-growth research.

Importantly, “sustainable development” and “sustainable development goals” remain separate keywords within this cluster because they are conceptually related but not semantically identical. Sustainable development represents the broader development paradigm concerned with integrating economic prosperity, social well-being, and environmental protection over the long term (Mensah, 2019; Hariram et al., 2023). In contrast, the Sustainable Development Goals refer specifically to the 17 goals institutionalised under the United Nations 2030 Agenda (Weiland et al., 2021). Their co-location within the same basic-theme cluster therefore demonstrates strong conceptual proximity, while their retention as separate terms preserve an analytically meaningful distinction between the broader sustainability paradigm and its specific global policy framework. Merging these terms during keyword harmonisation would have obscured this distinction.

The niche-theme quadrant is represented principally by “environmental policy,” “environmental degradation,” and “ecological footprint.” This cluster exhibits relatively high density but lower centrality, indicating a comparatively well-developed internal research stream that remains less strongly integrated with the core structure of the field. These themes reflect a specialised environmental-policy strand concerned with assessing ecological pressures and the effectiveness of policy responses. Their niche position does not imply limited scholarly value; rather, it indicates that the cluster has developed a relatively specialised knowledge base with weaker connections to the other dominant thematic areas.

A smaller cluster comprising “environmental technology,” “human capital,” and “urbanization” is located close to the boundary between the niche and emerging or declining quadrants. Its peripheral centrality suggests that these socioeconomic and technological dimensions have not yet become deeply integrated into the core research structure. However, because the cluster lies close to the quadrant boundary, its status should be interpreted cautiously rather than categorically classified as either established or declining.

Another noteworthy cluster comprises “energy transition,” “sustainable growth,” and “green finance.” Its location in the lower portion of the map, close to the centrality threshold, indicates relatively low thematic development and intermediate connectivity with the wider field. This positioning is particularly relevant to the future trajectory of the literature because these concepts represent mechanisms through which sustainability objectives may be translated into structural economic transformation. Nevertheless, because the lower-left quadrant can contain either emerging or declining themes, the thematic map alone cannot establish whether this cluster is gaining or losing scholarly momentum. Its developmental direction should therefore be interpreted in conjunction with the temporal evidence provided by the thematic evolution analysis.

Thematic Evolution Analysis

Figure 9. Thematic evolution of green energy, Sustainable Development Goals, and sustainable economic growth research across 2017–2026.

