Journal of Business and Economic Policy
UNIZIK Business School, Nnamdi Azikiwe University, Awka

UBSJBEP Volume 3 Issue 1
ISSN (Online) 0795 – 7149
https://journals.unizik.edu.ng/index.php/ubsjbep

IMPACT OF ENERGY (ELECTRICITY) CONSUMPTION ON ECONOMIC GROWTH IN NIGERIA: 1980 - 2023

Saad Buba
Department of Economics, Faculty of Arts and Sciences, American University of Nigeria, Yola
E-mails: saadbubadamare12@gmail.com

CITATION: Buba, S. (2025). Impact of Energy (Electricity) Consumption on Economic Growth in Nigeria: 1980 - 2023, *UBS Journal of Business and Economic Policy*, 3(1), 59 - 74.
Paper Type**: Original Research Paper; **Correspondence: saadbubadamare12@gmail.com

Abstract
This study examined the impact of energy consumption on economic growth in Nigeria using time series data for the period of 1980 to 2020. Nigeria is a country blessed with vast energy resources. However, the country has not substantially benefitted economically from this resource. Although, energy consumption leads to economic growth but the indices of economic development speak otherwise. The study adopted the Autoregressive Distributed Lag (ARDL) co-integration model to achieve objectives of the study. The results reveal a significant positive impact of energy consumption (particularly electricity consumption) on economic growth in Nigeria. Therefore, this study concludes that the interplay between energy consumption and economic growth is substantial in Nigeria. More to that, the study recommends that those in authority should strategise more to further enhance energy efficiency and strengthen sustainable energy sources to significantly foster economic development.

Key Words: *Energy Consumption, Economic Growth, Electricity Consumption, Sustainable Energy*

Introduction
Nigeria is a country with vast energy resources, including oil, natural gas, coal, and renewable energy sources such as solar and hydropower. Despite this wealth of resources, Nigeria's energy sector faces significant challenges, including inadequate infrastructure, inefficient energy distribution, and frequent power outages (Olayemi, 2012). These challenges have led to an energy crisis that hampers economic activities, affects industrial productivity, and reduces the quality of life for the population. Energy consumption in Nigeria has traditionally been dominated by non-renewable sources, particularly oil and natural gas, which are also the country's major export commodities (Akinlo, 2008). The reliance on fossil fuels has exposed the Nigerian economy to fluctuations in global oil prices, making the economy vulnerable to external shocks (Olusegun, 2015). However, there has been a growing interest in exploring renewable energy sources as a means of diversifying the energy mix and promoting sustainable economic growth (Iwayemi, 2008). Nigeria's energy sector is heavily reliant on fossil fuels, particularly oil and natural gas, which together account for approximately 90% of the nation’s export earnings and about 80% of government revenues (Central Bank of Nigeria, 2019). Over the years, energy consumption in Nigeria has grown steadily due to increased industrialization, urbanization, and population growth. According to the International Energy Agency (2021), Nigeria’s total energy consumption rose from 34.7

Mtoe (Million tonnes of oil equivalent) in 1980 to 140.7 Mtoe in 2020, demonstrating significant growth over four decades. However, despite this increase in energy consumption, Nigeria still experiences a substantial energy deficit, with frequent power outages and inadequate electricity infrastructure, causing disruptions in production and business activities.

From 1980 to 2023, Nigeria's energy consumption patterns have been characterized by an increasing demand for electricity, primarily fuelled by population growth and urban expansion. According to the Nigerian National Bureau of Statistics (NBS), electricity consumption in Nigeria increased from 5.96 TWh in 1980 to 27.96 TWh in 2021 (NBS, 2022). However, due to inefficiencies in the energy sector, the energy generated is insufficient to meet demand, as much of Nigeria's population continues to rely on alternative and less efficient energy sources such as firewood and kerosene (Oyedepo, 2014). Additionally, Nigeria's electricity generation has been heavily skewed towards non-renewable sources, with 77% of electricity generated from natural gas in 2020, while renewables (mainly hydroelectricity) accounted for only 23% (IEA, 2021). Efforts have been made to integrate renewable energy into the country's energy mix, but progress has been slow due to infrastructural and financial constraints (Akinyemi et al., 2019). Between 1980 and 2023, Nigeria's energy consumption grew at an average annual rate of 2.5%, driven by increasing demand for electricity and industrial energy needs. According to the International Energy Agency (2021), the country's total primary energy supply rose from 32.4 Mtoe in 1980 to 140.7 Mtoe by 2020.

Economic growth in Nigeria has been characterized by periods of boom and bust, largely driven by the performance of the oil sector. The oil sector has historically accounted for a significant portion of the country's gross domestic product (GDP), government revenue, and foreign exchange earnings (Central Bank of Nigeria, 2019). However, the over-reliance on oil has created structural imbalances in the economy, leading to issues such as unemployment, poverty, and income inequality (Adenikinju, 2005). Nigeria's economy has experienced periods of rapid growth and contraction, often tied to global oil price fluctuations. From 1980 to 2023, Nigeria's Gross Domestic Product (GDP) has shown significant growth, from approximately $50 billion in 1980 to over $500 billion by 2021, making it the largest economy in Africa (World Bank, 2022). However, despite this growth, Nigeria has struggled with economic diversification, poverty, unemployment, and inequality. The country's over-reliance on the oil sector has left the economy vulnerable to external shocks, such as the global oil price crash of 2014 and the economic downturn caused by the COVID-19 pandemic in 2020 (International Monetary Fund, 2020). Nigeria's real GDP grew from about $50 billion in 1980 to over $500 billion by 2021 (World Bank, 2022), an average annual growth rate of approximately 4.2%. However, the country experienced significant downturns during the global oil crises in the 1980s, the global financial crisis in 2008, and the economic recession following the 2014 oil price crash.

