# Does Energy Access Reduce Unemployment? An Empirical Evidence from Nigeria

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## ABSTRACT

The need for growth and development in Nigeria has been emphasized by regional economic communities. Key among determinants of economic development that has occupied recent discussion are access to energy and job creation. This study investigated the impact of energy access on unemployment in Nigeria from 1990 to 2023. The study proxy energy access and climate change by volume of electricity generated, electricity consumed and access to electricity while unemployment was measured by unemployment rate. The study used annual time series data sourced mainly from the International Energy Agency and the World Bank. The data analytical techniques used include: descriptive statistics, unit root test as well as Autoregressive Distributed Lag (ARDL) approach. The findings showed that volume of electricity generated, electricity consumed and access to electricity have negative but significant effect on unemployment rate in Nigeria in both short run and long run. This implies that access to energy (electricity) has very serious implication on job creation. Consequent upon these findings, the study concluded that energy access plays a vital role in reducing unemployment in Nigeria. The study therefore recommended increase effort toward electricity generation, effective implementation of electricity pricing regulation policy and electricity metering policy.

**Key words:** unemployment rate, electricity generation, electricity consumed and access to electricity.

## INTRODUCTION

Energy is essential for fostering global social and economic development and is a key need for almost all productive economic activities. This suggests that access to high-quality and reliable energy is beneficial for societal and economic advancement, as well as for environmental conservation. Maintaining access has a transformational impact on both persons and business entities. It results in several consequences, such as producing revenue, boosting economic specialization, substituting labor with capital to increase productivity, and facilitating the creation of new business ventures. This facilitates the reallocation of family time, especially for women. It enables them to transition their emphasis from energy supply to enhancing education. Furthermore, it offers insulation against severe temperatures, facilitates access to broader markets via diminished transportation and communication expenses, and presents opportunities for health enhancements resulting from less indoor smoke, cleaner water, and enhanced refrigeration (Ekone & Amaghionyeodiwe, 2020). Okeoma, Nwachukwu, Ezeonye, and Osatemple (2023) contend that reliable and affordable energy is essential for fostering economic development. They also emphasize the significant positive impacts that improved energy availability has on many African countries. Africa, a continent marked by diverse economies and developmental challenges, stands to benefit significantly from enhanced energy accessibility. The African Development Bank Group (2018) said that improved energy accessibility in African countries fosters industrialization, facilitating the growth of manufacturing and energy-intensive industries. A reliable power supply is crucial for industrial activities, and enhanced energy availability fosters the development of a more diverse and resilient economy. Sectors ranging from agro-processing to manufacturing possess the capacity for growth and may significantly enhance the region's GDP and job creation. Furthermore, as confirmed by the International Renewable Energy Agency (IRENA) (2019), agriculture is vital in several African countries, and

improving energy accessibility might significantly boost agricultural productivity. Access to electricity enables the use of modern agricultural technology, such as irrigation systems and equipment, resulting in increased crop yields and improved food security. Furthermore, the availability of energy facilitates the expansion of agro-processing industries, so enhancing the value of agricultural products and consequently fostering economic development. Improved energy accessibility significantly impacts Small and Medium Scale Enterprises (SMEs), which are vital for job creation in several African countries. A reliable energy supply allows small and medium-sized firms (SMEs) to operate more efficiently, resulting in increased output and competitiveness. This results in employment creation and money generation, fostering local economic advancement and growth.

The World Bank (2017) confirms that countries with improved energy infrastructure and a reliable power supply are more attractive to foreign investors. Energy accessibility is a vital factor for businesses seeking to establish operations in a certain region. The availability of accessible energy resources may influence investment decisions, resulting in an increase in Foreign Direct Investment (FDI) in African countries, hence facilitating economic growth and development. Likewise, the development of the energy sector creates employment opportunities. The expansion of energy infrastructure and the management of power plants enhance job creation in the energy sector, hence positively impacting employment rates in many African countries. Furthermore, the enhancement of energy accessibility promotes economic activities, creating a conducive environment for job creation across many sectors (Armeanu, Joldes, Gherghina & Andrei, 2021).

Nevertheless, inadequate energy infrastructure, namely transmission and distribution networks, is a significant barrier to improving energy accessibility and job creation in Nigeria. The lack of grid connectivity in rural and remote areas presents a barrier in delivering energy services owing to the unavailability of necessary infrastructure. Insufficient infrastructure hinders the reliability and stability of energy supply. A significant section of the Nigerian population relies extensively on conventional biomass, such as wood and charcoal, for cooking purposes. This connection intensifies the problems of deforestation, indoor air pollution, climate change, and elevated unemployment rates in Nigeria. Numerous studies have evaluated the relationship between energy availability and economic development; however, none have particularly investigated the impact of energy access on unemployment within the Nigerian setting or included data extending to the year 2023, a timeframe subsequent to the COVID-19 epidemic. This study sought to look at the impact of energy access on unemployment in Nigeria from 1990 to 2023 due to the identified issue and gap.