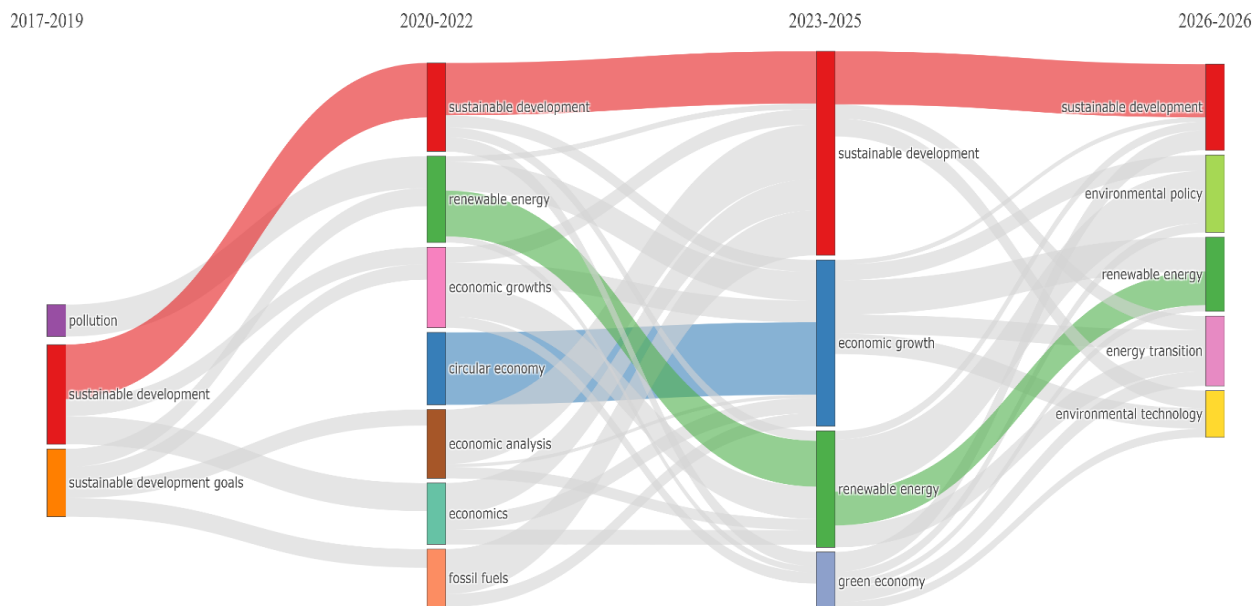


Figure 9 illustrates the thematic evolution of research on green energy, Sustainable Development Goals (SDGs), and sustainable economic growth across four periods: 2017–2019, 2020–2022, 2023–2025, and 2026. The connecting flows indicate how thematic clusters persisted, expanded, merged, or transformed across successive periods. Overall, the results reveal a clear progression from a relatively narrow sustainability and pollution-oriented knowledge base towards a more diversified research structure encompassing renewable energy, economic growth, green economy, energy transition, environmental policy, and environmental technology.

During the 2017–2019 period, the literature was organised around three principal themes: “sustainable development,” “sustainable development goals,” and “pollution.” Sustainable development constituted the most prominent theme and subsequently maintained strong connections with themes emerging in later periods. The presence of the SDGs as an identifiable theme during this initial stage indicates that the 2030 Agenda had already begun to provide an institutional framework for linking energy, environmental, and development concerns (Yu et al., 2020). Pollution, meanwhile, represents the environmental-pressure dimension from which part of the subsequent literature evolved.

A substantial thematic diversification occurred during 2020–2022. The earlier sustainability-oriented themes developed into a wider range of topics comprising “sustainable development,” “renewable energy,” “economic growths,” “circular economy,” “economic analysis,” “economics,” and “fossil fuels.” This diversification indicates that the literature increasingly moved beyond broad sustainability discourse towards more specific mechanisms and economic dimensions of sustainable transformation. In particular, the emergence of renewable energy as a major theme demonstrates the growing centrality of clean-energy transition, while the presence of economic growth and economic analysis reflects stronger integration of economic considerations into the sustainability literature. Circular economy and fossil fuels further illustrate the simultaneous development of resource-efficiency and conventional-energy perspectives (Xiao et al., 2025).

The 2023–2025 period represents a stage of greater thematic consolidation. The literature became strongly structured around “sustainable development,” “economic growth,” “renewable energy,” and “green economy.” Sustainable development remained a dominant theme, demonstrating substantial continuity from the preceding periods. At the same time, economic growth became considerably more prominent, indicating that the relationship between sustainability objectives and economic performance had become increasingly

central to the research field. Renewable energy also retained a substantial position, confirming its continuing role as a principal mechanism connecting environmental sustainability with economic transformation. The appearance of green economy further reflects an expansion of the literature towards economic systems and development models explicitly oriented towards environmental sustainability.

By 2026, the thematic structure had evolved into five visible areas: “sustainable development,” “environmental policy,” “renewable energy,” “energy transition,” and “environmental technology.” Sustainable development remained prominent, demonstrating considerable thematic continuity across the entire study period. Renewable energy likewise persisted as an important research theme, but the appearance of energy transition suggests that the literature was increasingly moving from research focused primarily on individual renewable-energy sources towards a broader concern with systemic transformation of energy systems. The emergence of environmental policy and environmental technology additionally indicates increasing attention to the institutional and technological mechanisms required to facilitate sustainability transitions (Handoyo, 2026).

