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# Renewable Energy Adoption and Environmental Sustainability: Analysis of Opportunities and Challenges in Niger State, Nigeria

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## Abstract

*Nigeria has great renewable potential. In Nigeria, energy challenges and environmental degradation are major issues for the country, particularly in Niger State. Opportunities and constraints influencing renewable energy adoption and environmental sustainability in Niger State were investigated in this study. The Table of Krejcie and Morgan was used to arrive at the sample size, 421 respondents, for a cross-sectional survey. Data was collected from 421 respondents across six Local Government Areas (LGAs), homes, institutions and small to medium enterprises (SMEs). Key informant interviews were conducted as well. It was found in the study that despite the current minimal application of RE, it is capable of fostering sustainability in the state. It recommends regulatory measures, creative financial mechanisms, capacity-building efforts, communications initiatives and rural electrification projects using off-grid decentralised alternatives. The programs will save 1200t of equivalent standard coal, and develop clean energy from new and renewable sources to replace traditional energy consumption. It will upgrade environmental quality and promote inclusive development. Data were analysed descriptively, through multiple regression and also by using thematic analysis. The findings revealed that most respondents still depend on the national grid and fossil fuel generators heavily.*

**Keyword:** Renewable Energy adoption, Environmental Sustainability, Opportunities, Challenges and Minna metropolis

## Introduction

We are living in a time defined by climate change and overdependence on unsustainable energy sources. Every day, the continued burning of fossil fuels adds pressure to an already fragile environment. Across the globe, the resilience is accelerating environmental degradation- damaging ecosystems, reducing biodiversity and putting both human health and climate stability at serious risk. The consequences are not long distant possibilities; they are realities unfolding in every region of the planet. Sustainable development goals (SDGs), in particular SDG 7, which calls for clean energy is met by renewable energy technologies such as solar, hydropower, biomass and wind, pointing toward cleaner solutions. According to Owusu and Asumadu-Sarkodie (2016), the deployment of renewable energy is not only a practical solution for many developing countries to combat climate change, but it is also an important strategy to combat energy poverty and promote sustainable development. Yet, Nigeria still struggles with many of these energy problems. National grid's overdependence on fossil fuel-based generators, frequent power outages due to deficits in generation capacity, worsen carbon emissions (Oyedepo, 2021). Niger State, in North Central Nigeria, is a clear example of these issues. With all the renewable resources available, like high solar radiation and hydro-plants from Kainji and Shiroro dams, the utilisation is still low (Energy Commission of Nigeria, 2022). Due to this dependence, households, SMEs, and institutions still consume non-renewable sources of energy, with an ill effect on the environment and human well-being.

The problem becomes even more urgent, given Niger State's fast population growth, increasing deforestation, and reliance on petrol and diesel generators. These engagements put pressure on biomes, deteriorate air quality, and increase greenhouse gas discharges. In spite of the renowned advantages of implementing renewable energy, including cost savings, reduced carbon emissions, creation of green jobs, rural and remote area electrification, encounters like enforcement of tax regulations, high initial costs, infrastructure and low awareness, gaps still exist (Okoye et al. 2019). Even though the embracing of renewable energy in Nigeria has been widely studied (Abubakar et al. 2020), there hasn't been ample empirical research conducted specially in Niger State, which confines evidence-based policy engagements and makes significant knowledge gaps.

Against this bedrock, the study's aims are to examine the adoption of renewable energy in Niger State and its effects on environmental sustainability, as well as to identify the opportunities and challenges

that stimulate the process. This study set out to examine the current level of renewable energy adoption in Niger State and to assess how much it contributes to environmental sustainability. It also seeks to identify the opportunities available for expanding renewable energy use, evaluate the barriers that may be slowing adoption, and propose practical strategies to encourage wider acceptance across the state.

To guide the investigation, the following hypothesis was tested:

$H_0$: Adoption of renewable energy has no significant effect on environmental sustainability in Niger State.