## LITERATURE REVIEW

### Theoretical Framework

The theoretical framework for this research is based on the Energy-Led Growth Hypothesis. The Energy-Led Growth Hypothesis asserts that energy use is a fundamental driver of economic growth and enhancement. If this idea holds true, more energy consumption will lead to heightened economic activity and advancement. It suggests that energy is an essential element of production and that the need for energy increases along with economic advancement. Energy consumption serves as an indicator or proxy for economic advancement, as supported by the Energy-Led Growth Hypothesis. Energy consumption is seen as a reliable measure of a nation's level of industrialization and overall economic growth. Yildrim and Aslan (2012) confirm that research on the relationship between energy use and economic development has been ongoing since the 1970s, initiated with the foundational study of Kraft and Kraft (1978). The authors identified a unidirectional correlation between energy use and the rise of the United States' Gross National Product (GNP) from 1947 to 1974. A lot of academics have recently undertaken additional experiments to ascertain a causal relationship between energy use and GDP development. Researchers have proposed four testable hypotheses to elucidate the relationship between energy consumption and economic growth; nevertheless, they have failed to differentiate between qualitative and quantitative dimensions. Four theories in the energy-growth literature on the relationship between energy consumption and economic development are: the Growth Hypothesis, the Conservation Hypothesis, the Feedback Hypothesis, and the Neutrality Hypothesis. Ekeocha, Penzin, and Ogbuabor (2020), Yildirim and Aslan (2012), and Ozturk (2010) all state that these theories have substantial policy consequences.

i. Growth Hypothesis: Under the Growth Hypothesis, energy consumption, in the absence of alterations to capital and labor, is deemed to have a direct impact on economic advancement. The theory posits a unidirectional causal relationship between energy utilization and GDP growth. Consequently, conservative energy policies aimed at reducing consumption will adversely affect economic expansion (Emeka, Nenubari & Godsgrace, 2019).

ii. Conservation Hypothesis: Ouedraogo (2013) posits that the conservation hypothesis implies a less energy-dependent economy by asserting that economic advancement is the driving force behind the evolution of the energy sector. The unidirectional relationship between economic advancement and energy consumption supports the hypothesis's practical relevance. Investments in energy efficiency and demand management tactics, as forms of energy conservation measures, will not impede economic growth in the long term.

iii. Feedback Hypothesis: The Feedback Hypothesis asserts a bidirectional relationship between energy usage and economic growth. Emeka, Nenubari, and Godsgrace (2019) assert that attempts to reduce energy consumption via conservation regulations may adversely impact economic growth, therefore influencing energy consumption.

iv. Neutrality Hypothesis: The Neutrality Hypothesis asserts that there is no correlation between energy use and GDP growth. It asserts that energy use and economic growth are not directly correlated. This idea gains validity when the link between energy use and GDP growth is absent. The economic upturn will remain unimpeded by energy conservation efforts designed to decrease consumption in this context (Emeka, Nenubari & Godsgrace, 2019). There is no association between the energy sector and GDP growth, as supported by the Neutrality Hypothesis. The Neutrality Hypothesis is valid since energy consumption does not induce economic growth. Economic advancement will remain unimpeded by measures that enhance consumption and accessibility to energy in this instance (Ouedraogo, 2013).

The Energy-Led Growth Hypothesis asserts that economic advancement and productivity are enhanced by a sophisticated and efficient energy infrastructure. Industries, transportation, and other essential sectors depend on a consistent and abundant energy supply. Alterations in energy use result in variations in GDP. Conventional wisdom posits that increasing energy consumption would yield a multiplicative effect on the economy, augmenting GDP and the Human Development Index by elevating industrial production and service delivery.

**Empirical Review**

Umoidem, Nteegah, and Osokogwu (2024) examined the influence of energy costs on the level of unemployment in Nigeria from 1981 to 2021. The research acquired data about the unemployment rate, hydro energy pricing, crude oil pricing, natural gas pricing, electricity tariffs, and power usage from the World Bank and the International Energy Agency. The data were then analyzed using the Autoregressive Distributed Lag (ARDL) method to achieve the study's purpose. The study results and conclusions imply that: Using hydro energy in Nigeria's economy has had a minimal long-term effect on alleviating unemployment, although it has little immediate impact on the unemployment rate in the short term. The long-term influence of crude oil prices on unemployment in Nigeria is minimal; yet, in the near term, it significantly reduces jobless levels. The prolonged effect of decreasing natural gas costs on the unemployment rate was somewhat positive; yet, in the short run, it had a mixed influence on unemployment levels, which was also significant. Electricity rates significantly influenced the unemployment rate, resulting in an increase.