An important feature of Figure 7 is the continuing role of sustainable development throughout the thematic evolution of the field. The theme is visible from 2017–2019 through 2026 and maintains substantial connections across the periods, indicating that it functions as a persistent conceptual foundation rather than a temporary research trend. By comparison, the Sustainable Development Goals appear explicitly as a separate theme in the earliest period but subsequently become connected with broader thematic clusters. This pattern should not be interpreted as indicating that the SDGs disappeared from the literature. Rather, it suggests that explicit SDG-oriented research became increasingly integrated into wider discussions of sustainable development, renewable energy, economic growth, and related sustainability themes. The distinction between “sustainable development” and “sustainable development goals” remains conceptually important. Sustainable development represents the broader paradigm of balancing economic, environmental, and social objectives, whereas the SDGs constitute the specific institutional framework established under the United Nations 2030 Agenda. Consequently, the two terms were intentionally retained separately during keyword harmonisation. Their thematic convergence over time is therefore analytically meaningful because it suggests increasing integration between the broader sustainability discourse and research explicitly framed around the SDG agenda rather than merely reflecting duplicated terminology.

The evolution of the economic dimension is equally noteworthy. The appearance of economic growth, economic analysis, and economics during 2020–2022, followed by the stronger position of economic growth and green economy during 2023–2025, indicates progressive integration of economic considerations into the sustainability-energy research landscape. By 2026, however, the visible thematic structure places greater emphasis on energy transition, environmental policy, and environmental technology. Given that 2026 represents only a partial year, this pattern should be interpreted as an emerging thematic configuration rather than evidence that economic-growth research has declined.

CONCLUSION

This study provides a comprehensive bibliometric and thematic assessment of the global research landscape connecting green energy, the Sustainable Development Goals (SDGs), and sustainable economic growth. By analysing 376 Scopus-indexed documents published between 2017 and 2026, the study consolidates an interdisciplinary knowledge base that spans renewable energy, sustainability science, environmental management, energy economics, resource policy, and economic development. The analysis demonstrates that the nexus has developed from a relatively limited research area into a rapidly expanding scholarly domain, reflecting growing recognition that energy transition, sustainability objectives, and economic development cannot be effectively examined in isolation.

The temporal analysis reveals particularly strong growth in scientific production during the latter part of the study period. The rapid expansion of publications indicates that the relationship among green energy, the SDGs, and sustainable economic growth has become an increasingly prominent research agenda. However, citation patterns follow a different trajectory because recent publications have had considerably shorter periods in which to accumulate citations. Consequently, the lower citation averages observed for recent years,

particularly 2025 and the incomplete 2026 publication year, should not be interpreted as evidence of declining scholarly influence or research quality.

The findings further demonstrate the multidisciplinary character of the research landscape. Sustainable Development emerged as the most productive publication source, followed by the Journal of Environmental Management, while other prominent outlets span environmental science, sustainability, resource policy, renewable energy, and energy economics. The absence of overwhelming dominance by any single journal indicates that the knowledge base remains distributed across multiple disciplinary communities rather than being concentrated within a specialised publication domain. Citation analysis similarly reveals that influential publications are distributed across energy, environmental, sustainability, and resource-policy journals, confirming the interdisciplinary intellectual foundations of the field.

At the conceptual level, renewable energy occupies a central position in the knowledge structure, alongside sustainable development, economic growth, green growth, the SDGs, green finance, and environmental sustainability. Importantly, sustainable development and the Sustainable Development Goals were retained as separate concepts because they represent related but analytically distinct constructs. Sustainable development represents the broader paradigm of balancing economic, social, and environmental objectives, whereas the SDGs constitute the institutionalised global framework established under the United Nations 2030 Agenda. Their simultaneous prominence indicates that the literature integrates both a broad sustainability discourse and a more specific policy-oriented SDG framework.

The thematic structure provides further evidence of the maturation of this research domain. Renewable energy, economic growth, and carbon emissions form the principal motor theme, indicating that the relationship between cleaner energy systems, economic performance, and environmental consequences constitutes a well-developed and highly connected research axis. In contrast, sustainable development, the SDGs, and green development function as basic themes that provide the broader conceptual foundation of the field. The positioning of energy transition, sustainable growth, and green finance within a less-developed thematic area is particularly significant, as these concepts represent mechanisms through which sustainability ambitions may be translated into structural economic transformation.