**Renewable Energy Adoption**

In this context, Renewable energy refers to a process through which households, businesses, and organisations incorporate renewable technologies such as wind, biomass, hydropower and solar into their overall energy mix (Owusu and Asumadu-Sarkodie, 2016). It is influenced by socioeconomic, cultural, institutional, and financial issues, in addition to the accessibility of technology. Price, accessibility, awareness, and government support are the main factors influencing adoption in the majority of developing economies (Abubakar, Dano, & Bala, 2020). Nigeria has substantial sun irradiation, averaging 5.5 kWh/m²/day, making solar energy a viable renewable source (Energy Commission of Nigeria, 2022). This potential has spurred the growth of off-grid solar systems, especially in peri-urban and rural areas. However, adoption rates are still modest when compared to the country's renewable energy potential. Several households and businesses continue to rely heavily on diesel and petrol generators because they are alleged to be less costly in the short term, regardless of their serious ecological and health effects (Oyedepo, 2021). The tenacity of these trends demonstrates that adoption of renewable energy not only portrays technology, but also a social and policy concern. Absence of adequate finance, strong institutional support, and public awareness will limit the renewable energy adoption. Therefore, assessing adoption in Niger State entails a study of both practical feasibility and the greater supporting environment that encourages family and business energy decisions (Okoye, Okeniyi, & Adeyemo, 2019).

**Environmental Sustainability**

The obligation of the use and management of natural resources in methods that maintain ecosystems, while meeting the desires of current and future generations, is termed environmental sustainability

(Goodland, 2017). It ranks clean energy production, climate change resistance, low greenhouse gas emissions, and biodiversity conservation. Factually, Nigeria's energy practices have diluted sustainability. The extensive use of firewood and charcoal for cooking adds to significant deforestation, mainly in rural areas, whereas a dependence on generators has worsened urban air and noise pollution (Okoye et al. 2019). These engagements have adverse costs for the environment, but also for public well-being, economic productivity, and social welfare.The carrying out of renewable energy technologies has consequently been acknowledged as a dire driver of sustainability. Renewable energy will help Nigeria meet its global climate obligations under the Paris Agreement by decreasing greenhouse gas emissions, safeguarding biodiversity, and alleviating environmental dreadful conditions (UNEP, 2022). Additionally, access to hygienic and reliable power enables communities to weather climate tremors such as heat waves and droughts. A feasible choice for Niger State to pool economic growth and environmental integrity is renewable energy adoption (Oyedepo, 2021).

**Opportunities of Renewable Energy Adoption**

Quite a lot of opportunities for Niger State and Nigeria as a whole, as regards renewable energy. To begin with, it offers a vital trail for climate change alleviation by reducing dependence on fossil fuels, which are the primary source of greenhouse gas emissions (UNEP, 2022). The replacement of generators with solar and other hygienic technologies openly decreases emissions and improves air quality in cities. Additionally, renewable energy inspires economic growth by generating employment opportunities in installation, maintenance, sales, and renewable energy entrepreneurship (Edenhofer et al. 2018). This is exclusively significant in Niger State, where youth unemployment remains an important issue. Again, renewable energy contributes to energy safety by varying the energy mixture and reducing dependence on the unreliable national grid. Off-grid and mini-grid solutions can help surge electricity supply in faraway rural communities that are repeatedly overlooked in grid extension projects (Akinwale, Jesuleye, & Siyanbola, 2014). Renewable energy has the potential change, especially in rural communities. When clinics have steady electricity, healthcare improves. When schools are powered reliably, learning becomes more effective. Small business too, can grow without constantly worrying about fuel shortages or generator breakdowns. Over time, renewable technologies also lead to meaningful cost savings. Although the initial investment can be substantial,

households and SMEs spend far less on fuel and generator maintenance (Okoye et al., 2019). Taken together, these outcomes show that renewable energy adoption goes beyond simply providing power. It can drive economic empowerment, support environmental protection, and improve overall social well-being. For Niger State, blessed with abundant solar resources, expanding renewable energy use could accelerate economic growth while aligning with Nigeria's broader sustainability.

