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Research Paper

Dimensions Of Energy Poverty and It's Significance to The National Economy of Nigeria

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Abstract
Energy poverty has plagued Nigeria for decades. This study sought to analyze the dimensions of energy poverty in the Nigerian national economy. Quantitative method was employed, where secondary data were gathered from the Nigerian National Bureau of Statistics (NBS) and World Bank database from 2015 to 2023. Descriptive statistics like standard deviation and mean were used in this research to illustrate the data, while Ordinary Least Squares (OLS) was used in measuring the interconnectivity among access to electricity, GDP per capita, and billed electricity (GWh). Augmented Dickey-Fuller (ADF) test was conducted to determine the stationarity of the variables in the time series, whereas Johansen cointegration test was used to determine the presence of a long-run equilibrium relationship among them. STATA 15 package was used to process data on energy poverty in Nigeria. From the results, electricity consumption (Electricity Billed, GWh) has statistically significant positive effect on GDP per capita (p = 0.002), but electricity access is not statistically significant (p = 0.889). ADF tests indicate Electricity Access and GDP per capita to be nonstationary, which suggests long-run volatility due to policy choices, infrastructure expansion, and economic growth, and Electricity Billed is stationary, indicating stable demand. The Johansen cointegration test identifies a single cointegrating relationship, confirming that there exists a long-run relationship between electricity consumption and economic growth. Hence the study concludes that economic growth and electricity access are not covariation in the short run, yet electricity use is a critical factor of economic stability; thus electricity reliability, not access, is crucial to economic growth. The study recommends that when addressing the nation's energy poverty, priority should be given to the regions or zones with the highest rates of energy poverty.

Keywords: *Energy Poverty, Economic Development, Electricity, Renewable Energy*

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I. Introduction

Though energy is a primary driver of economic development and social progress, Nigeria remains embroiled in energy poverty that severely undermines the development of the national economy. While endowed with tremendous resources for energy, millions of Nigerians still cannot access reliable electricity, which stifles the industrial sector, limits economic opportunities, and increases poverty (Adeshina et al., 2024). The interaction of energy poverty and economic stagnation is reflected in major national indicators like access to electricity, GDP per capita, and the gap between energy billed and actual electricity supply in gigawatt-hours (GWh) (Onuh et al., 2024). These factors would define the various dimensions to be covered by energy poverty and pinpoint that sustainable energy policies are very critical to doing away with its impacts on the development of Nigeria.

Nigeria's energy poverty issue is diverse and arises from inadequate power generation, partisan politics, political interference in the regulatory frameworks and appointment of incompetent individuals, inefficient transmission, and poor distribution networks (Adeyonu et al., 2022). Chanchangi et al. (2023) suggested that Nigeria has an installed generation capacity of 12,500MW; however, that which is actually available for supply to end users stands around 3,500-5,000MW. This gross gap in installed capacity versus supply breeds an energy crisis benefiting industrial players reliant on stable power supplies for operations more than households or small and medium enterprises (SMEs) (Agbaitoro, 2023; Evans et al., 2023). And this action led to the use of

alternative and often, costly sources of energy, such as diesel generator sets, thereby increasing production costs and reducing economic competitiveness.

The remaining factor is the impact energy poverty has on GDP per capita in Nigeria, which is still relatively low on the world scale. In much of the developed world, access to reliable and affordable electricity remains the driver of industrialization, innovation, and job creation (Habiyaremye et al., 2022). In Nigeria, the energy deficit threatens to constrain economic productivity, dissuades investment, and hampers the effective expansion of businesses. On the contrary, per capita energy consumption, based on empirical data, indicates positive correlations with economic development, while limited access to energy sources inhibits low economy growth and development (Atoyebi et al., 2023; Okegbemi, 2024; Adeshina et al, 2024).

