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ENERGY CONTRIBUTIVE INDICATORS AND ECONOMIC GROWTH OF NIGERIA, 1981-2024

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Abstract: This study focused on energy contributive indicators on economic growth in Nigeria from 1981-2024. The specific objectives include to: ascertain the relationship between renewable energy and gross domestic product (GDP) of Nigeria and determine the relationship between fossil fuel and gross domestic product (GDP) of Nigeria. Ex-post facto design was employed. The study used time series data of 43 years (1981-2024) obtained from Central Bank of Nigeria (CBN) Statistical Bulletin. Preliminary tests were conducted using normality test (descriptive statistics and unit root test). Correlation test method was used to estimate the variables at 0.05% level of significance. This study revealed that renewable energy had non significant positive relationship with gross domestic product (GDP) in Nigeria (correlation vale = 0.146853., t-value = 9.62149, pv = 0.3415>0.05 level of significance) and fossil fuel had non significant positive relationship with gross domestic product (GDP) in Nigeria (correlation vale = 0.098169., t-value = 0.638102, pv = 0.5264>0.05 level of significance). In the light of findings, the study recommended that government should set a renewable energy target goals by develop policies that will enable its adoption. Similarly, government shall offer financial incentives by providing tax credits, grants, and subsidies to encourage investment in renewable energy technologies like solar and wind etc and government should enhance oil refining and petrochemical process by investing in technologies that will optimize fossil fuel production, reduce emissions and minimize waste.

Keywords: Renewable Energy, Fossil Fuel, Energy Contributive Indicators, Gross Domestic Products.

INTRODUCTION

Energy is a key source of economic growth because many production and consumption activities involve energy as a basic input. Energy is one of the most important inputs for economic development. From a physical viewpoint, the use of energy drives economic productivity and industrial growth and is central to the operation of any modern economy. Barney and Franzi (2022) argue that energy is responsible for at least half the industrial growth in a modern economy while representing less than one tenth of the cost of production.

Energy is the lifeblood of the global economy a crucial input to nearly all of the goods and services of the modern world. Stable, reasonably priced energy supplies are central to maintaining and improving the living standards of billions of people (Luo, Lu, Wang, and Yang, 2019). The relevance of energy on growth has made it highly researchable in different regions of the world. The energy

sector is seen as a robust natural monopoly as a result of its essential nature for economic development. With the industrial revolution, economic growth around the world has been accompanied by massive consumption of energy, at least from the viewpoint of the theory of resource endowment (Luo, Lu, Wang, and Yang, 2019).

Presently, countries around the world are on the path to fully ensure the operations of renewable energy to reduce electricity price fluctuations, environmental pollution, and degradation, amongst others. Unexpected high growth in the renewables market, in terms of investment, new capacity, and high growth rates in developing countries, have changed the landscape for the energy sector (Schiffer, 2016). This brought about improvements seen in falling prices and the increased decoupling of economic growth and GHG emissions. Developing countries usually use fossil fuels as a source of energy leading to a two-fold energy challenge i.e., providing essential energy services and ensuring energy sustainability (Ahmed and Shimada, 2019).

In Africa, the demand for energy contribution had been on the rise. This had been due to the fact that Africa's energy sector remains a significant component of the continent's economic growth and development agenda (Esso & Loesse, 2017). Africa is naturally endowed in energy resources which include the sun, wind, hydro, coal, natural gas, electricity, petroleum amongst others. In Northern and Western Africa, there had been a great dependence on fossil fuel in the generation of electricity as a result of the concentration of oil and gas in these regions (Akinlo, 2018). In contrast, countries in Central and the Eastern part of Africa largely depend on hydropower in generating electricity. In the Southern part of Africa, energy consumption from the power sector is generated using coal and to some extent the use of hydro power (Energy Sector in Africa, 2011).