Mohammad and Mufidur (2023) examined the relationship among renewable energy development, unemployment, and GDP growth in Bangladesh, India, Pakistan, and Sri Lanka. The research used the autoregressive distributive lag (ARDL) framework and Toda Yamamoto causality using the vector autoregressive (VAR) method to examine the long-term and short-term effects of these variables from 1990 to 2019. The study's findings indicated a substantial co-integration among renewable energy usage, unemployment, and GDP growth in certain South Asian nations. The long-term analysis indicated that renewable energy usage adversely affects economic growth in Bangladesh, with no significant relationship to

unemployment.

Mawunyo, Philip, and Andrea (2022) investigated the relationship between unemployment and energy efficiency, accounting for variations in education. The research used the stochastic frontier methodology and the generalized technique of moments on an imbalanced panel dataset including 51 African nations from 1991 to 2017. The research performed many robustness tests to evaluate the consistency of the estimated association. The findings validated the theoretical assertion that energy efficiency directly decreases unemployment. Nevertheless, further empirical evidence indicated that countries with superior human capital achieve a more significant decrease in unemployment compared to those with underdeveloped human capital. This indicates that investing in education is a crucial supplementary element to augment the unemployment-reducing impacts of energy efficiency.

Adamu and Maijama'a (2021) examined the relationship between power consumption, unemployment, inflation, and transportation in Nigeria using yearly data from 1990 to 2019. The theoretical Philips curve was dismissed by both Fully Modified Ordinary Least Squares (FMOLS) and Ordinary Least Squares (OLS) regression due to the positive connection observed. The impulse response function further confirmed the significant correlation between unemployment and inflation. Energy use in transportation adversely affects unemployment, as shown by its interaction term. The conclusion of both short-run and long-run variance decomposition analyses suggested that power and transport energy consumption more effectively elucidated unemployment than inflation in Nigeria.

Muktar and Abdullahi (2021) analyzed the effect of power provision on unemployment in Nigeria. For this purpose, yearly time series data spanning 36 years from 1986 to 2020 were gathered and analyzed using the Ordinary Least Squares (OLS) method. The study's findings indicated a robust positive linear link between the decrease of unemployment and power supply, whereas a negative correlation was identified between unemployment reduction and government policy.

Chama, Yahya, and Hindou (2021) investigated the effect of the renewable energy sector on the alleviation of unemployment. The correlation between renewable energy usage and unemployment will be examined using the VAR model, the Johansen co-integration test, and the Granger causality test, spanning the years 1990 to 2017. The results demonstrated a causal link between the use of renewable energy and unemployment rates. The renewable energy sector might significantly contribute to reducing the unemployment rate in Morocco. Investments in the business may later be directed to provide employment, particularly during the Covid-19 pandemic, which caused substantial job losses.

Veli, Emel, Sinem, and Gökçe (2020) investigated the correlation between unemployment rates and renewable energy usage using the Fourier ADL Cointegration Test. The research addressed whether new energy technologies provide new job opportunities and contribute to alleviating the unemployment issue. The findings indicated a cointegration connection among the variables for Australia, Austria, Chile, France, Germany, Japan, Mexico, Portugal, Spain, and the United States. The findings indicated that renewable energy consumption had a beneficial impact on unemployment rates in Austria, Portugal, and Spain, but it adversely impacts unemployment rates in Australia, Chile, France, Germany, and Japan.

Hlalefang, Nwabisa, Clement, Izunna, and Siyasanga (2020) analyzed the correlation between renewable energy use and unemployment in South Africa from 1990 to 2014. The autoregressive distributed lag model was used to examine the long-term and short-term effects of renewable energy consumption on unemployment. The findings indicated that renewable energy use adversely and significantly impacts unemployment in the long term. Nonetheless, in the short term, the variables exhibit a negligible association.

Musa and Maijama (2020) examined the causal relationship between renewable energy usage and unemployment in Nigeria from 1991 to 2015. The authors used the Toda and Yamamoto causality test. Long-term causality analysis indicates a bidirectional relationship between renewable energy usage and unemployment, as well as between foreign direct investment and renewable energy consumption.

Shuddhasattwa, Ruhul, and Sgro (2018) examined the correlation between renewable energy usage and

unemployment across a sample of 41 countries from 1980 to 2014. The research used Fully Modified Ordinary Least Squares (FMOLS), Dynamic Ordinary Least Squares (DOLS), and the Granger causality test. The findings from the FMOLS and DOLS estimators indicate that industrialization, the service sector, governmental spending, and trade openness positively contribute to the reduction of unemployment.

George and Oseni (2012) examined the influence of electricity supply on unemployment rates in Nigeria. This research used an ordinary least squares regression model to analyze the impact of electrical power production, supply, and consumption on the elevated unemployment rate in Nigeria. The research, spanning from 1970 to 2005, revealed that the electricity supply to the industrial sector was inferior to that allocated for residential usage. The research determined that the primary cause of unemployment in Nigeria is attributable to insufficient and unreliable power supply to the industrial sector.

