Impact of Energy Consumption on Economic Growth in Nigeria: 1990 – 2023.

BABATOPE Ademola Awe, ULOKO Joseph

Doctoral Candidate, Faculty of Social Sciences, Department of Economics, Nile University of Nigeria, Airport Road, Abuja (FCT)-Nigeria

DOI: https://doi.org/10.47772/IJRISS.2026.1015EC0082

Received: 28 July 2026; Accepted: 03 August 2026; Published: 13 August 2026

ABSTRACT

This research work examined the relationship that exist between energy consumption and economic growth in Nigeria for the period covering 1990- 2023 The paper examined the relationship between energy consumption and economic growth in Nigeria. Taking clue form the basics of this theory, a model was specified using Real Gross Domestic Product as a function of Gross Capital Formation, Labor Force, Per Capita Income, Electricity Consumption, Coal Consumption and Crude Oil Consumption. The study used energy consumption secondary data readily available from Central Bank of Nigeria Statistical Bulletin, the study conducted a unit root test to ascertain the stationary status of the data series, while co-integration technique was used to test for the relationship between the variables in the model. Finally, a linear regression analysis was conducted using error correction model (ECM) method. In light of the test and regression analysis conducted covering a study period of 25years (1990-20235), the following are the major findings. There is a positive and significant relationship between Real Gross Domestic Products and Gross Fixed Capital Formation, Labor Force, Per Capital Income, Electricity Consumption and Coal Consumption. While Crude Oil Consumption has a negative and non-significant relationship with Real Gross Domestic Products. Government should diversify energy consumption from fossil fuel to renewable one and alternative energy infrastructure should be enhanced through intentional investment.

Keywords: Renewable Energy, Energy Consumption, RGDP, Coal Consumption Casualty, ECM, Regression

INTRODUCTION

Ending poverty and ensuring economic sustainability are defining challenges of our time. Energy is central to both of them. According to the former United Nation Secretary General Ban Ki-Moon, sustainable development is not possible without sustainable energy. Access to modem energy services is fundamental to human development and economic growth in our collective future (United Nation-Human Development Index, 2011).Energy is central to sustainable developments - a major enabler for achieving all the MDGs and maintaining their sustainability - its importance reflected in the strong correlation between electricity (energy) consumption and the United Nation's Human Development Index (HDI). The lack of universal energy access has been a chronic problem in the developing world. Many of the 1.3 billion people are without access to electricity and the 2.7 billion people are without access to modem cooking fuels live in Sub-Sahara Africa and South Asia (United Nation-Human Development Index, 2011). Although missing from the MDGs, subsequent work has emphasized the importance of energy for human development. In 2005, the United Nation Energy Group Study "The energy challenge for Achieving the MDGs" highlighted that energy services such as lightings, heating, cooking and mechanical power were essential for alleviating poverty and achieving the MDGs. Indeed, economic and social development is seriously impeded by the lack of sustainable energy services (United Nation-Energy Group, 2005).On September 10, 2014, the United Nation General Assembly (UNGA) adopted a resolution that paved the way for the "Report of the Open Working Group on Sustainable Development" to be the main basis for integrating the SDGs into the post 2015 development agenda. The Open Working Group identified energy as one of 17 goals in the ongoing post-MDGs dialogue, particularly as all

number seven. Its suggestion for a goal to secure sustainable energy in the post-2015 period builds on the Sustainable Energy for all (SE4ALL) targets-access, efficiency and renewable energy and its multi-tiei Global Tracking Frame-work (GTF) United Nation-Energy Group, 2014).

World Health Organizations estimates that if half of the global households that *still use* traditional fuels and stoves switched to cleaner cooking sources over a ten-year period, families would save US$34 billion per year and generate an economic return of US$105 billion per year (United Nation-Human Development Index, 2011). Deficient access also undermines resilience to socioeconomic and climate vulnerabilities. For example, energy services for use by health centers and communities are essential for disaster management. Energy access is therefore crucial to resilience and adaptive capabilities (United Nation-Human Development Index, 2011). According to the International Energy Agency (IEA) (2006), increasing access to modem forms of energy is crucial to unlocking faster economic and social development in Sub-Sahara Africa. In Sub-Sahara Africa, more than 620 million people in the region or about two-thirds of the population live without electricity, and nearly 730 million people rely on inefficient forms of cooking. The use of solid biomass, mainly firewood and charcoal outweigh that of all other fuels combined and average electricity consumption per capita is not enough to power a single 50W light bulb continuously "A better functioning energy sector is vital to ensuring that the citizens of Sub-Sahara Africa can fill their aspirations" said IEA Executive Director Marin Van Der Hoeven (International Energy Agency, 2006). The IEA's first comprehensive analysis of Sub-Sahara Africa, it was reported that the region's energy resources are more than sufficient to meet the consumption need of its population, but that they are largely under-developed. Region accounted for almost 30 percent of global oil and gas discoveries over the last five years, and it is already home to several major energy producers including Nigeria, South Africa and Angola. The region is also endowed with huge renewable energy resources, including widespread solar and hydro potential as well as wind and geothermal, (International Energy Agency, 2006). Faith Biro (IEA's Chief Economist, 2006) is of the opinion that economic and social development in Sub-Sahara Africa hinges majorly on fixing theenergy sector. The payoff can be huge with each additional dollar invested in the power sector boosting the overall economy.

Nigeria, officially known as the Federal Republic of Nigeria is a country that is located on the western coast of Africa, having a land size of about 923,768km^2. According to the Nigeria National Bureau of Statistics 2012, the total population of Nigeria was around 166.2 million people in 2012. In 2015, it is estimated to have over 178.5 million people although United Nations projections have placed the population as high as 186 million people. The entire population of Nigeria accounts for about 2.35% of the entire earth population, (World Bank, 2015).

Nigeria is a middle income, mixed economy and emerging market with expanding financial service, communication and technology and entertainment sector. It is ranked as 21st largest economy in the world and the 20th largest in terms of purchasing power parity, (World Bank, 2014). The GDP growth rate in 2013 was 5.4% (World Bank, 2013), while GDP growth rate in 2014 stands as 6.3% (World Bank, 2014). GDP growth rate in Nigeria averaged 0.30% from 2013 until 2015, reaching an all-time high of 9.19% in the third quarter of 2015, (Central Bank of Nigeria, 2015).

