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Green Financing Using Islamic Finance Instruments in Indonesia: A Bibliometrics and Literature Review

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ABSTRACT

Indonesia needs financial assistance to meet the emission reduction target by 2030, projected to cost USD 118 billion by developing renewable energy plants. The government cannot rely on the state budget in achieving the emission reduction target, so other financing innovations are needed. Islamic finance, with its unique principles and instruments, can play a significant role in this endeavour. This research attempts to investigate the interconnection between green finance and Islamic finance within the domain of energy transition in Indonesia. An study of bibliometrics using Vosviewer software and a literature review using the PRISMA concept were performed to provide a thorough overview and identify future research directions based on past works in the Scopus database on green finance and Islamic finance instruments. This research used 42 journal articles from 2014 to 2024. Studies within this group delve deeper into Islamic finance as a viable alternative for implementing sustainability concepts in the financial domain.

Keywords: Green Finance, Islamic Finance, Renewable Energy, Sustainable Economy, Energy Transition
JEL Classifications: G32, P18, P28, Q01, Q56

1. INTRODUCTION

Indonesia is committed to tackling climate change by outlining its Intended Nationally Determined Contributions (NDCs). These contributions aim to reduce greenhouse gas (GHG) emissions by 29% through domestic efforts and 41% with international assistance by 2030. Indonesia's primary goal in addressing greenhouse gas (GHG) emissions is to achieve carbon neutrality by 2060 or earlier. This goal will be achieved by progressively aligning with the Long-term Strategy for Low Carbon and Climate Resilience policies. Irfan et al. (2022) predict that the goals set in different nations' Nationally Determined Contributions (NDCs) will likely be achieved, and governments may gradually increase their climate ambition ambitions. Hence, the Indonesian government has designated the Energy Sector as one of the five crucial sectors that require prioritization to achieve the greenhouse gas (GHG) reduction target by 2030. Therefore, it is imperative to promptly adopt energy transition efforts to achieve the highly ambitious goal by 2030.

The Ministry of Energy and Mineral Resources (MEMR), Republic of Indonesia states that Indonesia needs up to USD 36.95 billion in investment to achieve a renewable energy mix target of 23% by 2025 (EBTKE, 2020). Besides, Indonesia needs financial assistance to meet the emission reduction target by 2030, projected to cost USD 118 billion by developing renewable energy plants. (Boer et al., 2021) However, the Climate Policy Initiative (CPI) Report found a significant yearly investment gap of up to 98% in Indonesia to generate power from renewable energy sources. (Wijaya et al., 2020) This investment gap highlights the need for increased financial support to pursue NDCs' targets through the energy sector. Without sufficient funding, Indonesia will struggle to develop and scale up its renewable energy infrastructure, hindering progress towards its target of 23% renewable energy mix by 2025. Therefore, the government and policymakers must prioritize and allocate resources towards renewable energy projects, as they reduce greenhouse gas emissions, diversify the energy mix, and promote sustainable development in the country.

The number of papers exploring financing potential for renewable energy development is enormous. Research by Belgacem et al. (2023) looks at the effects of financial innovation and renewable energy on Saudi Arabia's and the United Arab Emirates' environmental protection from 2010 to 2021. The research found that Renewable Energy sources and financial innovation play an important sector for environmental safety and sustainable development. Besides, the authors mentioned that RE significantly provide environmental protection that non-renewable sources. As mentioned by Young (2018), a larger amount of funding is available on the global platform to support renewable energy-related assets. Thus, to being a prerequisite for sustainable energy development, overcoming the financing barrier is the key to unleashing the immense economic, environmental, and social benefits renewable energy can offer.

However, prior literature has substantially contributed to multiple facets of renewable energy advancement (Klimenko et al., 2021; Sen and Ganguly, 2017; Udin, 2020). Research by Isah et al. (2023) also mentioned that to mobilize adequate investment in low-carbon technology, renewable energy must overcome financial, policy, and economic obstacles, particularly in low and middle-income nations. Current studies on renewable energy development discovered that financing is a crucial issue that should be considered (Azhgaliyeva et al., 2020). Specifically, limited access to affordable financing options hinders the widespread adoption of renewable energy technologies, according to a study (Liebman et al., 2019). Moreover, it emphasizes the need for innovative financial mechanisms and policies to attract investments and support the country's expansion of renewable energy initiatives (Kirari et al., 2018). Innovative financial mechanisms, clear regulatory frameworks, and collaborative partnerships will be essential drivers of progress as the nation endeavours to achieve its renewable energy goals and contribute to global climate goals.

Further, previous research suggests future opportunities to explore Islamic finance instruments as an alternative green financing tools (Akomea-Frimpong et al., 2022; Jaafar and Brightman, 2022; Pathan et al., 2022; Myronchuk et al., 2024; Kamaruddin et al., 2024). Islamic academics, financial professionals, and environmental think tanks have maintained that green finance, which aims to direct investments toward projects that improve the environment, and Islamic finance is intrinsically compatible (Ahmed et al., 2015; Obaidullah, 2017). Moreover, Islamic finance contributes to developing renewable energy projects by adhering to equity, fairness, and justice (Al-Ketbi and Nobanee, 2020). On the other hand, Liu and Lai (2021) argue that Islamic finance has limited contribution to climate action initiatives. Despite the differing opinions, it is evident that the potential of Islamic finance to support green financing in advancing climate and environmental goals.

This research is expected to be a recommendation for regulators to provide directions for stakeholders in the fields of both Islamic economics, finance, and the renewable energy industry. The synergy between the government, Islamic financial institutions, practitioners of Islamic economics and renewable energy, and academics is needed for the acceleration of energy transition in Indonesia. This collaborative effort would involve creating a macro structure of regulatory framework that encourages the use of Islamic finance instruments for green financing. This would attract more investors who are interested in aligning their financial goals with sustainable and ethical practices. Additionally, by leveraging the expertise of academics and professionals, innovative financing solutions can be developed to address the current challenges in energy transition in Indonesia.