## METHODOLOGY

This study's analytical approach is based on the Energy-Led Growth Hypothesis, selected for its relevance and application to the research. The Energy-Led Growth Hypothesis posits that the accessibility and use of energy are essential determinants in fostering economic advancement and job creation. This concept leads to an increase in energy accessibility and use, resulting in heightened economic activity and development. The model for this study was based on the empirical research done by Hlalefang, Nwabisa, Clement, Izunna, and Siyasanga (2020). This model was modified to align with the objectives and specific aims of this study with few changes. The revised model is shown in its functional, pooling, fixed effect, and random effect versions, respectively:

$$\text{UMR} = f(\delta_0 . VEG^{\delta 1}, ELC^{\delta 2}, AEC^{\delta 3}, CES^{\delta 4}) \quad (1)$$

To enhance estimation of equation 1, it is transformed into linear form thus:

$$\text{UMR}_{it} = \delta_0 + \delta_1 EPR_{it} + \delta_2 VEG_{it} + \delta_3 ELC_{it} + \delta_4 CES_{it} + U_{it} \quad (2)$$

The linear form of the model transformed into ARDL model thus:

$$\begin{aligned}\Delta(UMR_t) = {} & \delta_0 + \delta_{1i}\Delta(UMR_{t-1}) + \delta_{2i}\Delta(VEG_{t-1}) + \delta_{3i}\Delta(ELC_{t-1}) + \delta_{4i}\Delta\ln(AEC_{t-1}) + \delta_{5i}\Delta\ln(CES_{t-1}) \\ & + \sum_{t=1}^{p}\beta_{1i}\Delta(UMR_{t-1}) + \sum_{t=1}^{q}\beta_{2i}\Delta(VEG_{t-1}) + \sum_{t=1}^{p}\beta_{3i}\Delta(ELC_{t-1}) \\ & + \sum_{t=1}^{q}\beta_{4i}\Delta(AEC_{t-1}) \sum_{t=1}^{q}\beta_{5i}\Delta(CES_{t-1}) + \varepsilon_{1i} \quad (3)\end{aligned}$$

In furtherance, the short run dynamic parameters are arrived at by the estimation of an error correction model linked with the long-run estimates. The models are stated below:

$$\begin{aligned}\Delta\ln(UMR_t) = {} & \beta_0 + \sum_{t=1}^{p}\beta_{1i}\Delta(UMR_{t-1}) + \sum_{t=1}^{q}\beta_{2i}\Delta(VEG_{t-1}) + \sum_{t=1}^{p}\beta_{3i}\Delta(ELC_{t-1}) \\ & + \sum_{t=1}^{q}\beta_{4i}\Delta(AEC_{t-1}) \sum_{t=1}^{q}\beta_{5i}\Delta(CES_{t-1}) + \delta ECMT_{t-1} + \varepsilon_{14i} \quad (4)\end{aligned}$$

Where:

UMR = Unemployment rate, VEG = Volume of electricity generated, ELC = Electricity consumed, AEC = Access to Electricity, CES = Carbon emission, $\delta_0$ = Constant variables in the model, $\delta_1$ - $\delta_4$ = Co-efficient of volume of electricity generated, $U_i$ = Error term, $\Delta$ = Difference operator and indicates the optimum lag, $t$ = Time lag

**A Priori Expectation**

The variables denoting electricity production, electricity consumption, and electricity access are expected to have negative coefficients, indicating a detrimental correlation with the unemployment rate. In contrast, carbon emissions are expected to have a positive association with the unemployment rate. This may be mathematically shown as:

$\delta_1 < 0; \delta_2 < 0; \delta_3 < 0; \delta_4 > 0.$

**Estimation Techniques**

The Autoregressive Distributed Lag (ARDL) methodology is a widely used econometric method for modeling the connection between a dependent variable and many independent variables in both the short and long term. The ARDL technique is especially advantageous in this research since all variables in the model exhibit integration at varying orders, indicating that certain variables are stationary at level I(0) while others are stationary at first difference I(1).

## RESULTS

Table 1: Descriptive Statistics

| | UMR | VEG | ELC | AEC | CES |
|---|---|---|---|---|---|
| Mean | 4.128235 | 16.09692 | 115.8841 | 48.19882 | 45.83390 |
| Median | 3.825000 | 16.18365 | 122.2813 | 48.98500 | 46.84420 |
| Maximum | 6.000000 | 22.40386 | 173.0447 | 65.10000 | 54.46350 |
| Minimum | 3.100000 | 10.52038 | 71.92220 | 30.52000 | 33.15260 |
| Std. Dev. | 0.780169 | 3.380140 | 31.19929 | 8.857669 | 5.872118 |
| Skewness | 1.356273 | 0.064667 | -0.007407 | -0.161551 | -0.276220 |
| Kurtosis | 3.725370 | 1.884428 | 1.683902 | 2.302196 | 2.117282 |
| Jarque-Bera | 11.16910 | 1.786741 | 2.454138 | 0.837712 | 1.536206 |
| Probability | 0.003755 | 0.409274 | 0.293150 | 0.657799 | 0.463892 |
| Sum | 140.3600 | 547.2954 | 3940.059 | 1638.760 | 1558.353 |
| Sum Sq. Dev. | 20.08589 | 377.0365 | 32122.06 | 2589.124 | 1137.898 |
| **Observations** | **34** | **34** | **34** | **34** | **34** |

Source: Author's Computation, 2024.