Statement of the Problem

Poor access to energy in Nigeria has been a major impediment to Nigeria economic growth. Small and Medium Scale Enterprises have been adjudged as the engine of economic growth but is performance is grossly dismal due to inadequate energy supply, (Adeyemi and Ayomide, 2013).

Nigeria economic growth. The questions that this study would try to address are as follows:

i. What are the main sources of energy in Nigeria and what are the levels of their contribution to the economy?

ii. What is the relationship between energy consumption and economic growth?

iii. What is the impact of energy consumption on Nigeria economic growth?

Objectives of the Study

The broad objectives of this study is to critically examine the impact of energy consumption on Nigeria's economic growth between 1990 and 2015. While the (specific objectives are to:

i. Examine the main sources of energy in Nigeria and the level of their contribution to the economy.

ii. Examine the relationship between energy consumption and economic growth.

iii. Examine the impact of energy consumption on Nigeria economic growth.

Research Hypotheses

The research hypothesis is aimed at measuring the extent to which energy consumption would have impacted or otherwise on the economic growth of Nigeria. The hypotheses are stated as follows:

Ho_1: There is no significant variation in energy consumption from 1990 to 2015.

Ho_2: There is no significant relationship between energy consumption and economic growth in Nigeria.

Ho_3: Energy consumption has no significant impact on economic growth in Nigeria

LITERATURE REVIEW

Conceptual Review

Concept of Energy

Energy is defined as the capacity of matter to perform work as the result of it's motion or its position in relation to forces acting on it, (Encarta, 2009).According to (Merrian-Webster Dictionaries, 2015) Energy is define as a fundamental entity of nature that is transferred between part of a system in the production of physical change within the system and usually regarded as a capacity for doing work.

Also, the (English Oxford Dictionary, 2015) defines Energy as a power derived from the utilization of physical or chemical resources, especially to provide light and heat or to work machines. The concept of energy efficiency has been in use since the early 1970s. Lovins was among the first to develop a definition of energy efficiency. And that energy efficiency means using less energy to produce greater economic output, (Lovins, 1976). This definition, coupled with a review of the apparently highly inefficient use of energy by society, indicates that market alone cannot produce the most desirable social outcome in the use of energy without government policy intervention, (International Energy Agency, 2007).

Population growth and competition for resources have continuously been an impetus for the control and use of energy. In harnessing energy, inventions evolved from previous innovations, ebbing and flowing with changes in population pressures and the availability of resources necessity shaping history.

For millennia, societies depended on resources provided by solar energy (radiation stored as vegetation), wind (a type of solar energy), animal and human energy, water, and fossil fuels, (Richard, 2004).

The advent of mechanized labor and its synchronized production demands transformed the lives of workers previously tuned to seasonal energy rhythms. Technological innovations during the early 18^{th} century resulted in enormous growth in the economic wealth and sociopolitical power of nation-states. Sustained growth in Western Europe and Britain spread via exploration and trade. The competition to colonize and control the raw natural resources in the Caribbean and the Americas, in conjunction with imperialism in Indochina, the Mideast, and the Mediterranean, changed the global energy map, (Richard, 2004).

Sustainable Energy

Energy is central to sustainable development - a major enabler for achieving all the MDGs and maintaining their sustainability - its importance reflected in the strong correlation between electricity consumption and the UN's Human Development Index (HDI). It seems therefore inconceivable that global leaders failed to consider an energy-specific goal when drawing up the MDGs fifteen years ago, (Faris and Namat, 2014). The lack of universal energy access has been chronic problem in the developing world. Many of the 1.3 billion people without access to electricity and the 2.7 billion people without access to modem cooking fuels live in Sub-Saharan Africa and South Asia (Human Development Index, World Bank, 2014). Although missing from the MDGs subsequent work has emphasized the importance of energy for human development. In 2005, the UN Energy Group study entitled "The Energy Challenge for Achieving the MDGs" highlighted that energy services such as lighting, heating, cooking and mechanical power were essential for alleviating poverty and achieving the MDGs, (United Nation- Energy Group, 2005).

Indeed, economic and social development is seriously impeded by the lack of sustainable energy services. Countless examples have shown that, once modern energy is available, families and business benefit enormously from that, power and heat and the associated opportunities for job creation and income generation.

Energy (Electricity) Generation in Nigeria: Stylized Facts

The Nigeria economy is heavily dependent on energy. Electricity is used for a number of purposes that include, industrial, commercial and household purposes. Electricity generation in Nigeria began in 1896, fifteen years after its introduction in England. The Nigeria Electricity Supply Company (NESCO) commenced operations as an electric utility company in Nigeria in 1929 with the construction of a hydroelectric power station at Kaura near Jos. The[1] Electricity Corporation of Nigeria (ECN) was established in 1951, while the first 132KV line was constructed in 1962, linking Ijora Power Station to Ibadan Power Station. The Niger Dams Authority (NDA) was established in 1962 with a mandate to develop the hydropower potentials of the country. However, ECN and NDA were merged in 1972 to form the National Electricity Power Authority (NEPA). The law which established the National Electricity Authority (NEPA) in 1972 stipulated that it should develop and maintain an efficient, coordinated and economical system of electricity supply for all parts of Nigeria. At the inception of NEP A in 1973, only five of the IS were connected to the national transmission grid system. Today, practically all state capitals are being served from the national grid, although haphazardly, (Adetunji and Shaibu, 2008).

In 1988, the National Electricity Power Authority (NEPA) was partially commercialized, supported by an upward review in tariffs. As part of the restructuring effort of the power sector, the Electric Power Sector Reform Act 2005 was enacted. Consequently, the defunct National Electric Power Authority (NEPA) is now known as Power Hold Company of Nigeria (PHCN). The law paved the way for the unbundling of NEPA into the 18 companies - 6 generating companies, 1 transmission company and 11 distribution companies. The generating companies are made up of 2 hydro and 4 thermal (gas based) stations.The Nigerian power sector is marked by low generating capacity relative to installed capacity and much of the country's citizens do not have access to uninterrupted supplies of electricity. At present electricity generation ranges from between 1500 megawatts to about 2,000, even with the inclusion of three gas-powered independent power projects in the Nigeria Delta region, while estimated national consumption is in excess of 10,000 megawatts, (Adetunji and Shaibu, 2008).