**Challenges of Renewable Energy Adoption**

Yet, despite these abundant opportunities, adoption remains constrained by several challenges. For many low-income households and small businesses, the upfront cost of solar panels, batteries and inverters is simply too high. Access to financing is limited, and flexible repayment options are often not available. Policy and regulatory weakness further complicate the situation. Continued subsidy for fossils, weak enforcement of renewable energy policies, and inconsistent government incentives undermined investors' confidence and slower market growth (Oyedepo, 2021). There are also practical barriers. Technical expertise is not always readily available, and many households lack clear information about the long-term benefits of renewable energy compared to generators. At the same time shortage of skilled technicians increases maintenance costs and discourages wider adoption (Akinwale et al. 2014). Infrastructural gaps, such as a weak supply chain for renewable energy components, add another layer of difficulty (Okoye et al., 2019). All of these limitations point to one clear need: a supportive environment that actively encourages renewable energy adoption. Addressing these problems will require coordinated efforts—stronger policy frameworks, innovative financing models, expanding technical training, and sustained public awareness campaigns. Without these deliberate steps, renewable energy in Niger State may fall short of its vast potential, despite the clear opportunities it presents.

**Conceptual Framework**

The illustration below presents the conceptual framework of the study.


**Figure 1:** Conceptual Framework of Renewable Energy Adoption and Environmental Sustainability

This outline highlights how the adoption of renewable energy is closely linked to environmental sustainability in Niger State. In this framework, renewable energy adoption serves as the independent variable, while environmental sustainability is the outcome sought to influence. The model does not assume a simple one-way relationship. Instead, it recognises the role of mediating factor—both opportunities and challenges. On the opportunity side are cost savings, rural electrification, improved productivity, and job creation. At the same time, there are real obstacles that can slow progress. Altogether, the framework suggests that renewable energy affects environmental sustainability in both direct and indirect ways, shaped by these enabling and limiting conditions.

### 2.2 Theoretical Framework

The study draws on the two major theoretical foundations.

#### i. Diffusion of Innovation Theory

Everett Rogers (2003) introduced the diffusion theory, which explains how new ideas and technologies spread within a social system. According to this theory, adoption depends largely on how people perceive five key attributes: relative advantage, compatibility, complexity, trialability and observability. In the context of Niger State, this means that the uptake of renewable energy will depend on whether potential users see it as more beneficial than a generator, affordable enough to justify the switch, and compatible with their daily realities and cultural expectations.

#### ii. Ecological Modernisation Theory

Arthur Mol and Gert Spaargaren (2000) advanced Ecological Modernisation theory. This perspective argues that environmental protection does not have to stand in opposition to development. Rather,

environmental improvement can be integrated into modern economic systems through technology, sound regulation, and market-based solutions. Applied to Niger State, the theory suggests that renewable energy adoption can expand where institutions are strong, regulatory frameworks are clear and effective, and market incentives are properly structured. Together, these theories offer a solid lens for understanding not only why renewable energy is adopted but also the opportunities it creates, the constraints it faces, and its broader implications for sustainability.

**Empirical Review**

A number of empirical studies further support this discussion. For instance, Okoye et al. (2019) found that solar energy adoption in urban areas significantly reduces reliance on generators and improves household affairs. Abubakar et al. (2020) observed that although renewable energy offers substantial environmental benefits, high initial cost and weak institutional support remain major barriers to widespread adoption. Similarly, Oyedepo (2021) linked Nigeria's slow energy transition to policy inconsistency, structural challenges, and limited political commitment. Taken together, these findings reinforce the need to address both enabling factors and the structural constraints shaping renewable energy adoption in Niger State. Gyamfi et al. (2018) exhibited in Ghana that renewable energy improved countryside electrification and means of living, regardless of continuous affordability and know-how issues. Mwangi (2020) revealed that the adoption of renewable energy heightened environmental sustainability and corporate yield in Kenya, but surmounting it required state-backed investment. Fewer empirical data in Niger State is the case. Although research on the adoption of renewable energy has been embarked on all through Nigeria and Sub-Saharan Africa, rare studies have obviously focused on Niger State, even with its immense renewable potential and stern sustainability challenges. The prevailing study has principally focused on technical and economic aspects, with slight care paid to the integration of adoption opportunities, limits, and environmental consequences. This study seals the gap by providing empirical proof from Niger State on how the adoption of renewable energy shapes environmental sustainability, likewise accounting for the intervening roles of opportunities and challenges.