Table 1 indicates that the unemployment rate (UMR) averaged 4.12% over the period, with a high of 6.0% and a low of 3.1% per year. The standard deviation of the unemployment rate (UMR) is 0.78%, indicating a significant departure from the mean over the studied period (1990 - 2023). The volume of electricity produced (VEG) has a mean of 16.1, a maximum of 22.4, and a low of 10.52 per year. The standard deviation of the volume of electricity produced (VEG) is 3.38, indicating a significant dispersion from the mean. The electricity consumption (ELC) had a mean value of 115.88, with a high of 173.04 and a minimum of 71.92 annually. The standard deviation of electricity consumption (ELC) is 31.2, indicating significant dispersion

from the mean. Furthermore, access to electricity (AEC) had a mean value of 48.20, with a maximum of 65.1 and a minimum of 71.92 annually. The standard deviation of access to electricity (AEC) is 8.85, indicating a significant departure from the mean. Ultimately, carbon emissions (CES) exhibited a mean value of 45.83%, with a high of 54.46% and a minimum of 33.15% annually. The standard deviation of carbon emissions (CES) is 5.87%, indicating a minimal departure from the mean.

## Trend Analysis

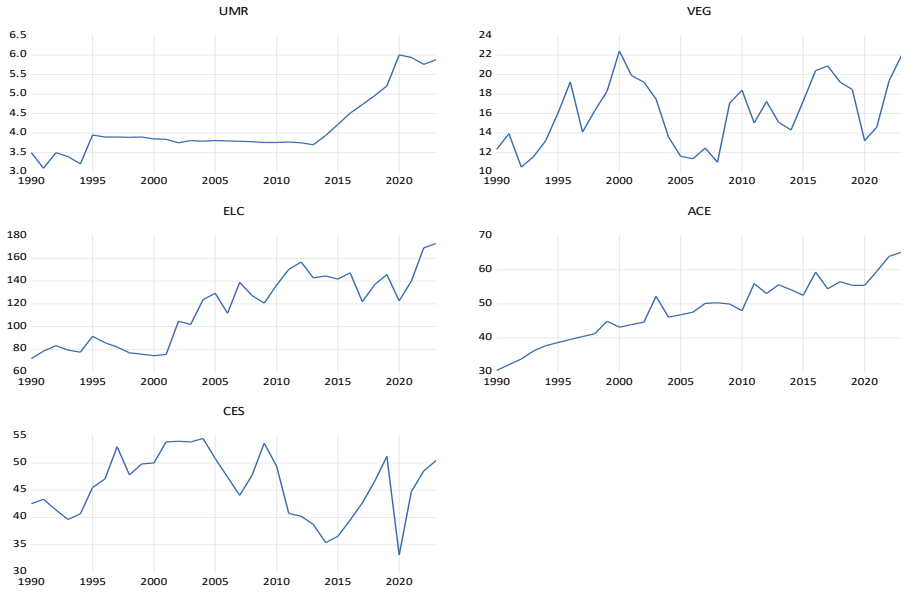


Figure 1: Line Graph Showing the Trend in Unemployment Rate (UMR), Electricity Generated (VEG), Electricity Consumed (ELC), Access to Electricity (AEC), Carbon Emission (CES)

Figure 1 revealed that all the research variables (unemployment rate, electricity generated, electricity consumed, access to electricity, carbon emission) experience inconsistent upward and downward movements throughout the research period from 1990 – 2023.

## Unit Root Test

The results of the unit root test are presented in Table 2 below:

Table 2: Augmented Dickey-Fuller (ADF) Test Results

| ADF | | | | | | |
|---|---|---|---|---|---|---|
| **Variables** | **Level** | **Critical Value @ 5%** | **1st Difference** | **Critical Value @ 5%** | **I(d)** | **Stationary @** |
| UMR | 0.469445 | -2.954021 | -6.231281*** | -2.957110 | I(1) | 1st Difference |
| VEG | -4.265521 | -2.957110*** | - | - | I(0) | Level |
| ELC | -0.995851 | -2.954021 | -6.999825*** | -2.957110 | I(1) | 1st Difference |
| AEC | -0.713927 | -2.957110 | --9.377335*** | -2.957110 | I(1) | 1st Difference |
| CES | -2.633673 | -2.954021 | -6.697504*** | -2.957110 | I(1) | 1st Difference |

Note: *, **, and *** denote significance at 10%, 5% and 1%, respectively

Source: Author's Computation, 2024.

