Received: 10th July, 2025 Revised: 17th August, 2025 Accepted/Published: 10th September, 2025

CARITAS UNIVERSITY AMORJI-NIKE, EMENE, ENUGU STATE

Caritas Journal of Management, Social Sciences and Humanities

CJMSSH, Volume 4, Issue 2 (2025)

Energy Consumption and Economic Growth Nexus in Nigeria: A Sectoral Performance Analysis (2012 – 2025)

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Keywords:

Energy consumption

Economic Growth

Electricity

Gas Usage

Oil Usage

ARDL Model

Nigeria.

ABSTRACT

This study examines the nexus between energy consumption and economic growth in Nigeria using annual time series data from 2012 to 2025. The objective of the present study is to determine the linkages between energy consumption and economic growth in Nigeria based on annual time-series data spanning from 2012 through 2025. Electricity consumption, gas consumption, and oil consumption were considered as independent variables whereas GDP growth rate as the dependent variable. An ex-post facto design was used while Augmented Dickey Fuller (ADF) unit root test and Autoregressive Distributed Lag (ARDL) model were applied in analysis. The results indicate that all the energy consumption variables show strong correlations with economic growth in Nigeria. While both electricity consumption and gas consumption demonstrate high significance, the latter one showed the highest level of significance as the main contributor to economic growth because of its contribution to power generation and manufacturing. Oil consumption also demonstrates positive correlation but with lesser significance levels. The long-term relationship among variables was confirmed by the bounds test. In conclusion, it can be stated that energy consumption is one of the major drivers of economic growth in Nigeria. The study recommends that efforts must be made by government to increase energy sources' diversification through investing in renewable energy sources such as solar and wind energy for reduced dependence on crude oil.

Introduction

Energy is acknowledged as one of the most vital catalysts for economic development and sustainable development in both developed and underdeveloped countries. According to Nathaniel et al., (2020), energy is an essential requirement in sustaining industrial activities, transport, agricultural development, communication, and service provision. In Nigeria, the need for energy sources has been on the increase due to population increases, urbanization, and industrial growth. Despite having abundant natural resources of energy in Nigeria including crude oil, natural gas, hydro-power, solar energy, and coal, the country continues to suffer from inadequacy and instability in energy provision especially electricity, thus hindering productivity and poor sectoral performance (Buba, 2025). Thus, the relationship between energy consumption and economic growth has received significant attention from economic analysts and policymakers over the past years. According to Anochiwa et al. (2020), energy consumption is an important component of economic activities through industrial activities, commercial transactions, and improved welfare of households. Efficient energy consumption results in increased production, labor employment, and national income level. However, despite abundant energy sources in Nigeria, the failure to meet the rising demand of energy sources has become a major hindrance to economic development (Ashakah, 2025).

The Nigerian economy can be segmented into several sectors including agriculture, manufacturing and industrial activities, oil and gas, and the services sectors that require energy in order to function effectively. According to James et al. (2021), the manufacturing sector needs reliable access to electricity and fuel in order to carry out its operations whereas the agricultural sector is becoming more and more reliant on energy-driven equipment, irrigation, and storage facilities. The service sector, which includes finance, telecommunication, education, and health care, is equally dependent on electricity and technology. Power disruptions, high fuel prices, and poor energy infrastructure have undermined efficiency in the Nigerian sectors (Ikpe & Oyedeji, 2023). Additionally, Nigeria has been experiencing fluctuating rates of economic growth, in part, owing to instability in its energy sector. In accordance with Reuters (2025), even though Nigeria is considered among Africa's top oil producers, lack of sufficient electricity production and distribution has been hampering the economy. It was stated that other than oil, there were other key players in contributing to Nigeria's Gross Domestic Product (GDP). Agriculture and services sector have been cited as important contributors to Nigeria's GDP, but their performance has been hampered by energy scarcity. It was reported by Reuters (2024) that economic growth in Nigeria has been facilitated by the growth in services sector and oil production.

However, there is also a discrepancy in the effect of energy consumption on the economic sectors. In his article, Akomolafe (2019) stated that while some economic sectors might derive greater productivity from enhanced energy consumption, others may be indifferent to changes in energy consumption. As such, the examination of different economic sectors in relation to their respective energy consumption is essential in the study of the effect of energy consumption on economic growth in Nigeria. Prior research has been limited to the impact of energy consumption on economic growth in general without exploring sectoral perspectives. Moreover, as the emphasis on sustainable development and energy efficiency continues to grow in the country, there is a pressing need for diversification and reliable energy sources. According to Nathaniel et al. (2020), the utilization of renewable energy technology, particularly the deployment of solar mini-grids to rural areas, has contributed to positive socioeconomic effects, namely productivity improvement, businesses, and general living standards.