2. LITERATURE REVIEW

2.1. Green Financing

The concepts of green financing, particularly in renewable energy investment, environmental sustainability investment, and social impact investment, have gained increasing attention from the public in the recent decade (Morano et al., 2020; Taghizadeh-Hesary and Yoshino, 2020; Zhongping et al., 2023). As a means of bringing attention to the potential for renewable energy investment, this study attempts to examine green financing through Islamic finance instruments, such as sukuk, waqf, and takaful, as the unit of analysis to enhance the advancement of renewable energy in Indonesia. The Islamic finance instrument as an alternative green financing product is a suitable approach to resolving the underachievement issues arising in Indonesia's renewable energy investment due to the low cost of funds. Thus, it has the potential to attract more investors and accelerate the growth of the renewable energy sector in the country.

Green financing has been introduced as an alternative solution to enhance renewable energy investment. According to Wang and Zhi (2016), green financing is a novel financial mechanism that aims to safeguard the environment and promote the sustainable use of resources. A critical coverage in green finance is measures to mitigate the risk of natural damage, including investment or financing in infrastructure construction projects from new and renewable energy sources (Agrawal et al., 2023; Wang and Zhi, 2016). For example, since 2017, Indonesia has issued a green scheme to finance eligible green projects related to new and regenerative energy, waste management into energy, and other environmentally friendly energy conversion projects (Azhgaliyeva et al., 2020).

Different parts of the world apply the concept of green financing with different financial instruments. The green financing instrument whose popularity has increased significantly in the last decade in Asian countries is green bonds (Durrani et al., 2020). Green Bonds were first introduced in Europe by the European Investment Bank in 2007 (Gilchrist et al., 2021). Although it has been 15 years since it was first published, its popularity has only increased in the last 7 years, especially when China joined the green bond exchange in 2015 and became the world's largest green bond issuer (Ning et al., 2022). Since then, the growth in the world's nominal number of green bonds has increased significantly over time. Dealogic and Bloomberg recorded the total nominal green bonds issued globally amounting to $228.2 billion in 2019, up six times as high as the recorded $36.6 billion in 2014 (Deschryver and de Mariz, 2020).

Muslim-majority countries implement alternative schemes other than green bonds. Muslim countries have used green sukuk, such

as Indonesia (Abubakar and Handayani, 2020; Musari, 2021), Malaysia (Abdullah and Nayan, 2020; Liu and Lai, 2021) Pakistan (Nehal, 2021), and Sub-Saharan Africa (Aassouli et al., 2018). This practice is prominently well-known because green bonds use interest rates, which Islamic principles prohibit. Nevertheless, the green Sukuk is not only used in Muslim-majority countries; countries with non-Muslim-maximum populations, like Italy, also apply the green Sukuk in funding green projects in their country (Morea and Poggi, 2017).

Green loans are another form of green financing instrument that has grown considerably in some countries. Unlike the green bonds and the green coins generally issued by governments and private companies, green loans are instruments issued through financial institutions (Gilchrist et al., 2021; Li et al., 2018; Li et al., 2018). For example, the phenomenon of green loans has grown considerably in Bangladesh, where banking institutions are involved in financing green projects (Julia and Kassim, 2016). Many of the benefits that banks have gained from providing green loans can enhance the bank's reputation as an environmentally friendlyinstitution (Zhang et al., 2022). As in China, banks with high green loan ratios impact low non-performing loans (NPLs) ratios (Cui et al., 2018).

In addition to products that generate returns, green financing instruments include non-interest products that are more social, such as the Corporate Social Responsibility (CSR) Fund. This instrument is widely implemented in countries with relatively high population poverty rates, such as India and Indonesia (Wahyuni et al., 2019). Private companies issue the CSR Fund to demonstrate their commitment to social responsibility towards the environment. However, minimal touches the energy sector, while energy is a basic human need due to a lack of knowledge, ideas, and the obligation to operate it (Bir Bista, 2019). The role of the CSR Fund will be significant in the financing of green projects once it has entered the policy level by the regulator). Lastly, the green financing instrument with voluntary characteristics that has begun to be used in the development of green projects is Waqf. Waqf is an instrument in Islamic finance used to fund charitable activities in the form of unconsumed assets (Fadilah, 2015). Previous research stated that Waqf can be used to finance the development and development of green projects related to zero waste initiatives to promote a circular economy because it is by the Maqashid Sharia in Islam (Khan, 2019).

The literature review on green financing shows the limitations, challenges, and future research opportunities to develop a new conceptual framework of green financing in the context of energy transition (Table 1). These limitations encompass the lack of standardized metrics to evaluate the environmental impact of green financing initiatives. Furthermore, challenges include the need for greater collaboration between financial institutions and environmental organizations to ensure effective implementation.

Based on the prior studies above, scholars find that green finance have challenges and limitation in practice such as limited impact on environmental economy and different impact among regional (Trukhachev and Dzhikiya, 2023; Wang and Wang, 2021). Green

Table 1: Limitations, challenges, and future opportunities of green financing

No	Source of literature	Limitations and challenges	Future opportunities
1	(Trukhachev and Dzhikiya, 2023)	- Undefined causal relationships between green finance and economic management.	- Assessing green finance's impact on achieving Sustainable Development Goals.
2	(Wang and Wang, 2021)	- Limited size of green finance hampers potential development. - Complex financing of new technology slows ecological sustainability progress.	- Investigate the impact of green financing on energy transition. - Explore renewable energy innovations for E7 economies. - Analyze the effects of energy sovereignty on energy transitions.
3	(Taghizadeh-Hesary and Yoshino, 2020)	- Lack of long-term financing - Low rate of return	- - Investigate innovative financing models for green energy projects. - Analyze the role of non-banking financial institutions in green financing.
4	(Soundarrajan and Vivek, 2016)	- Limited funding sources for green industries at different maturity levels. - Lack of awareness about green technologies among MSMEs.	- - Investigate regulatory gaps in green finance infrastructure. - Assess technology diffusion in eco-efficient infrastructure investments.
5	(Sharma et al., 2022)	- Green finance is in a relatively marginal state of research. - Lacking advanced financial product design and technical support	- Explore green finance's impact on sustainable development goals. - Analyze the role of fintech in promoting green finance.
6	(Selvapandian et al., 2022)	- The study lacks comprehensive regional analysis. - Limited to data from 30 provinces in China.	- Establish a comprehensive green financial indicator system. - Explore green finance's impact on industry energy consumption structure.
7	(Annenskaya and Nazar'yants, 2020)	- Limited studies on government regulation's impact on renewable energy consumption. - Lack of empirical evidence on green finance's firm-level effects. - Few examinations of green finance in emerging markets	- Study the interplay between green finance and technological innovation. - Analyze consumer behavior towards renewable energy adoption. - Assess digital transformation's role in renewable energy utilization.