The thematic evolution analysis demonstrates that the field has progressively broadened in both scope and analytical orientation. Early research during 2017–2019 was principally structured around sustainable development, the SDGs, and pollution. During 2020–2022, the knowledge base diversified to incorporate renewable energy, economic growth, circular economy, economic analysis, economics, and fossil fuels. The 2023–2025 period subsequently demonstrated greater consolidation around sustainable development, economic growth, renewable energy, and the green economy. By 2026, emerging attention to energy transition, environmental policy, and environmental technology indicates an increasing emphasis on the institutional, technological, and systemic mechanisms required to implement sustainability transitions. Given that the 2026 dataset represents only a partial publication year, these recent developments should be interpreted as emerging signals rather than definitive long-term changes.

Taken together, these findings suggest that the research frontier is gradually shifting from establishing whether renewable energy contributes to environmental sustainability towards understanding how green-energy transitions can simultaneously support economic development and the achievement of sustainability objectives. This shift has important implications for future scholarship. Greater attention is required to the mechanisms linking renewable-energy deployment with productivity, employment, industrial transformation, technological innovation, green finance, energy accessibility, and specific SDG outcomes. Future studies could also strengthen the literature through comparative analyses across developed and developing economies, particularly where differences in institutional capacity, financing constraints, technological readiness, energy infrastructure, and policy environments may produce heterogeneous sustainability outcomes.

From a policy perspective, the findings reinforce the need to approach green-energy transition as more than an environmental or energy-sector intervention. Renewable-energy policies should be integrated with economic-development strategies, technological innovation, green financing mechanisms, industrial policy, and the broader implementation of the SDGs. Such integration is particularly relevant to SDG 7 on Affordable and Clean Energy, SDG 8 on Decent Work and Economic Growth, SDG 9 on Industry, Innovation and

Infrastructure, and SDG 13 on Climate Action. The growing prominence of environmental policy, environmental technology, energy transition, and green finance further suggests that achieving sustainable economic growth will depend not simply on expanding renewable-energy capacity but also on establishing institutional and financial conditions capable of supporting systemic transformation.

Several limitations should nevertheless be acknowledged. First, the study relies exclusively on Scopus; consequently, publications indexed solely in other databases were not captured. Second, bibliometric indicators reflect patterns of scientific production, connectivity, and citation visibility rather than the methodological quality or substantive validity of individual studies. Citation performance is also affected by publication age and disciplinary citation practices. Third, bibliometric results are sensitive to the search strategy, keyword selection, screening criteria, and keyword-harmonisation procedures.

Although conservative harmonisation was employed to reduce artificial fragmentation while preserving conceptually distinct constructs, alternative analytical specifications may produce different network and thematic configurations. Finally, because the database was extracted on 22 June 2026, the publication and citation indicators for 2026 represent only a partial year and should therefore be interpreted cautiously. The manuscript itself documents this extraction date and final analytical corpus.

Despite these limitations, the study provides an integrated representation of the performance, intellectual, conceptual, and thematic development of research at the nexus of green energy, the SDGs, and sustainable economic growth. Its principal contribution lies in demonstrating that these dimensions are increasingly converging into a common scholarly agenda centred on the transformation of energy systems within broader sustainability and economic-development objectives.

As the international community approaches the final years of the 2030 Agenda, future research should increasingly move beyond documenting associations among renewable energy, environmental outcomes, and economic growth towards identifying the institutional, technological, financial, and policy conditions under which green-energy transitions can generate measurable progress towards sustainable economic development and the SDGs.

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Conflict of Interest Statement

The authors declare that they have no conflict of interest.

