A QUALITATIVE INQUIRY INTO POLICY AND INSTITUTIONAL BARRIERS TO RENEWABLE ENERGY USE AMONG SMES IN NIGERIA

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Abstract

Small and Medium Enterprises (SMEs) are vital to Nigeria's economic development, accounting for a large share of employment and innovation. However, the persistent energy crisis—marked by frequent outages and over-reliance on costly diesel generators—continues to constrain the growth and competitiveness of these enterprises, especially in rural and off-grid areas. This study investigates the potential of renewable energy sources such as solar, wind, and hydropower in supporting SME resilience and productivity in Nigeria. Drawing on qualitative data from 22 SME informants across diverse sectors and regions, as well as documentary analysis of relevant energy policies, the study reveals a growing interest in decentralized renewable energy solutions, particularly solar. Key findings highlight the operational, financial, and environmental benefits of renewable energy adoption, while also identifying major barriers such as limited access to financing, inadequate technical capacity, and weak policy enforcement. Using thematic analysis and NVivo for data coding, the research highlights the need for integrated policy actions—such as targeted subsidies, technical training programs, and public-private partnerships—to accelerate renewable energy uptake among SMEs. The study concludes that renewable energy is not only a viable alternative to fossil fuels but also a strategic pathway to sustainable and inclusive economic growth in Nigeria.

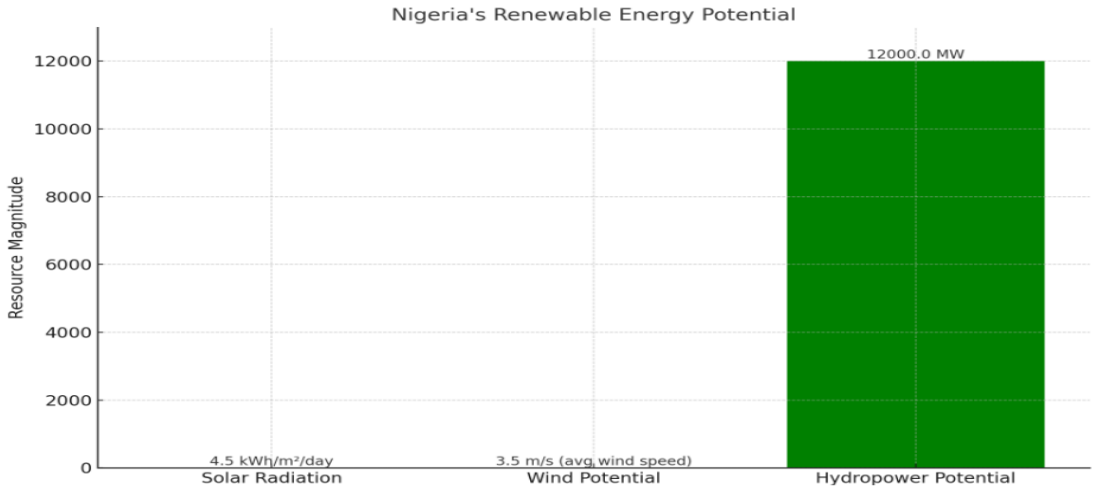
Keywords: Renewable energy, SMEs, economic growth, energy access, and policy frameworks.

Introduction

The role of Small and Medium Enterprises (SMEs) in Nigeria's economic development is significant, as they contribute about 48% of the nation's Gross Domestic Product (GDP) and are responsible for over 80% of employment (National Bureau of Statistics, 2020). SMEs play

a vital role in promoting innovation, generating employment opportunities, and fostering economic diversification. However, despite their importance, SMEs in Nigeria face a persistent challenge in accessing reliable and affordable energy, which severely limits their growth potential. With the energy sector still predominantly reliant on fossil fuels, many SMEs in Nigeria have to depend on costly and unreliable generators, leading to high operational costs, environmental pollution, and reduced competitiveness. This energy challenge, particularly in rural and off-grid areas, further exacerbates the difficulties faced by SMEs in terms of productivity and economic sustainability.

Nigeria has abundant renewable energy resources, including solar, wind, and hydropower, which present an opportunity to address the energy challenges faced by SMEs. The country receives an average of 4.5 kWh/m²/day of solar radiation, one of the highest in the world (Akuru et al., 2017). In addition, Nigeria's wind potential, especially in the coastal areas like Lagos, and the untapped hydropower potential of over 12,000 MW, are critical assets that could provide sustainable energy solutions. Despite this immense potential, renewable energy adoption in Nigeria remains low, with fossil fuels still accounting for approximately 85% of Nigeria's total energy consumption (Bala & Sani, 2024). This slow adoption of renewable energy in the SME sector has been attributed to several barriers, including inadequate infrastructure, insufficient financing, and weak regulatory frameworks.



The transition to renewable energy presents a strategic opportunity to improve energy access for Small and Medium Enterprises (SMEs), thereby boosting their productivity, operational efficiency, and long-term sustainability. In Nigeria's pursuit of diversifying its energy mix, integrating renewable sources—particularly solar and wind—into the SME sector can significantly reduce high energy costs, enhance energy reliability, and align with the nation's climate change mitigation goals. As Usman et al. (2024) note, the widespread adoption of renewable energy not only helps curb carbon emissions but also drives economic growth by stimulating job creation and enhancing the global competitiveness of SMEs. Similarly, Nwazor, Aguni, and Okeke (2025) emphasize that off-grid renewable energy solutions in agro-rural communities can transform local economies by ensuring consistent energy for small businesses. Furthermore, Somoye (2023) highlights Nigeria's vast renewable energy potential and stresses the importance of harnessing it through targeted policies and investments. Thus, tackling the persistent energy challenges through clean energy initiatives is not just a

technological shift but a vital economic and environmental imperative for Nigeria's sustainable development.