finance is also associated to long-term financing and low return on investment (Selvapandian et al., 2022; Taghizadeh-Hesary and Yoshino, 2020). Further, Soundarrajan and Vivek (2016) urge that private investment in green project is less competitive and mispricing in capital market. Lastly, Annenskaya and Nazar'yants (2020) find that there is lack of regulatory framework for green finance particularly in Russia. Thus, there is a need for the development of policies and regulations to encourage and support green finance initiatives throughout the world.

Based on the prior studies above, scholars find that green finance is a critical driver for sustainable development, yet it faces several limitations that hinder its full potential. Research by Trukhachev and Dzhikiya highlights undefined causal links between green finance and economic management, emphasizing the need to assess its impact on achieving Sustainable Development Goals (SDGs). Similarly, Wang et al. identify challenges like limited green finance size and complex financing models for new technologies, which slow ecological progress. Opportunities lie in exploring green financing's impact on energy transitions, renewable innovations, and energy sovereignty. Taghizadeh-Hesary and Yoshino emphasize the lack of long-term financing and low returns on investments in green projects, calling for innovative financing models and the involvement of non-banking institutions. Further, Soundarrajan and Vivek note limited funding sources for green industries and a lack of awareness about green technologies among MSMEs. They suggest addressing regulatory gaps and promoting eco-efficient infrastructure technologies. Sharma et al. raise concerns about sample biases and the lack of bank-specific issues in research, urging exploration of fintech's role and green finance's impact on SDGs. Gu et al. highlight a lack of comprehensive regional data and suggest creating a green financial indicator system to analyze its impact on energy consumption structures. Lastly, Cheng et al. point to limited studies on government regulation and firm-level effects, with particular gaps in emerging markets. They propose studying the interplay between green finance, technological innovation, consumer behavior, and digital transformation in renewable energy adoption.

2.2. Islamic Finance

Today, Islamic finance has become an integral part of the global financial system, attracting both Muslim and non-Muslim investors seeking ethical and socially responsible investment opportunities (Rahman et al., 2020). Over time, dialogues concerning Islamic social finance such as sukuk and waqf have emerged within the community of Muslim economists. Currently, Islamic banking in the world has also been integrated with Sukuk in its financial activities (Ibrahim, 2015). In principle, Islamic economics and finance are mutually integrated. Islamic commercial financial institutions are also expected to have an impact socially (Ascarya et al., 2022).

In recent years, Islamic finance has begun contributing to sustainable development. Al-Ketbi and Nobanee (2020) outlined several research exploring Islamic finance potential for environmental projects, likely renewable energy. This research highlights how Islamic finance can play a crucial role in supporting the transition towards clean energy. By utilizing Islamic financing principles such as waqf, renewable energy projects can receive very low cost of capital funding which adhering to ethical and sustainable practices. Following that, in the Bangladesh case, Julia and Kassim (2020) state that Bangladesh's commercial banks can satisfy the requirements of green finance. This not only ensures the preservation of the environment but also promotes economic growth and social welfare in Muslim-majority countries where Islamic finance is prevalent.

The literature review on Islamic finance for environmental projects is shown in Table 2. The review includes the limitation and challenge of Islamic finance in promoting environmental projects. It also highlights the future opportunity in research of Islamic finance for renewable energy sector. Overall, the literature review provides a comprehensive overview of the current research and developments in Islamic finance for environmental projects.

Table 2 explores the challenges and opportunities associated with Islamic finance, particularly green sukuk, in advancing

Table 2: Limitation, challenge, and future opportunity of islamic finance for environmental projects

No	Source of literature	Limitation and challenge	Future opportunity
1	(Morea and Poggi, 2017)	• Limited familiarity with Islamic finance among conventional investors	• Investigate the impact of sukuk on renewable energy financing
2	(Raeni et al., 2022)	• Limited transparency in financial and GHG accounting systems • Problems in connecting financial flows to sukuk funded projects	• Assess effectiveness of assurance in climate finance initiatives • Investigate integration of private financial flows in green initiatives
3	(Abdullah and Keshminder, 2022)	• Limited studies on drivers impacting green sukuk issuance	• Explore wider geographical contexts for green sukuk.
4	(Alam et al., 2023)	• Green sukuk has limitations in financial accounting systems.	• Future research should focus on comprehensive growth strategies for green sukuk
5	(Siswantoro and Mahmud, 2023)	• Lack of geographical diversity in existing green finance studies. • Insufficient studies on green sukuk in Asia.	• Future studies should include diverse geographical areas. • Explore cash waqf linked sukuk as a financial instrument.
6	(Karim, 2023)	• Islamic finance faces unique legal challenges in energy projects. • Lack of standardised legal frameworks creates ambiguity and uncertainty	• Further empirical analysis of Islamic finance in energy transitions. • Investigate legal frameworks supporting Islamic finance in energy projects.