**Study Area**

This study was conducted in Niger State, located in the North-Central geopolitical zone of Nigeria. The state occupies around 76,363 km², making it the country's largest by landmass (NSG, 2018).

Geographically, it is situated between latitude 8º30'00''N and 11º30'00''N, and longitude 3°30'00''E and 7°20'00''E. Niger state lies at an elevation of roughly 100 to 450 meters above sea level, a range that gives the landscape its distinct character. Geographically, the state is bordered by Kaduna State to the northeast, Kebbi State to the northwest, Kwara State to the southwest, and the Federal Capital Territory to the southeast. It also shares an International boundary with the Republic of Benin, placing it in a strategic position for cross-border interaction. Administratively, Niger State is divided into three senatorial districts: Niger North, Niger East, and Niger South. Together they comprise twenty-five Local Government Areas (LGAs). Key Urban centers include Bida, Kontagora, and Suleja and Mokwa, each playing important commercial and social roles within their districts. Minna, the state capital serve as the administrative and political hub. Through this structure, decisions about development planning, governance, and th distribution of resources are coordinated and implemented across the state.

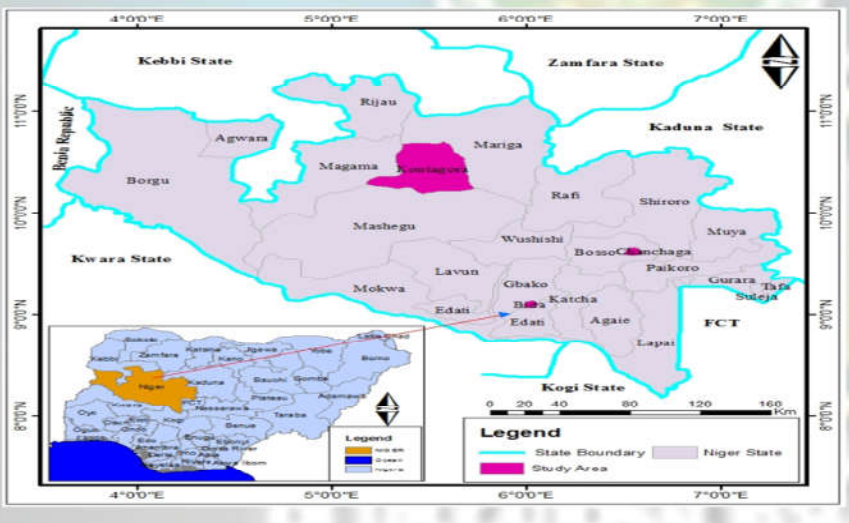


**Figure 2:** Map of Niger State Showing the Study Area.
**Source:** Modified from the Administrative Map of Niger State

Climatically, Niger State experiences a tropical continental pattern marked by two clearly defined seasons. The wet season typically runs from April to October, bringing the rainfall that supports agriculture and water supply. This is followed by the dry season, which lasts from November to March and is characterised by lower humidity and limited rainfall. The wettest months are July and August, with rainfall ranging from roughly 1,100 mm in the north to 1,600 mm in the South. With an average of 25ºC in December and 33ºC in April, temperatures are continuously high throughout the year (Balarabe & Usman, 2015). The state's economy is based on farming, which is encouraged by the mix of rainfall and temperature trends. Natural and renewable energy resources are plentiful in

Niger State. Nigeria's three main hydropower dams, Kainji, Shiroro, and Jebba, which produce electricity for the country's grid, are located there. The state is perfect for solar energy projects because of its exceptional sun irradiation, which averages 5.5 kWh/m²/day (Energy Commission of Nigeria, 2022). Niger State still depend on on fossil fuel makers, experiences steady power failure, and lacks energy regardless of these resources. A study on renewable energy adoption and its impact on enhancing environmental sustainability is critical, as this inconsistency highlights.