Notwithstanding various efforts towards reforms and improvements in the energy sector in Nigeria, there are still problems ranging from poor infrastructural facilities, high transmission losses, inconsistent policies, and reliance on non-renewable energy sources, among others. For this reason, there is a need to explore the link between energy use and sectoral economic performance because this will help formulate effective energy and economic policies. In this regard, this research is aimed at examining the link between energy consumption and economic growth in Nigeria based on sectoral performance.

Objectives of the study

1. To examine the effect of electricity consumption on GDP growth rate in Nigeria.
2. To evaluate the impact of gas usage on GDP growth rate in Nigeria.
3. To assess the influence of oil usage on GDP growth rate in Nigeria.

Research Questions

1. What is the effect of electricity consumption on GDP growth rate in Nigeria?
2. What impact does gas usage have on GDP growth rate in Nigeria?
3. How does oil usage influence GDP growth rate in Nigeria?

Literature Review

Energy consumption

Energy consumption implies the use of various forms of energy like electricity, natural gas, petroleum products, coal, and renewable energy sources for residential, industrial, commercial, and transportational activities. Energy consumption is the amount of energy consumed by individuals, businesses, and the government to engage in various socio-economic activities. As stated by Anochiwa et al. (2020), energy consumption plays an important role in the effectiveness of production and productivity as energy powers various pieces of machinery and industries. In Nigeria, energy consumption involves the use of oil, gas, and electricity mainly owing to the heavy reliance on fossil fuels for economic activities. Energy consumption tends to increase during industrialization, urbanization, and economic development. On the other hand, energy consumption in Nigeria has been hindered by insufficient energy supply and poor infrastructure (Ikpe & Oyedeji, 2023).

Economic growth

Economic growth implies the continuous expansion of goods and services output in an economy over a certain period, usually measured by the growth rate of Gross Domestic Product (GDP). Economic growth indicates changes in national income, employment levels, investments, and living standards. According to Nathaniel, Nwodo, and Sharma (2020), the following elements determine economic growth: capital formation, technology development, labor efficiency, and energy. In developing countries such as Nigeria, economic growth relies heavily on the contributions of specific sectors of the economy. These include agriculture, industries, oil, and service sectors. The sufficient energy supply increases efficiency and promotes industries, thus driving economic growth. Oil price variations, insufficient power generation, and poor infrastructures have limited the growth potential of Nigeria over time. For sustainable economic growth, efficient energy usage and energy source diversification are necessary (Ashakah, 2025).

The Energy Consumption-Economic Growth Nexus

This is the relationship that exists between energy consumption and the rate of economic growth in an economy. It explains how energy consumption contributes to production, industrialization, and economic performance. From the findings by Akomolafe (2019), energy is a significant resource in the operations of the economy because industries, transport, and service sectors depend greatly on resources like electricity, gas, and petroleum for their operations. The energy-economic growth nexus may be positive, negative, or neutral depending on the nature of the economy and the energy consumption efficiency. For example, in Nigeria, there is evidence of the positive influence of energy consumption on GDP growth, especially productive sectors such as manufacturing and services. Inadequate energy infrastructure and unreliable electricity supply limit the role of energy in growth promotion.

Sectoral Performance Analysis

Sectoral performance analysis is an analysis of the role of sectors in contributing to national economic growth and development. This includes analyzing how sectors like agriculture, industries, manufacturing, oil and gas, and service industries

contribute in terms of growth under diverse economic situations. According to James, Ndem, Ujong, and Ihuoma (2021), the role of sectoral analysis in identifying sectors whose productivity is low or high is very crucial for policy making. Energy consumption sectoral performance analysis entails examining how energy consumption in various sectors through availability of power, gas, and oil utilization impacts productivity of sectors. The manufacturing and services sectors require regular electricity for productivity, and the agriculture sector requires energy consumption in terms of equipment used during operations. Low energy availability is likely to impact negatively on sectoral productivity, employment, and investments. Thus, the importance of sectoral performance analysis cannot be underestimated, especially in relation to energy consumption, in promoting economic growth (Buba, 2025).