In recent years, there has been a concerted effort by the Nigerian government to diversify the economy and reduce its dependence on oil. Initiatives such as the Economic Recovery and Growth Plan (ERGP) aim to stimulate growth in non-oil sectors, including

agriculture, manufacturing, and services (Federal Government of Nigeria, 2017). However, achieving sustained economic growth requires addressing the energy deficit that continues to hinder the development of these sectors (Akinyemi, et al., 2019). The relationship between energy consumption and economic growth has been widely debated in the literature, with varying conclusions. Some studies suggest that energy consumption drives economic growth by providing the necessary input for industrial production, transportation, and other economic activities (Odhiambo, 2009). Others argue that economic growth leads to increased energy consumption as a result of higher demand for goods and services (Ozturk, 2010). In the context of Nigeria, several studies have examined the impact of energy consumption on economic growth, with mixed findings. Akinlo (2008) found a positive relationship between energy consumption and economic growth, suggesting that energy is a critical factor in driving Nigeria's economic performance. Similarly, Olusegun (2015) reported that energy consumption positively influences economic growth in Nigeria, particularly in the long run. However, other studies have found a bidirectional or even negative relationship between energy consumption and economic growth, indicating that the impact of energy consumption on economic growth may vary depending on factors such as the energy mix, efficiency, and external shocks (Akinyemi, et al., 2019).

In recent years, the global energy landscape has undergone significant changes, with increasing emphasis on renewable energy and the need to mitigate climate change. Nigeria, like many other developing countries, is faced with the challenge of balancing economic growth with environmental sustainability (Oyedepo, 2014). The Nigerian government has made some progress in promoting renewable energy through policies and initiatives aimed at increasing the share of renewables in the energy mix (Federal Government of Nigeria, 2017). However, the transition to a more sustainable energy system remains slow, and the country continues to rely heavily on fossil fuels. Recent literature highlights the importance of improving energy efficiency, investing in renewable energy infrastructure, and implementing policies that support the sustainable development of the energy sector (Adedoyin, et al., 2020). Moreover, the impact of the COVID-19 pandemic on global energy markets has further underscored the need for Nigeria to develop a more resilient and diversified energy sector to support economic growth (International Energy Agency, 2021).

Literature Review

Conceptual Review

Energy consumption is the amount of energy or power used (Ahmad, Hayat, Hamad & Luqman, 2012). Energy consumption refers to all the energy used to perform an action, manufacture something or simply inhabit a building (Akinlo, 2008). In a factory, total energy consumption can be measured by looking at how much energy a production process consumes, for example, by making car parts. This will include; water, electricity and gas amongst others. In a household, energy consumption will include the electricity, gas, water, and any other energy used to live in it. The energy consumption of a bus includes how much diesel or gasoline it uses to run. Energy consumption does not necessarily come from a single energy source. It is a common misconception to think

that to save energy you have to save electricity. It could very well be a totally different energy source that has the greatest impact on a certain process (Behara, 2015).

Economic growth of a country can be determined in the productivity level, volume of trade, investment in both human and physical capital. Ochejele (2017) conceptualized economic growth as "the quantitative and sustained increase in the country's per capita output or income accompanied by expansion in labour force, consumption, capital and volume of trade" .It is conventionally measured as the percentage rate of increase on Real Gross Domestic Product (RGDP). Economic growth is usually calculated in real terms, that is, inflation- adjusted terms, in order to net out the effect of inflation on the price of goods and services produced. Hence, the economic growth of any economy is measured by the amount of Real Gross Domestic Product (Central Bank of Nigeria, 2018). Taiwo (2011) conceptualized a country's economic growth as a long term rise in capacity to supply increasing diverse economic goods to its population, this growth capacity based on advancing technology and the institutional and ideological adjustment that is demanded. Economic growth is referred to the steady process by which the productive capacity of the economy is increased over time to bring about rising levels of national output and income (Todaro& Smith, 2005).World Bank (2014) conceptualized economic growth as increase in a country's potential Gross Domestic Product (GDP), though this differs depending on how national product has been measured.

Theoretical Review

This study is anchored energy ladder theory because it states that people with low incomes generally use traditional fuels as their main energy source and people with higher incomes tend to use modern fuels (Nicolai & Fiona, 2008). This tends to shift from traditional fuels to modern fuels basically when the income of the rural informal economy increases. Hence, the increase in the use of these modern fuels would contribute immensely to the production of goods and services in the Nigerian economy towards boosting economic growth. This study adopted this theory because energy ladder hypothesis is loosely based on economic theory of consumer behaviour. This explains the theory partially, showing when income increases households not only consumes more of the same good but they also climb the ladder to more modern goods with higher quality i.e. as a household gains socioeconomic status, it ascends the ladder to cleaner and more efficient forms of energy Further it assumes that cleaner fuels are normal economic goods while traditional fuels are inferior goods. The lower the household income, the greater the proportion of income spent on energy, poor families spend between 30 - 50% of their income on energy, whereas those with higher income spend less than 10%.

Empirical Review

Kassim and Abdurrahman (2020) investigated the impact of energy consumption on industrial growth. Variables used are; manufacturing vale added (dependent variable, electricity consumption, per capita income, exchange rate, import, and export by using yearly time series data from 1985 through 2017 in Nigeria. The OLS method of egression was used to estimate the equation in the period review. Unit root test, Co-integration test and Granger causality were carried out to test for stationarity, long run relationship, and causal relationship, respectively. Results show a negative and insignificant relationship

between electricity consumption and industrial growth. The unit root test shows that all variables are integrated of order one except for the exchange rate, which is stationary at level. The Co-integration test indicates that there exists the presence of long- run relationships. The granger causality indicates the growth hypothesis from industries in Nigeria. Generally, this paper stresses the dangers of inadequate electricity supply in the functioning of industries and businesses, which further worsens overall growth in the Nigerian economy.