Over eighty per cent of the local labour force is hired in agriculture, which dictates the indigenous economy. Cattle rearing and the production of staple crops, including yams, rice, maize, millet, sorghum, peanuts, and cassava, are supported by the fertile land. Agriculture and fishing are also supported by the Niger and Kaduna rivers, and the local economy is bolstered by trade and small businesses. However, climate fluctuation, unpredictability in the energy supply, and inadequate infrastructure all obstruct economic growth and development. Niger State offers an excellent environment for research on environmental sustainability and the use of renewable energy because of these features. Although Niger State is richly endowed with hydropower and solar energy resources, it continues to face recurring energy shortages, power outages are common, and dependency on fossils fuel remains high. This situation not only slows economic progress but also undermines environmental sustainability. Given this contrast--abundant renewable and potential on one hand and persistent energy challenges on the other. The state provides a compelling setting for examining how renewable energy technology can drive sustainable development.

**Methodology**

The study explores the relationship between renewable energy use and environmental sustainability in Niger State, Nigeria. A cross-sectional survey design was adopted, guided by an explanatory approach. This made it possible to collect the data systematically within a limited period while still drawing meaningful inferences about relationship among variables.

The targeted population covered households and small and medium-scale enterprises (SMEs). And government institutions across the three senatorial zones of the state. Using the sample size table developed by Krejcie and Morgan (1970), which recommended 384 respondents for large populations, the study arrived at an initial figure. To account for potential non-responders, this was increased by 15 per cent, resulting in a total sample size of 442 respondents. A multistage stratified sampling technique was applied. First, two local government Areas (LGAs) were randomly selected from each zone, giving a total of six LGAs. Next, two communities were proportionately selected

from each LGA. Institutions were purposely selected to ensure inclusion of those existing or planned renewable energy installations, while households and SMEs were chosen through a combination of purposive and random sampling.

Primary data were collected using a structured questionnaire designed with a checklist scale. The instrument covered demographic characteristics, renewable energy adoption, perceived opportunities and challenges, and sustainability outcomes. Its validity was strengthened through expert review, pilot testing, and alignment with research objectives and existing literature (as recommended by Bolarinwa, 2015). Reliability was assessed using Cronbach's alpha. With a coefficient of 0.70 and above considered acceptable, in line with Cronbach (1951). Throughout the field work, ethical standards were strictly observed, including informed consent, voluntary participation, and assurance of confidentiality. For data analysis, both descriptive and inferential statistical techniques were employed. Frequencies and percentages were used to summarise the data, inferential methods helped tests relationship and draws conclusion from the findings.

**Results**

This section presents the results of a field survey that examines renewable energy adoption and its effects on environmental sustainability in Niger State. The goals of the study were to review the current level of adoption of renewable energy, assess its effect on sustainability, pinpoint adoption opportunities and challenges, and suggesting improvement. Data were analysed using both descriptive and inferential statistics. Descriptive statistics like frequencies and percentages were used to summarise the socio-demographic background and adoption designs of the respondents, whereas inferential statistics like regression analysis and chi-square were used to assess the associations between the variables.

**Response Rate**

421 of the 442 questionnaires that were distributed to residences, SMEs, and institutions in Niger State's six designated LGAs were returned and deemed usable, yielding a response rate of 95.2%. The employment of skilled enumerators who were acquainted with the local environment and the distribution of questionnaires in person was credited with this high response rate. Such a response rate is suitable and reliable for generalisation, according to Krejcie and Morgan (1970).

**Socio-Demographic Characteristics of Respondents**

Table 1 summarises the socio-demographic characteristics of respondents.

**Table 1 Socio-Demographic Characteristics of Respondents (n = 421)**

| Variable | Category | Frequency | Percentage (%) |
|---|---|---|---|
| Gender | Male | 259 | 61.5 |
| | Female | 162 | 38.5 |
| Age | 18–30 years | 118 | 28.0 |
| | 31–45 years | 174 | 41.3 |
| | 46–60 years | 93 | 22.1 |
| | Above 60 years | 36 | 8.6 |
| Educational Level | No formal | 37 | 8.8 |
| | Secondary | 142 | 33.7 |
| | Tertiary | 242 | 57.5 |
| Occupation | Household heads | 192 | 45.6 |
| | SMEs operators | 161 | 38.2 |
| | Institutions reps | 68 | 16. 2 |
| **Total** | | **421** | **100** |

**Field Survey, 2025**

Table 1 shows that men made up the bulk of responses (61.5%), with 41.3% falling into the 31–45 age range. The fact that more than half of the respondents (57.5%) had completed higher education suggests that most of them were literate and able to comprehend the fundamentals of renewable energy. To guarantee a fair representation of stakeholders, respondents were split up among households, SMEs, and institutions.