Potential demand in the next few years is estimated at about 15000. This is despite the fact that Nigeria is endowed with massive reserves at hydro energy, petroleum reserves and one largest gas reserve. Government policy for the sector during the 1980s and the 1990s and until recently did not properly anticipate national needs. For example, the last major electric generation installation in Nigeria was in 1990 when the Shiroro power station was commissioned. Since then no new units have come on stream and none of the existing ones have had a major overhaul for 15 years, (Adetunju and Shaibu, 2008).

In 2005, the Power Sector Reforms Bill was signed into law thus enabling private companies to participate in electricity generation, transmission, and distribution. Previously, the state-owned Power Holding Company PLC dominated the power sector. The government has separated NEPA into eleven distribution firms, six

generating companies, and a transmission company, all of which will be privatized. Several problems, including union opposition, have delayed the privatization. In February 2005, the World Bank agreed to provide NEPA with $100 million to assist in its privatization efforts. Only 40% of the population has electricity, the majority of whom are concentrated in urban areas, (Energy Information Administration, 2007). It is estimated that an additional 10,00MW in capacity is required to meet current demand. Despite endemic blackouts, customers are billed for services rendered, partially explaining Nigeria's widespread vandalism and power theft and NEPA's problems with payment collection, (Adctunji and Shaibu, 2008).

The Nigerian government has made an effort to increase foreign participation in the electric power sector by commissioning independent power producers (IPPs) to generate electricity and sell it to PHCN, soliciting investors for the construction include the 276MW siemens station in Afan, Agip's 4J0MW plant in Kwale, ExxonMobil's 388MW plant in Bonny, ABB's 450MW plant in Abuja, and Eskom's 388MW plant in Enugu. Several State Governments have also commissioned oil majors to increase generation including Rivers State, which contracted shell to expand the 700MW Afam Station. The Nigerian government has approved the construction of four thermal power plants with a combined capacity: of 1,234MW to meet its generating goal of 6,500MW by 2006; Geregu, Alaoji, Papalanto, and Omotosho. Fourteen hydroelectric and natural gas plants are planned for completion by 2010. In July 2004, Nigeria signed an MOU to secure funding for supplying power to Benin, Burkina Faso, and Niger with electricity through a new transmission line based on the New Partnership for Africa's Development (NEPAD), (NEPAD, 2004).

Theoretical Review

This section considers three waves with respect to growth theory in the last 50 years. The first is the Harrod-Domar (1946) models is used to explain an economy's growth rate in terms of the level of saving and productivity of capital. It suggests that there is no natural reasons for an economy have balanced growth. The theory presupposed that growth rate depended on a country's saving rate, capital output ratio and capital depreciation. This implies that every economy must save a certain proportion of its national income, if only to replace worn-out or impaired Capital goods (building, equipment, and materials). However, in order to grow, new investments representing net additions to the capita! stock are necessary.

If follows that any net additions to the capital stock in the form of new investment either in human resources or other form of productive investment will bring about corresponding increases in the flow of national output, GNP.

The Harrod-Domar simple economic growth model is expressed as:

$$\frac{\Delta y}{\mathrm{Y}} = \frac{S}{K}$$

Where $\frac{\Delta y}{\mathrm{Y}}$ represents the rate of change or rate of growth of GNP, is the saving rate and K is the capital stock. The model simple means that for any economy to grow they must save and invest a certain proportion of their GNP. The more they can save and invest, the faster they can grow. But the actual rate at which they can grow for any level of saving and investment - how much additional output can be had from an additional unit of investment can be measured by the inverse of the capital-output ratio, k, because this inverse, $\frac{1}{\mathrm{k}}$ is simply the output capital or output-investment ratio. It follows that multiplying the rate of new investment, S = $\frac{1}{\mathrm{k}}$ by its productivity, $\frac{1}{\mathrm{k}}$ will give the rate by which national income or GNP will increase. This theory has often been criticized for three reasons. Firstly, it centres on the assumption of exogeinity for all key parameters. Secondly, it ignores technical change and lastly, it does not allow for diminishing returns when one factor expands relative to another, (Harrod- Domar, 1946).

The second began with the neoclassical (Solow) model. Solow's model describes a developed economy better than a developing one; it remains a basic reference point for the literature on growth and development. It implies that economies will conditionally converge to the same level of income, given that they have the same rates of savings, depreciation, labor force growth, and productivity growth. The key modification from the

Harrod-Domar growth model, considered above, is that the Solow model allows for substitution between capital and labor. In the process, it assumed that there are diminishing returns to the use of these inputs. He employed Cobb-Douglas production function and assumed that gross domestic product (Y) is a function of stock of capital, K (which may include human capital as well as physical capital), labor (L) and productivity of labor or knowledge (A), which grows over time (t) at an exogenous rate. This is mathematically expressed as:

$Y(t) = K(t)^{a}\hat{}(t)L(t))'-^{a}$

The model contained the thinking that growth reflected technology and key inputs (Labor and Capital). It allowed for diminishing returns, perfect competition but not externalities. In the neoclassical growth process, savings were needed to increase capital stock, capital accumulation had limits to ensure diminishing marginal returns and postulated that growth also depended on population growth rate and that growth rate was supposed to converged to a steady state in the long run (Solow, 1994). A common prediction of these models is that an economy will always converge towards a steady state rate of growth, which depends only on the rate of technological progress and the rate of labor force growth, (Solow-Swan, 1994).