Chinedu, Daniel and Ezekwe (2019) examined the impact of energy consumption on economic growth over a period of 1980 to 2017. The methods of data analysis were Augmented Dickey- Fuller unit root test statistic, Engle-Granger Co-integration test and error-correction mechanism. The study revealed that energy consumption had significant positive impact on energy consumption on economics growth in Nigeria. This study therefore recommends that companies in charge of oil refining and transportation should increase petroleum supply around the country by connecting the major towns with petroleum pipelines. Nigeria Government should formulate policy that encourages crude oil drilling companies to use sophisticated technology that will not cause crude oil spillage in the oil drilling environment.

Aliyu, Lawal and Beki (2018) examined the energy consumption and economic growth in Nigeria, using the time frame of thirty (30) years period from 1986-2016. The study used OLS estimation technique. The result of the study reviewed that energy consumption had significant relationship with economic growth in Nigeria. The study suggested that energy conservation policies could be effectively implemented without having any negative effect on economic growth in Nigeria and energy growth policy should be adopted in such a way that, growth in the energy sector could stimulates economic growth and thus expands employment opportunities in the country.

Idoko and Wada (2018) examined energy efficiency and manufacturing sector performance in Nigeria within the time frame of 1986-2016. Time series secondary data sourced from CBN Statistical Bulletin and International Energy Agency on manufacturing sector contribution to GDP as proxy for manufacturing sector performance while energy efficiency was proxy by energy intensity with labour and capital intensity as the independent variables. The study employed estimation techniques of ADF unit root test, Johansen co-integration test and Error Correction Model. The results based on Error Correction Model revealed that 65% of the deviation in the variables employed in the study would be restored in one year. It was also revealed that energy intensity, labour intensity and capital intensity had significant positive impact on manufacturing sector contribution to GDP in Nigeria within the study period. The study concluded that increased in energy intensity, labour intensity and capital intensity led to increased in manufacturing sector performance in Nigeria within the study period. Based on the findings, the study recommended that government should ensure there is increase in the amount of energy intensity so as to enhance manufacturing sector performance in Nigeria. Government should also make sure that the amount of labour intensity is also increased in order to promote the performance of manufacturing sector in Nigeria. Finally, government should ensure that adequate provisions are made in order to increase

the amount of capital intensity in the manufacturing sector so as to improve its performance in Nigeria.

Mahmood and Kanwal (2017) analyzed the relationship between energy efficiency and economic growth in Pakistan using Error Correction Model, Johansen Co-integration Vector Error Correction Model and Granger Causality test. The study found that long-run relationship between energy intensity and GDP. The results from VECM showed that energy intensity is increasing with economic growth. The study recommended that the government of Pakistan should use energy efficient management policy for this sector. For example, government can promote public transport by introducing energy efficient transport system with the help of China in all major cities. Babatunde (2016) investigated the time-varying relationship between energy consumption and economic growth in Nigeria using annual data for the period 1970-2014. Vector Autoregression, Augumented Dickey Fuller and Phillips Peron were used in the study. The study utilized variables such as; electricity consumption, natural gas consumption and gross domestic product. The study found statistical independence between energy consumption and economic growth. The lack of long-run relationship between energy consumption and economic growth implies that energy consumption does not have any linkage with economic growth in Nigeria. The study recommended that until certain bottlenecks are removed, Nigeria may not be able to utilize the abundant nonrenewable energy resources.

Bernard and Oludare (2016) studied the contribution of energy consumption on output of industrial sector in Nigeria. Time series data from the period of 1980-2013 on energy consumption and industrial output was employed. The Error correction mechanism was used to analyzed energy consumption and output of industrial sector in Nigeria. The ECM result provides strong evidence in support of convergent relationship between energy consumption and industrial output in Nigeria. The study revealed that the entire variable contributed positively to industrial output in Nigeria. The study finally recommended that government should strictly monitor the implementation of the policy of 2003 for the growth of industrial sector in Nigeria. For better policy formulation and implementation, the study also recommended that government agencies responsible for data collection should improve on the collection of current data for research.

Ogbonna, Idenyi and Nick (2016) analyzed the impact of power generating capacity on economic growth in Nigeria from 1980-2015. The study employed co-integration test, vector error correction mechanism and granger causality. The study found that a stable long run relationship exist between the dependent and explanatory variable in the model as supported by the presence of two co- integrating equations. The study revealed that there is no causality between power generating capacity and economic growth in Nigeria within the study period. The study recommended that government must ensure transparency in the overall implementation of power sector policy and its attendant reform agenda. There is need to ensure full implementation of power sector budget through oversight function by the legislative arm of government to check the endemic corruption associated with the sector.

Huanying (2016) examined the relationship between economic growth and energy consumption. An econometric investigation using China's data over the period of 1991 to 2016. The study explored the augumented dickey fuller model (ADF), co integration technique and Error Correction Model (ECM). The study result indicates that there is a linear relationship between economic growth, energy consumption and carbon dioxide emission. China is currently extensive mode of economic growth at the expense of increase in carbon dioxide emissions. The study recommends China's should develop new energy, adjust industrial structure and reduce economic growth rate in the long term. However, despite its empirical rigors, the study did not cover a robust time frame in order to capture the current state of macroeconomic implication the effect of energy consumption on economic growth.

Sama and Tah (2016), investigated the effect of energy consumption on economic growth in Cameroon using the Generalised Method of Moments (GMM) technique, the results obtained show that Gross Domestic Product (GDP), population growth rate and petroleum prices have a positive relationship with petroleum consumption. Also, there was an established positive relationship between GDP, population growth rate, electricity prices and electricity consumption. Again, the study found a positive and significant relationship between petroleum consumption, electricity consumption, Gross Domestic Investment (GDI) and population growth rate and economic growth. The study recommended that the government should expand current sources of energy such as solar energy, wind energy, thermal energy so as to increase the production and consumption of energy which increase economic growth.

