

Exploring the Nexus between Foreign Direct Investment and Energy Consumption: A Bibliometric Analysis of Global Research Trends

Hafizah Hammad Ahmad Khan^{1,*}, Rosmaiza Abdul Ghani², Muhammad Hanif Othman¹, Handri Handri³, Azib Azib³

¹Department of Economics and Financial Studies, Faculty of Business and Management, Universiti Teknologi MARA, Kampus Sungai Petani, Merbok, Kedah, MALAYSIA.

²Department of Economics and Financial Studies, Faculty of Business and Management, Universiti Teknologi MARA, Kampus Alor Gajah, Alor Gajah, Melaka, MALAYSIA.

³Faculty of Economics and Business, Universitas Islam Bandung, Kota Bandung, Jawa Barat, INDONESIA.

ABSTRACT

As global economies transition towards sustainable development, understanding the relationship between Foreign Direct Investment (FDI) and energy consumption has become increasingly critical. This relationship is complex, as FDI can simultaneously drive energy demand through industrial expansion while facilitating energy efficiency and renewable energy adoption via technology transfer. Despite the growing body of literature, existing studies remain fragmented across disciplines and regions, limiting a comprehensive understanding of the field. This study conducts a bibliometric analysis of 592 peer reviewed articles indexed in the Scopus database to systematically map the intellectual structure and evolution of research on the FDI-energy consumption nexus. The analysis employs Microsoft Excel, Harzing's Publish or Perish, Biblioshiny, and VOS viewer to examines publication trends, key contributors, citation impact, and thematic development. The findings reveal a significant acceleration in research output after 2013, reflecting heightened global attention to sustainability and energy transition. The field is highly multidisciplinary, with dominant contributions from environmental science, energy, and economics. China emerges as the leading contributor, supported by strong international collaboration networks. Importantly, the study identifies core thematic clusters related to economic growth, environmental sustainability, and technological innovation, highlighting both the maturity and fragmentation of the field. By providing a structured synthesis, this study contributes to a deeper understanding of the research landscape and offers strategic directions for future research and policy development.

Keywords: Bibliometric analysis, Biblioshiny, Energy consumption, Foreign direct investment, Harzing's Publish or Perish, VOS viewer.

Correspondence:

Hafizah Hammad Ahmad Khan

Department of Economics and Financial Studies, Faculty of Business and Management, Universiti Teknologi MARA, Kampus Sungai Petani, Merbok, Kedah-08400, MALAYSIA.
Email: hafizahhammad@uitm.edu.my

Received: 06-02-2026;

Revised: 23-03-2026;

Accepted: 18-05-2026.

INTRODUCTION

The relationship between Foreign Direct Investment (FDI) and energy consumption has emerged as a critical area of inquiry in the context of global economic development and environmental sustainability (Rath *et al.*, 2024). As countries pursue economic growth while addressing climate change and resource constraints, understanding how foreign capital inflows influence energy demand has become increasingly important.

FDI plays a multifaceted role in shaping energy consumption patterns. On one hand, it promotes industrial expansion, infrastructure development, and economic growth, all of which contribute to increased energy demand. On the other hand, FDI facilitates the transfer of advanced technologies, which can enhance energy efficiency and support the adoption of renewable energy systems (Salim *et al.*, 2017). This dual effect highlights the complex and context dependent nature of the FDI-energy consumption nexus.

The impact of FDI also varies significantly across sectors and economic contexts (Appiah-Otoo *et al.*, 2023; Jinapor *et al.*, 2025; Mogota and Djekonbe, 2022). Investments in renewable energy and clean technologies can improve energy efficiency and reduce environmental pressure (Doytch and Narayan, 2016; Ahmadi, 2023). In contrast, FDI directed towards pollution intensive industries may increase energy consumption and



DOI: 10.5530/jscires.20262179

Copyright Information :

Copyright Author (s) 2026 Distributed under
Creative Commons CC-BY 4.0

Publishing Partner : Manuscript Technomedia. [www.mstechnomedia.com]

environmental degradation (Aliyu and Ismail, 2015; Grabara *et al.*, 2021). Furthermore, regional differences such as technological absorption capacity and stages of economic development play a crucial role in shaping these outcomes (Adom *et al.*, 2019).

In many developing economies, FDI has been associated with increased reliance on non-renewable energy sources and higher levels of environmental degradation. This is often due to limited infrastructure for renewable energy and weaker regulatory frameworks, which constrain the ability to manage the environmental consequences of economic expansion (Caetano *et al.*, 2023; Zangoei *et al.*, 2021). Additionally, the relocation of pollution intensive industries from developed to developing countries may further intensify environmental pressures (Caetano *et al.*, 2022; Solarin *et al.*, 2018).

Despite the expanding body of literature, research on the FDI-energy consumption nexus remains fragmented across disciplines, regions, and methodological approaches. While numerous studies have employed econometric techniques to examine causal relationships, limited attention has been given to systematically mapping the intellectual structure, key contributors, and thematic evolution of the field. This gap restricts a comprehensive understanding of how the research domain has developed and where future efforts should be directed.

To address this limitation, this study conducts a bibliometric analysis to provide a structured overview of the research landscape. Specifically, the study aims to examine publication trends, identify key contributors, and uncover the major thematic areas shaping the field. By doing so, this study contributes not only to consolidating existing knowledge but also to identifying emerging research directions and informing future scholarly and policy discussions.

Accordingly, the study addresses the following research questions:

- RQ1: How has research on the FDI-energy consumption nexus evolved over time in terms of publication trends?
- RQ2: Who are the key contributors and influential actors shaping this research field?
- RQ3: What are the dominant and emerging thematic structures within the FDI-energy consumption literature?

The remainder of this paper is structured as follows. Section 2 details the methodological approach, including data collection and analytical procedures. Section 3 presents the empirical findings and discussion, highlighting publication dynamics, key contributors, collaboration networks, citation impact, and thematic evolution, together with directions for future research. Finally, Section 4 concludes by integrating the main insights and outlining their implications..

METHODOLOGY

This study employs a bibliometric approach to systematically map the research landscape on the relationship between Foreign Direct Investment (FDI) and energy consumption. The analysis aims to identify publication trends, key contributors, and thematic developments within the field. Prior to the bibliometric analysis, a structured search and screening procedure was conducted to ensure the inclusion of relevant and high-quality publications. Bibliometric methods are particularly valuable for synthesising large bodies of literature, enabling the identification of research patterns, intellectual structures, and emerging areas that warrant further investigation.