**Current Level of Renewable Energy Adoption in Niger State**

Respondents were asked to identify the energy sources they utilise. Because a checklist format was used, multiple responses were permitted. The findings are shown in Table 2.

**Table 2 Energy Sources Utilised by Respondents**

| Energy Source | Frequency | Percentage (%) |
|---|---|---|
| Solar panels | 95 | 22.6 |
| Biomass | 0 | 0 |
| Mini-hydro | 0 | 0 |
| Wind | 0 | 0 |
| National grid | 300 | 71.3 |
| Petrol/diesel generator | 26 | 6.2 |
| **Total** | **421** | **100** |

**Field Survey, 2025**

The national grid continues to be the most common energy source (71.3%), followed by gasoline/diesel generators (6.2%), as shown in Table 2. Adoption of renewable energy is comparatively low, with solar panels accounting for the largest share (22.6%). There is no use of other renewable energy sources like wind, micro hydro, or biomass. This demonstrates that, despite the growing popularity of renewable energy technologies, their adoption is still relatively low in comparison to conventional energy sources.

**Contribution of Renewable Energy Adoption to Environmental Sustainability**

Respondents were asked to list observable environmental benefits in order to assess how the adoption of renewable energy will affect sustainability.

**Table 3 Environmental Sustainability Outcomes from Renewable Energy Adoption**

| Sustainability Indicator | Frequency | Percentage (%) |
|---|---|---|
| Limited generator use | 170 | 40.4 |
| few household/business costs | 130 | 30.9 |
| Better air quality | 62 | 14.7 |
| Reduced deforestation | 39 | 9.3 |
| Climate adaptability | 20 | 4.8 |
| **Total** | 421 | 100 |

**Field Survey, 2025**

Based on Table 3, nearly half (40.4%) of respondents believed that using renewable energy reduced their reliance on generators, thus leading to a lesser amount of fuel consumption. About 14.7% stated healthier air quality, whereas 30.9% recounted lower costs. This proves how the use of renewable energy significantly improves environmental sustainability in Niger State, notwithstanding a slight impact due to minimal adoption rates.

**Opportunities Associated with Renewable Energy Adoption**

**Table 4 Opportunities from Renewable Energy Adoption**

| Opportunities | Frequency | Percentage (%) |
|---|---|---|
| Cost savings | 172 | 40.9 |
| Job creation | 40 | 9.5 |
| Rural electrification | 28 | 6.7 |
| Improved business productivity | 98 | 23.2 |
| Improved health/environment | 83 | 19.7 |
| **Total** | **421** | **100** |

**Field Survey, 2025**

The report of Table 4 shows that cost savings (40.9%) were the major revealed possibility, after which greater business productivity (23.2%) followed and improved (19.7%) environmental quality. Renewable energy vendors exhibited that there are employment opportunities in installation and maintenance services, although job growth was cited not as much frequently (9.5%).

**Challenges Hindering Renewable Energy Adoption**

Respondents similarly show imperative restraints that hinder their ability to adopt renewable energy.

**Table 5 Challenges of Renewable Energy Adoption**

| Challenges | Frequency | Percentage (%) |
|---|---|---|
| High capital outlay | 211 | 50.0 |
| Limited technical Knowledge | 100 | 23.8 |
| Policy constraint | 58 | 13.8 |
| Low awareness | 30 | 7.1 |
| Supply chain/infrastructure gaps | 22 | 5.3 |
| **Total** | **421** | **100** |

**Field Survey, 2025**

High capital outlay (50.0%) was the major problem, and an absence of technical-now how (23.8%). Limited Knowledge and little governmental backing were likewise witnessed, signifying that knowledge-related and institutional obstacles hamper comprehensive adoption. These outcome is in line with national research recognising policy discrepancies and the finance gap as substantial obstacles (Abubakar et al. 2020; Oyedepo, 2021).