An equally important dimension to Nigeria's energy lack is the disparity in the amount of energy billed relative to the actual supply of electricity. Glaring inefficiencies in the electricity sector have led to huge revenue loss collection, where many electricity subscribers pay less than what they should for the energy consumed or simply steal the electricity (Obafemi et al., 2021). The archaic metering system and dysregulated billing practices further contributed to consumer distrust towards the power sector, thus making the improvement of service delivery even more onerous (Arakpogun et al., 2023). To tackle this problem demands a vast reform of the electrical market, involving regulatory frameworks for increasing the transparency, accountabilities, and efficiencies of energy distribution and billing systems. Socio-political dynamics surrounding energy poverty in Nigeria are a further complicating problem. Energy access expansion policy implementation often runs foul of bureaucratic inefficiencies, corruptions, and a shortage of funding (Anaba, 2024). While loans and grants from international financial institutions and development agencies have aided the Nigerian power sector, lack of political will along with mismanagement of funds have stalled progress (Onuh et al., 2024). Conclusively, the monopoly of electricity distribution companies (DisCos) has limited competition and your private sector investment in power infrastructure.

II. Literature Review

Energy Poverty and Economic Growth in Nigeria

Energy poverty is a major setback to Nigeria's economic growth, dampening productivity and development as a whole. Causality in energy poverty and economic growth has been a well-researched area in current literature with a consensus that lack of access to energy has a crippling impact on economic performance. Aigheyisi and Oligbi (2020) contend that energy poverty significantly impedes Nigeria's economic growth by weakening industrial productivity, reducing agricultural output, and affecting service delivery. Their research, which utilized the robust least squares estimator using time-series data for the period 1990-2017, determined that energy poverty had a statistically significant and negative effect on economic growth. They stressed that improving access to electricity is paramount in spurring economic growth, raising living standards, and encouraging industrialization.

Olusegun et al. (2023) empirically explored the relationship between economic growth and energy poverty in Nigeria between 1990 and 2021. Quantitative method with secondary data obtained from the Central Bank of Nigeria (CBN), National Bureau of Statistics (NBS), and concerned government parastatals was adopted for the study. This is long-term analysis appropriate for ascertaining the role of access to energy in promoting economic development in Nigeria. The research utilized descriptive statistics, Ordinary Least Squares (OLS) regression, the Augmented Dickey-Fuller (ADF) test, and the Johansen cointegration test in examining the link between economic growth and energy poverty. The result of the OLS regression indicated the existence of statistically significant positive correlation between access to electricity and economic growth, with a coefficient estimate of 0.83 and a p-value of 0.000. Moreover, the Johansen cointegration test corroborated the existence of a long-run equilibrium relation between economic growth and access to energy, with the significance of electricity in economic progress. It was discovered that even though Nigeria's GDP followed an increasing trend from 1990 to 2014, after 2014 it decreased, whereas access to electricity kept improving. ADF test findings indicated that energy poverty and economic growth variables were stationary at various levels, determining the appropriateness for further econometric investigation. The research established that economic growth is negatively influenced by energy poverty, confirming the necessity for further investment in the energy sector.

Afaha and Ifarajimi (2021) analyzed the impact of energy poverty and climate change on Nigeria's economic growth during the period from 1980 to 2018 by means of the Autoregressive Distributed Lagged (ARDL) model. They found out that energy poverty severely impairs economic growth and reduces GDP, but they observed that energy imports did contribute positively to GDP to the extent of 10%, inferring that except for domestic energy constraints, other countries were a great source in sustaining economic activities. This affirms the importance of boosting domestic energy supply and distribution for the long-term benefit of economic stability.

Similar trends are seen in other developing economies. On India, Acharya and Sadath (2019) examined the impact of energy poverty upon economic development through household-level data. Their study found a strong negative relation between energy poverty and growth performance, emphasizing how energy unavailability hampers productivity and reduces employment opportunities, thereby increasing income inequality in the nation. Further evidence indicated that education and income levels played vital roles in reducing energy poverty with high levels of education leading to improved energy access and economic development.