Data collection

The data were obtained from the Scopus database due to its extensive coverage of peer-reviewed literature and its reliability for bibliometric analysis (Baas *et al.*, 2020). The search query applied was (“Foreign Direct Investment” OR “FDI” OR “Capital Inflow”) AND (“energy consumption” OR “energy use” OR “energy demand” OR “power consumption” OR “electricity consumption”). The search was conducted using article titles and keywords to ensure the relevance of the retrieved documents. These terms were carefully selected to capture studies examining the relationship between FDI and various dimensions of energy consumption.

The initial search yielded 671 documents. A screening process was subsequently conducted based on predefined inclusion criteria. Only journal articles were included to ensure the use of peer-reviewed and methodologically rigorous studies, which generally provides more reliable empirical evidence compared to other document types such as conference papers, book chapters, or editorials. Publications in English were selected to maintain consistency in analysis and interpretation, as English is the dominant language used in international academic publications.

Further screening involved reviewing the abstracts to confirm that each study directly addressed the relationship between FDI and energy consumption. Records with incomplete bibliographic information were manually verified and corrected using the original sources to ensure dataset accuracy.

To enhance consistency in the analysis, keyword standardization was performed by consolidating synonymous terms. For instance, “Foreign Direct Investment” and “FDI” were unified, while variations such as “energy consumption” and “energy use” were treated as equivalent. Similarly, terms related to emissions were standardized into consistent categories. This step ensured greater accuracy in subsequent network and thematic analyses.

Following the screening process, 79 documents were excluded. The final dataset comprised 592 articles, which were deemed suitable for bibliometric analysis. The overall data collection and screening procedure is illustrated in Figure 1.

Data analysis

The study employs a combination of descriptive and network-based bibliometric techniques to analyse the dataset. Descriptive analysis was conducted to examine publication trends, subject areas, leading sources, most productive countries, influential institutions, and prolific authors.

Citation analysis was performed to assess the scientific impact of the literature, including indicators such as total citations, citations per paper, and author-level metrics. Network analysis techniques were applied to explore relationships within the dataset, particularly through co-authorship and keyword co-occurrence patterns.

Multiple analytical tools were utilised to support these analyses. Microsoft Excel and Biblioshiny were used for descriptive statistics and preliminary exploration of publication patterns. Harzing's Publish or Perish was employed to generate citation metrics, while VOSviewer was used to construct and visualise bibliometric networks, enabling the identification of clusters and thematic structures within the field. The integration of these tools provides a comprehensive and robust analytical framework, ensuring both accuracy and depth in mapping the intellectual structure of the FDI-energy consumption literature. Figure 2 summarizes the analytical tools applied in this study.

FINDINGS AND DISCUSSION

This section presents the bibliometric findings in relation to the study's research questions, providing insights into publication trends, key contributors, citation impact, and the evolving thematic structure of the FDI-energy consumption literature.

Publication trend

The publication trend illustrated in Figure 3 reveals a substantial increase in scholarly output on the FDI-energy consumption nexus over the past three decades. Between 1995 and approximately 2012, the field recorded relatively few publications, indicating that although the relationship between FDI and energy consumption had already been recognised, it had not yet become a major focus of sustained academic inquiry. From 2013 onwards, however, publication activity increased markedly, signalling a turning point in scholarly attention. This upward trajectory coincides with rising global concern over climate change, intensified debates on sustainable development, and increasing FDI flows into developing economies, where energy consumption patterns have been changing rapidly (UNCTAD, 2013, 2014).

The number of publications reached its peak in 2022, with 116 documents. This surge was associated with growing interest in energy transition, especially in relation to renewable energy technologies, many of which have been supported by foreign investment. In addition, stronger international and national commitments to energy efficiency and carbon reduction have

stimulated research on the broader consequences of FDI for energy use. Although output declined slightly in 2023, the literature continued to grow in 2024, indicating that the field remains active and relevant. Overall, the publication trend suggests that the FDI-energy consumption nexus has developed into an increasingly important research domain at the intersection of economic development and environmental sustainability.

The distribution of subject areas presented in Figure 4 further confirms the multidisciplinary character of this research field. Environmental Science accounts for the largest share of publications (31%), indicating that the environmental consequences of energy use and foreign investment are central to the literature. The Energy subject area follows with 24%, reflecting strong interest in how FDI affects energy production, efficiency, and consumption. Economics, Econometrics, and Finance contribute 15% of the publications, highlighting the continued importance of economic perspectives in explaining the interaction between investment flows and energy systems. Engineering represents 7% of the literature, focusing on technological and technical dimensions of energy production and efficiency. Social Sciences (8%) and Business, Management, and Accounting (6%) further illustrate the broader policy, managerial, and socio-economic implications of the topic. Taken together, these subject area patterns indicate that the field has evolved beyond a narrowly economic perspective and is increasingly framed through interdisciplinary and sustainability-oriented lenses.

Most productive countries and collaboration patterns

Table 1 provides a geographical overview of the most productive countries in research on FDI and energy consumption. China clearly dominates the field, contributing 43.6% of the total publications. This leading position reflects China's dual significance as one of the world's largest recipients of FDI and one of its highest energy consumers. The prominence of Chinese scholarship is therefore consistent with the country's central role in debates on economic growth, industrial development, energy demand, and environmental sustainability.

Other emerging and developing economies, including Pakistan (18.6%), Turkey (12.7%), India (8.1%), Malaysia (7.6%), and Saudi Arabia (6.9%), also demonstrate substantial research output. This pattern suggests that countries experiencing rapid economic expansion and rising inflows of FDI are particularly active in this area of research, largely because they face pressing challenges related to energy demand, environmental degradation, and sustainable development. By contrast, the presence of the United Kingdom among the leading contributors signals that developed economies remain important actors in the field, although their research priorities appear to be more strongly oriented towards policy design, energy transition, and sustainability governance.