The last one which is the endogenous growth model, also known as the neo-classical growth model or new growth theory or Solow-Swan growth model is a term used to sum up the contributions of various authors to a model of long- run economic growth within the framework of neoclassical economics. The neoclassical model was an extension to the Harrod-Domar (1946) model that included a new term, productivity growth. It was developed in the 1980s as a response to criticism of the neo-classical growth model. The endogenous growth theory holds that policy measures can have an impact on the long-run growth rate of an economy. For example, subsidies on research and development or education increase the growth rate in some endogenous growth models by increasing the incentive to innovate. Endogenous growth theory tries to overcome Solow's model by building macroeconomic models out of microeconomic foundations. Households are assumed to maximize utility subject to budget constraints while firms maximize profits. Crucial importance is usually given to the production of new technologies and human capital, (Romer, 1998).

The engine for growth can be as simple as a constant return to scale production function or more complicated set ups with spillover effects, increasing number of goods, increasing qualities, etc. Often, endogenous growth theory assumes constant marginal product of capital at the aggregate level, or at least that the limit of the marginal product of capital does not tend towards zero. This does not imply that larger firms will be more productive than small ones, because at the firm level the marginal product of capital is still diminishing (Lucas, 1998 and Romer, 2000).

Empirical Review

Economic debates surrounding the research can't explicitly link the relationship between energy consumption and economic growth to theories, though empirical evidences have stated results for about two decades. The seminal work of Kraft and Kraft (1978) presented the premier study on the casual relationship between economic growth and energy consumption; Also, research evidences have discovered a story correlation between electricity use and wealth creation (Gosh 2002; Shiu and Lam 2004; Morimoto and Hope 2004; Jumbe 2004; Wolde-Rufael 2004; Narayan and Smyth 2005; Yoo 2005. Altinay and Karagol (2004) discovered a rising energy used for most developing countries; Turkey also facing an ever-increasing electricity demand experienced 8.1% per annum in the average growth rates of total electricity consumption between 1980 and 2000; Nigeria also face similar trend experiencing about 23% increase in energy use between 2000 and 2008, (Adeyemi and Ayomide, 2013).

Several studies have attempted the relationship and direction of causality between energy consumption and economic growth, Ahmed, Hayat, Hamed and Inqman (2012) investigated the relationship between energy consumption and economic growth in Pakistan for the period of 1973-2006 and found a positive relationship with unidirectional causality from GDP to energy consumption. A similar study of Kouakou (2010) in Cote d'Ivoire covering 1971-2008 found a bi-directional causality between per capita electricity consumption and per capita GDP. A study by Ouadraogo (2012) for fifteen countries o ECOWAS from 1980-2008 using a panel co-integration technique found GDP and energy consumption as well as GDP and electricity to exhibit a long

run co-integrating relationship, likewise found an unidirectional causality running from GDP to energy consumption. Ciarreta and Zarrage (2007) using a standard Granger causality running from real GDP to electricity.

Studies, most especially in developing economies have found electricity consumption to be a significant determinant of GDP growth (Soytas and Sari 2003; Asafu-adjaye 2000; Ferguson et al 2000; Altinay and Karagol (2005). Contrarily to the foregoing assumptions, Mehrara and Masai (2002) using a panel analysis of 11 selected oil exporting countries found that electricity use does not have any significant effects on GDP.

In a study undertaken by Odell (1965) while investigating the role of electricity in a rapidly developing economy like Columbia, he observed that electricity was very important for industrialization which leads to economic growth and development. According to Odell (1965), what is critically important for development is the capacity to produce it. That is, supply to meet required demand and not supply surplus or excess demand.

A 1991 survey of small enterprises in Ghana cited power outages and other infrastructure problems among the top four problems of operations. With this response, strongest among "micro" and small firms, electricity outage was ranked by very small firms among their top four constraints to expansion (steel and Webster, 1991). Thus, the issue of electricity supply, its adequacy and reliability is very important for the overall performance of the business sector and the economy and deserves policy attention.

METHODOLOGY

Analytical Techniques

The analytical techniques used in regression analysis. The secondary data gotten from the Central Bank of Nigeria (CBN) statistical bulletin and National Bureau of Statistics was analyzed using the Error Correction Model (ECM) method. Inferential analysis such as Unit Root Test, Co-integration Test and Casuality Test were performed. The data collected was estimated using the E- views software 7.0. This analytical technique was chosen to enable us analyze the impact among the economic variables, that is, the dependent and independent variables.

Model Specification

Taking inference from the empirical findings and theories, which was derived from the theoretical exposition of the endogenous growth theories, and then making energy central to the equation, a model will be drawn up to determine economic growth in Nigeria context and the model was adopted from the work of Gbadebo and Chinedu (2009) and was modified for the purpose of achieving the objectives of this study.

According to Gbadebo and Chinedu, (2009), if energy is taken as an independent variable then the model can be stated as:

Y=f (K, L, E).....3.0

Where:

Y = Output = Real Gross Domestic Production

K = Gross Fixed Capital Fromation

L = Labour Force and E = Energy Consumption

Modifying model 3.0 by capturing Per Capital Income (PCI) for the purpose of achieving the objective of this study, thus, we have:

Y= f (K,L, I, E)……3.1

Where:

Y= Output = Real Gross Domestic Product

K = GFCF = Gross Fixed Capital Formation

L = LAF = Labour Force

I = *PCI* = *Per* Capital Income

E = Energy Consumption

However, in Nigeria context, 3 main energy types are considered and they include petroleum, electricity, and coal. Therefore, splitting E into 3 then the model could be restated as follows:

RGDP = f (GFCF, LAF, PCI, ETC, CLC, COC) 3.2

Where: RGDP is Output, that is, the Gross Domestic Product in Nigeria, GFCF is Gross Fixed Capital Formation in Nigeria, LAF is the Labour Force in Nigeria, PCI is the Per Capital Income in Nigeria, ETC is the Electricity Consumption in Nigeria, CLC is the Coal Consumption in Nigeria and COC is the Crude Oil Consumption in Nigeria

Rewriting the model above in a linear and econometric, we obtain:

$RGDPi = \alpha_0 + \alpha i GFCF_t + \alpha_2 LAF_t + \alpha_3 PCY_t + \alpha_4 COC_t + \alpha 5\ ETC_t + \alpha_6\ CLU_t + U_t$...3.3

Priori expectations:

$\alpha l > 0, \alpha 2 > 0, \alpha 3 > 0, \alpha 4 > 0, \alpha 5 > 0, \alpha 6 > 0,$

Where: αi_t to α_6 represents the slope coefficients, α_0 is the intercept, U_t is the error term at time t.

