International Journal of Community Service
ISSN: 3083-9696

Implementation of SWOT Analysis in the Development of Green Energy-Based Social Businesses in Local Communities

Nelly[1], Syaifuddin Yana[1], Radhiana[1], Juwita[1], Erdi Surya[2]

[1]Department of Economic Management, Universitas Serambi Mekkah, Banda Aceh, 23245, Indonesia
[2]Department of Biology Education, Universitas Serambi Mekkah, Banda Aceh, 23245, Indonesia

Corresponding author: nelly@serambimekkah.ac.id

Abstract
The transition to green energy is a global priority to address the environmental crisis and climate change. This study analyzes the development of green energy-based social businesses using the SWOT approach to identify the Strengths, Weaknesses, Opportunities, and Threats factors that influence their sustainability. The analysis results show that community involvement and government incentives are the main strengths in supporting the sustainability of green energy projects. However, there are significant obstacles in the form of high initial investment costs (30%) and limited expertise and access to funding (25%). Regarding opportunities, international policies that support green energy are the most significant driving factor (35%), followed by technological advances that contribute 30% to increasing the efficiency and accessibility of renewable energy. However, green energy businesses still face threats from policy uncertainty (30%) and competition with fossil fuels (25%), which can hinder investment and adoption of new technologies. To overcome these challenges, strategies such as stabilizing energy policies, increasing access to funding through partnerships with investors, and technological innovation to reduce operational costs are needed. By implementing these strategic steps, green energy-based social businesses can grow faster and provide long-term environmental and societal benefits.

Article Info
Received: 22 January2025
Revised: 10 February 2025
Accepted: 25 February 2025
Available online: 25 April 2025

Keywords
Green Energy
SWOT
Social Business
Energy Policy
Sustainable

1. Introduction
The transition to green energy is becoming an essential global priority as environmental degradation and climate change concerns continue to rise. Various studies have emphasized the need for sustainable energy solutions, particularly in communities with limited access to affordable and reliable energy. The development of green energy-based social businesses presents an opportunity to address these challenges while fostering economic and social development. Several studies highlight the potential benefits of green energy initiatives. Adopting renewable energy technologies in rural areas significantly improves economic conditions by creating new job opportunities and enhancing energy security [1–3]. Similarly, community-led solar and wind energy projects increase social cohesion and environmental awareness [4–6].

Despite these benefits, challenges are associated with implementing green energy-based social businesses. High initial investment costs and the need for technical expertise have been identified as significant obstacles [7–9]. The regulatory environment and policy inconsistencies often hinder the growth of sustainable energy projects in developing regions [10–12]. Opportunities for expansion and collaboration are also evident. International funding and technological advancements make renewable energy projects more viable [13–15]. Furthermore, partnerships between governments, private

enterprises, and community organizations have been shown to enhance the success rates of these initiatives.

Given the importance of strategic planning in overcoming these challenges, SWOT analysis has been widely recognized as an effective tool for assessing the strengths, weaknesses, opportunities, and threats associated with green energy-based social businesses. A well-structured SWOT analysis provides valuable insights for policymakers and entrepreneurs seeking to develop sustainable energy solutions [16–18]. This paper explores the application of SWOT analysis in developing green energy-based social businesses in local communities. By synthesizing existing research and case studies, this study will offer strategic recommendations to optimize the success and impact of these initiatives.

2. Methodology

This study employs a qualitative approach to assess the potential of green energy-based social businesses using SWOT analysis. The methodology consists of three primary stages: data collection, SWOT matrix formulation, and strategic analysis. The data collection phase involves gathering information through literature reviews, case studies, and interviews with key stakeholders such as business owners, policymakers, and community representatives. These insights help identify the internal strengths and weaknesses as well as the external opportunities and threats that influence the success of these businesses. After data collection, the SWOT analysis is conducted by categorizing the findings into the four elements of the framework. A strategic assessment is then carried out to formulate recommendations that optimize business performance and sustainability. The findings from this analysis help stakeholders develop action plans to strengthen advantages, mitigate challenges, leverage opportunities, and prepare for potential risks.