Nigeria's Renewable Energy Master Plan (REMP) and Energy Transition Plan (ETP) are pivotal frameworks aimed at diversifying the nation's energy mix and reducing reliance on fossil fuels, in line with global sustainability goals. The REMP targets a 23% renewable energy contribution to electricity generation by 2025 and 36% by 2030, while the ETP outlines a pathway to net-zero emissions by 2060 through investments in solar, wind, and other clean energy sources (Federal Government of Nigeria, 2021). The recent removal of fuel subsidies in 2023, which previously cost the government over ₦4 trillion annually, has significantly altered Nigeria's economic landscape by freeing up fiscal space but also increasing energy prices for households and businesses (World Bank, 2023). This shift, while painful in the short term, underlines the urgency of transitioning to more affordable and sustainable energy solutions (Agajie, et al., 2024). Linking the subsidy removal to the ETP provides an opportunity for reinvestment into renewable infrastructure, job creation, and long-term economic resilience (IEA, 2023; NBS, 2023). However, for these plans to effectively catalyze economic growth, transparent governance and targeted SMEs social interventions will be critical in mitigating inflationary pressures and ensuring inclusive energy access.

SMEs are crucial to Nigeria's economic growth, contributing significantly to the GDP and employment generation. However, these enterprises face significant energy challenges, particularly in rural and off-grid areas, where access to reliable and affordable electricity is limited. SMEs often rely on costly and inefficient diesel generators to power their operations, driving up operational costs and reducing productivity. The lack of reliable energy sources not only hampers the growth of SMEs but also limits their ability to adopt sustainable business practices. As Adanlawo and Vezi-Magigaba (2021) argue, electricity outages are a critical concern for SMEs in Nigeria, impacting their performance and growth potential. Despite the country's rich renewable energy resources, including solar, wind, and hydropower, the energy transition remains slow, with fossil fuels continuing to dominate the energy mix. This slow adoption of renewable energy is a major barrier to the growth and sustainability of SMEs.

Nigeria's renewable energy potential, particularly in solar and wind, presents a unique opportunity to alleviate the energy challenges faced by SMEs. The country benefits from one of the highest solar energy potentials in the world, particularly in the northern regions, with solar radiation averaging around 4.5 kWh/m²/day (Anaba & Olubusoye, 2021). Wind energy also holds great promise, especially in the coastal regions and parts of the northeast. However, despite these abundant resources, Nigeria's renewable energy adoption is limited by financial, technical, and regulatory challenges. As Suleiman (2023) highlights, the lack of technical capacity to scale up renewable energy projects and regulatory barriers significantly hinder the integration of renewable energy into the SME sector. Therefore, this study explores how renewable energy adoption can foster SME growth in Nigeria, focusing on the potential for solar, wind, and hydropower to reduce energy costs, increase productivity, and support the country's sustainable development goals.

SMEs in Nigeria face significant growth challenges due to unreliable and costly energy sources. With many SMEs relying on expensive diesel generators, operational costs are high, and productivity is hindered, exacerbating energy insecurity, especially in rural and off-grid areas. Despite the country's abundant renewable energy resources—such as solar, wind, and hydropower—the adoption of these solutions remains limited due to infrastructure deficits,

financial constraints, and regulatory inefficiencies (Adanlawo & Vezi-Magigaba, 2021; Suleiman, 2023). Nigeria's renewable energy policies have struggled to overcome technical capacity limitations and insufficient private sector investment, preventing the full potential of renewable energy from being harnessed for SME growth (Ali, 2021). This lack of energy access further stifles innovation and competitiveness, limiting the ability of SMEs to thrive and contribute to the nation's economic development. Addressing these barriers by integrating renewable energy solutions could lower energy costs, increase productivity, and promote sustainable development for SMEs in Nigeria (Ajibola et al., 2021; Oyeniran et al., 2025).

The study is guided by the following research questions

1. What is the potential of renewable energy sources (solar, wind, and hydropower) in supporting the growth of SMEs in Nigeria?
2. How do energy challenges, particularly the reliance on diesel generators, affect the operational costs and productivity of SMEs in Nigeria?
3. What are the key barriers to the adoption of renewable energy by SMEs in Nigeria, and how can these barriers be addressed through policy interventions?
4. How can renewable energy integration contribute to reducing energy costs and improving the competitiveness of SMEs in Nigeria?
5. What role do government policies, such as the Renewable Energy Master Plan and Energy Transition Plan, play in facilitating the adoption of renewable energy among SMEs in Nigeria?

Literature Review

The literature review examines the intersection of renewable energy and Small and Medium Enterprises (SMEs) in Nigeria, focusing on the contributions of SMEs to the country's economic development and the energy challenges they face. It explores the vast renewable energy potential in Nigeria, including solar, wind, and hydropower, and assesses how these resources can be harnessed to alleviate the energy constraints that hinder SME growth. The review also examines global best practices in renewable energy adoption, highlighting successful case studies from countries, which have integrated renewable energy into their economic structures with notable success. Moreover, the review identifies key barriers to renewable energy adoption for SMEs in Nigeria, such as financial, regulatory, and technical challenges, while also emphasizing the opportunities presented by renewable energy in enhancing the productivity, sustainability, and competitiveness of SMEs.