REFERENCE

1. Ab-Rahim, R., Nero, D. E., Mohamad, A. H. H., & Mohd Razali, M. W. (2025). The impact of green accounting disclosure on financial performance of public listed firms in Malaysia. *SDGs Review*, 5, e05155. <https://doi.org/10.47172/2965-730X.SDGsReview.v5.n03.pe05155>
2. Adedoyin, F. F., & Zakari, A. (2020). Energy consumption, economic expansion, and CO2 emission in the UK: the role of economic policy uncertainty. *Science of the total Environment*, 738, 140014. <https://doi.org/10.1016/j.scitotenv.2020.140014>
3. Aria, M., & Cuccurullo, C. (2017). bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics*, 11(4), 959–975. <https://doi.org/10.1016/j.joi.2017.08.007>
4. Aria, M., Cuccurullo, C., D'Aniello, L., & Spano, M. (2026). Biblioshiny and the SAAS workflow: An integrated framework for transparent and reproducible science mapping. A demonstration through the replication of a study. *Journal of Informetrics*, 20(3), 101837. <https://doi.org/10.1016/j.joi.2026.101837>
5. Bekun, F. V. (2024). Race to carbon neutrality in South Africa: what role does environmental technological innovation play?. *Applied Energy*, 354, 122212. <https://doi.org/10.1016/j.apenergy.2023.122212>
6. Das, T., Holland, P., Ahmed, M., Husain, L., Ahmed, M., & Husain, L. (2021). Sustainable development goal 3: Good health and well-being. In *South-East Asia eye health: Systems, practices, and challenges* (pp. 61-78). Singapore: Springer Singapore. https://doi.org/10.1007/978-981-16-3787-2_4

7. Fonseca, L. M., Domingues, J. P., & Dima, A. M. (2020). Mapping the sustainable development goals relationships. *Sustainability*, 12(8), 3359. <https://doi.org/10.3390/su12083359>
8. Ghorbani, B. D. (2024). Bibliometrix: Science mapping analysis with R Biblioshiny based on Web of Science in applied linguistics. In *A scientometrics research perspective in applied linguistics* (pp. 197-234). Cham: Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-51726-6_8
9. Han, N., Wang, C., Song, Q., Xu, H., & Chen, L. (2026). Climate economics and finance: a systematic literature review from macro to micro perspectives. *Journal of Chinese Economic and Business Studies*, 24(2), 175-209.
10. Handoyo, S. (2026). Sustainability in the energy sector: A systematic literature review of energy transitions, technologies, and policy instruments. *Energy Reports*, 15, 108937. <https://doi.org/10.1016/j.egyr.2025.108937>
11. Hariram, N. P., Mekha, K. B., Suganthan, V., & Sudhakar, K. (2023). Sustainalism: An integrated socio-economic-environmental model to address sustainable development and sustainability. *Sustainability*, 15(13), 10682. <https://doi.org/10.3390/su151310682>
12. Hassan, Q., Viktor, P., Al-Musawi, T. J., Ali, B. M., Algburi, S., Alzoubi, H. M., ... & Jaszczur, M. (2024). The renewable energy role in the global energy Transformations. *Renewable Energy Focus*, 48, 100545. <https://doi.org/10.1016/j.ref.2024.100545>