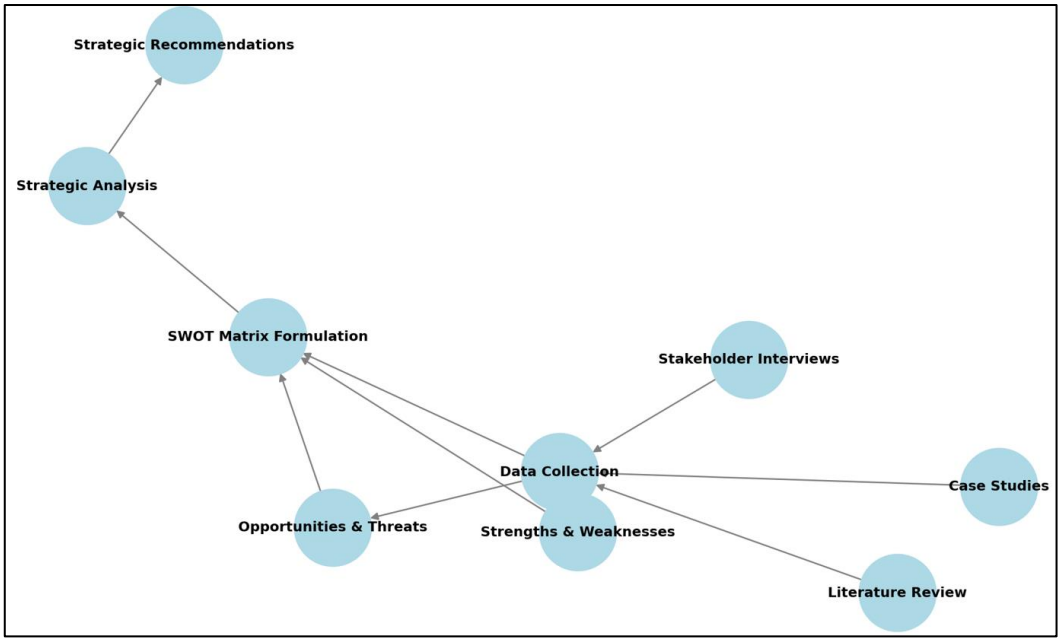

Figure 1: Schematic diagram for research methodology

Figure 1 shows a schematic diagram of the research methodology used in this study. This diagram systematically illustrates the research process, starting from data collection through literature review, case studies, and stakeholder interviews. The data obtained were then categorized into two main aspects of SWOT: internal strengths and weaknesses and external opportunities and threats. The results of this analysis were used to form a SWOT matrix, which was then analyzed to produce strategic recommendations for the development of green energy-based social businesses in local communities. The relationship between each research stage is depicted through arrows indicating the flow of information and the analysis process, providing a clear understanding of the approach used in this study.

3. SWOT Analysis

Strengths

Based on previous research results, the strengths in developing green energy-based social businesses mainly lie in community involvement and government incentives that support long-term sustainability. Active community involvement in green energy projects contributes to increased adoption of renewable technologies, strengthens environmental awareness, and creates a higher sense of ownership in local communities [19,20]. In addition, incentives such as subsidies, tax breaks, and policy support from the government have been shown to accelerate the growth of the renewable energy sector in various regions. The combination of technological advances and supportive policies has increased the competitiveness of green energy businesses, particularly in developing countries where implementing renewable energy was once challenging [21]. In addition to policy and community factors, the potential for economic benefits is also a significant strength in green energy-based social businesses. Adopting renewable energy technologies, such as solar and wind power, enhances energy security and creates new jobs in the manufacturing, installation, and maintenance sectors [22]. Community-based green energy projects can improve social welfare through business models that empower local communities [23]. With these opportunities, green energy-based social businesses have great potential to develop further, especially with technological innovation and strategic partnerships with the private sector and government.

Table 1: Weaknesses In Green Energy Businesses

Weaknesses	Key Findings
High Initial Investment Costs	Capital expenditure limits scalability in developing regions [24]
Limited Technical Expertise	Lack of skilled personnel affects operational efficiency [25]
Challenges in Securing Funding	Community-led projects struggle with financial viability without external support [26]
Dependency on External Policies	Unstable policies hinder long-term planning and investment [27]

Table 1 shows several significant weaknesses in the green energy business that can hinder its growth, especially in developing regions. One of the biggest challenges is the high initial investment costs, which limits the scale of green energy projects and hinders technology adoption in areas with limited capital [28]. In addition, the lack of expertise in the renewable energy sector is also a significant constraint, as limited skills can affect the operational efficiency and maintenance of energy systems [29]. Another barrier is the difficulty in obtaining funding, especially for community-led projects, which often rely on external support to survive financially [30]. In addition, dependence on unstable external policies also threatens long-term planning and investment in the sector, as regulatory changes can create uncertainty for stakeholders [31]. Therefore, although the green energy business has great potential, these challenges need to be addressed through more stable policies, improved access to finance, and increased technical capacity of the workforce in the sector.

Weaknesses

Green energy businesses face several weaknesses hindering their growth and widespread implementation, especially in developing countries. One of the main weaknesses is the high initial investment costs, which include technology procurement, infrastructure, and high maintenance costs. Limited capital hampers the expansion of green energy projects, particularly in communities with limited access to external funding, while a shortage of renewable energy expertise further impedes progress [32]. The lack of skilled labour results in operational inefficiencies and inadequate system maintenance, thereby increasing the long-term risk of project failure [33]. Another common weakness is the difficulty of obtaining funding, especially for community-based green energy projects. Many projects face financial challenges due to limited access to long-term loans or investments [34]. Another contributing factor is the dependence on external policies that often change, creating uncertainty in investment and long-term planning [35]. Unstable policy changes can hamper the sustainability of green energy projects, reduce incentives for investors, and slow the growth of the sector. More stable policy

support, adequate fiscal incentives, and improved workforce training programs are needed to overcome these challenges so green energy businesses can grow sustainably.