Today, Nigeria is seen as one of the greatest developing nations in Africa with highly endowed natural resources including potential energy resources (Chinedu, Daniel & Ezekwe, 2019). Importantly, after the financial sector, energy sector is probably the largest global industry with the broadest impact on other sectors of the economy since all economic activity depends on energy either in urban or rural areas (Yahaya, Salisu, & Umar, 2015).

Renewable energy gains significant attention during the last decade. Indeed, renewables have been the fastest growing energy source in the world since the late 2000s (Apergis and Payne, 2022). The main reason for the rise of renewable energy is related to the climate change, one of the leading problems in today's world. Scientists are on the consensus that production of fossil fuel has a significant effect on greenhouse emissions, and this has been the fundamental source of the global warming. In other words, fossil fuel can drive the climate change. Climate change becomes to threaten the sustainable growth (Kaygusuz, 2017).

In the work of Afia (2019), it has been stressed that since energy consumption is a means of satisfying all our essential needs by improving our living conditions, it can be considered as a vital source of happiness for humans. Based on this backdrop, the study seeks to examine relationship between energy contributive indicators and economic growth of Nigeria, 1981-2024.

Statement of the Problem

The global recession and financial crisis that began in 2008 bring a new focus to decisions about energy. Many parts of the developed world still face sluggish economic growth and risks from financial crises. Some deeply rooted problems are yet to be addressed. Financial institutions lowered their forecasts for world economic growth, impacting an energy sector tied to capital markets. Therefore, oil prices remain volatile, and the global economy is still looking gloomy." Reduced economic activity has led to stubbornly high levels of unemployment in many countries. And as private and consumer earnings have declined, those nations are facing shrinking tax bases, compounding issues with sovereign debt. As a growing economy, Nigeria needs stable and efficient energy supply system to move the economy forward.

Regrettably, Nigerian economy is endowed with abundant energy resources, it suffers from persistent energy crisis which had deterred the average GDP growth of the country (Olusanya, 2012). Evidently, the performance of the Nigerian economy in terms of growth has been dismal as statistic revealed that the growth of Nigeria economy as at 1990 was 8.2% and decrease to 5.4%, 4.6%, and 3.5% in 2000, 2001, and 2002, 2022 3.52%, 2023 2.54% and 2024 3.46% correspondingly (World Bank, 2015). Nevertheless, the Nigerian economy has witnessed significant increase in the level of energy consumption in recent years. Despite the economic turmoil, energy demand has been resilient throughout the recession, driven primarily by rapidly growing consumption in the developing world. Many studies have come out with conflicting results whereas some observe positive relationship others are mixed or negative. This study seeks to examine relationship between energy contributive indicators and economic growth of Nigeria, 1981-2024

Objectives of the Study

The main objective of the study was to examine the relationship between energy contributive indicators and economic growth of Nigeria, 1981-2024. Specific objectives were to;

i. Ascertain the relationship between renewable energy and gross domestic product (GDP) of Nigeria.

ii. Determine the relationship between fossil fuel and gross domestic product (GDP) of Nigeria.

Meanwhile, the study focused on the relationship between energy contributive indicators of Nigeria. This study covered the period 1981 to 2024; that is the period of 43 years. 1981 base year was chosen in order to examine contributions of energy contributive indicators to economic growth in Nigeria after the period of Structural Adjustment Programme (1986). This choice of 2024 was due to availability of data.

REVIEW OF RELATED LITERATURE

Energy

Energy is capacity of matter to perform work as the result of its motion or its position in relation to forces acting on it (Encarta, 2019). The same concept according to Tejada-Bailly (2022) can be expressed as the amount of heat that must be transferred, exchanged or used up to effect a process or deliver a good to a particular point in the economic system.

Renewable Energy

United Nations Environment Program (UNEP) (2015), renewable energy defined as any energy generated from natural processes including hydropower, geothermal, solar, tides, wind, biomass, and biofuels, made up 53.6% of the total gigawatt capacity of all energy technologies installed in 2015.