13. Hejnowicz, A. P., Thorn, J. P. R., Giraudo, M. E., Sallach, J. B., Hartley, S. E., Grugel, J., ... & Emberson, L. (2022). Appraising the water-energy-food nexus from a sustainable development perspective: a maturing paradigm?. *Earth's Future*, 10(12), e2021EF002622. <https://doi.org/10.1029/2021EF002622>
14. Itangishaka, I., Ab-Rahim, R., & Mohamad, A. H. H. (2026). Foreign direct investment and the natural resource curse in Sub-Saharan Africa: Pathways to sustainable development. *International Journal of Business and Society*, 27(1), 48–58. <https://doi.org/10.33736/ijbs.12806.2026>
15. Krannich, A. L., & Reiser, D. (2023). United nations sustainable development goals 2030, the. In *Encyclopedia of sustainable management* (pp. 3862-3867). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-031-25984-5_178
16. Küfeoğlu, S. (2022a). SDG-9: industry, innovation and infrastructure. In *Emerging technologies: value creation for sustainable development* (pp. 349-369). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-031-07127-0_11
17. Küfeoğlu, S. (2022b). SDG-12: Responsible consumption and production. In *Emerging technologies: value creation for sustainable development* (pp. 409-428). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-031-07127-0_14
18. Le, T. V., Canh, H. P., Minh, T. N., & Tu, N. C. (2026, April). Global Knowledge Structure of Energy Policy in the Sustainable Development Goals Era: A Bibliometric Analysis of Studies Indexed in Scopus. In *Proceedings of the International Conference on Emerging Challenges: Business Dynamics in Disruptive Economy (ICECH 2025)* (p. 277). Springer Nature.
19. Li, M., Hamawandy, N. M., Wahid, F., Rjoub, H., & Bao, Z. (2021). Renewable energy resources investment and green finance: evidence from China. *Resources Policy*, 74, 102402. <https://doi.org/10.1016/j.resourpol.2021.102402>
20. Mahmood, A., Arshad, M. A., Ahmed, A., Akhtar, S., & Khan, S. (2018). Spiritual intelligence research within human resource development: a thematic review. *Management Research Review*, 41(8), 987-1006. <https://doi.org/10.1108/MRR-03-2017-0073>
21. Makedon, V., Politykin, M., Hromyak, S., Novosad, I., & Doronina, I. (2025). The role of renewable energy in advancing SDG 7: Ensuring clean and affordable energy. *Grassroots Journal of Natural Resources*, 8(2), 485-505. <https://doi.org/10.33002/nr2581.6853.080223>
22. Marlés-Sáenz, E., Gómez-Luna, E., Guerrero, J. M., & Vasquez, J. C. (2025). Innovative bibliometric methodology: a new big data-based framework for scientific research. *Energies*, 18(10), 2437. <https://doi.org/10.3390/en18102437>
23. Mensah, J. (2019). Sustainable development: Meaning, history, principles, pillars, and implications for human action: Literature review. *Cogent social sciences*, 5(1), 1653531. <https://doi.org/10.1080/23311886.2019.1653531>
24. Mishra, P., & Singh, G. (2023). Energy management systems in sustainable smart cities based on the internet of energy: A technical review. *Energies*, 16(19), 6903. <https://doi.org/10.3390/en16196903>