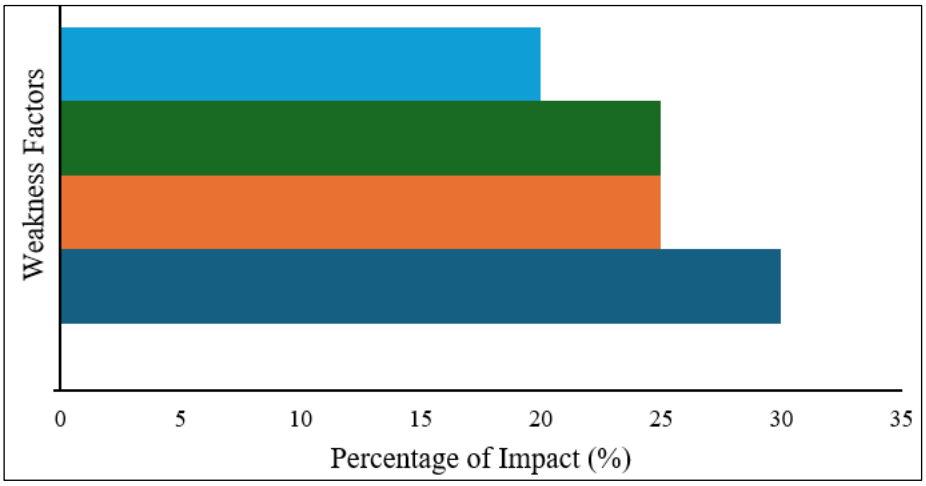

Figure 2: Key Weaknesses in Green Energy Businesses

Based on previous research, **Figure 2** illustrates the main weaknesses of the green energy business. From the graph, the high initial investment costs are the most significant factor, with an impact of 30%, followed by limited expertise and difficulty in obtaining funding, each at 25%. Dependence on external policies also has a significant impact, reaching 20%. These data show that the main weaknesses in the green energy business are centred on financial and policy aspects, which can hinder the development of large-scale projects. Therefore, strategic steps are needed to overcome these challenges, such as providing subsidies by the government, increasing training for experts, and more flexible funding schemes for communities and green energy business actors.

Opportunities

Opportunities in the green energy business continue to grow with the increasing global awareness of sustainability and clean energy transitions. One of the main opportunities is the support of international policies and initiatives that encourage using renewable energy. Various incentive policies, such as green energy subsidies, carbon taxes, and sustainable financing programs, have increased investment attractiveness in this sector [36]. In addition, renewable energy technology advances have opened new opportunities for green energy-based social businesses. Technological developments, such as more efficient solar panels, high-capacity energy storage batteries, and intelligent grid systems, have increased the accessibility and efficiency of green energy [37]. With the decreasing cost of technology, green energy businesses can be more easily implemented in various communities, including in remote areas previously difficult to reach by conventional energy. In addition to policy and technology factors, the growing market demand for clean energy also provides excellent opportunities for green energy businesses. Consumers and industries increasingly turn to environmentally friendly energy sources due to regulatory pressures and market demands to reduce carbon footprints [38]. Large industrial sectors such as manufacturing, mining, and transportation are beginning to adopt green energy to improve operational efficiency and meet sustainability targets [39]. In addition, strategic partnerships between the private sector, government, and non-profit organizations have helped accelerate the development of green energy infrastructure. With this collaboration, various green energy projects can obtain more stable funding and access to a broader market. Therefore, by taking advantage of existing opportunities, green energy-based social businesses have the potential to grow faster and have a positive impact on society and the environment.

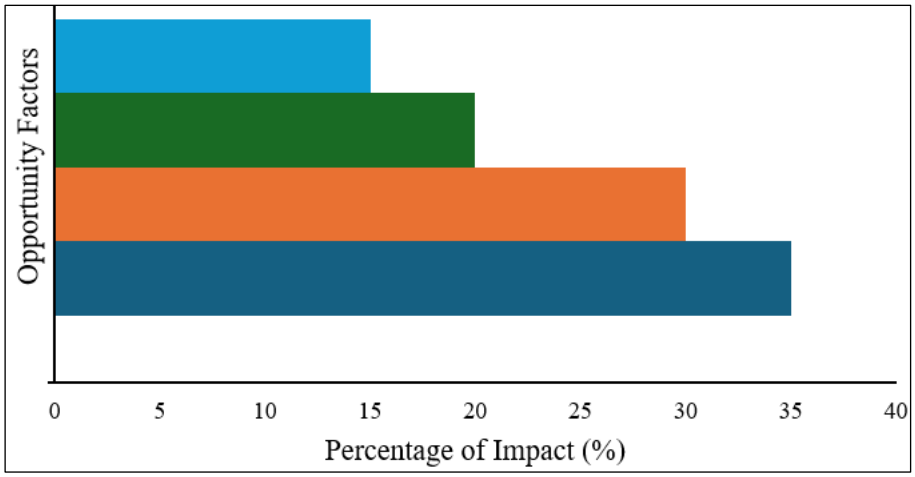

Figure 3: Key Opportunities in Green Energy Businesses

Based on previous studies, **Figure 3** shows the main factors that are opportunities in green energy businesses. Government policy support and incentives are the most significant factors, with an impact of 35%, indicating that regulations that support green energy can encourage investment and development in this sector. Advances in renewable energy technology are also a significant opportunity with an impact of 30%, indicating that technological innovations such as solar panel efficiency and energy storage systems are increasingly increasing the competitiveness of green businesses. In addition, the growth in market demand for clean energy has an impact of 20%, indicating an increasing trend in the need for sustainable energy from various industries. Strategic partnerships between the government, private sector, and communities also play an essential role, with a more negligible impact of 15%. By taking advantage of these opportunities, green energy-based social businesses can grow faster and provide broader economic and environmental effects.