sustainability and renewable energy initiatives. Morea and Poggi highlight limited familiarity with Islamic finance among conventional investors, suggesting the need to investigate the role of sukuk in financing renewable energy. Raeni et al. identify challenges such as limited transparency in financial and greenhouse gas (GHG) accounting systems and difficulties in linking financial flows to sukuk-funded projects. They propose assessing the effectiveness of climate finance assurance mechanisms and integrating private financial flows into green initiatives. Abdullah and Keshminder note a lack of research on the drivers behind green sukuk issuance, calling for studies that explore its application in broader geographical contexts. Alam et al. address limitations in financial accounting systems for green sukuk, advocating for research on comprehensive growth strategies for this instrument. Faisal et al. point out insufficient geographical diversity in existing green finance studies, with a specific gap in research on green sukuk in Asia. They propose expanding studies to diverse regions and exploring innovative financial tools like cash waqf-linked sukuk. Karim highlights unique legal challenges faced by Islamic finance in energy projects, exacerbated by the lack of standardized legal frameworks, which creates ambiguity and uncertainty. Opportunities include empirical analysis of Islamic finance's role in energy transitions and examining supportive legal frameworks for energy projects. Overall, while green sukuk offers significant potential for financing sustainability, challenges like limited transparency, geographical scope, and legal ambiguities must be addressed. Future opportunities lie in expanding research to diverse regions, integrating private financial flows, and developing innovative instruments and legal frameworks to enhance Islamic finance's role in addressing global sustainability goals.

3. METHODS

A literature review with bibliometric analysis was conducted to identify relevant research and assess their specific contributions to the green finance and Islamic finance implementation. The Scopus databases utilized in this study which also employed categorizations to define the nature of the aims, encompassing exploratory and descriptive inductive reasoning, while gathering data from both primary and secondary sources. The results were

Table 3: Keyword queries

Keyword A	Keyword A and B	Keyword A and C
"Islamic Financ*" OR "Sharia Financ*" OR "Sukuk" OR "Waqf" OR "Zakat" OR "Islamic Bond"	"Green financ*" OR "green Investment" OR "sustainable financ*" OR "climate financ*"	"Renewable energy" OR "Clean Energy" OR "Green Energy" OR "Renewable Energy Investment" OR "Energy Transition"

Figure 1: Preferred reporting items for systematic reviews and meta-analysis methodology to review keywords

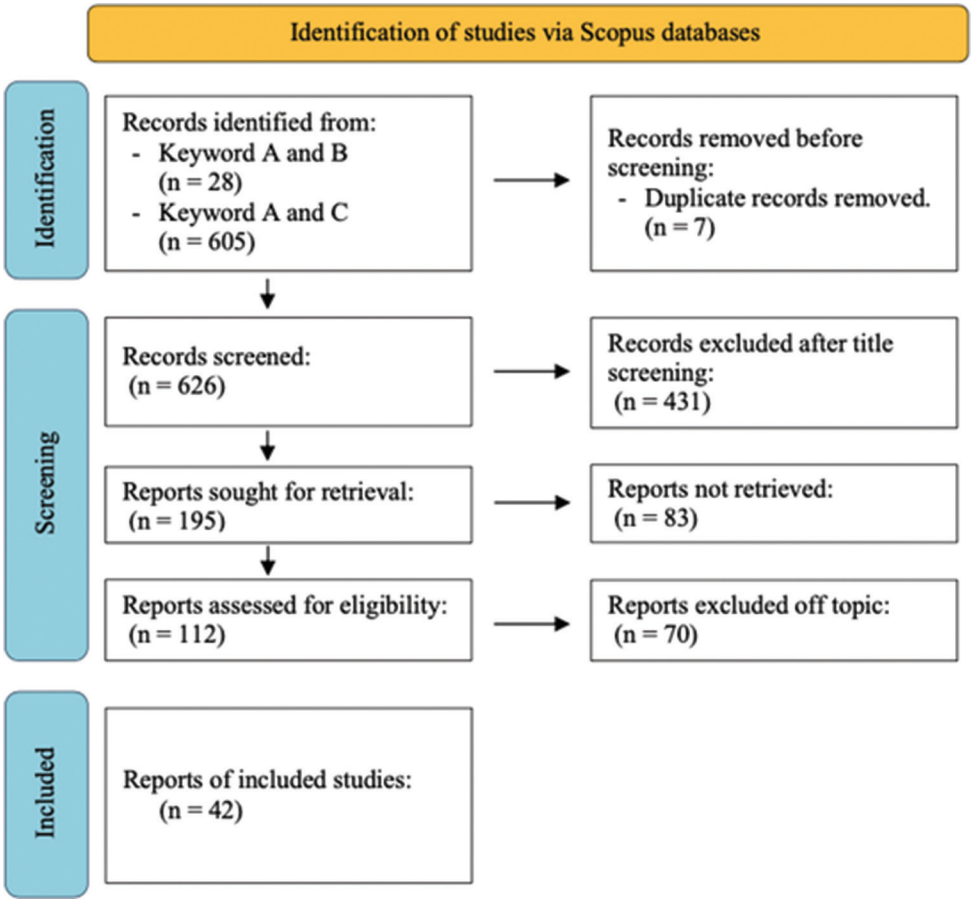
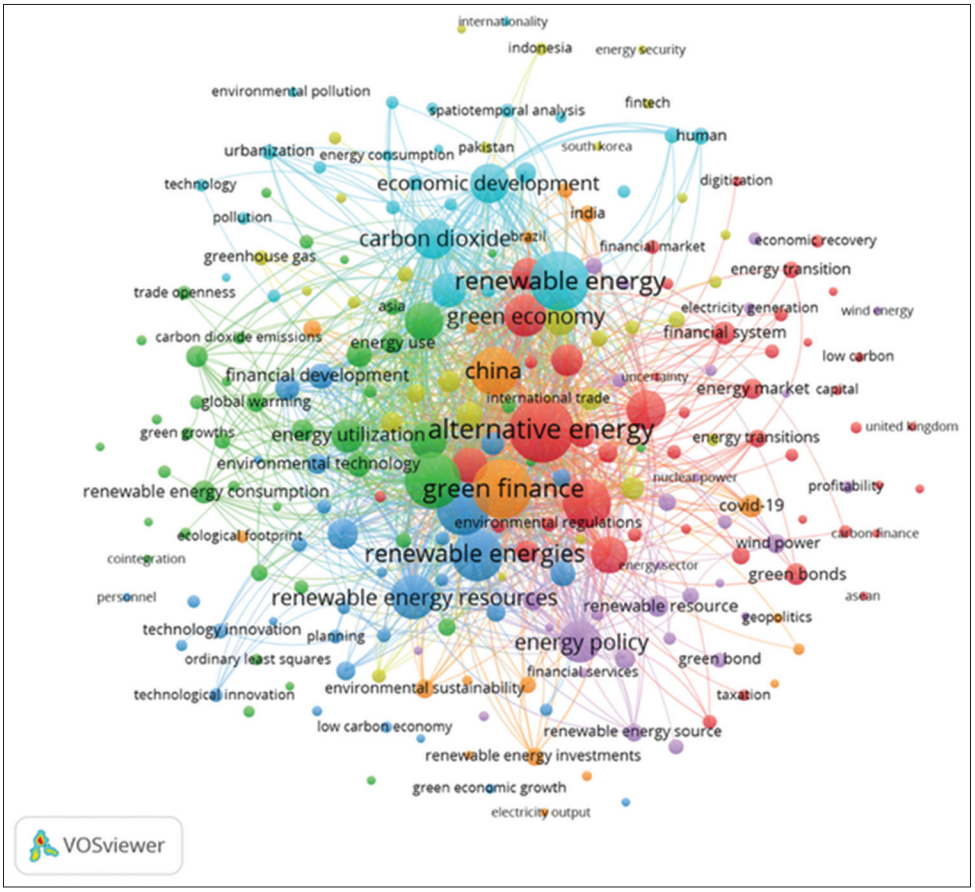