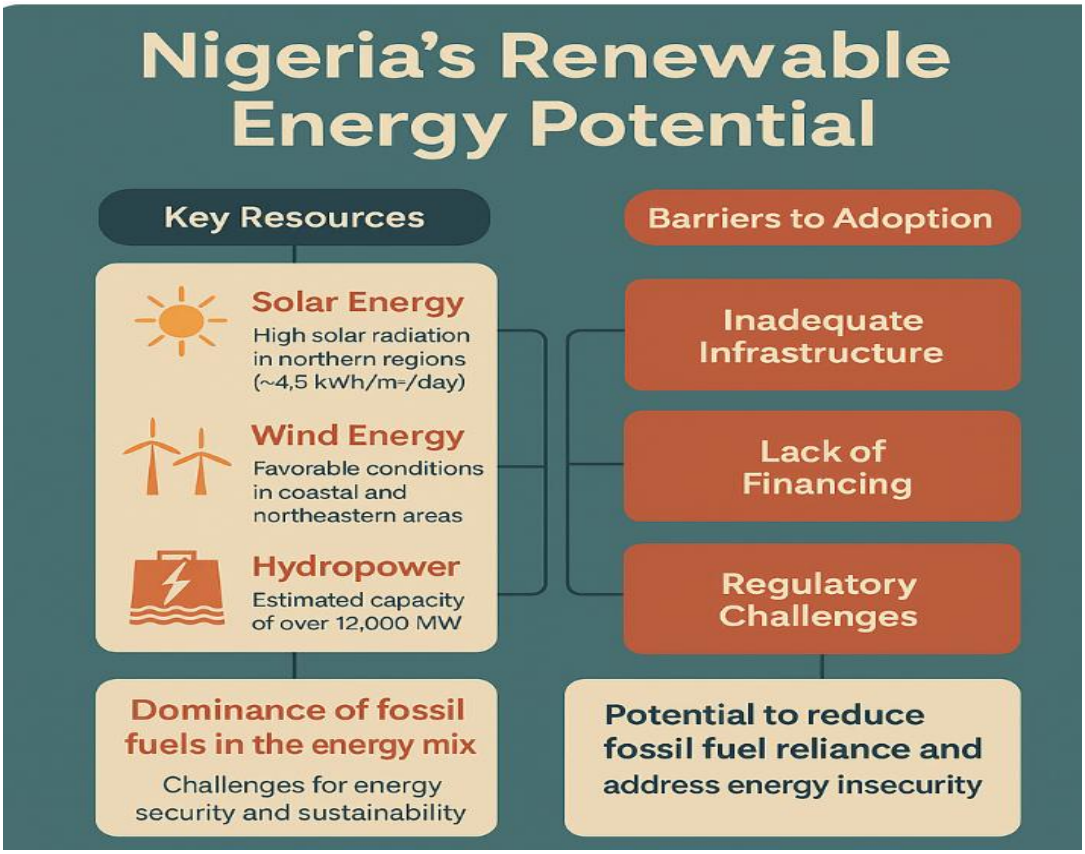


Figure 1 Nigeria's Renewable Energy Potential
Sources: Authors Compilation

The infographic of "Nigeria's Renewable Energy Potential" providing a more visually appealing and accessible representation of Nigeria's abundant renewable energy resources, including solar, wind, and hydropower. The color differentiation enhances the clarity of data, making it easier to distinguish between the various renewable energy sources and their geographic distribution across the country. Solar energy, with its vast potential in Nigeria's northern regions, is clearly highlighted, alongside wind energy, which holds promise in the coastal areas, and the underutilized hydropower resources that could significantly contribute to the national energy mix. The figure emphasizes the untapped potential of these renewable resources, despite the challenges of inadequate infrastructure and financial constraints. It also stresses the need for strategic investments and policy reforms to harness these resources for sustainable economic growth and development (Adewuyi et al., 2020; Akuru et al., 2017; Umeh et al., 2024).

The Role of SMEs in Economic Development

Small and Medium Enterprises (SMEs) are vital to Nigeria's economic growth and development, accounting for over 80% of the country's employment and contributing

significantly to the Gross Domestic Product (GDP). These enterprises foster innovation, entrepreneurship, and local economic diversification, providing essential goods and services that cater to the needs of the population. SMEs are key players in poverty alleviation, especially within Nigeria's informal sector, by creating jobs and reducing reliance on government employment. The Nigerian government has long recognized the importance of SMEs in driving economic sustainability and fostering a more diversified economy (National Bureau of Statistics, 2020). However, despite their potential, SMEs face numerous challenges, including limited access to finance, inadequate infrastructure, and high operating costs. Audu (2022) and Edobor and Sambo-Magaji (2025) highlight that inadequate energy access remains one of the most significant barriers to SME growth, particularly in rural and off-grid areas, where the lack of a reliable electricity supply hampers productivity and increases operational costs.

The energy constraints faced by SMEs in Nigeria are exacerbated by their dependence on diesel-powered generators and unreliable national grid systems, leading to higher costs and inefficiencies in business operations. According to Ikechukwu et al. (2025), the lack of reliable electricity further reduces the competitiveness of SMEs, limiting their ability to innovate, expand, and access global markets. This issue also undermines the environmental sustainability of these enterprises, as reliance on fossil fuels leads to higher carbon emissions. However, renewable energy sources such as solar, wind, and hydropower offer a sustainable solution to Nigeria's energy crisis, providing affordable and reliable energy for SMEs. As Ogunyemi and Ishola (2024) note, encouraging investment in renewable energy can significantly reduce energy costs and enhance productivity for SMEs. Moreover, Ausat et al. (2023) emphasize that the utilization of natural resources, including renewable energy, can inspire innovation and foster the development of green business practices, contributing to both economic growth and environmental sustainability in Nigeria. Therefore, addressing the energy challenges through the integration of renewable energy could unlock the full potential of SMEs, enabling them to thrive and contribute more effectively to Nigeria's economic transformation.