Threats

Green energy businesses face various threats that can hinder their growth, especially in economic, regulatory, and social aspects. One of the biggest threats is the fluctuation of government policies, where the instability of energy regulations and policies often creates uncertainty for investors and business actors. Sudden policy changes, such as reductions in subsidies or modifications to environmental regulations, can impede the development of green energy projects, while fluctuations in raw material and equipment prices further inhibit progress [40–42]. The prices of components, including solar panels and energy storage batteries, can fluctuate sharply due to shifts in the global market and a reliance on imports [43]. This condition makes the green energy business riskier, especially for small actors with limited capital. Competition with fossil fuels, which remain dominant in many countries, poses an additional threat, as large subsidies to the fossil fuel industry often render green energy less competitive in terms of price, thereby slowing the energy transition [44].

Furthermore, social resistance to technological change is also a significant challenge in implementing green energy. Some communities remain hesitant to adopt renewable energy technologies due to insufficient understanding and concerns over their economic impacts, including potential job losses in the conventional energy sector [45]. Considering these threats, mitigation strategies involving stable policies, supply chain diversification, and public education are essential to ensure the long-term sustainability of green energy businesses.

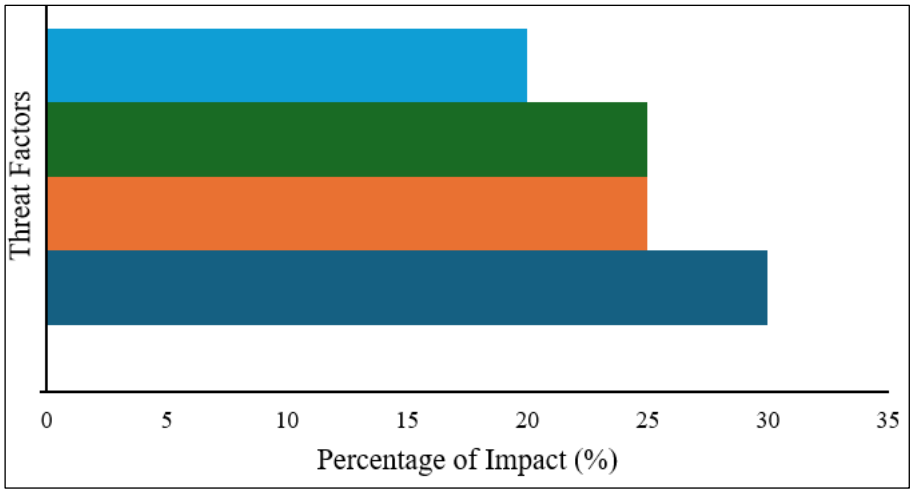

Figure 4: Key Threats in Green Energy Businesses

Based on previous studies, **Figure 4** illustrates the main factors threatening the green energy business. Uncertainty in government policy is the biggest threat, with an impact of 30%, indicating that unstable regulatory changes can hinder investment and the development of the green energy sector. Fluctuations in the prices of raw materials and green energy equipment have an impact of 25%, reflecting the risks businesses face due to dependence on the global market and unstable supply chains. In addition, competition with fossil fuels also has an equally significant impact (25%) because subsidies and preferences for conventional energy make green energy less competitive in terms of price. Another threat is social resistance to technological change, which reaches 20%, indicating that there are still obstacles to adopting renewable energy due to a lack of public awareness and concerns about its economic and social impacts. Therefore, a strategic approach is needed to overcome these threats, such as stabilizing energy policies, diversifying supply chains, and educating the public to increase acceptance of green energy.

4. Discussion

Previous research extensively used SWOT analysis to assess the viability of green energy-based social businesses. Identifying strengths such as community involvement and government incentives is crucial in ensuring long-term sustainability [46]. One of the primary weaknesses of these initiatives is the high capital expenditure required for technology acquisition and infrastructure development [47]. These challenges often limit the scalability of green energy projects in developing regions. However, studies suggest that strategic partnerships with governmental and private entities can alleviate financial burdens and enhance technical expertise.

An expanding renewable energy market and international sustainability initiatives have paved the way for a favourable environment for social businesses [48]. Advancements in green energy technology, including affordable solar panels and efficient energy storage solutions, offer significant advantages [49]. Nevertheless, threats like fluctuating government policies and resistance to change within communities remain prevalent. Political and economic instability can disrupt investment flows into green energy projects [50]. Thus, social businesses must develop adaptive strategies that mitigate external risks while leveraging technological and policy advancements.

Table 2: SWOT Analysis Summary

Factor	Key Findings
Strengths	Community involvement and government incentives enhance long-term sustainability [51]
Weaknesses	High capital expenditure limits scalability in developing regions [52]
Opportunities	International sustainability initiatives and advancements in renewable energy technology support business growth [52]
Threats	Fluctuating government policies and economic instability disrupt investment [53]

Based on previous studies, **Table 2** summarizes the main factors influencing the green energy business. In terms of Strengths, community involvement and government incentives are key factors in supporting the long-term sustainability of the green energy sector (Khan et al., 2020). However, there are significant Weaknesses, such as high initial capital costs that limit the scalability of renewable energy projects, especially in developing countries [54]. In terms of Opportunities, international sustainability initiatives and advances in renewable energy technology provide excellent opportunities for the growth of this business [55]. However, Threats such as unstable government policies and economic uncertainty can hinder investment and development of the green energy sector [56]. By understanding these four SWOT factors, stakeholders can design more effective strategies to optimize strengths and opportunities while mitigating existing weaknesses and threats.