Figure 2: Co-occurrence of keyword network visualization



obtained by applied research, where the methodology involved utilizing existing literature to identify developing difficulties in several areas such as green financing, Islamic finance instrument, and energy transition. Initially, we categorized the keywords into three distinct groups, allowing us to combine subjects and obtain more pertinent material. The selected time frame is the decade spanning from 2014 to 2024. The authors consider the previous decade to be a suitable timeframe for gathering and analyzing empirical and theoretical data. While several theories addressed in this study may trace their origins back to ancient times, they delve deeply into fundamental concepts of thinking. Table 3 provides a detailed description of the various combinations of keywords.

The detail of search queries is shown below,

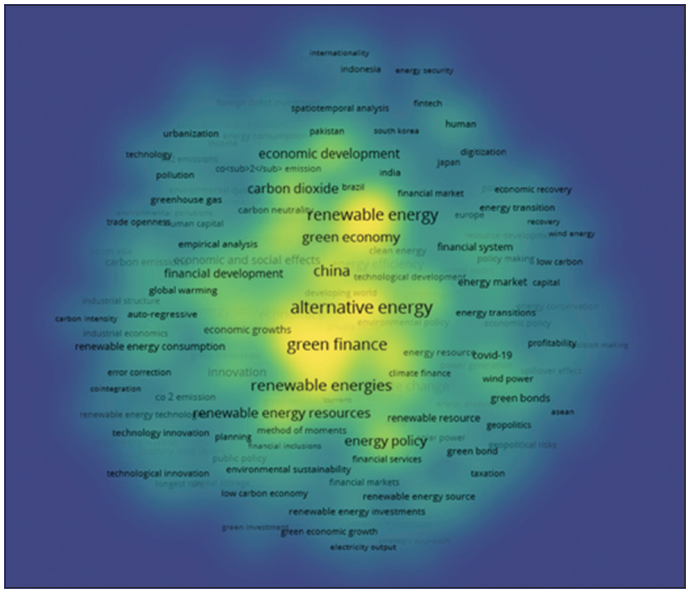
1. Keyword A and B

(TITLE-ABS-KEY ("Islamic financ*" OR "Sharia financ*" OR "Sukuk" OR "Waqf" OR "Zakat" OR "Islamic Bond") AND TITLE-ABS-KEY ("green financ*" OR "green investment" OR "sustainable financ*" OR "climate financ*")) AND PUBYEAR > 2013 AND PUBYEAR < 2025 AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (DOCTYPE , "ar"))

2. Keyword A and C

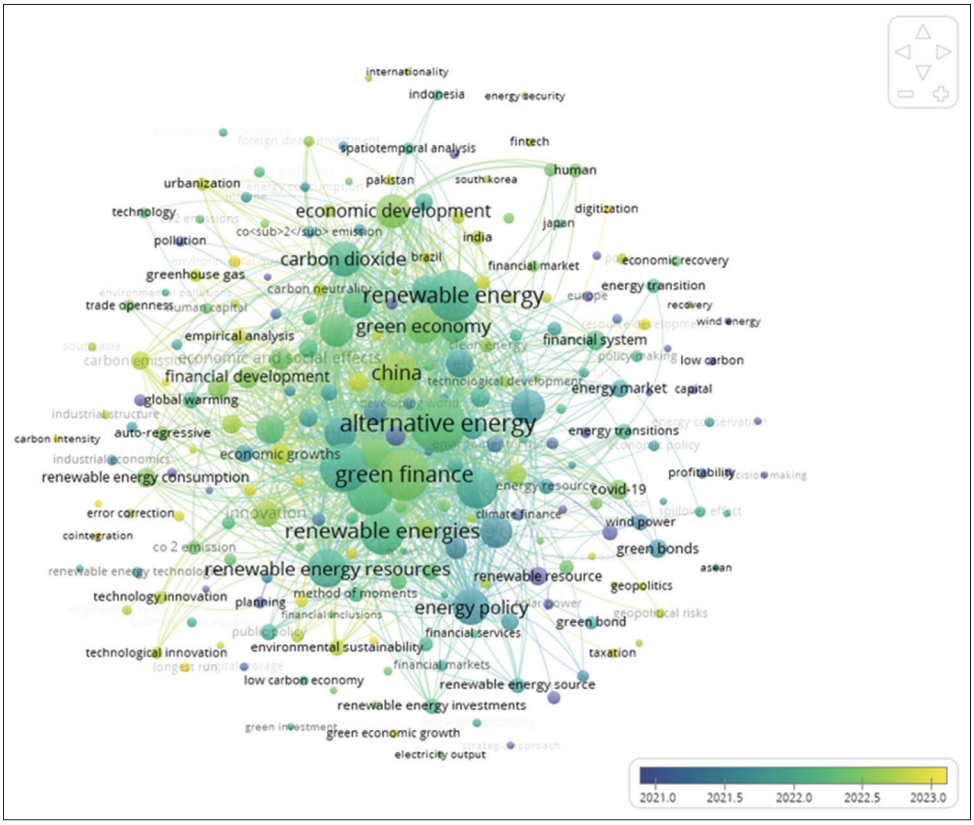
(TITLE-ABS-KEY ("Islamic financ*" OR "Sharia financ*" OR "Sukuk" OR "Waqf" OR "Zakat" OR "Islamic Bond") AND TITLE-ABS-KEY ("Renewable energy" OR "Clean Energy" OR "Green Energy" OR "Renewable Energy Investment" OR "Energy Transition")) AND PUBYEAR > 2013 AND PUBYEAR < 2025 AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (DOCTYPE , "ar"))