**Regression Analysis of Renewable Energy Adoption and Environmental Sustainability**

Multiple regression was utilised to assess the research hypothesis to examine the impact of the adoption of renewable energy on environmental sustainability.

**Table 6 Regression Model Summary**

| Model | R | $R^2$ | Adjusted $R^2$ | Std. Error | Sig. (p-value) |
|---|---|---|---|---|---|
| 1 | 0.618 | 0.382 | 0.377 | 0.482 | 0.000*** |

**Field Survey, 2025**

Renewable energy adoption and environmental sustainability are considerably correlated ($p < 0.05$), based on the regression model. Renewable energy adoption is accountable for about 38.2% of the disparity in environmental sustainability results. This strengthens the investigation's alternative

hypothesis, based on which Niger State's sustainability is significantly impacted by the usage of renewable energy.

**Discussion of Findings**

The research work finds that, despite Niger State's limited adoption rate, renewable energy considerably improves environmental sustainability. The outcomes confirm that while solar is the utmost or common renewable technology, yet a significant dependence on generators and the national grid. This is consistent with the findings of Okoye et al.'s (2019) study, that establish that Nigerians continue to use generators despite the accessibility of solar choices. The study known environmental advantages; lower usage of generator, cost savings, and healthier air quality are in validation of extra research (Abubakar et al., 2020; Apergis & Payne, 2019) that demonstrate the impact of renewable energy in dropping emissions and promoting sustainability. Nevertheless, Oyedepo's (2021) valuation of monetary and capability shortfalls as noteworthy hindrances to Nigeria's energy transition is consistent with the perceived restrictions, especially the high capital outlay and dearth of technical know-how. The study confirms that Niger State takes both opportunities and challenges when it comes to the use of renewable energy, all things considered. It provides ample monetary and environmental advantages, further economic means, political support, and know-how competence are desired for it to make an immense impact.

**Conclusion**

The determination of this research stood at environmental sustainability and the use of renewable energy in Niger State, Nigeria. According to the data, the state's adoption of renewable energy remained low, with solar energy being the most popular renewable source. Most houses, SMEs, and institutions still rely on fossil fuel generators and the national grid. Renewable energy has been demonstrated to positively impact environmental sustainability despite its limited use by lowering dependency on generators, lowering household and commercial expenses, enhancing air quality, and boosting resilience during blackouts. The study also discovered that the use of renewable energy has tremendous potential for cost reduction, rural electrification, enhanced productivity, job generation, and better environmental quality. Even so, the path to wider adoption is far from smooth. High upfront costs make it difficult for many households and small businesses to take the first step. Beyond that, limited technical expertise means installation and maintenance can be a challenge. Weak

enforcement of existing regulations, low public awareness and gaps in infrastructure. Can further slow progress. Adoption of renewable energy has a major and direct impact on environmental sustainability in Niger State, according to statistical analysis, which supports the main claim of the study. Overall, although adoption is still low, if systemic obstacles are removed by deliberate legislation, funding sources, awareness campaigns, and capacity building, it has great potential to promote environmental sustainability. Nonetheless, the findings and conclusions lead to the following suggestions:

1. To stimulate investment by households, SMEs, and institutions, policy reform should be implemented to improve renewable energy regulations, guarantee strict enforcement to increase adoption, and offer subsidies and tax breaks.
2. To lessen the burden of the high initial costs of renewable energy technology, creative financing methods such as microcredit programs, cooperative loans, and pay-as-you-go agreements should be created.
3. Building capacity to guarantee the execution of technical training programs for regional engineers and technicians to create a skilled labour force capable of correctly installing and maintaining renewable energy installations.
4. Increasing public awareness and building stronger support for renewable energy by using the media, engaging community groups, and organising a demonstration project.
5. Invest in infrastructure and strengthen supply chains to make renewable energy more accessible and affordable. This includes private sector participation in the production and distribution of solar, batteries, and related components.

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