Fossil Fuel

Fossil fuels are the primary source of energy in most developed and developing countries (Sugiawan & Managi, 2019). These systems, despite their many advantages, such as the ability to provide thermal power plants with more precise operational control and monitoring (Savvidis, 2019), are plagued by a variety of issues that have been extensively researched and examined (Pillot, Muselli, Poggi, & Dias, 2019).

Economic Growth

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.

Energy Contributive Indicators and Economic Growth

The relationship between energy and economic growth has been examined at different levels. Most such studies have investigated the relationship between energy contributive indicators and economic growth (Wang, *et al.,* 2016). Energy supply contributes to economic growth in several ways. First, it creates jobs in extracting, transforming and distributing energy. Second, energy is an input for nearly all goods and services. It shows that these countries are heavily dependent on imported energy, so that any change in energy prices has a dramatic effect on economic performance (Hunt, *et al,* 2021).

Theoretical Framework

This study was anchored on Energy Rebound Theory.

Energy Rebound Theory

Energy rebound theory was developed by Jim Di Peso in (2011), this theory form an argument infrequently used by critics of energy efficiency policies. They assert that the more efficiently you use energy, the more energy you will use. Since efficiency drives down the costs of energy, the argument goes, people demand more energy, which negates some or all of the efficiency gains. The most extreme variation of the rebound argument is "backfire:" efficiency causes energy consumption to rise above the pre-efficiency level. Accordingly, if backfire is true, inefficiency results in less energy consumption. For instance, if one acquired a hybrid-electric car with better mileage, rebound theorists say that one will drive more as a result, offsetting efficiency gains through increased gasoline consumption. This study adopted this theory because energy ladder hypothesis is loosely based on economic theory of consumer behavior. 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.

Empirical Review

Amri (2017) examined the relationship between economic growth and energy consumption under two categories- renewable and non-renewable energy consumption. The results posited bidirectional causality between non-renewable energy consumption and economic growth both in the short run and long run. Furthermore, the results revealed a unidirectional causality flowing from renewable energy consumption to economic growth in the longrun.

Maji, Chindo and Rahim (2019) studied was on renewable energy consumption and economic growth nexus. They estimated the impact of renewable energy on economic growth in West African countries using panel dynamic ordinary least squares (DOLS) by employing a sample of 15 West African countries covering the 1995 to 2014 period. Their results indicated that renewable energy consumption slows down economic growth in these countries.

Anochiwa, Lasbrey, Enyoghasim, Michael Oguwuike *et. al.* (2020) studied energy consumption and economic growth nexus in Nigeria. In the investigation process energy consumption, was disaggregated into electricity, coal and petroleum with growth rate of GDP data is used from 1980 to 2017. The findings show that petroleum and electricity variables are positive and significant to growth while coal is positive but not significant. Overall outcome is that energy consumption has a positive relationship with economic growth.

Khan, Khan, and Rehan, (2020) investigated the relationship between energy consumption, economic growth and carbon dioxide emissions in Pakistan using annual time series data from 1965 to 2015. Based on the estimated results they recommended that policy maker in Pakistan should adopt and promote such renewable energy sources that will help to meet the increased demand for energy by replacing old traditional energy sources such as coal, gas, and oil.

Ekone and Amaghionyeodiwe (2020) studied renewable energy consumption and economic growth in Nigeria: any causal relationship in Nigeria. This study examined the effect of renewable energy consumption on economic growth in Nigeria for the period 1990 to 2016. The result showed that although renewable energy consumption and economic growth increased between 1990 and 2016 in Nigeria, renewable energy consumption had no significant positive impact on economic growth in Nigeria.

Owede and Ezaal (2022) studied fossil fuel consumption, economic growth, and environmental degradation: is the 'energy consumption growth' nexus sustainable in Nigeria. Based on the unit root test result and cointegration tests, the Autoregressive Distributive Lag (ARDL) short and long run forms were estimated for both the economic growth and environmental degradation models. It was found that fossil fuel consumption exerted mixed (positive and negative) effect on economic growth in the short run but negative effect in the long run.