5. Strategic Recommendations

To improve the sustainability of green energy businesses, various strategies must be implemented to optimize strengths and opportunities while mitigating existing weaknesses and threats. One of the main strategies is strengthening government policies and regulations. Policy stability, including tax incentives and renewable energy subsidies, can boost investment in this sector [57]. In addition, increasing access to funding is another key strategy, especially for community-based projects that often have difficulty obtaining initial financing. Partnerships with financial institutions and private investors can reduce capital constraints and boost the scalability of green energy projects [58]. Other strategies include technological innovation and workforce capacity building, which can overcome technical obstacles in implementing renewable energy. Training experts in green energy technologies is crucial for ensuring operational efficiency and optimal maintenance of energy systems [59]. In addition, educational campaigns and increasing public awareness are also needed to overcome social resistance to green energy. Community involvement in planning and implementing renewable energy projects increases public acceptance and accelerates the adoption of new technologies [60]. By implementing these strategies, green energy businesses can grow faster and have a more significant positive impact on the environment and economy.

Table 3: Strategic Recommendations In Green Energy

SWOT Factor	Strategic Recommendations
Strengths	Strengthen government policies and incentives to ensure long-term sustainability [61]
Weaknesses	Improve access to funding through partnerships with financial institutions and investors [62]
Opportunities	Leverage technological advancements and promote innovation in green energy [63]
Threats	Develop adaptive strategies to mitigate policy uncertainty and economic instability [64]

Table 3 presents various key strategies that can be implemented to optimize the green energy business based on the SWOT analysis. In the Strengths aspect, the recommended approach is to strengthen government policies and incentives to ensure the long-term sustainability of the green energy sector [65]. To address weaknesses, increasing access to funding through partnerships with financial institutions and investors is an essential step in overcoming high initial capital barriers [66]. In Opportunities, utilizing technological advances and innovations in green energy is a key strategy to increase the efficiency and competitiveness of this business [67]. Meanwhile, in dealing with Threats, adaptive strategies are needed to reduce policy uncertainty and overcome economic instability that can hinder investment and development of the green energy sector [68]. By implementing these strategic recommendations, green energy businesses can be more resilient in facing challenges while taking advantage of existing opportunities for sustainable growth.

6. Conclusion

Based on the results of the SWOT analysis of the green energy business, it was found that the main Strengths factor in the development of this sector is community involvement and government incentives that can improve long-term sustainability. On the other hand, the biggest challenge in Weaknesses is the high initial investment cost, which limits the expansion of green energy projects, with an impact of

30% of the main obstacles. In addition, limited expertise and difficulty in obtaining funding contribute 25% to the challenges in this business, indicating the need for better technical and financial support. Meanwhile, from the Opportunities side, there are great opportunities for developing green energy, especially with policy incentives that contribute 35% to the chance of project success. The advancement of renewable energy technology is also a significant factor, with an influence of 30%, allowing for reduced operational costs and increased efficiency. However, Threats such as uncertainty in government policies and economic instability are still significant challenges, each having a negative impact of 30% and 25% on green energy investment. Therefore, the recommended strategies include strengthening government policies, increasing access to funding, technological innovation, and developing adaptive strategies to reduce risks. By implementing these strategic steps, green energy businesses can grow faster and provide long-term economic and environmental benefits.

References

[1] M. Majid, Renewable energy for sustainable development in India: current status, future prospects, challenges, employment, and investment opportunities, Energy. Sustain. Soc. 10 (2020) 1–36.

[2] B. Bahagia, M. Nizar, M.H.M. Yasin, S.M. Rosdi, M. Faisal, Advancements in Communication and Information Technologies for Smart Energy Systems and Renewable Energy Transition: A Review, Int. J. Eng. Technol. 1 (2025) 1–29.

[3] H. Pranoto, R. Rusiyanto, D.F. Fitriyana, Sustainable Wastewater Management in Sumedang: Design, Treatment Technologies, and Resource Recovery, Int. J. Sci. Adv. Technol. 1 (2025) 38–46.

[4] T. Sihotang, S. Chandra, M.R. Syaputra, C.D. Simatupang, Grassroots to Grid: Examining the Effectiveness of Community-Led Renewable Energy Projects, GEMOY Green Energy Manag. Optim. Yields. 1 (2024) 37–48.

[5] P. Selvakumar, A. Gani, J. Xiaoxia, M.R. Salleh, Porosity and Pore Volume Analysis of EFB Fiber: Physical Characterization and Effect of Thermal Treatment, Int. J. Eng. Technol. 1 (2025) 100–108.

[6] D.F. Fitriyana, R. Rusiyanto, W. Maawa, Renewable Energy Application Research Using VOSviewer software: Bibliometric Analysis, Int. J. Sci. Adv. Technol. 1 (2025) 92–107.

[7] S. D'Oca, A. Ferrante, C. Ferrer, R. Pernetti, A. Gralka, R. Sebastian, P. op 't Veld, Technical, financial, and social barriers and challenges in deep building renovation: Integration of lessons learned from the H2020 cluster projects, Buildings. 8 (2018) 174.

[8] A. Gani, M. Zaki, B. Bahagia, G. Maghfirah, M. Faisal, Characterization of Porosity and Pore Volume in EFB Samples through Physical and Morphological Parameters, Int. J. Eng. Technol. 1 (2025) 90–99.