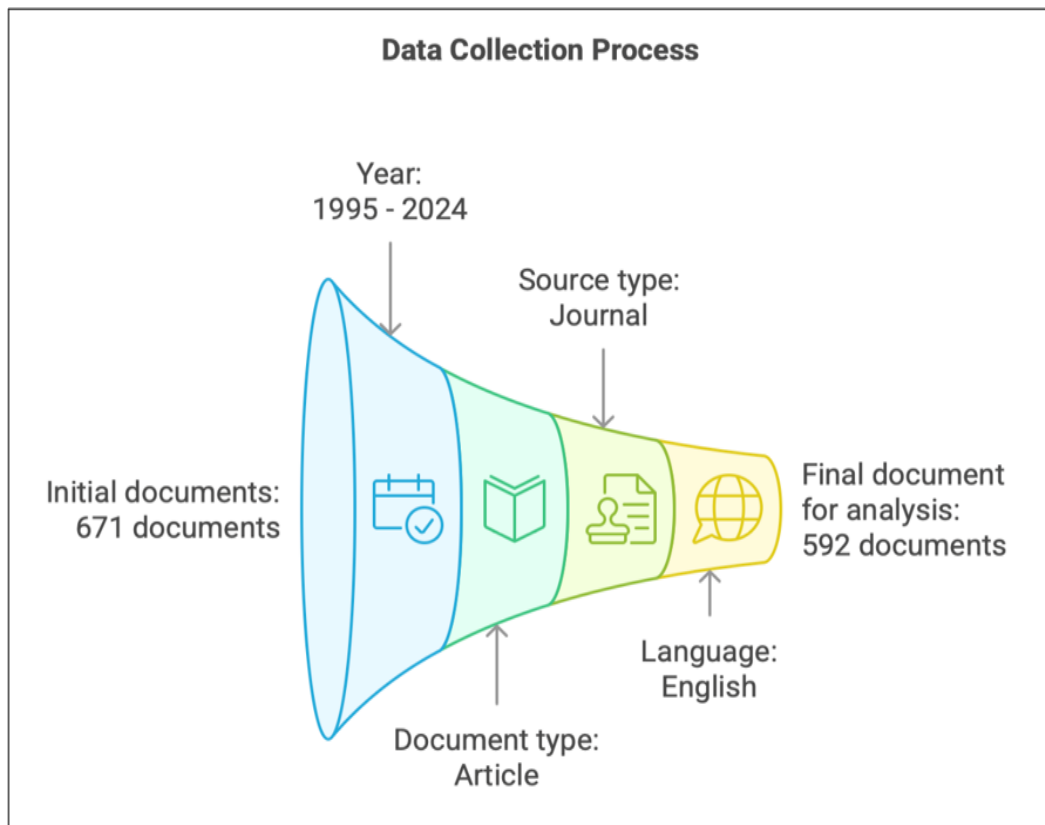


Figure 1: Data collection process.

Countries such as Bangladesh, Vietnam, Nigeria, Ghana, and the United States contribute smaller shares of publications, yet their inclusion confirms the broad international relevance of the topic. Overall, the geographical distribution of output shows that the FDI-energy consumption nexus is a globally relevant field, while also revealing clear differences in the motivations and policy contexts that drive research across countries.

Building on this geographical profile, the country collaboration network shown in Figure 5 illustrates the structure of international research interaction in the field. China emerges as the central node, recording the highest total link strength (215) alongside the largest number of publications (258), which indicates both high productivity and extensive international collaboration. Its large citation count (13,632) further confirms its influential role in shaping the academic discourse.

Pakistan, Malaysia, and Turkey also occupy prominent positions in the collaboration network, functioning as important connectors between regional clusters. Their relatively large node sizes and multiple linkages indicate active participation in international research partnerships, especially within Asia and between Asia and other regions. This suggests that emerging economies are not only productive contributors but are also increasingly central to the collaborative development of the field.

By contrast, European countries such as Spain, Romania, Finland, and the Czech Republic appear in smaller but more tightly linked

Table 1: Most productive countries.

Countries	Total publications	Percentage
China	258	43.6
Pakistan	110	18.6
Turkey	75	12.7
India	48	8.1
Malaysia	45	7.6
Saudi Arabia	41	6.9
United Kingdom	31	5.2
Bangladesh	29	4.9
Vietnam	25	4.2
Nigeria	22	3.7
Ghana	21	3.5
United States	21	3.5

clusters. Although they exhibit fewer connections than the major hubs, their positions suggest more focused and specialised collaboration patterns. Similarly, smaller nodes such as Lebanon and the United Arab Emirates indicate meaningful participation in more selective collaboration networks.

Overall, the spatial distribution of nodes reveals regional clustering centred mainly in Asia, Europe, and parts of Africa, while also showing increasing cross-regional connectivity. This

pattern indicates that research collaborations remain partly regionally concentrated, but the field is gradually becoming more globally integrated. Strengthening such cross-regional partnerships may enhance knowledge exchange and broaden the comparative reach of future scholarship.

Most influential institutions

Table 2 further highlights the most influential institutions in the field. The Beijing Institute of Technology leads with 21 publications (3.5%), followed by Jiangsu University with 18 publications (3.0%). The strong presence of Chinese institutions is consistent with the country's dominant position in the literature and reflects its strategic emphasis on issues related to rapid economic growth, high energy demand, and sustainability challenges.

İstanbul Gelişim Üniversitesi in Turkey ranks next with 16 publications, signalling increasing research activity in emerging economies where FDI is closely linked to industrial transformation and energy demand. King Saud University in Saudi Arabia follows with 13 publications, reflecting growing scholarly attention in the Middle East to the role of foreign investment in energy diversification and sustainability transitions.

Xiamen University in China and Eastern Mediterranean University in Northern Cyprus each contribute 11 publications, further demonstrating the active role of both established and emerging research environments. Institutions such as the Universidad de Castilla-La Mancha in Spain, the Southwestern University of Finance and Economics in China, and Bahria University and Ilma University in Pakistan, each with 10 publications, reflect the broader global participation in this field.

Taken together, the institutional distribution suggests that while research is globally dispersed, leading institutions tend to be located in countries facing strong development, investment, and energy-related policy pressures.

Most relevant sources

Table 3 presents the leading journals publishing research on FDI and energy consumption, highlighting both the diversity of outlets and the disciplinary composition of the field. The literature is primarily concentrated in journals related to environmental

Table 2: Most influential institutions.