Adoption Error Correction Model (ECM) method, we obtain:

$\Delta RGDP_t = \alpha o + \alpha i \Delta GFCF_t^{+} \alpha_2 \Delta LAF_t + \alpha_3 \Delta PCY_t + \alpha_4 \Delta COC_t + \alpha_5 \Delta ETC_t + \alpha_6 \Delta CLU_t + E\ CM(U-1) + U_t$ 3.4

Where: U_t is a white noise error term at time t. While ECM(U-l) is the lagged value of the error term.

Sources of Data

The date used are secondary data. They are time series data on the included variable. The data are sourced from the Central Bank of Nigeria (CBN) Statistical bulletin (2015) online version and National Bureau of Statistics (2015).

Evaluation Criteria

The evaluation shall be based on three criteria; economic criteria, statistical criteria and econometric criteria. This evaluation consists of deciding whether the estimates of the parameters are theoretically meaningfully, and statistically satisfactory. The signs and magnitude of the parameters estimate will be examined to know whether they are in conformity with their priori expectation. Economic criteria will help to know when they are deviating from what is actually required.

The analysis of the time series data was performed using statistical techniques multiple regression modeling and model estimation based on contemporary econometric estimation method of Error Correction Model (ECM) of regression analysis using E-views version 7.0 to validate the hypothesis formulated for the research

work. We decided to use ECM method for estimation and analysis of data usually requires that the data be stationary to avoid the problem of spurious regression, Noula (2013). The regression of one time series variable on one or more time series variables often can give nonsensical or spurious results. Hence, to avoid the tendency of spurious results in our estimation and analysis, the Error Correction Model (ECM) method of estimation and analysis was used in this study. Secondly, this method was adopted basically for its purpose of reconciling the short-run behavior of an economic variable with its long-run behavior in a model.

Pre-testing procedures, that is, Stationery and Co-integration test was carried out. Also, causality test was conducted. The stationary test was carried out using Augmented Dickey-Fuller (ADF) Unit Root Test to examine the unit root property of the variable in the model. While the Co-integration Test was conducted using Johansen and Joselius Co-integration Test to ascertain the long-run relationship between the economic variables in the model. Casualty test was also carried out using Pairwise Granger Causality Test to show the causal relationship between the variables in the model.

DATA ANALYSIS & RESULT

Table 4.1: Analysis of Unit Root Test Result

Variable	Order of Integration	ADF Statistics	Mackinnon Critical Values
RGDF	1(2)	4.2848	5% = 3.6450
GFCF	1(1)	5.0198	1% = 4.4163
LAF	1(1)	5.1294	1% = 4.3943
PCI	1(1)	4.4089	= 4.3943
ELC	1(1)	4.226	5% = 3.6122
CLC	I(1)	6.7725	1% = 4.3943
COC	1(0)	4.9268	1% = 4.4407

Source: Student Computation using E-Views 7.0

Using the augmented Dickey-Fuller tests, the results as presented in table 4.1 has shown that only Crude Oil Domestic Consumption (COC) is stationary at level while some other series (variables) - Gross Fixed Capital Formation (GFCF), Labour Force (LAF), Per Capital Income (PIC), Electricity Consumption (ELC) and Coal Consumption (CLC) are stationary at first level difference, Only Real Gross Domestic Product (RGDP) is stationary at second level difference. This result indicates that the variable COC is integrated of order zero - 1(0), while variables GFCF, LAF, PCI, ELC and CLC are integrated of order one - 1(1). Meanwhile, variables RGDP is integrate of order two -1(2).

Regression Analysis

Table 4.2: Error Correcting Model Estimate Result

`	Coefficient	Std. Error	t-Statistics	Prob.
C	-580.5714	1995.449	-0.290948	0.7746
GFCF	73.16777	18.97946	3.855104	0.0013
LAF	0.380349	0.067240	5.656564	0.0000
PCI	0.034364	0.005256	6.537801	0.0000
ELC	6.053184	1.529680	3.957156	0.0010
CLC	0.019989	0.011837	1.688733	0.1095
COC	-0.004175	0.016808	-0.248398	0.8068
ECM(-1)	0.300504	0.228225	1.316700	0.2054

R-squared	0.996991	Mean dependent var	34778.57
Adjusted R-squared	0.995752	S.D dependent var	15983.05
S.E of regression	1041.661	Akaike info criterion	16.98936

Sum squared reside	18445980	Schwarz criterion	17.37940
Log likelihood	-204.3670	Hannan-Quinn criter	17.09754
F-statistic	804.7689	Durbin-Watson stat	1.824435
Prob(F-statistics	0.000000		_____

Sources: Student Computation using E-Views 7.0

From the regression analysis reported in table 4.2, the parameter shows that variability in Real Gross Domestic Product (RGDP) is as a result of all the independent variables put together (Gross Fixed Capital Formation, Labour Force, Per Capita Income, Electricity Consumption, Coal consumption and Crude Oil consumption). This means that a unit increase in the Gross Fixed Capital Formation will increase Real Gross Domestic Products by 73.17 magnitude ceteri paribus, a unit increase in Labour Force will increase Real Gross Domestic Product by 0.38 magnitude ceteri paribus, a unit increase in per capital Income will increase Real Gross Domestic Products by 0.03 magnitude ceteri paribus, a unit increase in Electricity Consumption will increase Real Gross Domestic Products by 0.03 magnitude ceteri paribus, a unit increase in Electricity Consumption will increase Real Gross Domestic Products by 6.05 magnitude ceteri paribus and a unit increase in Coal consumption will increase Real Gross Domestic Products by 0.02 Magnitude ceteri paribus. Meanwhile, a unit increase in Crude Oil Consumption will decrease Real Gross Domestic Products by 0.004 magnitudes ceteri paribus. The empirical results revealed that among the three energy consumption variables in the study, Electricity consumption and Coal consumption have significant and positive relationship with economic growth in Nigeria. However, Crude Oil Consumption although negative, does not significantly affect economic growth in Nigeria within the study period.