Cheng (2016) evaluated the effect of electricity consumption and economic growth: Evidence from 17 Taiwanese industries over the period 1998-2014. The study employed Panel cointegration, Granger causality test and Panel Dynamic ordinary least squares. Empirical results over the period suggest that a panel cointegration test shows a long-run equilibrium relationship and bidirectional Granger causality between electricity and economic growth has been found. The result indicates that a 1% increase in electricity consumption boosts the real GDP by 1.72%. The study recommended that, the government can pursue energy conservation and carbon reduction policy in some industries without impending the economic growth for adjusting the industrial structure.

Methodology

This study uses annual time series data from Nigeria spanning from 1980 to 2023. The dependent variable is economic growth, measured by real gross domestic product (RGDP) at 2010 constant market prices, while the independent variables are coal consumption (COC) measured by percentage of coal rent to GDP. Additionally, electricity consumption (ELC) and crude oil consumption (COC) are considered as independent variables and are measured in terms of kWh per capita of electric power consumption and number of barrels per day respectively. These variables are anticipated to have positive effects on economic growth (GDP) of Nigeria. Data for variables adopted for this study was gotten via the following sources: RGDP (CBN, 2024), CAC (WDI, 2024), COC (CBN, 2024) and ELC (WDI, 2024)

Journal of Business and Economic Policy
UNIZIK Business School, Nnamdi Azikiwe University, Awka
UBSJBEP Volume 3 Issue 1
ISSN (Online) 0795 – 7149
https://journals.unizik.edu.ng/index.php/ubsjbep

In order to examine the effect of energy consumption on economic growth in Nigeria, previous studies adopted neoclassical theory to examine the nexus between energy consumption and economic growth around the globe. The Autoregressive Distributed Lag (ARDL) model is adopted for this study and is given as:

$RGDP_t = \beta_0 + \beta_1 CAC_t + \beta_2 COC_t + \beta_3 ELC_t + \mu_t$ ... ...(1)

Where:

RGDP = Real Gross Domestic Product
CAC = Coal Consumption
COC = Crude Oil Consumption
ELC = Electricity Consumption
.β_0 = Coefficients
.$\beta_1 - \beta_3$ = Parameters
μ and t = Error term or white noise and time trend over the study period respectively.

The technique of data analysis adopted in this study is autoregressive distributed lag (ARDL) bound testing approach to cointegration proposed by Pesaran, Shin and Smith. (2001) to analyze the relationship between energy consumption and economic growth in Nigeria. The merits of this technique over traditional econometrics techniques for the analysis of level relationship between dependent variable and a set of independent variables are; first, ARDL is a more robust approach that allow testing for cointegration regardless of whether the regressors are individually I(0) or I(1) or a mixture of both, secondly, unlike other cointegration approaches (e.g. Johansen's procedure) which require certain pre-testing for unit roots and that the underlying variables to be integrated of the same order, the ARDL model provides an alternative test to examining a long-run relationship regardless of whether the underlying regressors are purely I(0) or I(1) or even fractionally integrated. Lastly, ARDL approach generates better results for small sample data compared to conventional econometrics techniques of cointegration like Engle and Granger (1987), Johansen and Juselius (1990) approaches (Pesaran, Shin and Smith. 2001).

Specification of Autoregressive Distributed Lag (Bound Testing) Model

$$\Delta RGDP_t = \beta_0 \sum_{i=1}^{m} \beta_1 RGDP_{t-i} + \sum_{i=1}^{m} \beta_2 \Delta CAC_{t-i} + \sum_{i=1}^{m} \beta_3 \Delta COC_{t-i} + \sum_{i=1}^{m} \beta_4 \Delta ELC_{t-i} + \alpha_1 RGDP_{t-1} + \alpha_2 CAC_{t-1} + \alpha_3 COC_{t-1} + \alpha_4 ELC_{t-1} + \mu \quad (2)$$

$$CAC_t = \beta_0 \sum_{i=1}^{m} \beta_1 CAC_{t-i} + \sum_{i=1}^{m} \beta_2 \Delta RGDP_{t-i} + \sum_{i=1}^{m} \beta_3 \Delta COC_{t-i} + \sum_{i=1}^{m} \beta_4 \Delta ELC_{t-i} + \alpha_1 CAC_{t-1} + \alpha_2 RGDP_{t-1} + \alpha_3 COC_{t-1} + \alpha_4 ELC_{t-1} + \mu \quad (3)$$

$$COC_t = \beta_0 \sum_{i=1}^{m} \beta_1 COC_{t-i} + \sum_{i=1}^{m} \beta_2 \Delta RGDP_{t-i} + \sum_{i=1}^{m} \beta_3 \Delta CAC_{t-i} + \sum_{i=1}^{m} \beta_4 \Delta ELC_{t-i} + \alpha_1 COC_{t-1} + \alpha_2 RGDP_{t-1} + \alpha_3 CAC_{t-1} + \alpha_4 ELC_{t-1} + \mu \quad (4)$$

$$ELC_t = \beta_0 \sum_{i=1}^{m} \beta_1 ELC_{t-i} + \sum_{i=1}^{m} \beta_2 \Delta RGDP_{t-i} + \sum_{i=1}^{m} \beta_3 \Delta CAC_{t-i} + \sum_{i=1}^{m} \beta_4 \Delta COC_{t-i} + \alpha_1 ELC_{t-1} + \alpha_2 RGDP_{t-1} + \alpha_3 CAC_{t-1} + \alpha_4 COC_{t-1} + \mu \quad (5)$$

Δ is the difference operator, β_0 in each equation is the constant parameter, β_1 to β_4 are the vectors of the coefficients of the first difference lagged values of the variables controlled in models, while α_1 to α_4 for each equation represent the coefficients of the level lagged values of variables captured in models. Although, the ARDL model consist of two parts, the first part of the equations with β_1 to β_4 stand for the short-run dynamics of the models, while the coefficients α_1 to α_4 represents the long-run relationship. The null hypothesis of the above models is defined as H_0: $\alpha_{1=}$ $\alpha_{2=}$ $\alpha_{3=}$ $\alpha_{4=0}$ which tell us that there is no cointegration (no existence of long run relationship) among the variables under consideration whereas the alternative hypothesis is defined as H_1: $\alpha_1 \neq \alpha_2 \neq \alpha_3 \neq \alpha_4 \neq 0$ which signify the existence of cointegration (presence or evidence of long run relationship) (Pesaran, Shin and Smith. 2001).