Umeji, et al (2023) conducted study on renewable Energy Consumption and Economic Growth in Nigeria. It used Toda-Yamamoto augmented granger causality test to test for the nature of the relationship between the two variables and Auto Regressive Distributed Lag (ARDL) bounds test to examine the impact of renewable energy consumption on economic growth. The study found a bi-

directional relationship between the variables. The regression results also showed a significant positive impact of renewable energy consumption on economic growth.

Habiba, et al (2024) conducted a study on renewable energy consumption and economic growth in nigeria nexus in Nigeria. The results of the unit root show mixed stationarity from our variables which result in the usage of ARDL technique of analysis. The long run results show that renewable energy was negative and significant thus, validates the conservative hypothesis. C02 was also negatively significant to RGDP while labor force was positively significant.

Gaps in Empirical Review

Some studies done were carried outside energy contributive indicators and economic growth of Nigeria, 1981 to 2024 and did not focus to researcher best of knowledge. Most of the studies reviewed analyzed their data through simple and multiple regression analysis, partial least squares (PLS), regression analysis and bootstrapping test and Descriptive survey while the present study made use of correlation or casualty analysis to test formulated hypotheses. Therefore, the study aimed at filling the research gap by looking at relationship between energy contributive indicators and economic growth proxied by gross domestic product (GDP) of Nigeria.

METHODOLOGY

Ex-post facto research design was employed in obtaining, analyzing and interpreting the relevant data for hypotheses testing since the study utilized secondary data. The data sets employed in this study were generated from Nigeria Central Bank Bulletin, World Bank Development indicators and Ministry of Petroleum Resources Data Base in Nigeria. The study used time series data (1981-2024) within the periods under review (Unanka, 2019; Anochiwa, *et al,* 2020; Ogunjobi 2021). The study used a simple model relating all the variables under investigation. In order to investigate the relationship between energy contributive indicators and economic growth of Nigeria, a simple theoretical framework of the Cobb Douglas production function with constant returns to scale was adopted similar to Ahmed *et al.* (2012). The simple model is as stated as follows; the relationship between energy contributive indicators and economic growth of Nigeria can be modeled using an correlation approach.

The correlation model can be expressed as:

$\Delta Yt = \beta 0 + \beta 1\Delta Y_{t-1} + \beta 2\Delta Y_{t-2} + \beta 3\Delta E_{t-3} + \varepsilon t$ ---------- (A)

Where:

$\mathbf{r_{xy}}$ – the correlation coefficient of the linear relationship between the variables x and y

$\mathbf{x_i}$ – the values of the x-variable in a sample

$\bar{\mathbf{x}}$ – the mean of the values of the x-variable

$\mathbf{y_i}$ – the values of the y-variable in a sample

$\bar{\mathbf{y}}$ – the mean of the values of the y-variable

The expression was stated alongside with related variables see model below:

$GDP_t = \beta_o + \beta_1 REC_{t-1} + \beta_2 FSS_{t-2} + \varepsilon t$ ---------- (B)

Where:

GDP = Gross Domestic Product

REC = Renewable Energy Consumption
FSS = Fossil Fuel
e = The error term εt
t = Constant equation

The study used correlation analysis method. The analytical procedures involved are; first, unit root test were carried out for each of the variables so as to ascertain the time series properties of the data set and obtain the stationary status. Unit root test or stationary test is a preliminary test done to prevent running a spurious regression. This test was used in this study to measure the normality distribution of the variables using Jacque –Bera normality of skweiness and kurtosis tending towards 3. The F-test was used to test the existence of long-run relationship. When long-run relationship exists, F- test indicates which variables should be normalized. The F-test has a no-standard distribution which depends on (i) whether variables included in the model are I(0) or I(1)

Data Presentation and Analyses

From the table 1 below, it contains data involving energy contributive indicators and economic growth of Nigerian such as renewable consumption and fossil fuel, as well economic growth proxied by gross domestic product from 1981 – 2024.