Figure 3: Co-occurrence of keyword density visualization



The subsequent phase of analysis will employ the preferred reporting items for systematic reviews and meta-analysis (PRISMA)

Figure 4: Co-occurrence of keyword based on average publication per year



methodology. PRISMA is a standardized collection of essential elements for documenting findings in systematic reviews and meta-analyses, based on empirical evidence. PRISMA primarily focuses on reporting reviews that assess the effectiveness of interventions. However, it can also serve as a framework for reporting systematic reviews with purposes that go beyond evaluating interventions. The following steps (Figure 1) were performed as suggested by PRISMA 2020 statements (Page et al., 2021).

4. RESULTS AND DISCUSSION

The keywords "green finance" and "renewable energy" from Scopus databases, accessed on 8 November 2024, were analyzed using VOSviewer software to find the existing literature from the past decade that has been investigated by previous scholars. By analyzing two primary terms, the author discerned the overarching concept and discovered a potential for novelty. Figure 2 depicts a network visualization of the connections found by co-occurrence keyword analysis.

Prior scholarly works have discussed the relationship between Islamic finance and green finance. The green finance and Islamic finance are primarily associated with the alternative instrument such as Sukuk. The adoption of the Islamic finance and green finance in renewable energy sector has a substantial influence on sustainability development, leading to increased interest from researchers and practitioners conducting more research. Another connection between the green finance and Islamic finance is linked to green economy, sustainable financing, social financing, Islamic banking, fintech, and other related factors.

In addition, VOSviewer allows us to examine the density of our research interests. The density visualization produced by the spectrum visualization helps us determine which sectors have been often investigated by scholars and which sectors are yet unexplored or have limited investigation (Figure 3).

The visualization of density based on main keywords indicates that the potential for study related to "renewable energy". This low density suggests that there is a lack of integration and collaboration between the green finance and Islamic finance in renewable energy sector. Thus, there is a need for further research and exploration to understand the reasons behind this limited study and to identify strategies for fostering stronger connections. By establishing stronger ties between green finance and Islamic finance, we may effectively channel financial resources towards sustainable and clean energy projects, ultimately contributing to the achievement of Indonesia NDC in 2030.

Other analysis conducted using VOSviewer is a co-occurrence keyword analysis based on the recent year of publication. The time frame described above was ten years between 2014 and 2024, but this data visualization shows that research on green finance and Islamic finance began to take shape in 2019 and has been quickly expanding ever since (see Figure 4). The data visualization also indicates that research on green finance and Islamic finance is likely to continue growing in the future. This is evident from the increasing number of recent publications and the clustering of keywords related to sustainability, sdg, and Islamic bonds. These findings highlight the growing interest and importance of green finance and Islamic finance in the academic

community, as well as the potential for future advancements and innovations in the green energy sector. It also suggests that researchers are recognizing the urgency of transitioning to a more sustainable and climate-friendly financial system through Islamic bonds (sukuk) and waqf.

5. CONCLUSION

Indonesia's commitment to tackling climate change through its Intended Nationally Determined Contributions (NDCs) demonstrates the nation's dedication to reducing greenhouse gas emissions and achieving carbon neutrality by 2060 or earlier. However, significant challenges remain, particularly in closing the investment gap required to scale up renewable energy infrastructure. The country must prioritize the development of renewable energy projects, which are essential for meeting its ambitious targets and contributing to global climate goals. Addressing these challenges will require innovative financial mechanisms, clear regulatory frameworks, and collaborative partnerships between the government, financial institutions, and other stakeholders. Islamic finance emerges as a promising alternative for green financing, offering the potential to align investment strategies with sustainable and ethical practices. By leveraging this synergy, Indonesia can accelerate its energy transition and make meaningful progress toward its climate ambitions. Ultimately, the success of these efforts will depend on the ability of all stakeholders to work together in creating a sustainable and resilient energy future for Indonesia.

Moreover, the increasing attention towards green financing in the last decade reflects a global shift towards sustainable investment practices, particularly in renewable energy, environmental sustainability, and social impact investments. Indonesia's adoption of green financing instruments, especially through Islamic finance products such as sukuk, waqf, and takafulz, highlights a strategic approach to overcoming the challenges in renewable energy investment. These instruments not only align with Islamic principles but also offer low-cost funding options that have the potential to attract more investors, thereby accelerating the growth of the renewable energy sector in Indonesia. The global landscape of green financing shows a diverse application of financial instruments, with green bonds gaining popularity worldwide and green sukuk emerging as a viable alternative in Muslim-majority countries. Additionally, the growth of green loans and the role of CSR funds underscore the expanding repertoire of green financing options available to governments and private sectors alike.