Results and Discussion

The summary of variables used in estimating the relationship among the variable is summarized and presented in the table below

Descriptive Statistics

The Table 1 below spread the data used in this study using descriptive statistics results as follows:

Table 1: Descriptive Statistics Results.

	CAC	LCOC	LELC	LRGDP
Mean	0.001263	8.749953	4.619513	10.43468
Minimum	0.007030	9.137130	5.038071	11.26364
Maximum	4.02E-05	8.307208	3.933404	9.693476
Std. Dev.	0.001566	0.236818	0.256787	0.551084
Skewness	1.737972	-0.182246	-0.415221	0.228223
Jarque-Bera	35.36120 (0.000000)	1.994010 (0.368983)	1.664829 (0.434998)	4.821506 (0.089748)
Observations	44	44	44	44

Source: Authors computation using E-views (2024)

Table 1 shows the summary statistics for coal consumption (CAC), the natural logarithms of real gross domestic product (LRGDP), crude oil consumption (LCOC), and electricity consumption (LELC) which reveal insightful details about the distributional characteristics of each variable. On average, LRGDP stands at approximately 10.435 and a standard deviation of 0.001566 indicating less variability. The skewness of 0.228 suggests a slight rightward skewness while the Jarque-Bera statistic of 4.822 with a p-value of 0.897 implies no strong evidence against normality. LCOC and LELC exhibit similar descriptive patterns, with skewness values close to zero indicating approximately symmetric distributions. Also, their Jarque-Bera statistics are significant exhibiting normality. However, CAC revealed different but significant findings with mean of 0.001263, ranging from a minimum value of 0.007030 to maximum of 0.00000402.

All the variables depict positive evidence, and this implies that we have more of increase than decrease in the changes among the variables. Also, CAC has lower standard deviation (0.001566), which shows that the dispersion of the data is closer to its mean. Each variable has 44 observations and these findings is crucial for robust statistical modeling and analysis.

Journal of Business and Economic Policy
UNIZIK Business School, Nnamdi Azikiwe University, Awka

UBSJBEP Volume 3 Issue 1
ISSN (Online) 0795 – 7149
https://journals.unizik.edu.ng/index.php/ubsjbep

Stationarity Test

This study investigated the stationarity level of the variables under study in order to ensure that none of the series is beyond integration of order one (I(1)). To achieve the forgoing aim, unit root tests were conducted using Augmented Dickey Fuller (ADF) tests.

Table 2: Unit Root Test Results

Augmented Dickey-Fuller (ADF) Test			
Variables	**ADF Test Statistics**	**At level value I(0)**	**At first diff. value I(1)**
RGDP	-3.061574	-	-2.935001**
CAC	-4.369204	-3.592462***	-
COC	-5.720554	-	-3.596616***
ELC	-9.471065	-	-3.596616***

Note: Significant at 1% (***), 5% (**) and 10% (*)
Source: *Author's computation using Eviews (2024)*

Table 2 above, shows result of the unit root test carried out using ADF. From the result obtained, CAC was found to be stationary at a level value 1(0) and other variables became stationary after the first difference 1(1). This is good for the model as it will pave way for the use of ARDL model; co-integration test will be carried out using autoregressive distributed lag model.

Estimation of ARDL Model

When the stationarity level of the variables was examined, the study then conducts ARDL test by conducting co-integration bound test, long run estimate of ARDL and short run dynamic estimate of ARDL consecutively.

Table 3: Results of ARDL Co-integration Bounds Test Estimation

Critical value Bounds of the F-statistic; intercept and no trend						
K	90% level		95% level		99% level	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
3	2.933	4.020	3.548	4.803	5.018	6.610
F-Statistic = 6.2145**		**N = 43**				

Note: N= no of observation, I(0) = Lower bound, I(1) Upper bound and K = no of variables
Critical Value based on Narayan 2005 table – Unrestricted Intercept with no Trend
Source: *Authors Computation using Microfit (2024)*

Table 3 above shows that F-statistic value of 6.2145 falls below critical test statistics at 99% of the upper bound I(0), but above the critical test statistics at 95% of the upper bound. This indicates that there is existence of co-integration among all the underlying variables in the model, which are RGDP, CAC, COC, and ELC. Total number of variables is four (4), therefore K=3. The study then estimates long-run relationship because the variables could maintain equilibrium in the long run. Thus, this result had satisfied the condition for estimating long run relationship between the variables.