CONCLUSION & POLICY RECOMMENDATIONS

Conclusion

From the study carried out, it would be a fallacy to conclude that there is no relationship between energy consumption and economic growth in Nigeria for the period of 1990 - 2015. The impact of energy consumption on the Nigeria economic growth is positive and enormous; hence the place of energy as a contributor to economic growth in Nigeria cannot be overemphasized. It is therefore paramount that such a sector is not neglected in the country. The government should ensure that energy supply is beefed up in diversity so that more economic activity can thrive.

Energy is the vital backbone of an economy. Research and development backed up by energy efficiency will be beneficial to the nation. Also, increased investment by the government in energy sector will be needed to foster increased energy production. The private, public, or a partnership project could be carried out to see to the increase in provision of energy.

Policy Recommendations

Based on the findings derived from the study, it is paramount that the following recommendations be made. They include:

I. Increase Energy Supply around the Country

Since it has been found that energy consumption is related to economic growth, increasing energy production and supply in an energy hungry nation like Nigeria will have a positive influence on economic growth. Increasing energy supply should also involve optimal production and utilization at all levels by the government and private investors in all forms of energy available in the country.

II. Sustain and Enhance Energy Infrastructure

This does not only involve good maintenance practices of existing energy infrastructure it also deals with ensuring that there is increase in such infrastructure through the issuance of licenses to the private sector for

operation of such facilities and by reducing regulatory barriers even to long term capacity contracting. Also, natural gas infrastructures are required in the country to reduce natural gas flare. Availability of such facilities will increase the gas production and consumption and possibly economic growth.

III. Total Deregulation of the Energy Sector of the Economy

The government in the spirit of economic liberalization should fully deregulate the energy sector of the economy to allow for private sector participation in the generation, transmission, and distribution of all forms of energy products such as coal and lignite, natural gas, crude oil products and electricity. This will enhance economic growth in Nigeria. In addition, policy reforms should focus on encouraging a level-playing field for al| energy forms in the country so as to develop the energy sector to a full scale that will meet the demand of the nation. This in turn will enhance a greater performance of the economy

REFERENCES

1. Adegbemi B. O., Adegbemi 0. 0., Olalekam A. J. and Babatunde 0. 0., (2013).Energy Consumption and Nigeria Economic Growth: An Empirical
2. Analysis. European Scientific Joumal,.February 2013 edition Vol. 9, No. 4 ISSN.T857 - 7881.
3. Adegbulugbe A. and Akinbami J. (2002). Policy Options for the Attainment of Sustainable Electricity Supply in Nigeria. Central Bank of Nigeria.
4. Adenikinju A. (2005). Analysis of the Coswt of Infrastructure Failure in a Development Economy: The case of the Electricity Sector in Nigeria. African Economic Research Consortium (AERC) Research Paper, 143, 112- 154.
5. Adetunji M. B. and Isa M. S. (2008). The Demand for Residential Electricity in Nigeria: A Bound Testing Approach
6. Adeyemi A. O. and Ayomide A. (2013). Electricity Consumption and Economic Growth in Nigeria. Journal of Business Management and Applied Economics, Vol. II, issue 4.
7. Afangideh U. J and Obiora I. K. (2004). Trade Policy and Manufacturing Exports in Nigeria: Performance, Challenges and Prospects. Paper presented during the 2004 annual conference of NES, August 24.
8. African Review of Business and Technology, (2014), Energy Sector to Power sub-Saharan Affican.www.afiricanreview.com
9. Aigbokan B. E. (1999). Evaluating investment on basic infrastructure in Nigeria. Proceedings of the eight annual conference of the zonal research units. Organized by Research Department, Central Bank of Nigeria, June 30.
10. Alam M. S. (2006). Economic Growth with Enerty. Retrieved on the '20th November.
11. Alayande B. and Ekone F. (2001). The macro economic effects of government expenditure, money, exchange consumption in Nigeria. Proceedings of Nigerian Economic Society (NES) Annual Conference, 5,231 -244.
12. Ali-Akpajiak S. E and Pyke M. T. (2003). Poverty in Nigeria. Abuja: Oxfam Publications.
13. Aminu M. M and Aminu M. F. (2015). Energy Consumption and Economic Growth in Nigeria: A Causality Analysis. Journal of Economics and Sustainable Development. Vol. 6 No. 13.
14. Aqeel A and Butt M. S. (2001). The Relationship between Energy Consumption and Economic Growth In Pakistan, Asia-Pac, Dev. J. 8(2): 101-109.
15. Archibong P. E. (1997). The staqaus of supporting infrastructural facilities and service for non-oil sector development. Central Bank of Nigeria Economic and Financial Reviews, 35(4), 92- 115.
16. Asafu-Adjaye J. (2000). “The relationship between energy consumption. Energy prices and economic growth: time series evidence from Asian developing countries: Energy Econ. 22. 615-625.
17. Asian Development Bank (ADb). (2006). Report of the energy efficiency initiative.httpi//developmentasia.org/Documents/Reports/Energy-Efficiency- Initiative/exesum.pdf. Accessed 26 April, 2012.
18. Atser G. (2008). World Bank’s report on investors infrastructure decay. Sunday Punch, May 10, 8.
19. Ayodele A. S. (1999). Illegitimate energy market activities in the Nigerian energy industry: “The case of electricity and petroleum products”. DPC working paper, 2 63-81.