[9] S.M. Rosdi, G. Maghfirah, E. Erdiwansyah, S. Syafrizal, M. Muhibbuddin, Bibliometric Study of Renewable Energy Technology Development: Application of VOSviewer in Identifying Global Trends, Int. J. Sci. Adv. Technol. 1 (2025) 71–80.

[10] E. Obuseh, J. Eyenubo, J. Alele, A. Okpare, I. Oghogho, A Systematic Review of Barriers to Renewable Energy Integration and Adoption, J. Asian Energy Stud. 9 (2025) 26–45.

[11] Erdiwansyah, A. Gani, R. Mamat, Bahagia, M. Nizar, S. Yana, M.H. Mat Yasin, Muhibbuddin, S.M. Rosdi, Prospects for renewable energy sources from biomass waste in Indonesia, Case Stud. Chem. Environ. Eng. 10 (2024) 100880. https://doi.org/https://doi.org/10.1016/j.cscee.2024.100880.

[12] A. Gani, Erdiwansyah, E. Munawar, Mahidin, R. Mamat, S.M. Rosdi, Investigation of the potential biomass waste source for biocoke production in Indonesia: A review, Energy Reports. 10 (2023) 2417–2438. https://doi.org/https://doi.org/10.1016/j.egyr.2023.09.065.

[13] Q. Hassan, P. Viktor, T. J. Al-Musawi, B. Mahmood Ali, S. Algburi, H.M. Alzoubi, A. Khudhair Al-Jiboory, A. Zuhair Sameen, H.M. Salman, M. Jaszczur, The renewable energy role in the global energy Transformations, Renew. Energy Focus. 48 (2024) 100545. https://doi.org/https://doi.org/10.1016/j.ref.2024.100545.

[14] O. Hoogland, E. Veenstra, L.G. Opinska, P.C.T. Vega, K. Rademaekers, Study on impacts of EU actions supporting the development of renewable energy technologies, Eur. Comm. Luxemb.

(2019).
[15] M.F. Ghazali, S.M. Rosdi, Erdiwansyah, R. Mamat, Effect of the ethanol-fusel oil mixture on combustion stability, efficiency, and engine performance, Results Eng. 25 (2025) 104273. https://doi.org/https://doi.org/10.1016/j.rineng.2025.104273.
[16] P.M. Falcone, Sustainable energy policies in developing countries: a review of challenges and opportunities, Energies. 16 (2023) 6682.
[17] Erdiwansyah, Mahidin, H. Husin, Nasaruddin, M. Zaki, Muhibbuddin, A critical review of the integration of renewable energy sources with various technologies, Prot. Control Mod. Power Syst. 6 (2021) 3. https://doi.org/10.1186/s41601-021-00181-3.
[18] D. Bolzani, E. Luppi, Assessing entrepreneurial competences: Insights from a business model challenge, Educ. Train. 63 (2021) 214–238.
[19] S.M. Hammami, S. chtourou, A. Triki, Identifying the determinants of community acceptance of renewable energy technologies: The case study of a wind energy project from Tunisia, Renew. Sustain. Energy Rev. 54 (2016) 151–160. https://doi.org/https://doi.org/10.1016/j.rser.2015.09.037.
[20] B.J. Kalkbrenner, J. Roosen, Citizens' willingness to participate in local renewable energy projects: The role of community and trust in Germany, Energy Res. Soc. Sci. 13 (2016) 60–70.
[21] D. Gielen, F. Boshell, D. Saygin, M.D. Bazilian, N. Wagner, R. Gorini, The role of renewable energy in the global energy transformation, Energy Strateg. Rev. 24 (2019) 38–50. https://doi.org/https://doi.org/10.1016/j.esr.2019.01.006.
[22] A.O.M. Maka, J.M. Alabid, Solar energy technology and its roles in sustainable development, Clean Energy. 6 (2022) 476–483.
[23] S. Guerreiro, I. Botetzagias, Empowering communities–the role of intermediary organisations in community renewable energy projects in Indonesia, Local Environ. 23 (2018) 158–177.
[24] P. Shyamsundar, F. Cohen, T.M. Boucher, T. Kroeger, J.T. Erbaugh, G. Waterfield, C. Clarke, S.C. Cook-Patton, E. Garcia, K. Juma, Scaling smallholder tree cover restoration across the tropics, Glob. Environ. Chang. 76 (2022) 102591.
[25] I.L. Edeh, E. Nnamani, P.C. Mbah, Skilled manpower and organizational performance in Manufacturing Firms in South East Nigeria, Adv. J. Arts, Humanit. Soc. Sci. 6 (2023) 1–28.
[26] S. Cecilia, T. Murayama, S. Nishikizawa, K. Suwanteep, Stakeholder evaluation of sustainability in a community-led wastewater treatment facility in Jakarta, Indonesia, Environ. Dev. Sustain. 26 (2024) 8497–8523.
[27] S. Wenjuan, K. Zhao, Balancing fiscal expenditure competition and long-term innovation investment: Exploring trade-offs and policy implications for local governments, PLoS One. 18 (2023) e0293158.
[28] A.P.C. Chan, A. Darko, E.E. Ameyaw, D.-G. Owusu-Manu, Barriers affecting the adoption of green building technologies, J. Manag. Eng. 33 (2017) 4016057.
[29] A. Hauashdh, S. Nagapan, J. Jailani, Y. Gamil, An integrated framework for sustainable and efficient building maintenance operations aligning with climate change, SDGs, and emerging technology, Results Eng. 21 (2024) 101822.
[30] D. Gooch, R.M. Kelly, A. Stiver, J. van der Linden, M. Petre, M. Richards, A. Klis-Davies, J. MacKinnon, R. Macpherson, C. Walton, The benefits and challenges of using crowdfunding to facilitate community-led projects in the context of digital civics, Int. J. Hum. Comput. Stud. 134 (2020) 33–43. https://doi.org/https://doi.org/10.1016/j.ijhcs.2019.10.005.
[31] P.M. Connor, C.J. Axon, D. Xenias, N. Balta-Ozkan, Sources of risk and uncertainty in UK smart grid deployment: An expert stakeholder analysis, Energy. 161 (2018) 1–9.
[32] B. Michoud, M. Hafner, Financing clean energy access in sub-Saharan Africa: Risk mitigation strategies and innovative financing structures, Springer Nature, 2021.
[33] F. SLAEAT, The impact of poor planning on the duration and cost of the projects: The implications of poor planning on the projects, Mesopotamian J. Civ. Eng. 2024 (2024) 60–81.
[34] K. Jarosiński, B. Opałka, The Risk of Long-Term Financing of Public Investments, Eur. J. Mark. Econ. 2 (2019) 42–51.
[35] M. Gong, W. Ou, F. Zhang, Economic uncertainty and 'short-term debt for long-term investment'in energy firms: Evidence from China, Energy Econ. (2025) 108228.
[36] H. Yan, M. Qamruzzaman, S. Kor, Nexus between green investment, fiscal policy,