Journal of Business and Economic Policy
UNIZIK Business School, Nnamdi Azikiwe University, Awka

UBSJBEP Volume 3 Issue 1
ISSN (Online) 0795 – 7149
https://journals.unizik.edu.ng/index.php/ubsjbep

Result of Post Estimation Diagnostic Tests

To ensure the adequacy of the ARDL model, post-estimation diagnostic tests for serial correlation (autocorrelation), functional form misspecification and heteroskedasticity have been conducted and the outcomes are presented in Table 4 below:

Table 4: Diagnostic Test Results

Diagnostic Test	LM Version	F Version
Serial Correlation	CHSQ(1)= .59099[.442]	F(1, 30)= .43876[.513]
Functional Form	CHSQ(1)= .88718[.346]	F(1, 30)= .66351[.422]
Normality	CHSQ(2)= .99611[.608]	Not applicable
Heteroscedasticity	CHSQ(1)= 1.1301[.288]	F(1, 39)= 1.1054[.300]

R – Squared 0. 99748 Durbin Watson – Statistic 1.7091

Source: Author's computation using Microfit (2024)

Breusch-Godfrey serial correlation LM test has a p-value of 0.513 and this indicates that the null hypothesis of no serial correlation is accepted, since F-statistic is significant at 5% level. The result additionally revealed no functional form misspecification in the model. Also for the Breusch-Pagan-Godfrey heteroscedasticity test, the result did not show any evidence of heteroscedasticity in the ARDL model. In other word, the result shows the evidence of homoscedasticity as indicated by their respective p-values. Therefore the null hypothesis is accepted and rejects the alternative hypothesis because the P-value is greater than levels of significance. From the foregoing, we can conclude that the ARDL output is strongly adequate to explain the model.

Long run Coefficient Estimation

This has been carried out after knowing the level of co-integration among the variables so as to know the nature of relationship in the long run between dependent and independent variables.

Table 5: Result of Estimated Long-run Coefficient

Variables	Coefficients	Standard error	T – Ratio [prob.]
LELC	2.4725***	0.46191	5.3527 [0.000]
LCAC	-0.24791**	0.086556	-2.8641 [0.007]
LCOC	0.33978	0.85543	0.39720[0.694]
INPT	-5.2873	7.8306	-0.6752[0.505]

Note: LGDP = Dependent Variable, ***and ** = significant at 1% and 5% respectively, *Lag lengths 1, 2, 2, 1 selected based on Schwarz Bayesian Criterion*

Source: *Author's Computation using Microfit (2024)*

The findings from Table 5 above present insights into the relationships among key economic variables, namely coal consumption (CAC), crude oil consumption (COC), electricity consumption (ELC), and economic growth (RGDP). The dynamic model utilized in this analysis is the Autoregressive Distributed Lag (ARDL) model, incorporating lag order of 2 for both dependent and independent variables. The focus of this study is on elucidating the long-run and short-run interactions, with RGDP (represented by the natural logarithm, LRGDP) as dependent variable.

The coefficient of CAC is observed to be -0.247. This negative coefficient signifies that in the long-run, a 1% increase in CAC is associated with -0.247% decrease in RGDP. This is revealed by the p-value of 0.007, which means the relationship is significant at

5% level. The t-statistic of -2.8641 however indicates the statistical significance of this relationship. Hence, this suggests that coal consumption plays a lesser role in contributing to economic growth of Nigeria during the period under study. More so, the coefficients of COC shows a positive but no significant impact on the real GDP of Nigeria. Electricity consumption (ELC), which is the variable of interest in this study is positively and significantly related to RGDP. The result depicts a p-value of 0.000 that is to say the relationship between electricity consumption and economic growth of Nigeria is significant at 1% level. Therefore, this implies that in the long-run a 1 percent change in electricity consumption would trigger a 2.4725% increase in real gross domestic product. The positive relationship suggests that more electricity consumption contribute to economic expansion. Hence, higher energy usage especially electricity may be indicative of increased industrial activity, technological advancements, or enhanced productivity, leading to a positive impact on the overall economic output.

Short run and Error Correction Estimation

Table 6: Result of Estimated Short Run and Error Correction Model

Variables	Coefficients	Standard error	T – Ratio [prob.]
ΔLELC	0.12479*	0.069777	1.7885 [0.083]
ΔLCAC	0.00686	0.010623	0.6464 [0.522]
ΔLCOC	0.19190**	0.065944	2.9101 [0.006]
INPT	-0.3511	0.34124	-1.0290[0.311]
ECM_{t-1}	-0.6641*	0.04012	-1.6553[0.017]

Note: LGDP = Dependent Variable, *and ** = significant at 10% and 5% respectively, *Lag lengths 1, 2, 2, 1 selected based on Schwarz Bayesian Criterion*

Source: *Author's Computation using Microfit (2024)*

Table 6 shows the result of the short run and error correction model. The results revealed that both electricity consumption and crude oil consumption have positive impact on economic growth and are significant at 10% and 5% respectively. This is similar to the estimates of the long-run values. On the other hand, the error correction model is negative, significant at 10% and less than one (1) (-0.6641). This means that the degree of adjustment to equilibrium is about 66% annually.

Conclusion and Recommendations

This study employs time series data from Nigeria to investigate the relationship between energy consumption (with emphasis on electricity consumption) and economic growth. Utilizing data spanning from 1980 to 2023, this study uses the Autoregressive Distributed Lag (ARDL) estimator. The results reveal a significant positive impact of electricity consumption on economic growth in Nigeria. Therefore, this study concludes that the interplay between electricity consumption and economic growth is substantial in Nigeria. Based on these findings, this study recommends that those in authority should maintain strategies that can enhance energy efficiency and promote sustainable energy sources to further enhance economic development.

References

Adedoyin, F. F., Alola, A. A., Bekun, F. V., & Agboola, M. O. (2020). The nexus of environmental sustainability and agro-economic performance of Sub-Saharan African countries. *Science of the Total Environment*, *706*, 135642.

Adegbemi O.O & Babatunde O. O. (2013). energy consumption and Nigerian economic growth: an empirical analysis. *European Scientific Journal*. 9 (4), 25-40.

Adenikinju, A. F. (2019). Analysis of the cost of infrastructure failures in a developing economy: The case of the electricity sector in Nigeria. *African Economic Research Consortium*.

Ahamad, M. G. & Islam, A.K.M. N. (2011). electricity consumption and economic growth nexus in Bangladesh. *Journal of Energy Policy*, 9(6), 6145–6150.