Also, Islamic finance has increasingly become a vital component of the global financial system, appealing to both Muslim and non-Muslim investors interested in ethical and socially responsible investment opportunities. The integration of Islamic social finance, such as zakat and waqf, into broader financial activities underscores the holistic nature of Islamic economics, which seeks to balance commercial objectives with social impact. As Islamic finance continues to evolve, its role in supporting sustainable development, particularly in environmental projects like renewable energy, has gained prominence. Research indicates that Islamic financial principles, such as those applied in waqf, can provide low-cost funding for renewable energy initiatives, aligning with ethical and sustainable practices. This potential is evident in various contexts, such as in Bangladesh, where Islamic financial institutions are increasingly contributing to green finance, promoting both environmental preservation and socio-economic growth. Despite the progress, challenges and limitations remain in fully realizing the potential of Islamic finance for environmental projects. These include the need for more research and development to overcome obstacles and expand the scope of Islamic finance in supporting the renewable energy sector. However, the opportunities for future exploration are vast, offering a promising outlook for the continued integration of Islamic finance into global efforts toward sustainability.

The relationship between green finance and renewable energy has garnered significant attention in recent years, particularly in the context of advancing alternative energy solutions and promoting a green economy. The increasing interest from researchers and practitioners highlights the importance of understanding how green finance can effectively support renewable energy investments and contribute to broader economic development and environmental sustainability. The use of tools like VOSviewer has provided valuable insights into the research landscape, revealing areas of high and low research density. The findings indicate a notable gap in the integration and collaboration between green finance and renewable energy investments, suggesting an urgent need for further exploration in this area. Addressing this gap is crucial for effectively channeling financial resources towards sustainable and clean energy projects, which are essential for achieving Indonesia's Nationally Determined Contributions (NDC) by 2030.

Additionally, the co-occurrence keyword analysis underscores the rapid growth of research in green finance and renewable energy since 2021, with projections indicating continued expansion in the future. The increasing number of publications and the emergence of new research clusters related to environmental sustainability, technology innovation, and green economic growth reflect the growing recognition of the need for a more sustainable and climate-friendly financial system. Overall, these findings emphasize the importance of fostering stronger connections between green finance and renewable energy investments to accelerate the transition to a sustainable energy future. Continued research and innovation in this field will be vital in supporting global efforts to combat climate change and achieve long-term environmental and economic goals.

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REFERENCES

Aassouli, D., Asutay, M., Mohieldin, M., Chiara Nwokike, T. (2018), Green Sukuk, Energy Poverty, and Climate Change A Roadmap for Sub-Saharan Africa. Available from: http://www.worldbank.org

Abdullah, M.S., Keshminder, J.S. (2022), What drives green sukuk? A leader's perspective. Journal of Sustainable Finance and Investment,