20. Ayodele A. S. (2001). Improving and sustainaing power (electricity) supply for socio-economic development in Nigeria. Retrieved May 12, 2009 from www.cenbank.org/out/annual/ACZRU/2001.
21. Ajkinolif E. A. (2009). Electric Consumption and Economic growth in Nigeria: Evidence from Cointegration and Co-feature Analysis Journal of Policy Modeling 31(5), 6.81-693.
22. Ahmad N. Hayat M. F., Hamad N. and lugman M. (2012). Energy Consumption and Economic Growth: Evidence from Pakistan. Australian Journal of Business and Management Research. Vol. 2 No. 06 (09-14).
23. Ahrens F. (2012). "Economy Watch", The Washington Post Online, 1980 http://www.washingtonpost.com/wp-siv/business/economy- watch/fireside-chats/(l 6 Feb 12).
24. Almay G. and Karagol E. (2005). Electricity Consumption and Economic Growth: Evidence for Turkey. Energy Economies 27(6), 859-856.
25. Asafu-Adjaye J. (2000). The Relationship Between Energy Consumption, Energy Prices and Economic Growth: Time Series Evidence from Asian Development Countries. Energy Economies 22(6) 615-625.
26. Birol F. (2007). World Energy Prospects and Challenges, Melbourne: Blackwell Publishing.
27. Bright O. and Machame H. (2011). Energy Consumption and Economic Growth in Nigeria. JORIND (9) 1, 2011. www.ajol.info/iournals/jorind.
28. Central Bank of Nigeria, (2000). The changing Structure of the Nigerian Economy and Implications for development. Lagos: Realms Communication Ltd.
29. Central Bank of Nigeria Statistical Bulleting (2015). Online version.
30. Ciarreta A and Zarraga A. (2007). Electricity Consumption and Growth: Evidence from Spain. Department of Economic Analysis II, University of the Basque Country, Lehendakari Agirre 83, Bibao 48015, Spain.
31. Dare-Ajayi D (2007). "Recent Trends and Patterns in Nigeria's Industrial Development", Afr. Dev. 32-139-155.
32. Decanio S. (1993). Barriers within firms to energy-efficient investments. Energy Policy. 21, 906-914.
33. Ekpo A. (2008). World Bank's Report on Investors Infrastructure decay in Nigeria. Sunday Punch May 10, 8.
34. Ekpo, U. N. (2014) "Nigeria Industrial Policies and Industrial Sector Performance: Analytical Exploration", IOSR Journal of Economics and Finance (IOSR- JEF) e-ISSN:2321-5933, p-ISSN:2321-5925.3(4):01- 1 lwww.iosrjoumals.org www.iosrjoumals.org
35. Energy Information Administration (2007). Country Analysis briefs: Nigeria. Retrieved on 12th November form www.eia.doe.gov.
36. Electric Power Sector reform implementation Committee (EPIC) (2004). National Electric Power Policy. Retrieved on 21st July, 2007.
37. European Environmental Agency. (2005). Climate Change and European low- carbon energy system, EEA Report No. 1/2005, ISBN: 92-9167-765-5.
38. Faris H. and Namat A. A. (2015). Sustainable Energy: The Missing MDG. OFID Quarterly, January, 2015.
39. Gbadamosi et al, R. A. Story of the Deregulation of the Nigerian Downstream Oil Sector, (Abuja; Petroleum Product Pricing Regulatory Agency, 2007) p, 143.
40. Gbadebo O. O. & Chinedu O. (2009). Does Energy Consumption Contribute to Economic Performance? Empirical Evidence from Nigeria. Journal of Economic and International Finance, Vol. 1(2), pp. 044-058.
41. Gosh S. (2002). Electricity Consumption and Economic Growth in Idia. Energy Policy 30(2), 125-129.
42. Golove W. H. and Eto J. H. (1996). Market Barriers to Energy Efficiency: A Critical Reappraisal of the rational for public policies to promote energy efficiency. Energy and Environment division, Lawrence Berkeley National Laboratory, University of California. Berkeley. Report No. LBL-38059, UC-1322, http://eetd.ibi.gov/ea/EMP/reports/ 38O59.pdf. Accessed 1 May *2012*.
43. Gujarati D. B. & Sangeetha A. (2007) Basic Econometrics (4th ed). New Delhi: Tata McGraw-Hill
44. Hirschman A. 0. (1953). The Strategy of Economic Development. 1st Edition, New Haven.
45. Iledare, O. (2006). Natural gas based development in Nigeria. Abstract for the energy and development Panel, 31st IAEE International Conference, 45- 77.
46. International Energy Agency (IEA), (2006). World Energy Outlook, ISBN: 92- 64-10989-7. Paris, France.

47. International Energy Agency (IEA), (2012). Energy efficiency: Policies and Measured database. http://www.iea.org/textbase/pm/?mode=pm. Accessed 19 April 2012.
48. Iwayemi A. (1991). Infrastructure deficiencies and the Nigerian business environment: Basic issues and policy options, Proceedings of a one-day seminar organized by the Nigerian Economic Society, Ibadan, March 15.
49. Iwayemi A. (1998). Energy Sector Development in Africa: A background paper prepared for the African Development report, Sponsored by African Development Bank, July 30.
50. Iwayemi A. (2008). Investment in Electricity Generation and Transmission in Nigeria: Issues and Options. International Association for Energy Economics, Pp 137-421.
51. Jochem E. (2004). World Energy Assessment: Energy and the Challenges of Sustainability. Energy end-use efficiency pp. 174-217.
52. Johanseh S. and Juselius K. (1990). Maximum Likelihood Estimation and Inference on Co-integration with Applications to the Demand for Money. Oxford Bulletin of Economics and Statistics 52, 162-210.
53. Jollands N. Waide P., Ellis M., Onoda T., Lausten J., Tanak, K., et al (2010). The 25 IEA energy efficiency policy recommendations to the G8 Gleneagles plan of action. Energy policy, 38(11), 6409-6418.
54. Kessides C. (1993). The contributions of infrastructure to economic development: A review of experience and policy implications. World Bank Discussion papers, 213, 64 - 89.
55. Klessmann C., Graus W., Harmelink M., and Geurts, F. (2007). Making Energy-Efficiency Happen: From Potential to Reality: The road not taken? Foreign Affairs 55(1), 65-96.
56. Krizanic F. (2007). The European Market of Electricity and Natural Gas. EIB Forum, Ljubljana.
57. Kouakou K and Auguste, (2010). Economic Growth and Electricity Consumption in Cote d'Ivoire. Evidence from time series analysis. Energy, Policy. Science Director.
58. Kraft J and Kraft A. (1978). On the Relationship Between Energy and GDP. Journal of Energy and Development 3, 401-403.
59. Morimoto R. and Hope C. (2001). The Impact of Electricity Supply on Economic Growth in Sri Lanka. Judge Institute of Management Research Paper. National Bureau of Statistics. (2015).
60. Navroz K.D. (2004) Electric Power Reform: Social and Enviromnental Issues. Encyclopedia of Energy Vol 2.
61. Ndebbio J.E.U (2006). The structural economic dimensions of underdevelopment. Associated vicissitude and imperatives: Agenda for positive change. 33rd inaugural lecture. Calabar: Saesprint.
62. Nigerian National Committee of the World Energy Council (NNC-WAC) (2007). Communique on Africa forum on energy efficiency. 8 - 9th January.
63. Odell P.R. (1965). The demand for energy in a developing region. A case study of the upper anca valley in Columbia. Journal of Development Studies, 4, 115-138.
64. Oke O.A. (2006). Impact of energy on the manufacturing sector in Nigeria. Retrieved December 24, 2009 from http://www.fypower.org/ pdf/mfg NAM NASE.pdf.
65. Okonkwo W.L (2000). Attainment of sustainable electricity supply in nigeria: Photovoltaic option. Central Bank of Nigeria Bullion, 5, 13 - 20.
66. Okpanefe P.E and Owolabi, S. (2001). Small Hydropower in Nigeria. 2001 TCDC Training Workshop on SHP.
67. OPEC Fund for International Development (OFID) Quarterly Publication, January 2015. *I? t*1*
68. Oviemuno A.O (2006). Impact of energy on the manufacturing sector of Nigeria. Retrieved on 01 November 2007 from www.searchwap.com.
69. Oyaromade R., Adagunodo M. and Bamidele P. (2014). Energy Consumption and Economic Growth in Nigeria: A Causality Analysis. International Journals of Sustainable Energy and Environmental Research, 2014 3(1): 53-61.
70. Quedraogo l.M. (2010). Electricity Consumption and Economic Growth in Burkina Faso: Aco-integration Analysis. Energy Economices 32 (3), 524-531.
71. Richard D.P). (2004). Early Industrial World Energy Flow in Encyclopedia of Energy Vol. 1.
72. Romer P.M (1986). Increasing returns and long run growth, the journal of political Economy, 98 (5), 1002-1037.
73. Romer P.M (1994). Endogenous technological change. The Journal of Political Economy, 98 (5), S71 - S102.