The result of ADF Unit root tests revealed that electricity generated (VEG) was stationary at level and integrated at order zero [i.e., I(0)]. On the other hand, unemployment rate (UMR), electricity consumed (ELC), access to electricity (AEC) and carbon emission (CES) were stationary at first difference and integrated at order one [i.e., I(1)]. Hence, the attainment of mixed stationarity in the variables (that is stationary at order zero and stationary at order one) necessitated the use of ARDL in the estimation of the long run relationship among the variables and the error correction model.

**Correlation Analysis**

The results of the correlation are presented in Table 3:

Table 3: Correlation Matrix

| | **UMR** | **VEG** | **ELC** | **AEC** | **CES** |
|---|---|---|---|---|---|
| **UMR** | 1 | | | | |
| **VEG** | 0.372349 | 1 | | | |
| **ELC** | 0.569377 | 0.195942 | 1 | | |
| **AEC** | 0.437785 | 0.41299 | 0.486596 | 1 | |
| **CES** | -0.05230 | 0.303277 | -0.17461 | -0.06554 | 1 |

Source: Author's Computation, 2024.

The result of the correlation matrix in Table 3 revealed that unemployment rate is positively and negatively correlated with volume of electricity generated, electricity consumed, access to electricity and carbon emission but the correlation is weak. The result further reveals no threat of multicollinearity among the explanatory variables given their correlation coefficients. This implies that the explanatory variables can interact effectively in the unemployment equation.

**Bounds Cointegration Test**

The result of bounds cointegration test is presented in Table 4:

Table 4: ARDL Bounds Cointegration Test

| | **Critical Value Bound** | | **F-Statistics** |
|---|---|---|---|
| $F_{UMR}$(VEG, ELC, AEC, CES) | | | 4.816652*** |
| K = 4 | | | |
| Significance | I(0) Bound | I(1) Bound | |
| 10% | 2.2 | 3.09 | |
| 5% | 2.56 | 3.49 | |
| 2.5% | 2.88 | 3.87 | |
| 1% | 3.29 | 4.37 | |

Note: Null hypothesis: No level relationship; K = number of regressors; *, ** and *** denote significance at 10%, 5% and 1% level, respectively.

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Source: Author's Computation, 2024.

A limits test was done to ascertain the presence of cointegration among the unemployment rate (UMR), volume of electricity produced (VEG), electricity consumed (ELC), access to electricity (AEC), and carbon emissions (CES). The bounds correlation test results in Table 4.4 demonstrate that the bound test indicates a long-run relationship among the unemployment rate (UMR), volume of electricity generated (VEG), electricity consumed (ELC), access to electricity (AEC), and carbon emissions (CES), as the F-statistic value of 4.816652 exceeds the 5% upper bound critical value of 3.49. The null hypothesis is rejected, leading to the conclusion that a cointegrating connection exists among the variables. The validation of long-term dynamics among the variables required the assessment of the link between the dependent and independent variables via the estimate of the Autoregressive Distributed Lag (ARDL) model.

**Autoregressive Distributive Lag (ARDL) Long-Run and Short-Run Dynamics**

The results of the long-run and the short-run are shown in Table 5 below:

Table 5: Estimated Long-Run and Short-Run Coefficients of ARDL

| **Dependent Variable = UMR** | | | | |
|---|---|---|---|---|
| **Long-Run Results** | | | | |
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.*** |
| VEG | -0.040434 | 0.011251 | -3.593664 | 0.0070 |
| ELC | -0.032137 | 0.009527 | -3.373165 | 0.0097 |
| AEC | -0.029519 | 0.010941 | -2.697972 | 0.0272 |
| CES | 0.236458 | 0.306413 | 0.771697 | 0.4625 |
| C | 12.74443 | 15.28586 | 0.833740 | 0.4286 |
| **EC = UMR - (-0.0404*VEG -0.0321*ELC -0.0295*ACE + 0.2365*CES +12.7444)** | | | | |
| **Short-Run Results** | | | | |
| D(UMR(-1)) | -0.098921 | 0.147012 | -0.672879 | 0.5200 |
| D(VEG) | -0.044458 | 0.015667 | -2.837714 | 0.0219 |
| D(VEG(-1)) | 0.052307 | 0.017734 | 2.949541 | 0.0184 |
| D(ELC) | -0.021750 | 0.005106 | -4.259801 | 0.0028 |
| D(ELC(-1)) | 0.021750 | 0.005106 | 4.259801 | 0.0028 |
| D(ELC(-2)) | 0.013351 | 0.003935 | 3.392847 | 0.0095 |
| D(ACE) | -0.101904 | 0.024761 | -4.115585 | 0.0034 |
| D(ACE(-1)) | -0.011829 | 0.014061 | -0.841287 | 0.4246 |
| D(ACE(-2)) | -0.056805 | 0.017582 | -3.230837 | 0.0120 |
| D(CES) | 0.015018 | 0.007348 | 2.043717 | 0.0752 |
| D(CES(-1)) | 0.280183 | 0.287912 | 0.973154 | 0.3590 |

| | | | | |
|---|---|---|---|---|
| CointEq(-1)* | -0.293964 | 0.050951 | -5.769573 | 0.0004 |
| $R^2$ | 0.790930 | | | |
| Adjusted $R^2$ | 0.533614 | | | |
| Durbin-Watson stat | 2.682245 | | | |

Source: Author's Computation, 2024.