12(3), 985-1005.
Abdullah, N., Nayan, M.A. (2020), Green Sukuk: Financing the future to sustainable environment. International Journal of Zakat and Islamic Philanthropy, 2, 2672-7471.
Abubakar, L., Handayani, T. (2020), Green Sukuk: Sustainable Financing Instruments for Infrastructure Development in Indonesia. Netherlands: Atlantis Press.
Agrawal, R., Agrawal, S., Samadhiya, A., Kumar, A., Luthra, S., Jain, V. (2023), Adoption of green finance and green innovation for achieving circularity: An exploratory review and future directions. Geoscience Frontiers, 2023, 101669.
Ahmed, H., Mohieldin, M., Verbeek, J., Aboulmagd, F. (2015), On the Sustainable Development Goals and the Role of Islamic finance. World Bank Policy Research Working Paper, 7266.
Akomea-Frimpong, I., Adeabah, D., Ofosu, D., Tenakwah, E.J. (2022), A review of studies on green finance of banks, research gaps and future directions. Journal of Sustainable Finance and Investment, 12(4), 1241-1264.
Alam, A., Tri Ratnasari, R., Latifathul Jannah, I., El Ashfahany, A. (2023), Development and evaluation of Islamic green financing: A systematic review of green sukuk. Environmental Economics, 14(1), 61-72.
Al-Ketbi, A.Y., Nobanee, H. (2020), Islamic Finance and Renewable Energy: A Mini-Review. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.3538658
Annenskaya, N.E., Nazar'yants, A.A. (2020), Green finance: An uprising trend in the Russian financial market. Digest Finance, 25(4), 462-479.
Azhgaliyeva, D., Kapoor, A., Liu, Y. (2020), Green bonds for financing renewable energy and energy efficiency in South-East Asia: A review of policies. Journal of Sustainable Finance and Investment, 10(2), 113-140.
Belgacem, S.B., Khatoon, G., Alzuman, A. (2023), Role of renewable energy and financial innovation in environmental protection: Empirical evidence from UAE and Saudi Arabia. Sustainability, 15(11), 8684.
Boer, R., Dewi, R.G., Siagian, U.W., Ardiansyah, M., Sunkar, A., Budiharto, Ratnasari. (2021), Indonesia Third Biennial Update Report. In: United Nations Framework Convention on Climate Change. Vol. 1(2).
Deschryver, P., de Mariz, F. (2020), What future for the green bond market? How can policymakers, companies, and investors unlock the potential of the green bond market? Journal of Risk and Financial Management, 13(3), 61.
Durrani, A., Rosmin, M., Volz, U. (2020), The role of central banks in scaling up sustainable finance what do monetary authorities in the Asia-Pacific region think? Journal of Sustainable Finance and Investment, 10(2), 92-112.
EBTKE. (2020), Laporan Kinerja Ditjen Ebtke Tahun 2020. Indonesia: EBTKE.
Gilchrist, D., Yu, J., Zhong, R. (2021), The limits of green finance: A survey of literature in the context of green bonds and green loans. Sustainability, 13(2), 478.
Irfan, M., Razzaq, A., Sharif, A., Yang, X. (2022), Influence mechanism between green finance and green innovation: Exploring regional policy intervention effects in China. Technological Forecasting and Social Change, 182, 121882.
Isah, A., Dioha, M.O., Debnath, R., Abraham-Dukuma, M.C., Butu, H.M. (2023), Financing renewable energy: Policy insights from Brazil and Nigeria. Energy, Sustainability and Society, 13(1), 2.
Jaafar, A.Z., Brightman, M. (2022), From structure to purpose: Green and social narratives, and the shifting morality of Islamic finance in Kuala Lumpur. Sustainability, 14(9), 5433.
Kamaruddin, M.I.H., Salleh, S., Shafii, Z., Hanefah, M.M., Zakaria, N. (2024), Exploring Shariah governance practices in Islamic co-operatives in Malaysia. International Journal of Economics and Financial Issues, 14(3), 89-96.
Karim, R. (2023), Prospects and challenges of Islamic finance instruments for low-carbon energy transitions: A legal analysis from an energy justice perspective. Journal of Energy and Natural Resources Law, 41(2), 195-209.
Kirari, J.K., Adel, M., Lakaseru, B.O. (2018), Supporting Indonesia's Renewable Energy Development in Remote and Rural Areas through Innovative Funding. United States: United Nations Development Programme.
Klimenko, V.V., Ratner, S.V., Tereshin, A.G. (2021), Constraints imposed by key-material resources on renewable energy development. Renewable and Sustainable Energy Reviews, 144, 111011.
Liebman, A., Reynolds, A., Robertson, D., Nolan, S., Argyriou, M., Sargent, B. (2019), Green Finance in Indonesia. In: Handbook of Green Finance. Singapore: Springer. p1-30.
Liu, F.H.M., Lai, K.P.Y. (2021), Ecologies of green finance: Green sukuk and development of green Islamic finance in Malaysia. Environment and Planning A, 53(8), 1896-1914.
Morano, P., Tajani, F., Anelli, D. (2020), A decisions support model for investment through the Social Impact Bonds: The case of the city of Bari (Italy). Journal Valori e Valutazioni, 24, 163-179.
Morea, D., Poggi, L.A. (2017), An innovative model for the sustainability of investments in the wind energy sector: The use of green Sukuk in an Italian case study. International Journal of Energy Economics and Policy, 7(2), 53-60.
Musari, K. (2021), Green sukuk, Islamic green financing: A lesson learned from Indonesia. In: Handbook of Research on Climate Change and the Sustainable Financial Sector. United States: IGI Global. p1-16.
Myronchuk, V., Yatsenko, O., Riznyk, D., Hurina, O., Frolov, A. (2024), Financing sustainable development: Analysis of modern approaches and practices in the context of financial and credit activities. International Journal of Economics and Financial Issues, 14(5), 317-329.
Ning, Y., Cherian, J., Sial, M.S., Álvarez-Otero, S., Comite, U., Zia-Ud-Din, M. (2022), Green bond as a new determinant of sustainable green financing, energy efficiency investment, and economic growth: A global perspective. Environmental Science and Pollution Research. 30(22), 61324-61339.
Obaidullah, M. (2017), Managing climate change: The role of Islamic finance. SSRN Electronic Journal. 26(1), 31-62.
Page, M.J., McKenzie, J.E., Bossuyt, P.M., Boutron, I., Hoffmann, T.C., Mulrow, C.D., Shamseer, L., Tetzlaff, J.M., Akl, E.A., Brennan, S.E., Chou, R., Glanville, J., Grimshaw, J.M., Hróbjartsson, A., Lalu, M.M., Li, T., Loder, E.W., Mayo-Wilson, E., McDonald, S., Moher, D. (2021), The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. BMJ, 372, n71.
Pathan, M.S., Ahmed, M., Khoso, A.A. (2022), Islamic banking under vision of green finance: The case of development, ecosystem and prospects. International Research Journal of Management and Social Sciences, 3(1), 193-210.
Raeni, R., Thomson, I., Frandsen, A.C. (2022), Mobilising Islamic funds for climate actions: from transparency to traceability. Social and Environmental Accountability Journal, 42(1-2), 38-62.
Selvapandian, G., Jeyapaul, P.P., Gunabalan, B. (2022), Adoption of green financing strategies with renewable energy resources for global economic growth. Global Economy Journal, 22(4), 2350004.
Sen, S., Ganguly, S. (2017), Opportunities, barriers and issues with renewable energy development - A discussion. In: Renewable and Sustainable Energy Reviews. Vol. 69. Netherlands: Elsevier Ltd. p1170-1181.
Sharma, G.D., Verma, M., Shahbaz, M., Gupta, M., Chopra, R. (2022), Transitioning green finance from theory to practice for renewable

energy development. Renewable Energy, 195, 554-565.
Soundarrajan, P., Vivek, N. (2016), Green finance for sustainable green economic growth in India. Agricultural Economics (Czech Republic), 62(1), 35-44.
Taghizadeh-Hesary, F., Yoshino, N. (2020), Sustainable solutions for green financing and investment in renewable energy projects. Energies, 13(4), 13040788.
Trukhachev, V.I., Dzhikiya, M. (2023), Development of environmental economy and management in the age of AI based on green finance. Frontiers in Environmental Science, 10, 1087034.
Udin, U. (2020), Renewable energy and human resource development: Challenges and opportunities in Indonesia. International Journal of Energy Economics and Policy, 10(2), 233-237.
Wang, X., Wang, Q. (2021), Research on the impact of green finance on the upgrading of China's regional industrial structure from the perspective of sustainable development. Resources Policy, 74, 102436.
Wang, Y., Zhi, Q. (2016), The role of green finance in environmental protection: Two aspects of market mechanism and policies. Energy Procedia, 104, 311-316.
Wijaya, M.E., Alke, H., Mecca, B.M. (2020), Enhancing Decentralized Renewable Energy Investment to Achieve Indonesia's Nationally Determined Contribution. Available from: https://www.climatepolicyinitiative.org
Young, K.E. (2018), Prioritizing renewable energy in a time of fiscal austerity. In: The Economics of Renewable Energy in the Gulf. 1th ed., p. 23. UK: Routledge.
Zhongping, S., Yongjun, G., Yunbao, X., Qifeng, X., Andlib, Z. (2023), Green financial investment and its influence on economic and environmental sustainability: Does privatization matter? Environmental Science and Pollution Research, 30(39), 91046-91059.