In addition, Zhang et al. (2019), employing the Bayesian Model Averaging approach, conducted a cross-country analysis on 48 developing nations. This study found a long-term positive relationship between access to energy and various economic indicators such as industrialization, education, and financial inclusion. The improved access to electricity, while enhancing economic infrastructure, provided an easier business environment and fostered higher levels of educational attainment, consequently contributing to economic growth. This study highlights the more ambiguous nature of energy poverty, which extends its implications from merely economic stagnation to multiple spheres of human and societal development.

In Nigeria, energy poverty manifests itself through load-shedding of electricity, overdependence on power alternatives, and lack of affordable energy access/energy market. The huge dependency on self-generated electricity through highly-priced diesel and petrol-powered generators has placed unbearable financial burden on households and businesses (Afaha & Ifarajimi, 2021). Such overdependence on self-generated energy sources increases the cost of power supply and hence most of the industries do not operate at optimum capacity. The small enterprises find it hard to operate under these strenuous economic conditions. Lack of access to energy does disproportionately limit opportunities for farming mechanization, education, and the provision of health care services among rural communities.

The impact of energy poverty also extends to labor productivity and human capital development. Aigheyisi and Oligbi (2020) observed that poor access to electricity deterring the use of technology and industrialization makes Nigerian industries uncompetitive in the global market. Apart from that, poor access to energy prevents entrepreneurship and innovation as well as leads to high rates of unemployment and deep-rooted income inequality. To address these challenges, experts advise undertaking total reforms in the energy sector, increasing investment in clean energy sources, and improved governance in the provision of energy. Afaha and Ifarajimi (2021) suggest that policy intervention should aim at increasing energy infrastructure, diversifying the energy mix, and reducing energy prices for low-income families. Public-private partnerships in the production and supply of energy can also address the existing energy shortage and ensure sustained economic growth.

Access to Electricity and its Impact on Development

A constant source of electricity is a foremost driver of economic and social development that influences industrialization, education, healthcare, and the general quality of life. In Nigeria, persistent energy poverty has greatly derailed development, leaving millions without access to stable power. Studies give a positive correlation between electricity and economic growth, as electricity usage enables businesses and increases productivity and technological advancement. Aigheyisi and Oligbi (2020) contended that energy poverty negatively impacted Nigeria's economic development, thereby highlighting the rationale for the universality of electricity. Afaha and Ifarajimi (2021) studied the impact of energy poverty hindering econometric growth against energy imports positively affecting it. These findings echo that of Zhang et al. (2019), which established the long-run positive linkage between access to electricity and other key socio-economic indicators such as industrialization, education, and financial inclusion.

Other than the economic, access to electricity is a basic requirement in human capital development. Acharya and Sadath (2019) demonstrated that energy poverty has a direct correlation with socioeconomic backwardness and educational level and income as the mitigating variables. Bridge (2017) also depicted that improved access to electricity improves income at the household level and education to complement the aggregate development benefit. Despite Nigeria's abundant energy endowments, inefficiencies in power generation and distribution still limit access. Closing this gap requires strategic investment in infrastructure, policy reform, and renewable energy alternatives to enable sustainable and inclusive development. Poverty reduction in energy terms is at the heart of Nigeria's longer-term economic security and improved living standards.

Electricity Supply and Efficiency Challenges in Nigeria

Nigeria's electricity supply also suffers from the chronic inefficiencies, significantly blocking Nigeria's economic growth and general well-being in society. Notwithstanding Nigeria having an installed generating capacity of over 12,500 MW, the actual production is constantly hovering below 5,000 MW. The deficit largely arises as a result of the culmination of infrastructural gaps, normal loss in transmission, and unpredictable

supply of gas to the country's power plants (World Bank, 2021). The national grid itself is dated and frequently liable to failure, resulting in wide-scale power cut-offs that cut off millions of Nigerians from a reliable source of electricity. As a result, companies and residential consumers around the nation are forced to utilise expensive and ecologically damaging alternative sources such as diesel and petrol generators to augment their energy sources. This reliance on stand-by generators significantly aggravates the economic burden placed on the citizens and causes environmental degradation by contributing to greenhouse gas emissions (Afaha & Ifarajimi, 2021).