Institutions	Total publications	Percentage
Beijing Institute of Technology, China	21	3.5
Jiangsu University, China	18	3.0
İstanbul Gelişim Üniversitesi, Turkey	16	2.7
King Saud University, Saudi Arabia	13	2.2
Xiamen University, China	11	1.9
Eastern Mediterranean University, Northern Cyprus	11	1.9
Universidad de Castilla-La Mancha, Spain	10	1.7
Southwestern University of Finance and Economics	10	1.7
Bahria University, Pakistan	10	1.7
Ilma University, Pakistan	10	1.7

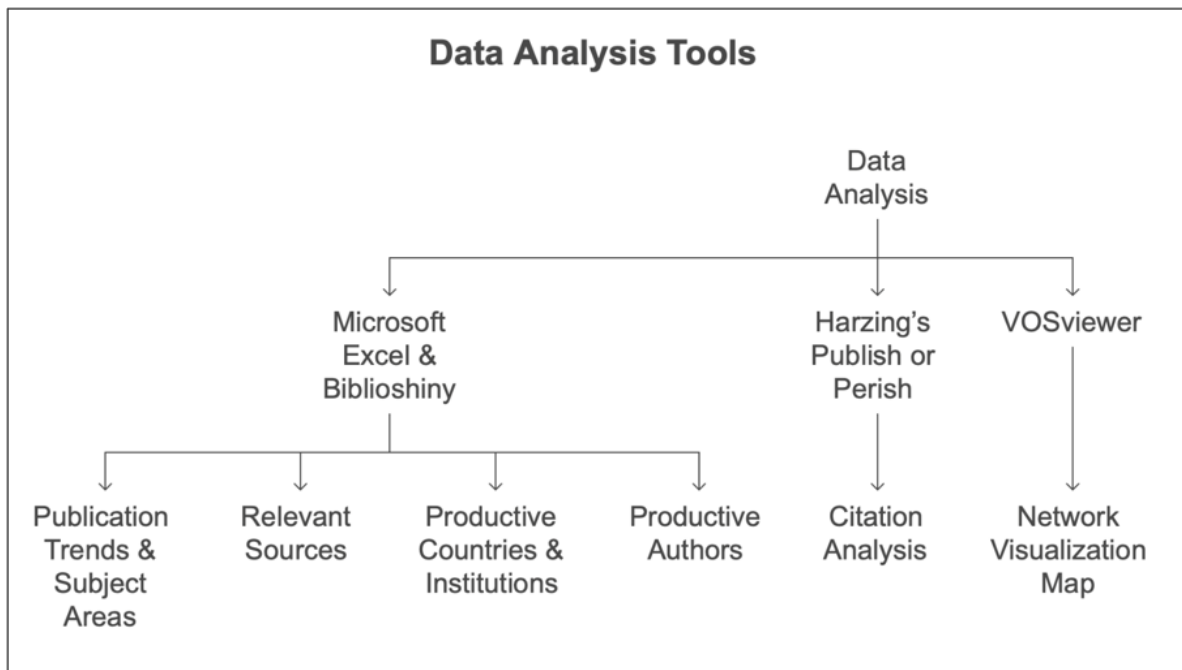


Figure 2: Data analysis tools.

science, energy, and economics, which is consistent with the interdisciplinary character of the research area.

Environmental Science and Pollution Research emerge as the most prolific source, publishing 102 articles (17.2%). Its prominence indicates the strong environmental framing of the field, particularly in relation to pollution, emissions, and sustainability concerns. The International Journal of Energy Economics and Policy follow with 41 publications (6.9%),

Table 3: Source Titles.

Item	Total publications	Percentage
Environmental Science and Pollution Research	102	17.2
International Journal of Energy Economics and Policy	41	6.9
Energy	23	3.9
Journal of Environmental Management	23	3.9
Energy Policy	21	3.5
Sustainability	21	3.5
Renewable Energy	20	3.4
Energies	17	2.9
Energy Economics	17	2.9
Science of The Total Environment	16	2.7
Energy and Environment	14	2.4
Environment Development and Sustainability	13	2.2
Journal of Cleaner Production	13	2.2

reflecting the importance of economic and policy perspectives in explaining the relationship between FDI and energy systems.

Other leading journals, including Energy, Journal of Environmental Management, Energy Policy, Sustainability, and Renewable Energy, demonstrate that research on the FDI-energy nexus is increasingly embedded within broader debates on energy transition, environmental governance, and sustainable development. The presence of journals such as Energy Economics, Science of the Total Environment, Energy and Environment, Environment Development and Sustainability as well as Journal of Cleaner Production further indicates that the field has developed across both economic and environmental dimensions rather than within a single disciplinary tradition. Overall, the source distribution suggests that scholarship on FDI and energy consumption is increasingly shaped by sustainability-oriented and policy-relevant debates.

Most productive authors

Table 4 outlines the leading authors in the field of FDI and energy consumption, highlighting those who have made substantial contributions to the academic discourse on this subject. These authors are primarily affiliated with institutions in Asia, Europe, and emerging economies, reflecting the geographical concentration of research activity in this field.

Shahbaz, who is affiliated with the Beijing Institute of Technology, stands at the forefront with 16 publications (2.7% of the total scholarly output). His research primarily focuses on the nexus between economic growth, energy consumption, environmental degradation, and FDI. Zaman follows closely with 15 publications (2.5%), with research largely centered on sustainability,

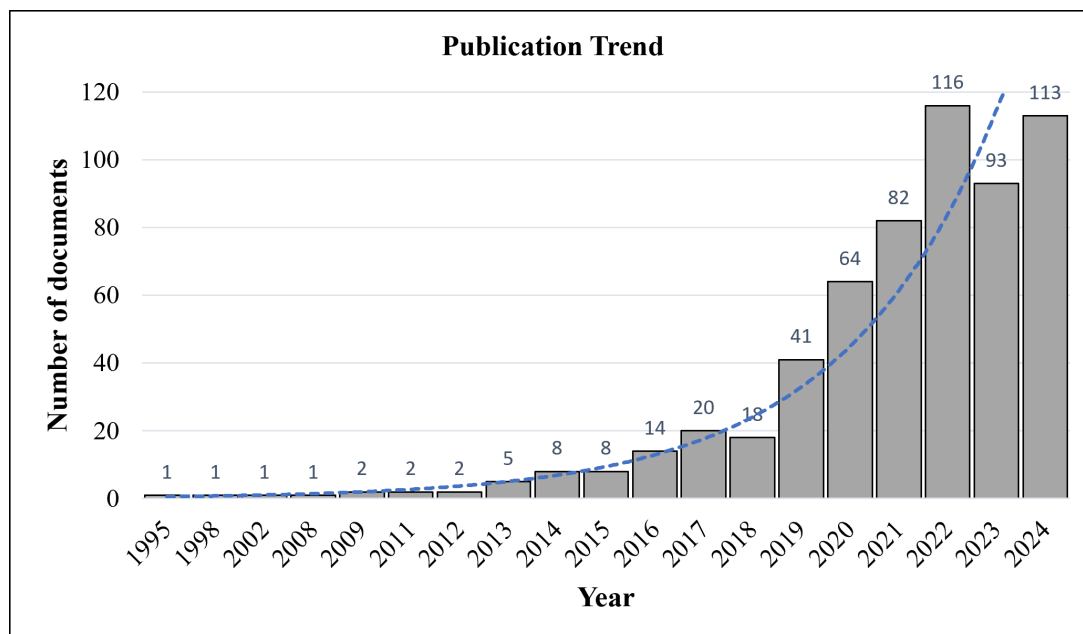


Figure 3: Publication Trends.