Ahmad, Hayat, Hamad & Luqman (2012). relationship between energy consumption and economic growth of Pakistan. *Journal of Human Ecology*, 31(1) 19-26

Akinlo, A. E. (2020). Energy consumption and economic growth: Evidence from 11 Sub-Saharan African countries revisited. *Energy Economics*, *88*, 104739.

Akinlo, A.E. (2017). *Energy Consumption and Economic Growth: Evidence from 11 Sub-Sahara African countries*. Energy Economics, 30 (5) 2391-2400.

Akinyemi, O., Efobi, U., Asongu, S., & Beecroft, I. (2019). Energy security, trade and transition to green economy in Africa. *Energy Policy*, *134*, 110958.

Aliyu S. B., Lawal, A. D & Beki O. D (2018). an examination of Energy Consumption and

Altintas, H. & Kum, M. (2013). Multivariate Granger Causality between electricity generation, exports, prices and economic growth in Turkey. *International Journal of Energy Economics and Policy*, 3(7), 41-51.

Aqeel, A., & Butt, M. (2001).The relationship between energy consumption and economic growth in Pakistan. *Asia Pacific Development Journal*, 8(2), 101-110.

Arnold S., Kohlin D., & Persson V., (2006). Energy Consumption and Economic Growth in

Babatunde O.O. (2016). relationship between energy consumption and economic growth in Nigeria. Sustainable development and energy security level after shutdown. Technological and Economic Development of Economy,17 (1):5–21.

Behara A. (2015). energy consumption and economic growth in India. Pakistan *Journal of Social Sciences* (PJSS), 32 (2), 371-382.

Bennett, J. (2000). The agency of assemblages and the North American blackout. Public Culture, 17, 445.

Bernard, O.A. & Oludare, A. (2016). contribution of energy consumption on output of industrial sector in Nigeria. *Journal of economic and transformation* 1(3), 11-22

Cheng T. (2016). effect of electricity consumption and economic growth: Evidence from 17 Taiwanese industries. *Journal of Energy and Employment*, 13(1): 113-122.

Choji, L. D. (2014). *Energy Demand and Economic Growth in Nigeria*. A thesis Submitted to the Institute of Graduate Studies and Research in Partial Fulfillment of the Requirements for the Degree of Master of Science in Economics.

Dahmardeh S., Mahmoodi F. & Mahmoodi P. (2012). causal relationship between Energy Consumption and Economic Growth for a panel of Ten Asian developing countries. *Journal of Economics and Business*, 12 (1), 2–3.

Davidson N. & Mackinnon F. (1999). *Introductory Econometrics*. New York: Springer

Publisher, *Development in Nigeria*. Paper presented at the 3rd international conference of National Association for Energy Economics held at Abuja, Nigeria, April 2010.

Echeta, Igwemma & Nwosu (2014) examined access to energy and productivity of firms using a comparative analysis of two industrial clusters in South-eastern Nigeria

Economic Co-operation and Development (OECD) Countries. *International Journal of Energy Economics and Policy* , 01-17.

Economic Growth in Nigeria. *International Journal of Economics and Business Management* 4(6), 47-64.

Erbaykal, E. (2018). Disaggregate energy consumption and economic growth: Evidence from Turkey: *International Research Journal of Finance and Economics*. 20(8), 172-179.

Esso, L. J. (2010). Threshold cointegration and Causality Relationship between Energy Use and growth in seven African countries. Energy Economics, 32 (6), 1383-391.

Fardis S. (2014). relationship between electricity consumption and economic growth being evidence from 82 countries. *Journal of Economic Theory*, 2(4): 118-123.

Federal Government of Nigeria. (2017). *Economic Recovery and Growth Plan 2017-2020*.

Georgantopoulos D. (2012). causality between Electricity Consumption and Real Gross Domestic Product for Greece. *Journal of Policy Modeling*, 26(8-9): 973–981.

Godwin C. N. (1980). *The Nigerian Coal Corporation: An Evaluation of Production Performance*. Quantitative Economic Research Bureau, 23-45.

Growth: Evidence from Nigeria and South Africa. *Journal of Economics and Sustainable Development*. 3(11), 113-124.

Huanying N. (2016). Relationship between economic growth and energy consumption in China. *Journal of Economics and International Finance*, 1(2): 44-58.

Ighodaro G. (2010). co-integration and causality relationship between energy consumption and economic growth for Nigeria. *Journal of the American Statistical Association*, 90(429): 268-291.

Ikpe F. & Udo E. (2014). Relationship between energy consumption and economic growth in Nigeria. *Journal of Basic and Applied Scientific Research* , 1385-1390.

International Energy Agency (2018). Renewables in Global Energy supply: An IEA Facts sheet.

International Energy Agency. (2021). *Nigeria energy outlook*.

Iyke, B. N. (2014). Electricity Consumption, Inflation, and Economic Growth in Nigeria: A Dynamic Causality Test. Munich Personal RePEc Archive.

Jaruwan, C. (2010). Modelling Causality between Electricity Consumption and Economic Growth in Asian Developing Countries. *International Journal of Business Economics*, 6(4), 318, 319.

JORIND (9) 1, 153-165. Retrieved from www.ajol.info/journals/jorind

Kasperowicz H. (2014). relationship between electricity consumption and economic growth in Poland. *Asia-Pacific Development Journal* , 5(3), 137-150.

Kostyannikova G. (2012). economic growth and energy consumption in Organisation for

Kumar C. (2011). Causality in both static dynamic frameworks between energy consumption CO_2 emission and economic growth in Indian. *Journal of East Asian Economic Integration*, 4(2) 3-32.

Lamia S. & Abdelkader A. (2016). energy consumption and economic growth on the environmental degradation in Asian countries. *Research in Business and Economics Journal*, 2(1), 1-15.