The issue of energy poverty in Nigeria has a myriad of consequences that extend way beyond the very economic sphere. It has explicit impacts on manufacturing output, learning, and provision of health care. Ineffectiveness and inconsistency in power supply lead to breakdowns in routine services in hospitals, schools, and industries. For instance, doctors struggle to access critical devices in the healthcare sector, while schools experience a lack of resources that are only available via electricity power (Aigheyisi & Oligbi, 2020). Along with these challenges, low-quality investments, corruption at all levels, and inefficient policies have developed additional impediments to the sector and made it even more challenging to implement required reforms (International Energy Agency [IEA], 2022). The country's transmission and distribution networks are plagued with inefficiencies, both technical and commercial losses. Much of the generated electricity is lost before it reaches the consumers, adding to the already widespread shortages.

To address these issues and increase the availability of electricity in Nigeria, boosting the use of renewable sources of energy, i.e., solar and wind power, offers a good alternative. These sources have the ability to provide cleaner, more reliable, and less expensive alternatives to the existing energy mix in the country. In particular, decentralized energy solutions such as mini-grids and off-grid solar supply a sound way of advancing rural electrification and reducing the reliance of the country on the unstable national grid. These solutions are particularly apt for far-flung communities that historically have been poorly supplied by the central grid (International Renewable Energy Agency [IRENA], 2023). There must also be a strengthening of regulatory institutions together with spurring private sector involvement in the energy sector. The energy infrastructure such as transmission and distribution lines must be upgraded to help reduce energy losses as well as improve the efficiency of power delivery in the nation.

The Role of GDP Per Capita in Energy Poverty Analysis

Gross Domestic Product (GDP) per capita is one of the key economic indicators that measure the average economic production per capita in a country. It greatly helps to actualize the link between energy poverty and economic growth. Energy poverty refers to the lack of access to cheap, reliable, and sufficient energy services, which has the potential to significantly limit socio-economic growth. The GDP per capita comparison provides crucial information on the broader economic setting in which energy poverty occurs and indicates the role that economic growth plays in enabling access to energy. An elevated GDP per capita is likely linked to enhanced energy service availability. Wealthier nations typically have greater resources with which they are able to invest in energy systems so that they have better electricity transmission and higher-quality energy access. In economically more advanced nations, the government is more likely to invest in generation and distribution networks so that power becomes available to more people. This helps in reducing energy poverty by providing wider access to cleaner energy sources such as electricity, gas, and renewables and also bringing these services within easier reach.

Conversely, low GDP per capita countries tend to have gigantic limitations in the application of energy poverty. Low financial means translate into a restriction to invest significant amounts of money in energy infrastructure, and thus large portions of the population remain without proper energy access. Energy poverty becomes all the more pervasive in such situations, and rather than the advanced technology-based systems, households resort to old and inefficient means like kerosene lights or wood-fired heating, which apart from being cost-prohibitive is also harmful to health and the environment.

III. Methodology

The study was done in Nigeria. Descriptive statistics, Regression, Augmented Dickey-Fuller (ADF) test and Johansen Cointegration Test were used in analyzing data obtained. Secondary data was employed due to the nature of the study. The data used are obtained from the various sources including the Nigerian National Bureau of Statistics (NBS) and World Bank database from 2015 to 2023. STATA 15 package was used to process data on energy poverty in Nigeria. Data received included Energy Billed/Electricity Supply (GWh), GDP per Capita, and Electricity Access.

Model specification:

Ordinary Least Squares (OLS) regression was used to analyse the relationship between electricity access, GDP per capitan and energy billed in Nigeria. ADF test is used to ascertain if the data is staionary or not, VIF checks for multicollinearity, Durbin-Watson runs the autocorrelation. The dependent variable is electricity access, while GDP per capita and energy billed are independent variables.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \epsilon_t$$

Where:

$$Y = Electricity\ Access$$
$$X_1 = GDP\ per\ capita$$
$$X_2 = Energy\ billed\ (GWh)$$
$$\beta_0 = intercept\ or\ constant$$
$$\beta_1, \beta_2 = Coefficients\ to\ be\ estimated$$
$$\epsilon_t = error\ term$$

IV. Result and Discussion

Table 1: Descriptive

Variable	Obs	Mean	Std. Dev.	Min	Max
ElectAccess	9	4.031	0.048	3.960	4.102
GDP per capita	9	7.627	0.130	7.375	7.857
ElectBilled (GWh)	9	9.938	0.083	9.808	10.057

Source: Data Analysis 2025.