Table 5 presents the long-run estimates of the ARDL model. The findings indicated that, at the initial level, the amount of power produced exhibits a negative and substantial correlation with the unemployment rate in Nigeria. The negative coefficient value (-0.040434) of power generation volume, together with its p-value (0.0070), which is below 0.05, substantiates this observation. An increase in the amount of power produced by a unit will result in a considerable drop of 0.040434 in the unemployment rate over the long term. The short-run estimations of the ARDL model indicated a negative and substantial correlation between the amount of electricity produced and the unemployment rate in Nigeria. The negative coefficient value (-0.044458) of power generation volume, together with its p-value (0.0219) being less than 0.05, substantiates this observation. An increase in the amount of power produced by a unit will result in a considerable drop of 0.044458 in the unemployment rate in the near term.

Moreover, the long-run estimates of the ARDL model indicated that, at the starting level, electricity consumption had a strong negative long-run connection with the unemployment rate in Nigeria. The negative coefficient of electricity consumption (-0.032137) and its p-value (0.0097), which is below 0.05, provide proof for this assertion. An increase in energy consumption by a unit will result in a considerable drop of 0.032137 in the unemployment rate over the long term. The short-run estimates of the ARDL model indicate a strong negative long-run association between power consumption and the unemployment rate in Nigeria. The negative coefficient value of power consumption (0.021750) and its p-value (0.0028), which is below 0.05, provide proof for this assertion. An increase in energy consumption by a unit will result in a considerable drop of 0.021750 in the unemployment rate in the near term.

Furthermore, the long-run estimates of the ARDL model indicated that, at the starting level, access to electricity had a strong negative long-term association with the unemployment rate in Nigeria. The negative coefficient value (-0.029519) of access to electricity, together with its p-value (0.0272), which is below 0.05, substantiates this observation. An increase in access to electricity by one unit will result in a considerable long-term drop of 0.029519 in the unemployment rate. The short-run estimations of the ARDL model indicated that access to electricity had a strong negative long-run connection with the unemployment rate in Nigeria. The negative coefficient value (-0.101904) of electricity access, together with its p-value (0.0034), which is below 0.05, substantiates this observation. An increase in access to electricity by one unit will result in a considerable fall of 0.101904 in the unemployment rate in the immediate term.

Furthermore, the long-run estimates from the ARDL model indicated that carbon emissions had a non-significant positive long-run association with the unemployment rate in Nigeria. The positive coefficient value of carbon emission (0.236458) and its p-value (0.4625), which above 0.05, provide support for this observation. An increase in carbon emissions by one unit will result in a negligible rise of 0.236458 in the unemployment rate over the long term. The short-run estimations of the ARDL model indicated that carbon emissions exhibit a non-significant positive long-run association with the unemployment rate in Nigeria. The positive coefficient value of carbon emissions (0.015018) and its p-value (0.0752), which above 0.05, provide proof for this assertion. An increase in carbon emissions by one unit will result in a negligible rise of 0.015018 in the unemployment rate in the near term.

The short-run dynamic coefficients related to the long-run relationships derived from the error correction model are shown in Table 4.5. The indicators of short-run dynamic interactions align with those of the long-run connection. The predicted error correction coefficient of -0.293964 (with a p-value of 0.0004) is highly significant, has the appropriate sign, and indicates a gradual adjustment to equilibrium after a disturbance. This indicates that around 29% of imbalances from the prior year's disturbance return to the long-term equilibrium

in the current year.

The Adjusted R-squared value of 0.533614 from the short-run estimates of the ARDL model in table 4.5 indicates that the model is well-fitted, as systematic changes in the explanatory variables (volume of electricity generated, electricity consumed, access to electricity, and carbon emissions) account for approximately 53 percent of the variation in the unemployment rate, while the remaining 47 percent is attributed to factors outside the model.

Lastly, Durbin-Watson stat of 2.682245 which is greater than 2 indicates the absence of serial autocorrelation.