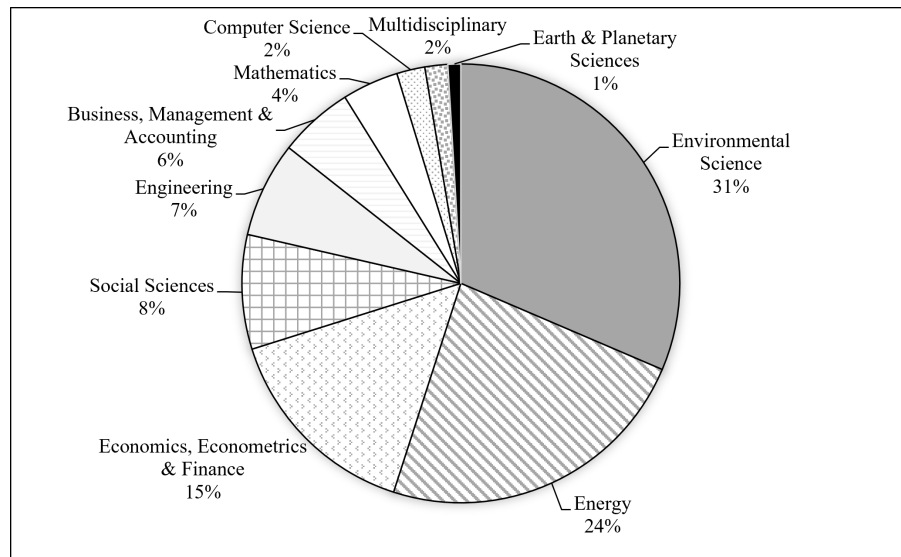


Figure 4: Subject Areas.

Table 4: Most active authors.

Author	Total publications	Percentage
Shahbaz, M.	16	2.7
Zaman, K.	15	2.5
Nassani, A.A.	10	1.7
Udemba, E.N.	10	1.7
Bekun, F.V.	8	1.4
Khan, M.K.	8	1.4
Ozturk, I.	8	1.4
Abro, M.M.Q.	7	1.2
Balsalobre-Lorente, D.	7	1.2
Murshed, M.	7	1.2
Qamruzzaman, M.	7	1.2

environmental economics, and policy-related aspects of energy use.

Authors such as Nassani and Udemba, each with 10 publications (1.7%), also demonstrate significant involvement in the field, particularly in examining the relationships between economic development, energy consumption, and environmental sustainability. Bekun, Khan, and Ozturk, each contributing eight publications, further enhance the literature through their work on energy economics, renewable energy, and the environmental impacts of economic activities.

Meanwhile, Abro, Balsalobre-Lorente, Murshed, and Qamruzzaman, each with seven publications, broaden the literature through work centred on developing and emerging economies. Overall, the author profile indicates that the field is shaped by a relatively concentrated group of scholars with sustained engagement in core thematic areas.

Following the identification of leading authors, Figure 6 presents the distribution of author productivity according to Lotka's Law. The Figure shows a pronounced imbalance in scholarly output, with more than 80% of authors contributing fewer than five documents. This steep decline suggests that sustained research productivity is concentrated among a relatively small subset of scholars. As the curve extends beyond ten publications, it becomes increasingly flat, indicating that highly prolific authors constitute only a small proportion of the research community.

This pattern is consistent with Lotka's Law, which proposes that most authors contribute only one publication, while progressively fewer authors produce multiple works. In the present field, the most productive 20% of authors tend to share common characteristics whereby they are generally affiliated with established institutions, participate actively in international collaborations, and remain engaged with core themes such as economic growth, energy demand, and environmental sustainability. Their sustained contribution helps shape the intellectual structure of the FDI-energy consumption literature and supports the field's cumulative development.

Citation analysis

Table 5 provides a summary of citation-based indicators for the literature on FDI and energy consumption over the period 1995-2024. The dataset consists of 592 publications that have accumulated 32,859 citations, indicating substantial scholarly influence and sustained academic relevance. On average, the literature receives 1,095.30 citations per year, demonstrating continued interest in the topic.

The average citation per paper is 55.51, which suggests that many studies achieve substantial visibility and influence. In addition, the average number of authors per paper is 3.38, reflecting the collaborative and interdisciplinary nature of research in this field.

This pattern suggests that the study of the FDI-energy consumption nexus increasingly relies on joint efforts that combine expertise from economics, energy studies, and environmental sciences.

In terms of impact indices, the h-index of 99 indicates that a large number of papers have achieved a high level of citation recognition, while the g-index of 163 shows that the most influential studies have accumulated especially strong citation counts. Together, these metrics suggest that the literature has developed into a mature and increasingly influential body of research.

Highly cited articles

Table 6 presents the most highly cited articles in the field, collectively illustrating the strong interplay between FDI, energy consumption, and environmental outcomes across different regions and economic settings. Sarkodie and Strezov (2019), with 901 citations, is the most highly cited study. Its strong citation performance can be attributed to its broad cross-country scope, robust empirical design, and direct relevance to sustainability and climate change debates. Similarly, Pao and Tsai (2011), with 841 citations, and Zhu *et al.* (2016), with 679 citations, are influential because they combine rigorous econometric analysis with contexts of major policy relevance, such as the BRIC and ASEAN-5 countries.

Other highly cited studies, including Zafar *et al.* (2019) and Tang and Tan (2015), have gained recognition due to their integration of multiple determinants and their applicability to both developed and emerging economic contexts. Meanwhile, Solarin *et al.* (2017), Lee (2013), Shahbaz *et al.* (2015), Sbia *et al.*

(2014), and Shahbaz *et al.* (2019) make important contributions to understanding how FDI interacts with environmental quality, clean energy, and regional policy settings.

Collectively, these highly cited studies are characterised by methodological rigour, broad or strategically important geographical coverage, and strong policy relevance. These features help explain their visibility and lasting influence within the literature.

Keywords analysis

Table 7 presents the frequency and prominence of author keywords in the literature. “FDI” and “energy consumption” appear as the most frequent keywords due to their direct relevance to the study and their inclusion in the search strategy. The analytical emphasis therefore rests on the additional keywords, which provide deeper insight into the thematic structure of the field.

Table 5: Citation metrics.