74. Sambd A.S. (2008). Electricity demand from customers of INGA hydropower projects: the case of Nigeria. Paper presented at the WEC workshop on financing INGA hydropower projects, Lagos, June 12.
75. Sanchis M.T. (2007). Quantifying the contribution of electricity to Spanish economic growth during the twentieth Century. Paper presented at the iii Iberometrics Valencia, March 23 - 24.
76. Shen L. (2006). Advancing more banks entering into the field of energy conservation by using new energy conservation mechanism. http://3countryee.org/paris/AgenderParisEEconf.pdf. Accessed 26 April 2012.
77. Simpson E.S (1969). Electricity production in Nigeria. Economic Geography. 45 (3): 239-257.
78. Solar Energy Research Institute (SERI) (1981). A new prosperity: Building a sustainable energy future. And over, MA: Brick House Publishing.
79. Steel W.F and Webster L.M (1991). Small enterprises under adjustment in Ghana. World Bank Technical Paper, 138, 62 - 83.
80. Stem N. (1991). The determinants of growth. Economic Journal, 101, 213 - 231.
81. Subair K. and Oke D. (2008). Privatization and trends of aggregate consumption of electricity in Nigeria: An empirical analysis. African Journal of Accounting, Economics, Finance and Banking Research, 3 (3), 18-26.
82. Ubi P. S. and Effiom L. (2013). The Dynamic Analysis of Electricity Supply and Economic Development: Lesson form Nigeria. Journal of Sustainable Society, Vol. 2, No. 1 7 < ~
83. Uchendu O. A. (1993). Economic cost of electricity outages: Evidence from sample study of industrial and commercial Finns in the Lagos area of Nigeria. Central Bank of Nigeria Economic and Financial Review, 31(3), 21-87.
84. Udahand Enag B. (2010). Industrial Development, Electricity Crisis and Economic Perfonnance in Nigeria. European Journal of Economics, Finance and Administrative Sciences. 105-121. Retrived from: http://www.euroj'ouranls, com.
85. Ukpong I. I. (1973). The Economic Consequences of electric power failures. Nigerian Journal of Economic and Social Studies, 15(1), 53-74.
86. Ukpong I. I. (1976). An Analysis of causes of power shortage in Nigeria. Nigerian Journal of Economic and Social Studies, 18, 39 - 49.
87. United Nations, (1996). 1994 energy statistics yearbook, New York: United Nations.
88. United Nations - Energy Group, (2005). The Energy Challenge for Achieving the Millennium Development Goals (MDGs). Washington D.C.
89. United Nations - Human Development Index, (2011). Accessing Modem Energy Services - Fundamental to Human Development
90. UNDP, (2010). EU-UN joint workshop on climate change and development. http .7/ web. undp. org/eu/documents/ec-un m exico-p4.pdf. Accessed 16 May, 2012.
91. United Nations Foundation, (UNF), (2007). Realizing the potential of energy efficiency - targets, policies, and measures for G8 countries. Expert report of the United Nations Foundation, Washington, D. C.
92. LJNEP, (2002). Capacity building for Sustainable development; An overview of UNEP environmental capacity development initiatives. ISBN: 92-807- 2266-2.
93. Wesselink B. Harmasen R. and Eichhammer W. (2010). Energy Savings 2020: How to triple the impact of energy saving policies in Europe. http://roadmap2050.eu/attachments/files/lEnergySavings2020- Full Report.pdf.Accessed 16 May 2012.
94. Worlde-Rufael Y. (2009). Energy Consumption and Economic Growth: The Experience of African Countries revisited. Energy policy 34(10), 1106- 1114.
95. World Bank, (1993). World Development Report. Washington D. C: World Bank.
96. Yang H. Y. (2000). A note on the causal relationship between energy and GDP in Taiwan. Energy Economies 22(3), 309-317.
97. Yoo S. (2005). Electricity Consumption and Economic Growth: Evidence from Korea, Energy Policy 33(12), 1627-1632.
98. Yu E. and Choi J. (1985). The causal relationship between energy and GNP, an international comparison. J. Energy Development