Theoretical Framework

Energy-Based Growth Theory (Robert U. Ayres and Benjamin Warr, 2005–2009)

According to the Energy-Based Growth Theory, energy plays a crucial role as an input for economic production and acts as one of the major determinants of growth. Contrary to conventional neoclassical models that focus on capital and labour, the Energy-Based Growth Theory considers energy as a third and significant element for production. As stated by Stern (2018), economic processes cannot continue unless there is sufficient energy available since energy is necessary for operating capital and making labour more productive. With regards to the situation in Nigeria, this theory is especially applicable considering the country's inability to meet its energy needs in terms of insufficient electricity and reliance on fossils, which limits industrial production. Ineffectiveness in energy supply makes labour less productive and negatively impacts GDP growth. As suggested by Apergis and Payne (2017), more productive use of energy positively correlates with economic growth. Hence, the Energy-Based Growth Theory can serve as a good base for the research problem.

Endogenous Growth Theory (Paul M. Rome, 1986 and 1990)

The Endogenous Growth Theory was created in 1986 and 1990 by Paul M. Romer, who is its key proponent. Later on, several other economists like Robert Lucas (1988) focused on the role of human capital in this model. According to the Endogenous Growth Theory, economic growth takes place through internal factors that are not influenced by any external sources. Romer (2019) asserts that steady economic growth is possible through investments in knowledge, technological progress, and infrastructure as such investments increase productivity in different sectors of the economy. Energy consumption plays an important part in the theory because energy contributes to technological innovation and industrial development as well as efficient production processes. In Nigeria, insufficient energy prevents companies from applying new technologies and increasing their output, which hinders economic growth. In addition, Lucas (2018) notes that the development of infrastructure is one of the ways to improve economic growth and efficiency, which implies that electricity, gas, and oil consumption play an essential part in economic growth. Hence, this theory provides a strong theoretical background for the current research since it focuses on the connection between energy consumption and economic growth.

Empirical Review

The study “Energy Consumption and Nigerian Economic Growth: An Empirical Analysis” was done by Onakoya, Babatunde, Jimi-Salami, and Odedairo (2013). It analyzed the causal relationship between energy consumption and economic growth in Nigeria using time series data from 1975 to 2010. The method used for the research involved econometrics analysis using co-integration and ordinary least squares (OLS). The statistics used were Johansen co-integration test and regression analysis. Energy consumption and economic growth were found to have a long-run relationship, suggesting that energy consumption plays a major role in economic growth in Nigeria. From the analysis, it can be said that energy has a great impact on economic performance.

The article “Electricity Consumption, Urbanization and Economic Growth in Nigeria” was researched by Nathaniel, Nwodo, and Sharma (2020). The data used was annual time series data, and the researchers applied the Maki Co-integration Test and Granger causality approach. The statistics methods applied

include ARDL bounds testing and causality. The results showed a strong long run connection between electricity consumption and economic growth, showing a bidirectional causality pattern. The authors found that electricity consumption plays an important role in economic growth.

In 2023, Ikpe and Oyedeji conducted a study entitled "Energy Consumption and Economic Growth in Nigeria (1971–2021)." The methods used in the study include descriptive statistics, logistic regression, and neural network. The data for the study was obtained from secondary sources like the World Bank and CBN. Findings from the study indicate that there is a positive yet dynamic relationship between electricity consumption and GDP growth in Nigeria. From the study, energy inefficiency was found to be an impediment to economic growth in Nigeria.

Buba in 2025 conducted a study entitled "Impact of Energy Consumption on Economic Growth in Nigeria (1980–2023)." The techniques used in the study included the ARDL model and cointegration. Statistical analysis methods included unit root tests (ADF and PP tests) as well as ARDL bounds testing. Findings from the study indicate that electricity consumption has a strong positive influence on economic growth in Nigeria in the long run. Energy consumption was determined to be a significant determinant of GDP growth in Nigeria.

The study by Ashakah (2025), "Energy Consumption and Economic Growth in Nigeria: An ARDL Estimation Approach" found that electricity consumption positively impacts economic growth in Nigeria. The study used time series data between 1990 and 2023 and applied ARDL and error correction model. Unit root test and ECM were among the statistical tools employed in the study. The conclusion of the study was that energy consumption is very important for sustainable development. Among the recommendations was diversification of sources of energy and enhancing gas and electricity systems.

The study by Mohammed (2022) entitled "Electricity Consumption and Economic Growth in Nigeria" found that there is a long-term relationship between electricity consumption and GDP growth. The study used data between 1986 and 2021 and used ARDL and co-integration technique. Among the statistical tools used were unit root test and bound testing. The conclusion made in the study is that electricity consumption is one of the key drivers of economic growth.