Metrics	Data
Citation years	30 (1995-2024)
Papers	592
Total citations	32859
Citations/year	1095.30
Citations/paper	55.51
Authors/paper	3.38
h-index	99
g-index	163

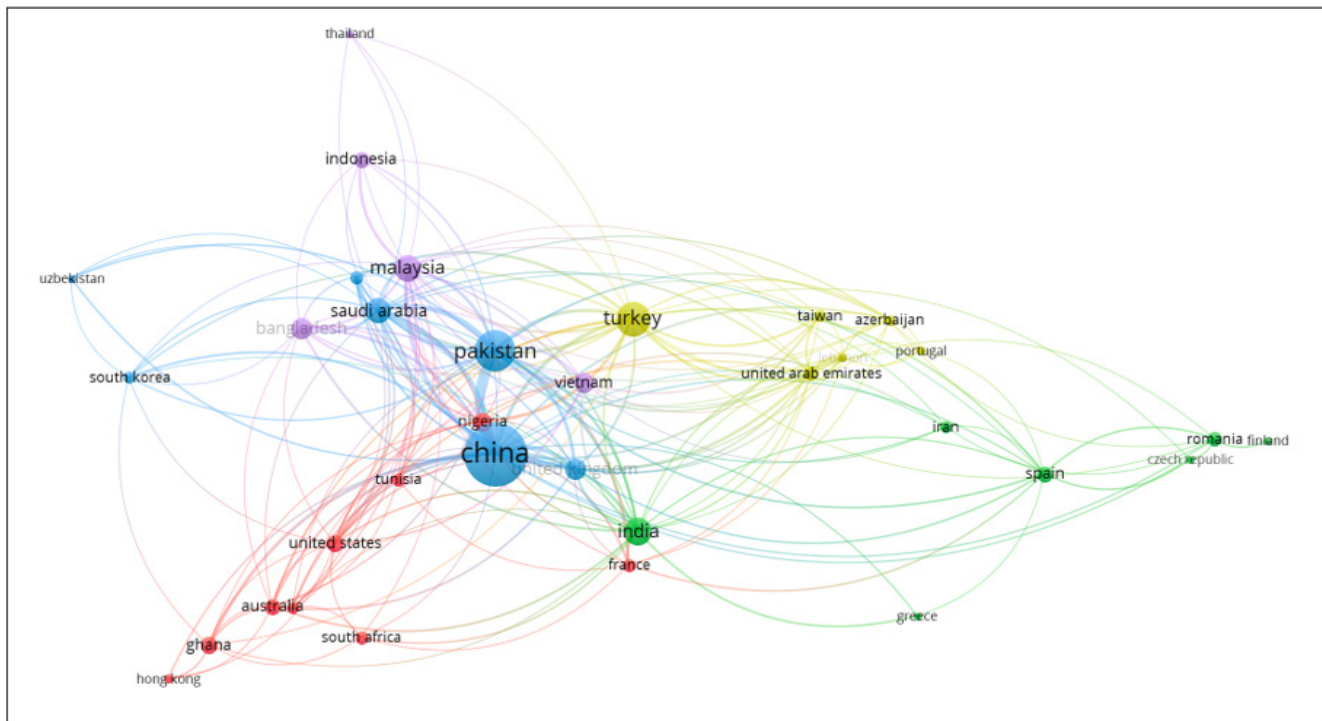


Figure 5: Network visualization maps of countries' collaboration.

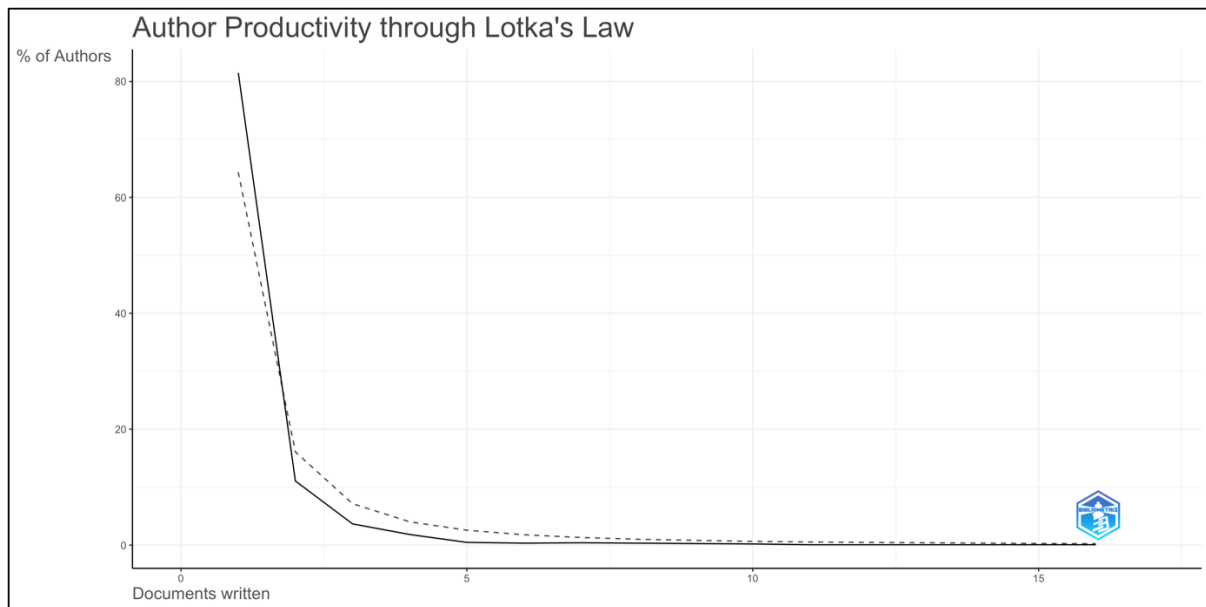


Figure 6: Authors' productivity through Lotka's Law.

Among these, “CO₂ emissions” is especially prominent, indicating a strong focus on the environmental consequences of FDI-driven energy use. Keywords such as “Investment” and “Economic Growth” show that the literature devotes substantial attention to the economic dimension of energy demand, while “Renewable Energy” reflects growing interest in sustainability transitions and clean technology adoption. “Economic Development” and “Sustainable Development” further suggest that the field increasingly addresses long-term growth strategies that incorporate environmental concerns.

The appearance of “Environmental Policy and Management” highlights the growing role of regulatory and institutional frameworks, while geographic terms such as “China” demonstrate the importance of specific national contexts, particularly rapidly developing economies. Additionally, the inclusion of “alternative energy” further reinforces the growing academic interest in sustainable energy transitions within the context of foreign investment. Overall, the keyword profile suggests that the literature has evolved towards a more integrated understanding of the interactions among FDI, energy systems, and environmental sustainability.