environmental tax, energy price, natural resources, and clean energy—a step towards sustainable development by fostering clean energy inclusion, Sustainability. 15 (2023) 13591.
[37] K.M. Tan, T.S. Babu, V.K. Ramachandaramurthy, P. Kasinathan, S.G. Solanki, S.K. Raveendran, Empowering smart grid: A comprehensive review of energy storage technology and application with renewable energy integration, J. Energy Storage. 39 (2021) 102591. https://doi.org/https://doi.org/10.1016/j.est.2021.102591.
[38] A. Yenipazarli, Incentives for environmental research and development: Consumer preferences, competitive pressure and emissions taxation, Eur. J. Oper. Res. 276 (2019) 757–769. https://doi.org/https://doi.org/10.1016/j.ejor.2019.01.037.
[39] A.Q. Al-Shetwi, Sustainable development of renewable energy integrated power sector: Trends, environmental impacts, and recent challenges, Sci. Total Environ. 822 (2022) 153645.
[40] S. Gawusu, X. Zhang, S.A. Jamatutu, A. Ahmed, A.A. Amadu, E. Djam Miensah, The dynamics of green supply chain management within the framework of renewable energy, Int. J. Energy Res. 46 (2022) 684–711.
[41] Erdiwansyah, R. Mamat, M.S.M. Sani, K. Sudhakar, Renewable energy in Southeast Asia: Policies and recommendations, Sci. Total Environ. (2019). https://doi.org/https://doi.org/10.1016/j.scitotenv.2019.03.273.
[42] Erdiwansyah, Mahidin, R. Mamat, M.S.M. Sani, F. Khoerunnisa, A. Kadarohman, Target and demand for renewable energy across 10 ASEAN countries by 2040, Electr. J. 32 (2019) 106670. https://doi.org/10.1016/J.TEJ.2019.106670.
[43] P. Buchholz, T. Brandenburg, Demand, supply, and price trends for mineral raw materials relevant to the renewable energy transition wind energy, solar photovoltaic energy, and energy storage, Chemie Ing. Tech. 90 (2018) 141–153.
[44] S.A. Hussain, F. Razi, K. Hewage, R. Sadiq, The perspective of energy poverty and 1st energy crisis of green transition, Energy. 275 (2023) 127487. https://doi.org/https://doi.org/10.1016/j.energy.2023.127487.
[45] A. Qazi, F. Hussain, N.A.B.D. Rahim, G. Hardaker, D. Alghazzawi, K. Shaban, K. Haruna, Towards sustainable energy: a systematic review of renewable energy sources, technologies, and public opinions, IEEE Access. 7 (2019) 63837–63851.
[46] A. Wibowo, Enhancing economic growth for the achievement of sustainable development goals through digital era fundraising schemes for sustainable community development: A policy analysis from the islamic economic perspective, in: Proceeding Int. Conf. Islam. Philantrophy, 2023: pp. 26–37.
[47] B. Weber, M. Staub-Bisang, H.W. Alfen, Infrastructure as an asset class: investment strategy, sustainability, project finance and PPP, John wiley & sons, 2016.
[48] A. Rahdari, S. Sepasi, M. Moradi, Achieving sustainability through Schumpeterian social entrepreneurship: The role of social enterprises, J. Clean. Prod. 137 (2016) 347–360.
[49] M. Ahmadizadeh, M. Heidari, S. Thangavel, E. Al Naamani, M. Khashehchi, V. Verma, A. Kumar, Technological advancements in sustainable and renewable solar energy systems, in: Highly Effic. Therm. Renew. Energy Syst., CRC Press, 2024: pp. 23–39.
[50] M. Qamruzzaman, S. Karim, Green energy, green innovation, and political stability led to green growth in OECD nations, Energy Strateg. Rev. 55 (2024) 101519. https://doi.org/https://doi.org/10.1016/j.esr.2024.101519.
[51] R. Ullah, H. Ahmad, F.U. Rehman, A. Fawad, Green innovation and Sustainable Development Goals in SMEs: The moderating role of government incentives, J. Econ. Adm. Sci. 39 (2023) 830–846.
[52] V. Songwe, N. Stern, A. Bhattacharya, Finance for climate action: Scaling up investment for climate and development, London Grantham Res. Inst. Clim. Chang. Environ. London Sch. Econ. Polit. Sci. (2022).
[53] C.-W. Wang, C.-C. Lee, M.-C. Chen, The effects of economic policy uncertainty and country governance on banks' liquidity creation: International evidence, Pacific-Basin Financ. J. 71 (2022) 101708.
[54] P.T.I. Lam, A.O.K. Law, Crowdfunding for renewable and sustainable energy projects: An exploratory case study approach, Renew. Sustain. Energy Rev. 60 (2016) 11–20. https://doi.org/https://doi.org/10.1016/j.rser.2016.01.046.