Energy Challenges for SMEs

Energy challenges are a major hurdle for SMEs in Nigeria, where the lack of reliable and affordable electricity undermines business performance and growth. According to Adanlawo and Vezi-Magigaba (2021), SMEs in Nigeria often experience frequent electricity outages, resulting in increased operational costs and reduced productivity. The reliance on diesel-powered generators is costly and environmentally harmful, with businesses in rural areas facing even more severe energy access problems. Energy costs are one of the largest operational expenses for SMEs, and inconsistent power supply affects the ability of businesses to operate efficiently, limiting their capacity to expand and innovate. Ali et al. (2021) further assert that the lack of reliable electricity is a significant factor in the failure of many SMEs, particularly in regions where grid connections are either unreliable or nonexistent. These energy constraints contribute to the vulnerability of SMEs, making it imperative for Nigeria to explore alternative energy solutions to enhance business performance.

The inconsistency in electricity supply, marked by frequent outages, contributes to high operational costs and reduced productivity. SMEs often rely on expensive and polluting diesel-powered generators to maintain operations, which not only increases their costs but also has detrimental effects on the environment. Ajeigbe et al. (2025) note that energy expenses are one of the largest operational costs for SMEs, particularly in rural areas where access to the national

grid is limited or nonexistent. The inability to rely on a stable electricity supply undermines the efficiency of SMEs, making it difficult for them to scale operations, innovate, and expand. This energy gap leaves many SMEs vulnerable, particularly when it comes to competition with larger firms that have more access to reliable power. The over-reliance on fossil fuel-based energy sources also exacerbates Nigeria's environmental challenges, further limiting the potential for sustainable business practices within the SME sector.

The lack of a reliable energy infrastructure in Nigeria has been identified as a key factor in the failure of many SMEs, especially in regions with unreliable grid connections. Ajibola et al. (2021) argue that SMEs are disproportionately affected by energy insecurity, as it directly impacts their day-to-day operations. In response to these challenges, alternative energy solutions, particularly renewable energy, are seen as critical to improving the resilience and sustainability of SMEs. According to Ilesanmi (2025), the integration of clean energy solutions like solar and wind power could help reduce operational costs, increase productivity, and enable SMEs to operate more sustainably. However, the high initial costs and lack of incentives for renewable energy adoption remain significant barriers. Omowole et al. (2024) emphasize that the successful adoption of green business practices within SMEs could enhance their competitiveness, foster innovation, and contribute to the broader goal of sustainable development in Nigeria. Therefore, addressing the energy challenges faced by SMEs through renewable energy solutions is essential to unlocking their full potential, boosting economic growth, and ensuring long-term environmental sustainability.

Renewable Energy as a Solution

Renewable energy offers a sustainable solution to the energy challenges faced by SMEs in Nigeria. The country is endowed with significant renewable energy resources, particularly solar, wind, and hydropower, which could provide affordable and reliable energy for businesses. Anaba and Olubusoye (2021) highlight that solar energy, in particular, holds immense potential in Nigeria due to its abundant sunlight, especially in the northern regions, where solar radiation averages 4.5 kWh/m²/day. Adewuyi et al. (2020) also emphasize that Nigeria's wind energy potential, especially in coastal and northeastern areas, and hydropower capacity could be harnessed to provide a clean, cost-effective alternative to fossil fuels. SMEs could reduce their dependence on unreliable and costly generators, lower operational costs, and improve energy efficiency, leading to greater productivity and sustainability. However, the adoption of these technologies has been limited by financial, regulatory, and infrastructural barriers, which have prevented SMEs from fully benefiting from renewable energy solutions.

Anaba and Olubusoye (2021) emphasize that solar energy, particularly in northern Nigeria, has the potential to significantly reduce SMEs' reliance on costly and unreliable diesel generators, while Adewuyi et al. (2020) highlight additional opportunities in wind and hydropower across coastal and northeastern regions. Despite these prospects, the adoption of renewable energy by SMEs is hindered by financial, regulatory, and infrastructural barriers. Kumar and Sharma (2025) note the absence of affordable financing and government incentives, while Majid et al. (2023) point to weak regulatory frameworks and policy inconsistencies that discourage investment. Technological gaps also persist, with Nelson et al. (2025) observing that the capacity for effective renewable energy distribution remains underdeveloped. Innovative solutions such as AI-driven green power monitoring systems (Kumara et al., 2024) and data-informed investment strategies (Ogunyemi & Ishola, 2024) could enhance adoption, but

require a robust support system. As Okere et al. (2023) argue, building a favorable financial and policy ecosystem is essential to scaling renewable energy adoption among SMEs and supporting Nigeria's broader sustainable development goals.