The keyword co-occurrence network shown in Figure 7 further provides a broader view of the thematic structure of the literature. The central positioning of “FDI,” “energy consumption,” “renewable energy,” and “CO₂ emissions” indicates that these concepts form the core of the research field.

Cluster 1 is strongly centered on FDI and its links with renewable energy, sustainable development, and energy efficiency. The presence of terms related to pollution and environmental degradation suggests sustained scholarly concern over the environmental costs of FDI-driven industrialization. The

inclusion of green finance and financial inclusion also indicates a newer line of inquiry focused on aligning investment flows with sustainability goals.

Cluster 2 highlights the use of econometric techniques, particularly the Autoregressive Distributed Lag model and the Vector Error Correction Model, in examining relationships among energy use, ecological footprint, and economic variables. The inclusion of country-specific terms such as Nigeria, Pakistan, and Turkey indicates a strong focus on regional empirical case studies.

Cluster 3 focuses on the relationship between CO₂ emissions and economic growth, particularly in the context of China, which remains central in both economic and environmental research. Cluster 4 centres on the Environmental Kuznets Curve hypothesis, linking economic development with changing environmental quality and energy consumption patterns.

Clusters 5, 6, and 7 extend the field into broader economic and institutional concerns, including financial development, trade openness, environmental sustainability, institutional quality, and urbanization. Smaller clusters capture niche but meaningful themes such as causality analysis, tourism, and governance-related factors. Taken together, these clusters suggest that the literature is increasingly organised around interconnected economic, environmental, and policy dimensions, reflecting the growing complexity and maturity of the field.

Future research avenues

The future research directions proposed here are derived from the bibliometric findings, especially the thematic patterns and gaps identified across the literature. While the field has generated important insights, several areas remain insufficiently explored.

Table 6: Highly cited articles.

Sl. No.	Authors and Year	Title	Source	Cites
1.	Sarkodie and Strezov (2019)	Effect of Foreign Direct Investments, economic development and energy consumption on greenhouse gas emissions in developing countries	Science of the Total Environment	901
2.	Pao and Tsai (2011)	Multivariate Granger causality between CO ₂ emissions, energy consumption, FDI (Foreign Direct Investment) and GDP (Gross Domestic Product): Evidence from a panel of BRIC (Brazil, Russian Federation, India, and China) countries	Energy	841
3.	Zhu, Duan, Guo, and Yu (2016)	The effects of FDI, economic growth and energy consumption on carbon emissions in ASEAN-5: Evidence from panel quantile regression	Economic Modelling	679
4.	Zafar, Zaidi, Khan, Mirza, Hou, and Kirmani (2019)	The impact of natural resources, human capital, and Foreign Direct Investment on the ecological footprint: The case of the United States	Resources Policy	592
5.	Tang and Tan (2015)	The impact of energy consumption, income and Foreign Direct Investment on carbon dioxide emissions in Vietnam	Energy	551
6.	Solarin, Al-Mulali, Musah, and Ozturk (2017)	Investigating the pollution haven hypothesis in Ghana: An empirical investigation	Energy	502
7.	Lee (2013)	The contribution of Foreign Direct Investment to clean energy use, carbon emissions and economic growth	Energy Policy	496
8.	Shahbaz, Nasreen, Abbas, and Anis (2015)	Does Foreign Direct Investment impede environmental quality in high-, middle-, and low-income countries?	Energy Economics	495
9.	Sbia, Shahbaz, and Hamdi (2014)	A contribution of Foreign Direct Investment, clean energy, trade openness, carbon emissions and economic growth to energy demand in UAE	Economic Modelling	483
10.	Shahbaz, Balsalobre-Lorente, and Sinha (2019)	Foreign Direct Investment-CO ₂ emissions nexus in Middle East and North African countries: Importance of biomass energy consumption	Journal of Cleaner Production	480

First, comparative studies across countries and regions are needed to better understand how institutional quality, policy frameworks, and technological readiness shape the impact of FDI on energy consumption. Such work would help generate context-sensitive insights and facilitate cross-regional learning.

Second, sector-specific investigations remain necessary. Future studies should examine how FDI affects energy consumption in sectors such as manufacturing, renewable energy, and transportation, thereby offering more targeted implications for policy and practice. Third, the strong prominence of renewable energy and sustainability themes indicates the need for further research on how FDI can accelerate clean energy transitions. This includes identifying the drivers and barriers shaping FDI inflows into renewable energy projects and assessing their effectiveness in improving energy efficiency and lowering emissions.

Fourth, more research is needed on policy and regulatory frameworks, particularly the role of subsidies, tariffs, and environmental regulations in shaping the sustainability outcomes of FDI. Fifth, future work should further investigate how FDI facilitates technological innovation and the transfer of advanced energy technologies. Finally, the broader socio-economic implications of FDI deserve greater attention. Future research should examine how FDI in the energy sector affects employment, income distribution, and social welfare, particularly in developing economies, to ensure that the benefits of investment are more equitably shared.

Overall, these future research avenues extend beyond the current findings by addressing underexplored themes and offering pathways for advancing both academic inquiry and evidence-based policymaking.

deeper insight into how themes evolve and how new directions emerge over time.

Overall, this study demonstrates that the FDI-energy consumption nexus has developed into a significant and evolving field of inquiry at the intersection of economic development, energy transition, and environmental sustainability. As global economies move towards more sustainable growth pathways, a deeper understanding of this nexus will remain essential for both informed policymaking and future research.

ACKNOWLEDGEMENT

The authors would like to express their sincere appreciation to Universiti Teknologi MARA (UiTM) for its support in facilitating the publication of this article.