25. Mohamad, A. H. H., & Ab-Rahim, R. (2024). Do the various sources of energy consumption affect the environmental degradation in India? *International Journal of Renewable Energy Development*, 13(2), 168–178. <https://doi.org/10.61435/ijred.2024.55836>
26. Mohamad, A. H. H., & Ab-Rahim, R. (2025). Mapping the research landscape of energy market and renewable energy: A bibliometric analysis. *International Journal of Renewable Energy Development*, 14(4), 703–716. <https://doi.org/10.61435/ijred.2025.61058>
27. Mohamad, A. H. H., & Shaari, M. S. (2026). The environmental Kuznets curve in Japan with nuclear energy and foreign direct investment using ARDL and NARDL models. *Discover Environment*, 3, Article 300. <https://doi.org/10.1007/s44274-025-00511-4>
28. Mohamad, A. H. H., Ab-Rahim, R., & Kadri, N. (2025a). Future trend of artificial intelligence and stock market: A comprehensive bibliometric analysis. *International Journal of Economics and Financial Issues*, 15(5), 306–316. <https://doi.org/10.32479/ijefi.19272>
29. Mohamad, A. H. H., Ab-Rahim, R., Assi, M. I. S. A., Abdul Gapor, S., Shaari, M. S., Wong, W. P. M., Rosli, S. N. F. A., Muhammad Hisham, M. H., & Mohamed Ossman, N. S. (2026a). Impact of renewable and non-renewable energy toward CO₂ emissions in Malaysia. *Journal of Sustainability Science and Management*, 21(3), 621–643. <https://doi.org/10.46754/jssm.2026.03.06>
30. Mohamad, A. H. H., Ab-Rahim, R., Edruce Kushairi, A. R., & Mohamed Esa, M. S. (2024a). Housing market: A bibliometric analysis from 2020 to 2024. *International Journal of Academic Research in Business and Social Sciences*, 14(8), 274–295. <https://doi.org/10.6007/IJARBS/v14-i8/22390>
31. Mohamad, A. H. H., Ab-Rahim, R., Omoregie, A. I., & Muhammad Hisham, M. H. (2026b). Artificial intelligence and education: A bibliometric analysis of global research trends and future directions. *Multidisciplinary Reviews*, 9, e2026488. <https://doi.org/10.31893/multirev.2026488>
32. Mohamad, A. H. H., Muhammad Hisham, M. H., & Abdul Gapor, S. (2025b). Indonesia: Comparison between the most consumption of renewable and non-renewable energy toward CO₂ emissions. *International Journal of Research and Innovation in Social Science*, 9(5), 260–279. <https://doi.org/10.47772/IJRISS.2025.90500025>
33. Mohamad, A. H. H., Rosli, S. N. F. A., Ab-Rahim, R., Kulub Abd Rashid, N., & Mohamed Esa, M. S. (2024b). Poverty in Malaysia region: A bibliometric analysis. *International Journal of Academic Research in Business and Social Sciences*, 14(8), 1676–1700. <https://doi.org/10.6007/IJARBS/v14-i8/22537>
34. Mohamad, A. H. H., Wahid, H., Nik Azhar, N. A. A., & Mohamed Esa, M. S. (2026c). Mapping global scholarship on Islamic family law through analysis of marriage divorce and family relations in Muslim societies. *Discover Global Society*, 4, Article 83. <https://doi.org/10.1007/s44282-026-00435-1>
35. Mohamad, A. H. H., Zainuddin, M. R. K. V., & Ab-Rahim, R. (2023). Does renewable energy transition in the USA and China overcome environmental degradation? *International Journal of Energy Economics and Policy*, 13(6), 234–243. <https://doi.org/10.32479/ijeep.14840>
36. Mostafa, M. M. (2023). Four decades of hijab research: knowledge structure, thematic evolution and collaborative networks. *Journal of Islamic Marketing*, 14(8), 1960–1988. <https://doi.org/10.1108/JIMA-11-2021-0357>
37. Murshed, M., Apergis, N., Alam, M. S., Khan, U., & Mahmud, S. (2022). The impacts of renewable energy, financial inclusivity, globalization, economic growth, and urbanization on carbon productivity: Evidence from net moderation and mediation effects of energy efficiency gains. *Renewable Energy*, 196, 824–838. <https://doi.org/10.1016/j.renene.2022.07.012>
38. Nabyeva, G. N., Wheeler, S. M., London, J. K., & Brazil, N. (2023). Implementation of sustainable development goal 11 (sustainable cities and communities): initial good practices data. *Sustainability*, 15(20), 14810. <https://doi.org/10.3390/su152014810>
39. Rasoulnezhad, E., & Taghizadeh-Hesary, F. (2022). Role of green finance in improving energy efficiency and renewable energy development. *Energy efficiency*, 15(2), 14. <https://doi.org/10.1007/s12053-022-10021-4>
40. Rossi, T. J. A., Silvestrini, M. M., Klapka, C. S., & Sarti, F. M. (2026). Building Standards for Agent-Based Models: A Proposal of Guidelines for Decision-Making on the Definition of Parameters and Sensitivity Analysis Methods. *Standards*, 6(2), 24. <https://doi.org/10.3390/standards6020024>
41. Saint Akadiri, S., Alola, A. A., Akadiri, A. C., & Alola, U. V. (2019). Renewable energy consumption in EU-28 countries: policy toward pollution mitigation and economic sustainability. *Energy Policy*, 132, 803–810. <https://doi.org/10.1016/j.enpol.2019.06.040>