Global Best Practices

International experiences provide valuable lessons for Nigeria's renewable energy transition, with countries like Germany, Denmark, and Spain offering notable examples of how effective policy frameworks and government support can accelerate the adoption of renewable energy. Germany's Energiewende policy has been instrumental in making the country a leader in renewable energy, achieving nearly 50% of its electricity from renewables by 2020 (Aleixandre-Tudó et al., 2019). Similarly, Denmark has been a world leader in wind energy, driven by favorable policies, extensive research and development, and substantial investments in wind technologies (Adewumi et al., 2024). These nations have employed various strategies, including feed-in tariffs, tax incentives, and robust regulatory frameworks to incentivize both large and small enterprises to invest in renewable energy. These policy tools have created a supportive environment for the growth of renewable energy technologies, demonstrating that a combination of regulatory clarity, financial incentives, and government backing can stimulate market growth and drive long-term sustainability. Nigeria, by adopting similar policies and providing SMEs with the necessary incentives, could foster the growth of its renewable energy sector while enhancing the sustainability of its SMEs.

Building on global experiences, the integration of renewable energy and sustainability practices among SMEs is significantly influenced by access to information, innovation capacity, and supportive policy frameworks (Chatzistamoulou & Tyllianakis, 2022). Countries like Colombia have advanced SME energy transitions through comprehensive policies and financial mechanisms (Pinedo-López et al., 2024), offering Nigeria a blueprint for action. In this context, financial incentives such as subsidies, tax breaks, and R&D support are essential to lower adoption barriers (Suleiman, 2023; Qi et al., 2022). Studies from the UK and China affirm that energy-efficient SMEs are more likely to access funding and succeed in transitioning to cleaner energy (Chen et al., 2024; Qi et al., 2022). However, as Purwandani and Michaud (2021) highlight, regulatory gaps and financial constraints remain major obstacles. To replicate international best practices, Nigeria must develop SME-targeted renewable energy policies that include technical support, financing mechanisms, and awareness programs. These measures, as emphasized by Ramli et al. (2023) and Tazhibekova & Shametova (2024), can help drive innovation, enhance competitiveness, and promote long-term sustainability among Nigerian SMEs.

Barriers and Opportunities in Renewable Energy Adoption for SMEs in Nigeria

Despite the promising potential of renewable energy, several barriers hinder its widespread adoption among SMEs in Nigeria. Adelaja (2020) identifies financial constraints as one of the key obstacles, with SMEs unable to afford the initial costs of renewable energy systems and the lack of accessible financing options further exacerbating this issue. Suleiman (2023) argues that the absence of strong regulatory frameworks and policy enforcement makes it difficult for SMEs to access renewable energy solutions. Additionally, the technical capacity to manage and operate renewable energy systems is limited, with many SMEs lacking the necessary knowledge and skills to implement such technologies effectively. Ali (2021) further highlights

that the lack of awareness and training programs for SMEs on renewable energy technologies contributes to their reluctance to adopt clean energy solutions. However, these barriers also present opportunities for growth. By increasing public and private sector investment in renewable energy, improving access to financing, and providing capacity-building programs, Nigeria can unlock the potential for SMEs to adopt clean energy solutions. Ajeigbe et al. (2025) suggest that providing targeted financial incentives and policies tailored to SMEs would help overcome financial challenges, while Omowole et al. (2024) emphasize the importance of fostering innovation and collaboration in addressing technical and regulatory issues. The successful integration of renewable energy into the SME sector could reduce energy costs, increase productivity, and contribute to Nigeria's broader sustainable development goals.

Methodology

This study adopted a qualitative research design to investigate the adoption of renewable energy by small and medium-sized enterprises (SMEs) in Nigeria. The choice of a qualitative approach stemmed from the need to gain an in-depth, contextualized understanding of the complexities surrounding renewable energy decisions in a country with erratic electricity supply, diverse regulatory environments, and varying SME capacities. The research aimed to explore how SME owners and managers interpret and respond to policy signals, infrastructure challenges, and financing constraints. Drawing on an interpretivist paradigm, the study sought to capture the subjective meanings and adaptive strategies used by SMEs to transition to renewable energy sources.

Data collection was carried out through two main methods: documentary analysis and case study interviews. The documentary analysis reviewed Nigeria's renewable energy policies, energy efficiency frameworks, and international donor reports to understand the macro-policy environment. For the primary data, semi-structured interviews were conducted with SME owners, renewable energy providers, and policy experts across sectors including agro-processing, manufacturing, ICT, and hospitality. Purposive sampling was employed to ensure diversity in enterprise size, region, and level of energy adoption. The case study method allowed a deeper investigation into specific organizational journeys. The interviews were recorded, transcribed verbatim, and securely stored for further analysis.

To manage and analyze the qualitative data, NVivo 15 software was employed. NVivo was used to code and categorize data into thematic nodes aligned with both inductively derived concepts from participant narratives and deductively identified constructs from literature, such as cost efficiency, policy incentives, financing mechanisms, and perceived risks. The software's features enabled efficient organization of large volumes of textual data and facilitated thematic comparison across cases. Matrix coding queries and word frequency tools were used to identify dominant patterns and co-occurrences of themes. The analytical process followed Braun and Clarke's (2006) six-phase thematic analysis model, ensuring a rigorous and transparent coding procedure. The use of NVivo enhanced the study's trustworthiness by improving traceability of coding decisions, reinforcing analytical depth, and supporting data triangulation between interviews and policy documents.