ABBREVIATIONS

FDI: Foreign Direct Investment; **CO₂:** Carbon Dioxide; **GDP:** Gross Domestic Product; **BRIC:** Brazil, Russian Federation, India, and China; **ASEAN-5:** Association of Southeast Asian Nations-5; **ARDL:** Autoregressive Distributed Lag; **VECM:** Vector Error Correction Model; **UNCTAD:** United Nations Conference on Trade and Development; **RQ1:** Research Question 1; **RQ2:** Research Question 2; **RQ3:** Research Question 3.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

REFERENCES

- Adom, P. K., Opoku, E. E. O., & Yan, I. K.-M. (2019). Energy demand-FDI nexus in Africa: Do FDIs induce dichotomous paths? *Energy Economics*, 81, 928-941. <https://doi.org/10.1016/j.eneco.2019.05.030>
- Ahmadi, Z. (2023). Decomposing the Magnitude and Technical Effects of Financial Growth and FDI on Renewable Energy Use. *Journal of the Knowledge Economy*. <https://doi.org/10.1007/s13132-023-01564-7>
- Aliyu, A. J., & Ismail, N. W. (2015). Foreign direct investment and pollution haven: Does energy consumption matter in African countries? *International Journal of Economics and Management*, 9 (Special Issue), 21-39.
- Appiah-Otoo, I., Chen, X., & Ampah, J. D. (2023). Exploring the moderating role of foreign direct investment in the renewable energy and economic growth nexus: Evidence from West Africa. *Energy*, 281, art. no. 128346. <https://doi.org/10.1016/j.eneco.2023.128346>
- Baas, J., Schotten, M., Plume, A., Côté, G., & Karimi, R. (2020). Scopus as a curated, high-quality bibliometric data source for academic research in quantitative science studies. *Quantitative science studies*, 1(1), 377-386.
- Caetano, R. V., Marques, A. C., & Afonso, T. L. (2022). How can foreign direct investment trigger green growth? The mediating and moderating role of the energy transition. *Economies*, 10(8), Article 199. <https://doi.org/10.3390/economies10080199>
- Caetano, R. V., Marques, A. C., Afonso, T. L., & Vieira, I. (2023). Could private investment in energy infrastructure soften the environmental impacts of foreign direct investment? An assessment of developing countries. *Economic Analysis and Policy*, 80, 961-977. <https://doi.org/10.1016/j.eap.2023.09.030>
- Doytch, N., & Narayan, S. (2016). Does FDI influence renewable energy consumption? An analysis of sectoral FDI impact on renewable and non-renewable industrial energy consumption. *Energy Economics*, 54, 291-301. <https://doi.org/10.1016/j.eneco.2015.12.010>
- Grabara, J., Tleppayev, A., Dabylova, M., Mihardjo, L. W. W., & Dacko-Pikiewicz, Z. (2021). Empirical research on the relationship amongst renewable energy consumption, economic growth, and foreign direct investment in Kazakhstan and Uzbekistan. *Energies*, 14(2), art. no. 332. <https://doi.org/10.3390/en14020332>
- Jinapor, J. A., Abor, J. Y., & Graham, M. (2025). Energy consumption and inclusive growth in Sub-Saharan Africa: Does foreign direct investment make a difference? *Energy Policy*, 198, art. no. 114500. <https://doi.org/10.1016/j.enpol.2025.114500>
- Lee, J. W. (2013). The contribution of foreign direct investment to clean energy use, carbon emissions and economic growth. *Energy policy*, 55, 483-489.
- Mogota, A. T., & Djekonbe, D. (2022). Renewable Energy and Economic Growth: The Role of Foreign Direct Investment in Sub-Saharan Africa. *Economic Research Guardian*, 12(2), 115-128.
- Pao, H. T., & Tsai, C. M. (2011). Multivariate Granger causality between CO₂ emissions, energy consumption, FDI (foreign direct investment) and GDP (gross domestic product): evidence from a panel of BRIC (Brazil, Russian Federation, India, and China) countries. *Energy*, 36(1), 685-693.
- Rath, B. N., Dash, A. K., & Mishra, A. K. (2024). The linkage between FDI and energy use in the case of emerging market economies. *Environment, Development and Sustainability*. <https://doi.org/10.1007/s10668-024-05747-3>
- Salim, R., Yao, Y., Chen, G., & Zhang, L. (2017). Can foreign direct investment harness energy consumption in China? A time series investigation. *Energy Economics*, 66, 43-53. <https://doi.org/10.1016/j.eneco.2017.05.026>
- Sarkodie, S. A., & Strezov, V. (2019). Effect of foreign direct investments, economic development and energy consumption on greenhouse gas emissions in developing countries. *Science of the total environment*, 646, 862-871.
- Sbia, R., Shahbaz, M., & Hamdi, H. (2014). A contribution of foreign direct investment, clean energy, trade openness, carbon emissions and economic growth to energy demand in UAE. *Economic modelling*, 36, 191-197.
- Shahbaz, M., Balsalobre-Lorente, D., & Sinha, A. (2019). Foreign direct Investment-CO₂ emissions nexus in Middle East and North African countries: Importance of biomass energy consumption. *Journal of cleaner production*, 217, 603-614.
- Shahbaz, M., Nasreen, S., Abbas, F., & Anis, O. (2015). Does foreign direct investment impede environmental quality in high-, middle-, and low-income countries? *Energy Economics*, 51, 275-287.
- Solarin, S. A., & Al-Mulali, U. (2018). Influence of foreign direct investment on indicators of environmental degradation. *Environmental Science and Pollution Research*, 25(25), 24845-24859. <https://doi.org/10.1007/s11356-018-2562-5>
- Solarin, S. A., Al-Mulali, U., Musah, I., & Ozturk, I. (2017). Investigating the pollution haven hypothesis in Ghana: an empirical investigation. *Energy*, 124, 706-719.
- Tang, C. F., & Tan, B. W. (2015). The impact of energy consumption, income and foreign direct investment on carbon dioxide emissions in Vietnam. *Energy*, 79, 447-454.
- United Nations Conference on Trade and Development. (2013). World investment report 2013: Global value chains: Investment and trade for development. United Nations.
- United Nations Conference on Trade and Development. (2014). World investment report 2014: Investing in the SDGs: An action plan. United Nations.
- Zafar, M. W., Zaidi, S. A. H., Khan, N. R., Mirza, F. M., Hou, F., & Kirmani, S. A. A. (2019). The impact of natural resources, human capital, and foreign direct investment on the ecological footprint: the case of the United States. *Resources Policy*, 63, 101428.
- Zangoei, S., Salehnia, N., & Khodaparast Mashhadi, M. (2021). A comparative study on the effect of alternative and fossil energy consumption on economic growth and foreign direct investment in selected countries using SUR approach. *Environmental Science and Pollution Research*, 28(16), 1979919809. <https://doi.org/10.1007/s11356-020-11575-5>
- Zhu, H., Duan, L., Guo, Y., & Yu, K. (2016). The effects of FDI, economic growth and energy consumption on carbon emissions in ASEAN-5: evidence from panel quantile regression. *Economic Modelling*, 58, 237-248.

Cite this article: Khan HHA, Ghani RA, Othman MH, Handri, Azib. Exploring the Nexus between Foreign Direct Investment and Energy Consumption: A Bibliometric Analysis of Global Research Trends. *J Scientometric Res*. 2026;15(2):510-21.