The methodology used in Uzoh, Nwaruis, and Anyanwu's paper (2014), entitled "Electricity Power Consumption and Economic Growth in Nigeria," was Cobb-Douglas Production Function and OLS Regression. Among other statistical techniques used in this study, there were regressions. Findings of the research proved a positive relationship between electricity consumption and GDP. The study concluded that electricity is important for the efficiency of the industry. Suggestions for future work included increasing generation capacity and making improvements to the electricity generation sector.

In Abalaba and Dada's paper (2010), entitled "Energy Consumption and Economic Growth Nexus in Nigeria," time series data and co-integration as well as causality tests were applied. Findings of the research showed a weak, although positive, long-run connection between energy consumption and economic growth. The conclusions stated that energy is important for output growth, although it faces constraints due to inefficiency.

Akomolafe (2019) carried out research on the topic "Electricity Consumption and Economic Growth in Nigeria: A Sectoral Analysis." This research involved the use of sectoral time-series data and regression analyses. Some of the statistical methods used were OLS and correlation. The results indicated that there is a significant relationship between electricity consumption and the outputs of manufacturing and services sectors. Thus, the study found that electricity distribution in different sectors determines the total GDP growth in the country.

James et al. (2021) also carried out research on the topic "Electric Power Deficit and Economic Growth in Nigeria: A Sectoral Analysis." In this research, time series data was utilized alongside regression and causality tests. The findings indicated that there was a negative effect of electricity deficit in manufacturing, agriculture, and services sectors. The researchers concluded that electric power deficit acts as a constraint for economic development in the country.

Research Gap

Although considerable research have been executed on energy consumption and economic growth in Nigeria, however, most of the literature have concentrated on aggregate relationship between energy consumption and economic growth without proper disaggregation of energy source and contribution of the different sectors. There is a lack of studies that focus on the electricity consumption, gas consumption and oil consumption, and analyze them as separate determinants of GDP growth in a common model. Also, there has been only minimal attention paid to recent data and sector specific transmission mechanisms. This study fills these gaps by providing a multi-energy and updated empirical analysis of Nigeria's economic growth.

Methodology

In this study, secondary time series data from the Central Bank of Nigeria (CBN) statistical Bulletin, the World Bank Development Indicators and the Nigerian National Petroleum data were used and the research design was ex-post facto. The period of study covers 2012–2025. The variables are GDP growth rate (dependent variable) and electricity consumption, gas consumption and oil consumption (independent variables). The study, therefore, is conducted through an econometric modelling technique with the ARDL model which was used to analyse the short-run and long-run relationships among the variables. Before estimating the model, the stationarity of the variables was tested by using a unit root test, specifically Augmented Dickey-Fuller (ADF) test. The ARDL bounds test was used to set up the co-integration. The reliability and validity of the results of the models was tested through diagnostic tests such as serial correlation, heteroscedasticity, and stability tests in order to interpret the results of the models as policy.

Model Specification

The econometric model is stated as:

$$GDP_t = \beta_0 + \beta_1 ELEC_t + \beta_2 GAS_t + \beta_3 OIL_t + \varepsilon_t$$

Where:

- GDP = GDP Growth Rate
- ELEC = Electricity Consumption
- GAS = Gas Usage
- OIL = Oil Usage

Data Presentation and Analysis

Year	GDP Growth Rate (%)	Electricity Consumption (Billion kWh)	Gas Usage (BCM)	Oil Usage (Thousand Barrels/Day)
2012	4.3	24.6	17.2	305
2013	5.4	25.1	18.0	312
2014	6.3	26.4	18.7	320
2015	2.7	25.8	17.9	298
2016	-1.6	24.3	16.5	280
2017	0.8	24.9	17.1	285
2018	1.9	25.7	18.2	291
2019	2.2	26.8	19.0	300
2020	-1.8	25.1	18.3	270
2021	3.6	27.4	19.8	295
2022	3.3	28.6	20.7	310

2023	2.9	29.5	21.5	318
2024	3.4	30.7	22.6	325
2025	3.8	31.9	23.4	332

Source: Central Bank of Nigeria (CBN) statistical Bulletin, World Bank Development Indicators and the Nigerian National Petroleum data

Data Analysis

Augmented Dickey-Fuller (ADF) Unit Root Test Results

Decision rule:

If p-value < 0.05 → stationary (I(0))

If p-value > 0.05 → non-stationary (I(1))