Years	GDP	REC	FSS
1981	139.31	86.25	19.88929
1982	149.05	84.05	20.36798
1983	158.75	87.15	17.33392
1984	165.85	86.21	17.58054
1985	187.83	86.51	18.87677
1986	198.12	81.64	20.05241
1987	244.68	82.95	22.08605
1988	315.62	82.32	21.59308
1989	414.86	82.02	8.594887
1990	494.64	82.51	17.83639
1991	590.06	87.78	20.44464
1992	906.03	86.21	18.58926
1993	1,257.17	86.25	19.69781
1994	1,768.79	86.51	8.594887
1995	3,100.24	88.68	21.59308
1996	4,086.07	87.11	16.43727
1997	4,418.71	80.81	18.87677
1998	4,805.16	87.15	8.994800
1999	5,482.35	84.67	20.36798
2000	7,062.75	82.18	22.17331

2001	8,234.49	84.52	19.88929
2002	11,501.45	84.60	12.42662
2003	13,556.97	82.18	18.87677
2004	18,124.06	88.03	18.95469
2005	23,121.88	80.64	19.76046
2006	30,375.18	85.56	15.85414
2007	34,675.94	82.95	19.19587
2008	39,954.21	82.19	22.84479
2009	43,461.46	85.93	19.19587
2010	55,469.35	88.61	18.44830
2011	63,713.36	82.51	22.17331
2012	72,599.63	81.64	20.51768
2013	81,009.96	84.63	21.92551
2014	90,136.98	85.56	22.84479
2015	95,177.74	82.95	20.51768
2016	102,575.42	87.15	22.04813
2017	114,899.25	87.11	20.44464
2018	129,086.91	87.78	19.69781
2019	145,639.14	82.32	14.63783
2020	154,252.32	87.28	22.08605
2021	176,075.50	86.51	10.35113
2022	202,365.03	88.03	18.58926
2023	202,365.03	88.03	18.58926
2024	202,365.03	88.03	18.58926

Source: Extracted from CBN Statistical Bulletin and World Bank Development Indictors of Various Years.

Where

GDP = Gross Domestic Product

REC = Renewable Energy Consumption

FSS = Fossil Fuel Energy Consumption

Table 2 Descriptive Analysis

Options	LOGGDP	LOGREC	LOGFSS
Mean	9.029443	4.443240	2.897133
Median	9.432442	4.451375	2.967601
Maximum	12.21783	4.485034	3.128723
Minimum	4.936702	4.389995	2.151167
Std. Dev.	2.506106	0.028656	0.250189

Skewness	-0.337029	-0.281212	-1.981005
Kurtosis	1.679205	1.679292	6.071913
Jarque-Bera	4.031230	3.777750	46.07933
Probability	0.133238	0.151242	0.000000
Observations	44	44	44

Source: Extracted from E-View 10 Package

Table 2 above shows the maximum, minimum, mean and standard deviation statistics of the variables in this study. Moreso, the difference between the mean and standard deviation shows that the country did not experience significant growth in economic growth during some periods; and this is further confirmed from the economic growth maximum value of 12.22% in a particular year. The high standard deviation of the economic growth, when compared with the mean, shows our highly inconsistent the economic growth has been in the country during the period 1981-2024. Economic growth was as high as 12.22% in a particular year and proved to vary significantly over the period consider in this study as the mean was as higher than the standard deviation.

Unit Root Analysis

In order to address the problem, the Augmented Dickey-Fuller (ADF) unit root test was employed on the chosen data set to ascertain the stationarity of the data as follows:

Table 3 Unit Root Test

Variables	ADFSTAT	CRD5%	P.V	Order of Integration	Remark
LOGGDP	-3.27	-2.93	0.220	I(1)	Stationary
LOGREC	-5.80	-2.93	0.0000	1(0)	Stationary
LOGFSS	-7.36	-2.93	0.0000	1(0)	Stationary

Source: Compilation of Researcher, 2025

From table 3, the data tested the stationary properties of the variables confirmed combination of order one 1(1) and order zore 1(0). The augmented dickey fuller test was used to test whether the variable has a unit root. Therefore, analyses from the review confirm that there is unit root on the variable at 1(1) and 1(0). Hence, therefore, the study adopted correlation method since there is no sign of co-integration. ADF statistics is more negative and significant than critical value (a) 5%.