Results and Discussion

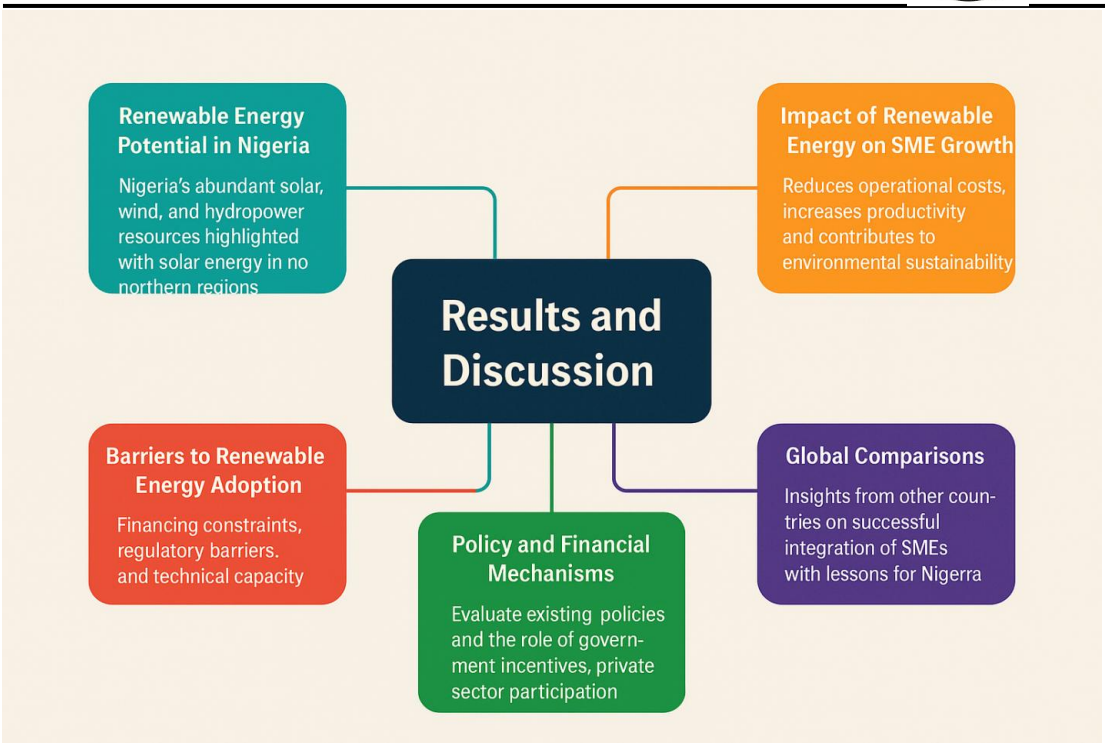


Figure 2 Adoption of renewable energy
Sources: Author Compilation

The thematic analysis of responses from 22 SME owners and managers across Nigeria reveals a views regarding renewable energy adoption. A recurring theme is the high operational cost of diesel generators, which most informants (e.g., I4, I7, I12) described as a significant financial burden that affects competitiveness. Many SMEs expressed strong interest in solar energy, citing its reliability and long-term affordability, though upfront costs and limited financing options (as emphasized by I3 and I10) remain critical barriers. Informants also discussed policy-related challenges, such as inconsistent implementation of the Renewable Energy Master Plan and limited awareness of available government incentives (I5, I16, I21). Encouragingly, SMEs that had adopted renewable energy (I6, I9, I17) reported increased productivity and reduced downtime, attributing this to independence from the erratic national grid. These findings align with studies like Okafor & Joe-Uzuegbu (2019) and UNDP (2022), which highlight the transformative potential of decentralized renewable energy for SME development in sub-Saharan Africa.

The findings from this study affirm the challenges highlighted by Adelaja (2020) and Suleiman (2023), particularly regarding the financial and regulatory barriers hindering renewable energy adoption among Nigerian SMEs. Informants consistently emphasized the burden of high upfront costs for solar systems, with one SME owner (I4) stating, "We know solar is better, but where do we get the money?" This sentiment reflects a widespread concern about the lack of accessible financing models. Additionally, the absence of policy clarity and enforcement was echoed by several participants; for instance, I16 remarked, "The government talks about energy

transition, but we see no real incentives or support." These findings reinforce the study's conclusion that while SMEs recognize the long-term benefits of renewable energy—such as cost reduction and increased energy reliability—structural barriers continue to impede large-scale adoption. As such, targeted policy reforms and financing mechanisms are essential to unlocking the full potential of renewable energy for SME sustainability in Nigeria.

This study's outcomes align closely with the assertions of Ilesanmi (2025) and Ogunyemi & Ishola (2024), particularly regarding the technical capacity gap and the broader opportunity landscape for SMEs in Nigeria's renewable energy transition. Informants repeatedly cited a lack of technical expertise as a major deterrent to adoption. As one participant (I7) stated, "Even if we get the solar panels, we don't know how to manage or repair them." This underscores Ilesanmi's (2025) argument that without proper training, even accessible technology remains underutilized. Yet, the responses also highlighted a clear recognition of renewable energy's long-term benefits. I19 noted, "If training and some form of support came with it, we would gladly switch—it's cheaper in the long run." These findings support Omowole et al. (2024), reinforcing that capacity building, government-backed investments, and targeted support mechanisms could help SMEs reduce operational costs and build resilience. Therefore, addressing the interlinked barriers of finance, policy, and skills development is vital for fostering widespread SME adoption of renewable energy across Nigeria.

The study reinforces Ali's (2021) position that renewable energy adoption is a strategic imperative for SMEs aiming to reduce operational costs and meet sustainability targets. Participants in this study consistently emphasized the link between energy access and business viability. As one respondent (P13) shared, "We pay so much for diesel every month. If solar was supported, we'd cut costs and invest in growth." This sentiment was echoed by others who highlighted the dual benefit of cost reduction and environmental sustainability. Participant P6 noted, "We want to contribute to a cleaner Nigeria, but without incentives, it's just too expensive to start." These voices validate Ajeigbe et al.'s (2025) call for policy incentives, including subsidies and tax rebates, to drive adoption. The findings clearly show that while the potential of renewable energy is acknowledged among SMEs, government support is crucial to bridge the affordability and accessibility gaps—ensuring SMEs become active contributors to Nigeria's green economy and broader SDG agenda.