Table 1 provides key summary statistics for electricity access, GDP per capita, and electricity billed in Nigeria. Electricity Access (ElectAccess) is averaged 4.031 with low variability (Std dev = 0.048), indicating relative stability in electricity access. GDP per capita is 7.627 on average, with a standard deviation of 0.130, indicating negligible economic fluctuations. Electricity Billed (GWh) is 9.938 on average, suggesting stable electricity consumption. The narrow range of values between variables reflects Nigeria's historic energy problems, with incremental trend of improving electricity access and economic development. These figures highlight the need for concerted energy sector reforms.

Table 2: OLS Regression

ElectAccess	Coef.	Std. Err.	T	P>t
GDP per capita	0.0094	0.065	0.15	0.889
ElectBilled (GWh)	0.535**	0.102	5.24	0.002
Constant	-1.357	0.872	-1.56	0.171
R-Squared	0.864			
F-Test	19.13			
Prob>F	0.002			

Source: Data Analysis 2025. Note: ** p<.05

Table 2 presents the outcome of the Ordinary Least Squares (OLS) regression, testing the relationship between electricity access and economic growth. The Electricity Billed (GWh) coefficient is 0.535 and statistically significant (p = 0.002), demonstrating a strong positive relationship between electricity consumption and GDP per capita. This is consistent with the literature, which emphasizes the role of reliable electricity in energizing economic activities and industrial output (Aigheyisi & Oligbi, 2020). However, Electricity Access does not have any significant effect (p = 0.889) on GDP per capita, indicating that access to electricity is not sufficient for economic growth unless the issues of supply reliability and efficiency are addressed. The model R-squared (0.864) indicates that 86.4% of the variation in GDP per capita is explained by the independent variables. These findings highlight the need for policy focused on improving both electricity access and reliability in order to boost Nigeria's economic growth rate.

Table 3: ADF Test

Variable	T-Statistic	p-val	Remark
ElectAccess	-2.17	0.144	nonstationary
GDP per capita	-2.392	0.081	nonstationary
ElectBilled (GWh)	-4.816	0.024	Stationary

Table 3 illustrates the outcome of Augmented Dickey-Fuller (ADF) test to analyze the stationarity of the variables of time series. Based on the test, the outcome reflects that Electricity Access (ElectAccess) has the value of -2.17 for t-statistic and 0.144 for p-value, which refute the null hypothesis of unit root at both significance levels of 5% and 10%. This means that electricity access is nonstationary, i.e., it exhibits long-term variability, likely caused by policy reforms, infrastructural development, population growth, and economic instability. In Nigeria, erratic power supply, inconsistent government policies, and frequent power sector reforms are some of the causes of these fluctuations, making long-term access to stable electricity uncertain.

Similarly, GDP per capita's t-statistic is -2.392 and p-value of 0.081, confirming it to be nonstationarity at the 5% level but closer to it at 10%. This suggests that GDP per capita exhibits a trend that is driven mainly by macroeconomic factors such as inflation, exchange rate volatility, investment, and government policy. Nigeria's economic growth has long been associated with oil revenue, exposing GDP per capita to the uncertainty of world oil prices. Structural factors such as high unemployment, weak infrastructure, and weak industrialization have also been responsible for this long-term trend behavior.

On the contrary, Electricity Billed (ElectBilled, GWh) is stable, with t-statistic -4.816 and p-value 0.024. As the test statistic is very negative and the p-value is less than 5%, we will reject the null hypothesis of unit root. That is, electricity billed does not have long-term trends and fluctuates around a constant mean. The relative stability in electricity billing could be attributed to constant demand for electricity by industries and consumers, irrespective of repeated power shortages.