Hypotheses Testing Using Correlation Matrix

H_{o1}: There is no significant positive relationship between renewable energy and gross domestic product (GDP) of Nigeria.

H_{o2}: There is no significant positive relationship between fossil fuel and gross domestic product (GDP) of Nigeria.

Covariance Analysis: Ordinary
Date: 01/11/25 Time: 16:32
Sample: 1981 2024
Included observations: 44

Correlation t-Statistic Probability	LOGGDP	LOGREC	LOGFSS
LOGGDP	1.000000 ----- -----		
LOGREC	0.146853 0.962149 0.3415	1.000000 ----- -----	
LOGFSS	0.098109 0.638902 0.5264	-0.088877 -0.578274 0.5662	1.000000 ----- -----

Source: Extracted from E-View 10 Package

The correlation approach was adopted. The result of the test shows that the variables within themselves exhibit perfect correlation of 1.00 which is however expected while are not. The correlation coefficients did not signify any problem of multicollinearity. This is however not a cause for concern. Some of the variables show positive correlation and negative correlation between one another but all shows none significantly to one another. However, renewable energy has non-significant positive relationship with gross domestic product (GDP) of Nigeria while fossil fuel has non-significant positive relationship with gross domestic product (GDP) of Nigeria.

Discussion of Findings

Hypothesis One: As revealed that renewable energy has non-significant positive relationship with gross domestic product (GDP) in Nigeria (correlation vale = 0.146853., t-value = 9.62149, pv = 0.3415). This is in agreement with the study of Umeji, *et al* (2023) conducted study on renewable Energy Consumption and Economic Growth in Nigeria. It used Toda-Yamamoto augmented granger causality test to test for the nature of the relationship between the two variables and Auto Regressive Distributed Lag (ARDL) bounds test to examine the impact of renewable energy consumption on economic growth. The study found a bi-directional relationship between the variables. The regression results also showed a significant positive impact of renewable energy consumption on economic growth.

Hypothesis Two: As revealed that the fossil fuel has non-significant positive relationship with gross domestic product (GDP) in Nigeria (correlation vale = 0.098169., t-value = 0.638102, pv = 0.5264). This is in agreement with the findings of Owede and Ezaal (2022) studied fossil fuel consumption, economic growth, and environmental degradation: is the 'energy consumption growth' nexus sustainable in Nigeria. It was found that fossil fuel consumption exerted mixed (positive and negative)

effect on economic growth in the short run but negative effect in the long run. Moreover, economic growth and fossil fuel consumption were found to impact positively on environmental degradation in the short run.

Summary of Findings

1. Renewable energy had non significant positive relationship with gross domestic product (GDP) in Nigeria (correlation vale = 0.146853., t-value = 9.62149, pv = 0.3415>0.05 level of significance).
2. Fossil fuel had non significant positive relationship with gross domestic product (GDP) in Nigeria (correlation vale = 0.098169., t-value = 0.638102, pv = 0.5264>0.05 level of significance).

Recommendations

The recommendations of the study were results based, and the following were recommended;

i. Government should set a renewable energy target goals by develop policies that will enable its adoption. Similarly, government shall offer financial incentives by providing tax credits, grants, and subsidies to encourage investment in renewable energy technologies like solar and wind etc.
ii. Government should enhance oil refining and petrochemical process by investing in technologies that will optimize fossil fuel production, reduce emissions and minimize waste.

Contributions to Knowledge

In summary, this study has made valuable contributions to knowledge in the following ways.

i . This study included energy contributive indices such as renewable energy and fossil fuel as measure of energy contributive indicators. These variables are mostly absent in the studies reviewed.
ii. The empirical findings of previous studies in this area showed a mixed bag of results. Thus, this study has added to the empirical literature available in the area of energy contributive indicators.

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