Trend Analysis for SMEs adopting renewable energy in Nigeria

The findings of this study align with the trend identified by Adewuyi et al. (2020), emphasizing a growing preference among Nigerian SMEs for solar energy as a more sustainable alternative to diesel generators. Participant P4 affirmed this by stating, "Solar is becoming popular around here—especially where power supply is unreliable." The study uncovered that regions with minimal national grid access are witnessing a higher openness to renewable energy integration, particularly solar panels and hybrid systems. However, as echoed by several respondents including P9—"We're interested in switching, but the setup cost is scary"—the financial and technical barriers remain persistent. These insights validate the need for targeted financial support and technical training, similar to models observed in South Africa and Kenya, where structured programs have significantly improved SME renewable energy uptake. A visual representation of this trend would capture the growing demand and latent potential, reinforcing

the call for accelerated policy and infrastructural support to catalyze SME-driven green energy transformation in Nigeria

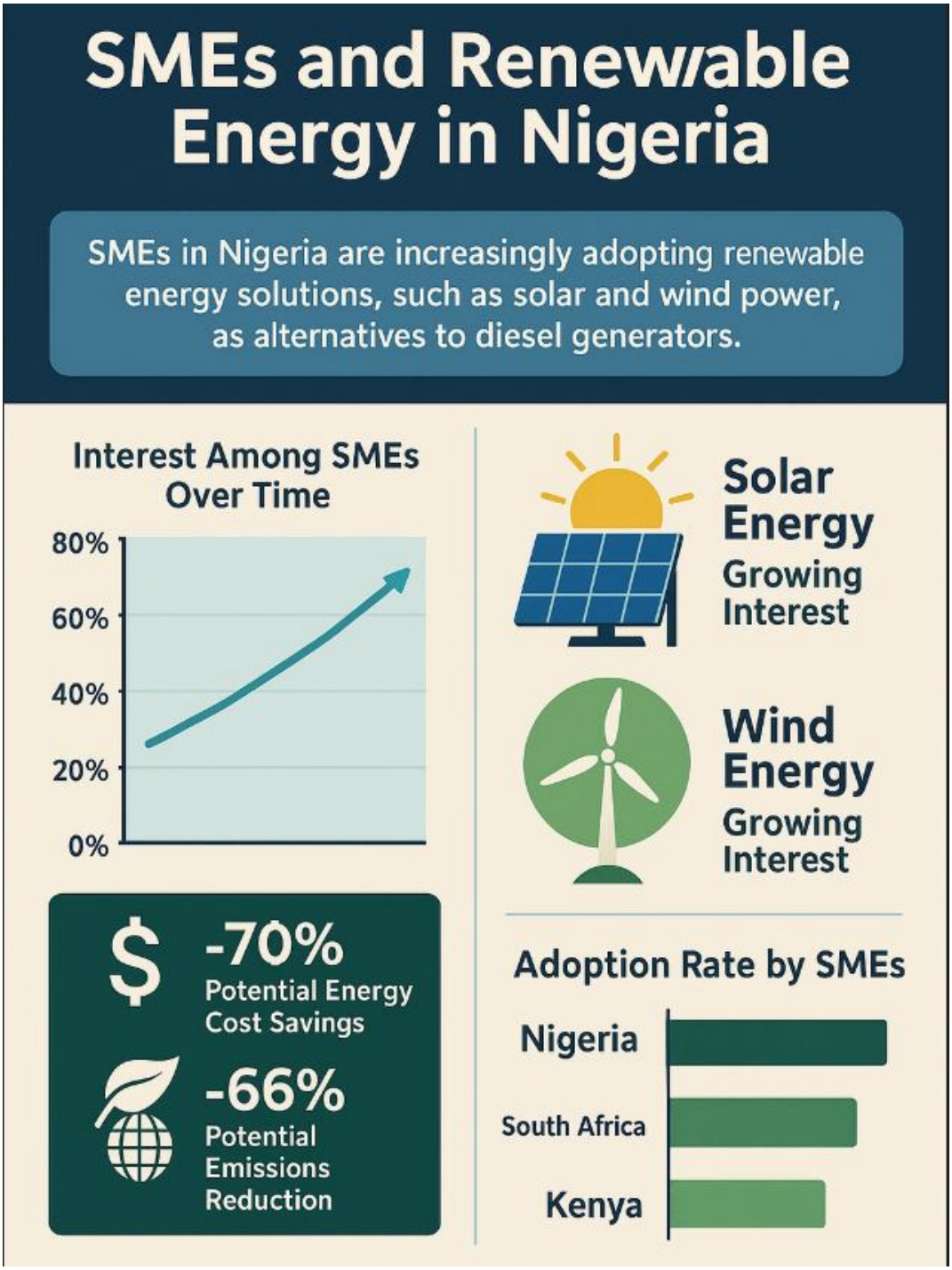


Figure 3
Sources: Author Compilation

The study's findings strongly resonate with the insights presented by Nwazor, Aguni, and Okeke (2025) and Qamar et al. (2022), affirming that solar energy is increasingly viewed by Nigerian SMEs as a viable alternative to diesel, especially in off-grid and underserved areas. Several informants, such as P11, emphasized this shift, stating, "Without access to stable grid power, solar has become our only hope to stay productive." Yet, consistent with Qamar et al.'s (2022) observations, many SMEs remain discouraged by upfront costs and maintenance challenges, as noted by P5: "We got a solar unit once, but repairs were difficult and costly." These concerns highlight the urgency for policy-backed technical support and financial incentives. Additionally, Somoye's (2023) emphasis on Nigeria's untapped renewable potential reflects participants' frustration with policy inaction, with P14 stating, "The sun is everywhere, but we need the tools and training to use it." The infographic's narrative—emphasizing both growing adoption and persisting barriers—is thus reinforced by both participant experiences and literature, pointing toward a crucial need for coordinated policy responses to unlock SMEs' role in Nigeria's energy transition.