42. Saqib, N., Usman, M., Ozturk, I., & Sharif, A. (2024). Harnessing the synergistic impacts of environmental innovations, financial development, green growth, and ecological footprint through the lens of SDGs policies for countries exhibiting high ecological footprints. *Energy Policy*, 184, 113863. <https://doi.org/10.1016/j.enpol.2023.113863>
43. Schwerhoff, G., & Sy, M. (2017). Financing renewable energy in Africa—Key challenge of the sustainable development goals. *Renewable and Sustainable Energy Reviews*, 75, 393-401. <https://doi.org/10.1016/j.rser.2016.11.004>
44. Sethi, L., Behera, B., & Sethi, N. (2024). Do green finance, green technology innovation, and institutional quality help achieve environmental sustainability? Evidence from the developing economies. *Sustainable Development*, 32(3), 2709-2723. <https://doi.org/10.1002/sd.2811>
45. Shaari, M. S., Mohamad, A. H. H., Esquivias, M. A., Majekodunmi, T. B., Sulong, A., & Lee, W. C. (2025). The non-linear relationship between green technology and life expectancy. *Environmental and Sustainability Indicators*, 27, 100870. <https://doi.org/10.1016/j.indic.2025.100870>
46. Shaari, M. S., Sulong, A., & Mohamad, A. H. H. (2026). Effects of marginal CO₂ emissions on life expectancy: A linear and nonlinear panel analysis of ASEAN. *Air Quality, Atmosphere & Health*, 19, Article 88. <https://doi.org/10.1007/s11869-026-01970-1>
47. Shafik, W. (2025). SDG 13: climate action—technology for climate resilience and mitigation. In *Factoring technology in global sustainability: a focus on the sustainable development goals* (pp. 393-419). Singapore: Springer Nature Singapore. https://doi.org/10.1007/978-981-96-7299-8_14
48. Shahar, S. N., Mohamad, A. H. H., & Ab-Rahim, R. (2025). Higher education with the Fourth Industrial Revolution: A bibliometric exploration of global research trends. *International Journal of Academic Research in Progressive Education and Development*, 14(4), 446-469. <https://doi.org/10.6007/IJARPED/v14-i4/26621>
49. Tawiah, V., Zakari, A., & Adedoyin, F. F. (2021). Determinants of green growth in developed and developing countries. *Environmental Science and Pollution Research*, 28(29), 39227-39242. <https://doi.org/10.1007/s11356-021-13429-0>
50. Tian, J., Culley, S. A., Maier, H. R., & Zecchin, A. C. (2024). Is renewable energy sustainable? Potential relationships between renewable energy production and the Sustainable Development Goals. *npj Climate Action*, 3(1), 35. <https://doi.org/10.3390/su12083359>
51. Ukoba, K., Olatunji, K. O., Adeoye, E., Jen, T. C., & Madyira, D. M. (2024). Optimizing renewable energy systems through artificial intelligence: Review and future prospects. *Energy & environment*, 35(7), 3833-3879. <https://doi.org/10.1177/0958305X241256293>
52. Wang, J., Ramzan, M., Makin, F., Mahmood, C. K., Ramos-Meza, C. S., Jain, V., & Shabbir, M. S. (2025). Does clean energy matter? The dynamic effects of different strategies of renewable energy, carbon emissions, and trade openness on sustainable economic growth. *Environment, Development and Sustainability*, 27(9), 21043-21052. <https://doi.org/10.1007/s10668-023-03505-5>
53. Wei, G. J., Ab-Rahim, R., Mohamad, A. H. H., & Ibrahim, M. S. (2025). The current state of behavioural economics studies: A bibliometric analysis. *International Journal of Economics and Financial Issues*, 15(4), 51-62. <https://doi.org/10.32479/ijefi.18799>
54. Weiland, S., Hickmann, T., Lederer, M., Marquardt, J., & Schwindenhammer, S. (2021). The 2030 agenda for sustainable development: transformative change through the sustainable development goals?. *Politics and Governance*, 9(1), 90-95. <https://doi.org/10.17645/pag.v9i1.4191>
55. Xiao, D., Xu, X., & Xu, Z. (2025). Circular economy and energy storage technologies: A comprehensive approach to reduce emission and promoting sustainable growth. *Energy Reports*, 13, 6596-6608. <https://doi.org/10.1016/j.egyr.2025.05.063>
56. Yang, X. (2025). Is fossil fuel intensity adversely affecting health improvement and sustainability?. *Resources Policy*, 101, 105388. <https://doi.org/10.1016/j.resourpol.2024.105388>
57. Yu, S., Sial, M. S., Tran, D. K., Badulescu, A., Thu, P. A., & Sehleanu, M. (2020). Adoption and implementation of sustainable development goals (SDGs) in China—Agenda 2030. *Sustainability*, 12(15), 6288. <https://doi.org/10.3390/su12156288>
58. Zehri, C., El Amin, B. M., Inaam, Z., & Sekrafi, H. (2024). Exploring the nexus of decent work, financial inclusion, and economic growth: A study aligned with SDG 8. *Sustainable Futures*, 7, 100213. <https://doi.org/10.1016/j.sft.2024.100213>