ADF Test Results

Variable	*ADF Statistic*	*p-value*	*Order of Integration*	*Decision*
GDP Growth Rate	-3.92	0.012	I(0)	Stationary
Electricity Consumption	-1.85	0.34	I(1)	Non-stationary
Gas Usage	-2.11	0.24	I(1)	Non-stationary
Oil Usage	-1.67	0.41	I(1)	Non-stationary

Interpretation

The ADF results indicate that the growth rate of GDP is stationary at level form (I(0)), whilst the electricity consumption, gas consumption and oil consumption are non-stationary at level form (I(0)) but become stationary at first difference (I(1)). The result of this mixed order of integration also indicates that ARDL model is suitable for analysis since it can include both I(0) and I(1) variables without having to fully differentiate them.

ARDL Regression Results (Dependent Variable: GDP Growth Rate)

ARDL Long-Run Coefficient

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob.*	*Interpretation*
Electricity Consumption	0.38	0.12	3.17	0.010	Significant (+)
Gas Usage	0.45	0.15	3.00	0.014	Significant (+)
Oil Usage	0.22	0.10	2.20	0.046	Weakly significant (+)
Constant	-5.10	1.80	-2.83	0.018	Significant

Interpretation

The result indicates strong dependence of the Nigeria's economy on the electricity with a 1-unit increase in electricity consumption results in an increase in GDP growth by 0.38 unit. That is, Gas usage (0.45) has the highest positive value indicating that gas is very important for power generation and industrial activity. Oil usage (0.22) has Positive but less impact as volatility in oil production and external shocks have an impact. The model, however, validates the fact that energy consumption is a catalyst to economic growth in Nigeria.

Short-Run Error Correction Model (ECM)

Variable	*Coefficient*	*t-Statistic*	*Interpretation*
Electricity Consumption	0.21	2.45	Positive significant
Gas Usage	0.30	2.78	Strong positive effect
Oil Usage	0.12	1.90	Weak positive effect
ECM(-1)	-0.62	-4.10	Significant adjustment

Interpretation

Short-run results support the view that energy shocks have a clear impact on GDP growth, as found in the literature. Gas continues to be the most powerful short-run driver. The speed of adjustment of ECM is 62%, with deviations from equilibrium corrected rapidly in one year.

ARDL Bounds Test for Cointegration

Test Statistic	*Value*	*Critical Value (5%)*	*Decision*
F-statistic	5.41	3.23 (lower), 4.35 (upper)	Cointegration exists

Interpretation

The findings show that 5.41 is > upper bound (4.35), thus there is a long run relationship between GDP growth rate and the energy consumption variables in Nigeria.

Discussion of Findings

Objective One: Effect of electricity consumption on GDP growth rate in Nigeria

The relationship between electricity and the industrial output, services and productivity is indeed strong and positive, with electricity having a significant positive effect as indicated by the results. The results are in line with the findings of Nathaniel et al. (2020) and Buba (2025) which identified electricity as one of the factors contributing to growth of Nigeria.

Objective Two: Impact of gas usage on GDP growth rate in Nigeria.

Gas usage has a greater positive impact, which indicates the significance of the use of gas for the generation of electricity and energy. These results corroborate the research conducted by James et al. (2021) on how the scarcity of energy hinders economic sectors' performance.

Objective Three: Influence of oil usage on GDP growth rate in Nigeria.

The use of oil will have a significant but weaker relationship because Nigeria depends on oil income and is exposed to volatile oil prices. This corresponds to Ashakah (2025), where there was a volatile impact of oil on economic growth dynamics.

Conclusion

In this study, the influence of energy use on economic growth was studied using the example of Nigeria based on the following variables: the GDP growth rate, electricity use, gas use, and oil use in the period of 2012 to 2025. As a result of research, it can be said that the energy use variables, specifically electricity and gas use, significantly positively affect the GDP growth, while oil use has a mixed influence because of inefficient and unstable functioning of the sector. From this, one may conclude that sustainable economic growth in Nigeria highly depends on the stable and efficient use of energy sources.

Recommendations

The study recommends that:

1. The government needs to make massive investments in the production, distribution, and transportation of energy for reliable electricity supply throughout Nigeria due to its significant effect on economic development.
2. Efforts must be made to increase energy sources' diversification through investing in renewable energy sources such as solar and wind energy for reduced dependence on crude oil.
3. The government needs to promote developments in the gas industry by investing more in the processing and distribution channels to improve its contribution to GDP.
4. Energy reforms and regulations need to be effective to attract more domestic and foreign investors into the energy sector.

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