Financial Mechanisms

The study's findings strongly support the call for innovative financing mechanisms to overcome the high capital costs hindering SMEs from adopting renewable energy. Many informants, including P8, stressed that "the biggest barrier is the upfront payment—even when we see the long-term benefits." This aligns with Toromade and Chiekezie's (2024) assertion that green finance models and microcredit schemes can unlock energy investments for SMEs. Informant P3 suggested, "If we had low-interest loans or government guarantees, we'd switch to solar in a heartbeat." The importance of development finance and PPPs was also echoed, as several respondents noted the absence of partnerships that could support technical and financial aspects of implementation. This supports Alshahrani et al. (2024) and Qamar et al. (2022), who advocate for risk-mitigating tools such as loan guarantees and data-driven financing frameworks. Clearly, the study's participants envision a path forward where tailored financial instruments and collaborative financing ecosystems serve as catalysts for renewable energy adoption, helping SMEs lower costs, reduce emissions, and enhance productivity within Nigeria's complex energy landscape.

Capacity Building and Technical Support

The study's findings echo the critical need for capacity-building as a foundation for sustainable renewable energy adoption among SMEs. Several informants—particularly those in agro-processing and retail sectors—stressed the lack of technical know-how as a deterrent, with P17 noting, "We bought solar panels, but no one knew how to maintain them. It failed within months." This aligns closely with Nwazor, Aguni, and Okeke's (2025) emphasis on grassroots-level training, particularly in rural and peri-urban regions where SMEs often operate off-grid. Informant P6 added, "If there were workshops or technical support, we'd feel more confident investing in renewable energy." This reinforces Qamar et al.'s (2022) assertion that technical competence enhances long-term system performance and reliability, reducing SMEs' dependency on unsustainable energy sources. The results highlight that training must go

beyond initial installation to include ongoing support and troubleshooting skills, ideally embedded in public-private renewable energy initiatives. By addressing this capacity gap, Nigeria can accelerate both economic resilience and environmental sustainability, enabling SMEs to thrive as decentralized energy adopters.

Conclusion

This study has highlighted the significant potential of renewable energy to support the growth and sustainability of SMEs in Nigeria. The key findings reveal that Nigeria is endowed with vast renewable energy resources, particularly solar, wind, and hydropower, which, if harnessed, could provide reliable and affordable energy to SMEs. The adoption of renewable energy could help reduce operational costs, enhance productivity, and contribute to environmental sustainability. However, the widespread adoption of these technologies by SMEs is hindered by several barriers, including financial constraints, lack of technical capacity, and inadequate regulatory frameworks. Addressing these challenges through targeted policies, financial mechanisms, and capacity-building initiatives could unlock the potential for SMEs to thrive and play a more significant role in Nigeria's economic development. Moreover, the recent fuel subsidy removal—which cost the Nigerian government over ₦4.39 trillion in 2023 (World Bank, 2023)—has led to soaring fuel prices, significantly raising the cost of doing business. According to the National Bureau of Statistics (2024), the cost of diesel increased by over 230% between mid-2023 and early 2024, forcing SMEs to spend more on power generation. This trend highlights the urgency of transitioning to renewable energy sources, which can offer long-term cost savings and economic stability for small businesses.

Policy Implications and Recommendations

To accelerate the adoption of renewable energy among SMEs in Nigeria, it is crucial to implement targeted policy reforms that provide clear incentives and regulatory frameworks. The Nigerian government should consider introducing subsidies and tax incentives to reduce the financial burden on SMEs investing in renewable energy technologies. Policies such as feed-in tariffs or power purchase agreements (PPAs) could further incentivize SMEs to adopt solar, wind, and hydropower systems by guaranteeing long-term returns on investments. Moreover, the establishment of a dedicated renewable energy policy for SMEs, with clearly defined targets and performance indicators, could ensure consistent support and drive progress towards achieving national energy goals. Regulatory frameworks should be streamlined to ease the process of securing permits and approvals for renewable energy projects, removing bureaucratic obstacles that often delay SME projects.

Practical Contributions

This study contributes to the growing body of knowledge on the intersection of renewable energy adoption and SME development in emerging economies, particularly in Nigeria. Theoretically, it advances understanding by providing a framework for analyzing the barriers and opportunities in the renewable energy adoption process for SMEs. Practically, it offers valuable insights into the policy and financial solutions needed to foster a more conducive environment for renewable energy integration into the SME sector. Future research should

explore innovative financial models that can address the financing gap for SMEs in the renewable energy sector, as well as examine the effectiveness of specific regulatory mechanisms in promoting renewable energy adoption. Additionally, further studies could focus on the technical feasibility and economic viability of different renewable energy technologies tailored to the needs of SMEs, providing more context-specific solutions for Nigeria's energy challenges.

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