Table 4: Johansen Cointegration Test

Max rank	Parms	LL	Eigenvalue	Trace	5% criteria
0	3	-29.876	--	28.0054*	29.68
1	8	-38.222	0.875	11.3126	15.41
2	11	-41.773	0.588	4.2104	3.76

Table 4 presents the results of the Johansen cointegration tests, which are tests for a long-run equilibrium relationship among the variables. The test is carried out by comparing the trace statistic with the 5% critical value in order to determine the number of cointegrating equations. At rank 0, the trace statistic is 28.0054, and this is less than the critical value of 29.68. Since the trace statistic is not higher than the critical value, we cannot reject the null hypothesis, meaning there is no cointegration at this level. This means the variables don't necessarily move together in the long run. At rank 1, we observe a trace statistic of 11.3126, which is less than the critical value of 15.41. This is another indication of no second cointegrating equation. Similarly, at rank 2, the trace statistic is 4.2104, which is higher than the 5% critical value of 3.76, so we reject the null hypothesis and conclude that there is one cointegrating equation.

V. Summary and Policy Implications

The research explores the interrelation of electricity access, electricity usage, and economic growth in Nigeria and identifies issues within the power sector. The analysis outcome reveals that electricity consumption (Electricity Billed, GWh) significantly and positively impacts GDP per capita, i.e., the supply of electricity enhances productivity in the economy. However, electricity access in itself does not exert any significant influence on GDP per capita, and this means that it is not sufficient to have more electricity coverage for economic development unless supply efficiency and reliability are improved. The Augmented Dickey-Fuller (ADF) test findings show that Electricity Access and GDP per capita are nonstationary, or they are governed by long-run economic and structural factors. However, Electricity Billed (GWh) remains constant, signifying constant electricity use despite long-term supply inadequacies. The Johansen cointegration test statistic points towards one cointegrating equation, and thus there exists a long-run equilibrium relationship between the variables. Economic growth and electricity access are not covariation in the short run, yet electricity use is a critical factor of economic stability.

The findings have significant policy implications for economic planning and the Nigerian power sector. Broadening access to electricity without increasing the efficiency and reliability of supply will not promote long-term economic growth. Radical power sector reforms with emphasis on infrastructure investment,

regulatory strengthening, and new energy sources are necessary. The government must focus on raising the generation capacity, reducing losses in transmission, and upgrading distribution systems so that the electricity produced can be transmitted in the most optimal way to the end-users. The private sector can be encouraged for involvement in power generation and distribution to guarantee the competition, improve the quality of supply, and keep the burden on the government minimum. In addition, solar and wind energy investment as sources of clean power can provide cleaner and greener electricity, particularly to rural locations where grid supply remains an issue. Corruption, mismanagement, and inefficiency in the electricity sector also must be fought in order for investments in the sector to be productive and make improvements to the power infrastructure.

VI. Conclusion and Recommendations

The article provides useful information regarding the role of electricity consumption in economic development in Nigeria. The findings center on the aspect that electricity reliability, not access, is crucial to economic growth. Additionally, by offering actual proof of a positive correlation between the two variables in Nigeria, the study contributes to the body of knowledge already available on energy poverty and economic growth. However the study recommends that:

1. When addressing the nation's energy poverty, priority should be given to the regions or zones with the highest rates of energy poverty.
2. Policymakers must ensure they have renewable energy policies that assist in enhancing the availability of electricity, provide efficient utilization of energy, and encourage investment in the power sector to achieve long-term economic growth and reduce energy poverty. Absent these reforms, Nigeria's economic growth will continue to be stifled by inefficient and un-reliable power supply.
3. Nigerians should be given access to quality work and education, since this will significantly reduce energy poverty. More should be done to ensure that Nigerian households have small families and only have children they can support.
4. Therefore, in order to help energy-poor families transition to modern energy sources and break free from the cycle of energy poverty, the government should establish incentives.
5. Additional research must examine sectoral energy requirements and how improvement in electricity quality and affordability can increase economic productivity and industrialization in Nigeria.

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