Mahedi M. (2012). Electricity Consumption and Economic Growth in Bangladesh: Co-Integration and Causality Analysis. *Global Journal of Management and Business Research.* 12(11), 47-57.

Mahmood S. & Kanwal Y. (2017). Relationship between energy efficiency and economic growth in Pakistan. *The Lahore Journal of Economics* 7(2), 45-58.

Majeed E. & Siddique J. (2016). Relationship between energy consumption and economic growth of Pakistan. *Journal of Economic Studies,* 37 (1): 53-95.

Masera, O. R., Saatkamp, B. D., & Kammen, D. M. (2000). *From linear fuel switching to multiple cooking strategies: A critique and alternative to the energy ladder model*. World Development, 28, 2083–2103.

Masuduzzaman, M. (2013). *Electricity Consumption and Economic Growth in Bangladesh: Cointegration Analysis.* Research Study Series No. – FDRS 02/2013.

Mustapha S. & Fagge C. (2015). Relationship between energy consumption and economic growth in Nigeria. *Journal of Energy and Development*, 3(2), 34-56.

National Bureau of Statistics (2010). Annual Abstract of Statistics, Federal Republic of Nigeria.

Neuhaus B. (2016). renewable energy consumption economic growth nexus in Sub-Saharan African countries. *International Business & Economics Research Journal*, 4 (12), 45-67. New York City

Nigeria: A Causality Analysis. *Journal of Economics and Sustainable Development*, Vol.6, No.13, 42 2015

Nwankwo, O.C & Njogo, B.O.(2013). The effect of electricity supply on industrial production within the Nigerian economy (1970 – 2010). *Journal of Energy Technologies and Policy*, 3(4), 34

Odularu, G.O. & Okonkwo C. (2009). Does energy consumption contribute to economic performance? Empirical evidence from Nigeria. *Journal of Economics and International Finance* 1 (3), 2044-058.

Ogbonna D., Idenyi W. & Nick S. (2016) power generating capacity and economic growth in Nigeria. *European Scientific Journal*, 8, (12), 34-54.

Ogundipe, A.A. & Apata, A.(2013). Electricity consumption and economic growth in Nigeria. *Journal of Business Management and Applied Economics*, 1(2), 4

Oji, J.O., Idusuyi N, & Kareem B. (2012). Coal power utilization as an energy mix option for Nigeria: A review. *American Academic & Scholarly Research Journal*, 4 (4), 49-69

Okafor, H.O. (2012) Testing the Relationship between Energy Consumption and Economic

Okoligwe A. & Ihugba Q. (2014) examined the causal relationship between electricity consumption and economic growth for Nigeria. *Journal of Policy Modeling*, 31(45), 681– 693.

Olayemi, S. O. (2022). Energy poverty in Nigeria: An assessment of spatial differences in household energy consumption patterns. *Journal of Geography and Regional Planning, 5*(4), 132-137.

Olusanya, S. O. (2012). Long run Relationship between Energy Consumption and Economic Growth: Evidence from Nigeria. *Journal of Humanities and Social Science*, 3 (3), 40–50.

Olusegun, O. A. (2009). Energy consumption and economic growth in Nigeria. A bound testing cointegration approach, *Journal of economic Theory* 2(4). Pp 118 – 123.

Olusegun, O. S. (2015). Energy consumption and economic growth in Nigeria: A bounds testing co-integration approach. *Journal of Economic Theory, 9*(1), 1-8.

Olusegun, O. S. (2015). Energy consumption and economic growth in Nigeria: A bounds testing co-integration approach. *Journal of Economic Theory, 9*(1), 1-8.

Onakoya, A. B., Onakoya, A. O., Salami, O.A., & Odedairo, B.O. (2013). Energy Consumption and Nigerian Economic Growth: An Empirical Analysis. *European Scientific Journal*, 9

Orhewere, B. & Machame H. (2011). *Energy Consumption and Economic Growth in Nigeria*

Ouedrago, I.M. (2013). *Electricity consumption and economic growth in Burkina Faso: A co- integration analysis.* Review on Energy Economics, 32, 524-531.

Oyedepo, S. O. (2014). Towards achieving energy for sustainable development in Nigeria. *Renewable and Sustainable Energy Reviews, 34*, 255-272.

Oyedepo, S. O. (2014). Towards achieving energy for sustainable development in Nigeria. *Renewable and Sustainable Energy Reviews*, *34*, 255-272.

Ozturk, I. (2010). A literature survey on energy-growth nexus. *Energy Policy, 38*(1), 340-349.

Romer, P. M. (1986). Increasing returns and long-run growth. *Journal of Political Economy, 94*(5), 1002-1037.

Sama, M. C & Tah, N. R. (2016). *The Effect of Energy Consumption on Economic Growth in Cameroon*. Asian Economic and Financial Review, 6(9): 510-52.

Sambo, A.S., Olayande, J.S., Ahmed, A.S. (2010). *Indicators for Sustainable Energy*

Samuel, U.P & Lionel, E.(2013). The dynamic analysis of electricity supply and economic development: Lessons from Nigeria. Journal of Sustainable Society, 2(1), 1-11.

Sarker, A.R.& Alam, K.(2010). Nexus between electricity generation and economic growth in Bangladesh. *Asian Social Science journal*, 6(12), 89-134.

Solow, R. M. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics, 70*(1), 65-94.

Stern, D. I. (2000). A multivariate cointegration analysis of the role of energy in the US macroeconomy. *Energy Economics, 22*(2), 267-283.

World Bank (2011). Renewable Energy Consumption and Economic Growth: The Case of 7 Asian Developing Countries. *American Journal of Scientific Research*, 4(6), 146-152.

World Bank (2018). *Nuclear energy consumption and economic growth in nine developed countries*. Review on Energy Economics,550-556.