[55] A.T. Hoang, Sandro Nižetić, A.I. Olcer, H.C. Ong, W.-H. Chen, C.T. Chong, S. Thomas, S.A. Bandh, X.P. Nguyen, Impacts of COVID-19 pandemic on the global energy system and the shift progress to renewable energy: Opportunities, challenges, and policy implications, Energy Policy. 154 (2021) 112322. https://doi.org/https://doi.org/10.1016/j.enpol.2021.112322.

[56] R. Yasmeen, W.U.H. Shah, Energy uncertainty, geopolitical conflict, and militarization matters for Renewable and non-renewable energy development: Perspectives from G7 economies, Energy. 306 (2024) 132480. https://doi.org/https://doi.org/10.1016/j.energy.2024.132480.

[57] R. Wall, S. Grafakos, A. Gianoli, S. Stavropoulos, Which policy instruments attract foreign direct investments in renewable energy?, Clim. Policy. 19 (2019) 59–72. https://doi.org/10.1080/14693062.2018.1467826.

[58] R. Clark, J. Reed, T. Sunderland, Bridging funding gaps for climate and sustainable development: Pitfalls, progress and potential of private finance, Land Use Policy. 71 (2018) 335–346.

[59] P. Mishra, G. Singh, Energy Management Systems in Sustainable Smart Cities Based on the Internet of Energy: A Technical Review, Energies. 16 (2023). https://doi.org/10.3390/en16196903.

[60] M.M.V. Cantarero, Of renewable energy, energy democracy, and sustainable development: A roadmap to accelerate the energy transition in developing countries, Energy Res. Soc. Sci. 70 (2020) 101716.

[61] H.M. Arslan, I. Khan, M.I. Latif, B. Komal, S. Chen, Understanding the dynamics of natural resources rents, environmental sustainability, and sustainable economic growth: new insights from China, Environ. Sci. Pollut. Res. 29 (2022) 58746–58761. https://doi.org/10.1007/s11356-022-19952-y.

[62] A. MacDonald, A. Clarke, L. Huang, Multi-stakeholder Partnerships for Sustainability: Designing Decision-Making Processes for Partnership Capacity BT - Business and the Ethical Implications of Technology, in: K. Martin, K. Shilton, J. Smith (Eds.), Springer Nature Switzerland, Cham, 2022: pp. 103–120. https://doi.org/10.1007/978-3-031-18794-0_7.

[63] G.S. Bapat, A. Kumar, A. Kumar, S.L. Hota, Kavita, K. Singh, Sustainable Green Manufacturing Approaches in India—A Step towards a New Green Revolution through SMEs, Eng. Proc. 59 (2023). https://doi.org/10.3390/engproc2023059211.

[64] U. Kayani, M.K. Hassan, A. Dejan, M. Khan, F. Nawaz, Assessment of Economic Policy Uncertainty spillovers: A cross-border analysis of global and BRIC economies, Int. Econ. 179 (2024) 100530. https://doi.org/https://doi.org/10.1016/j.inteco.2024.100530.

[65] R.-D. Chang, J. Zuo, Z.-Y. Zhao, G. Zillante, X.-L. Gan, V. Soebarto, Evolving theories of sustainability and firms: History, future directions and implications for renewable energy research, Renew. Sustain. Energy Rev. 72 (2017) 48–56. https://doi.org/https://doi.org/10.1016/j.rser.2017.01.029.

[66] W. Drover, L. Busenitz, S. Matusik, D. Townsend, A. Anglin, G. Dushnitsky, A Review and Road Map of Entrepreneurial Equity Financing Research: Venture Capital, Corporate Venture Capital, Angel Investment, Crowdfunding, and Accelerators, J. Manage. 43 (2017) 1820–1853. https://doi.org/10.1177/0149206317690584.

[67] M. Haseeb, H.I. Hussain, S. Kot, A. Androniceanu, K. Jermsittiparsert, Role of Social and Technological Challenges in Achieving a Sustainable Competitive Advantage and Sustainable Business Performance, Sustainability. 11 (2019). https://doi.org/10.3390/su11143811.

[68] Q. Kong, R. Li, Z. Wang, D. Peng, Economic policy uncertainty and firm investment decisions: Dilemma or opportunity?, Int. Rev. Financ. Anal. 83 (2022) 102301. https://doi.org/https://doi.org/10.1016/j.irfa.2022.102301.