**Diagnostic Tests**

The results of the diagnostic tests are presented and discussed below:

Table 6: Diagnostic Tests Results

| Test | Null Hypothesis | $X^2$ Value | $X^2$ Prob | Remark |
|---|---|---|---|---|
| **Jarque-Bera** | Normal distribution exists | 0.409427 | 0.814881 | Normal residuals |
| **Breusch-Godfrey LM** | Serial correlation does not exist | 2.831579 | 0.1361 | Serial independence |
| **Breusch-Pagan-Godfrey** | Homoscedasticity exists | 2.146174 | 0.0626 | Constant Variance |
| **Ramsey RESET** | Model is stable | 2.186800 | 0.1827 | correctly specified model |

Source: Author's Computation, 2024.

The Jarque-Bera test result in Table 6 indicates that the probability value (0.814881) above the 0.05 significance threshold, suggesting that the null hypothesis of normal distribution cannot be rejected. Consequently, this requires the acceptance of the null hypothesis, so concluding that the model follows a normal distribution. The Breusch-Godfrey Serial Correlation LM test result in Table 6 indicates that the probability value (0.1361) above the 0.05 significance threshold, suggesting that the null hypothesis of no serial correlation cannot be rejected. Consequently, this requires the acceptance of the null hypothesis, thereby concluding that the model exhibits no serial correlation issues. The Breusch-Pagan-Godfrey heteroskedasticity test result in Table 6 indicates that the probability value (0.0626) above the 0.05 significance threshold, suggesting that the null hypothesis of homoscedasticity cannot be discarded. Consequently, this requires the acceptance of the null hypothesis, so concluding that the model exhibits homoscedasticity. This indicates that relevant factors were not excluded. Finally, the Ramsey RESET test result in Table 6 indicates that the probability value (0.1827) above the 0.05 significance threshold, suggesting that the null hypothesis of proper specification cannot be rejected. Consequently, this requires the acceptance of the null hypothesis, so concluding that the model is accurately defined. This indicates that the model's functional form is accurate.

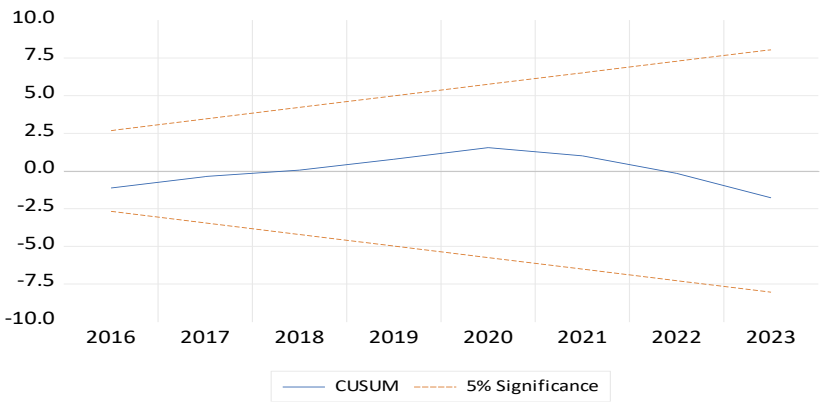


Figure 2: Stability Cusum Test

The cumulative sum (CUSUM) indicates that the CUSUM line stayed within the 5 percent critical bound while neither did CUSUM plot crosses the 5 percent critical lines. The implication of this is that there is stability of the long-run coefficients of the study variables.

## DISCUSSION OF FINDINGS

The long-run and short-run models estimated indicated that the amount of energy produced had a negative and considerable impact on the unemployment rate in Nigeria. An increase in power generation will significantly reduce the unemployment rate in both the long run and short term. This conclusion is corroborated by the empirical findings of Adamu and Maijama'a (2021), which indicate that energy consumption adversely affects unemployment hence has serious potential for job creation in Nigeria.

Secondly, the findings from the long-run and short-run estimations indicated that electricity consumption had a substantial negative correlation with the unemployment rate in Nigeria. This suggests that an increase in power consumption would result in a substantial reduction in the unemployment rate in Nigeria both in the long term and near term. The findings about the impact of energy availability on unemployment rates, which serve as a measure of economic progress, correspond with the study of Chama, Yahya, and Hindou (2021).

Thirdly, the long-run and short-run estimations indicated that access to electricity had a considerable negative impact on the unemployment rate in Nigeria. This suggests that enhanced access to electricity would result in a substantial rise in the unemployment rate in Nigeria, both in the short and long term. The study's results corroborated those of Mohammad and Mufidur (2023), which indicated that renewable energy use adversely affects unemployment in Bangladesh.

Ultimately, the findings from both the long-run and short-run estimations indicated that carbon emissions had a non-significant beneficial influence on the unemployment rate in Nigeria. This indicates that a rise in carbon emissions would result in a negligible increase in the unemployment rate in Nigeria, both in the long run and short term. The findings of this research contrasted those of Hlalefang, Nwabisa, Clement, Izunna, and Siyasanga (2020), who determined that renewable energy consumption had a negative and substantial impact on long-term unemployment.

### Concluding Remarks

This research empirically investigated the impact of energy availability on unemployment in Nigeria. The study's findings revealed that the volume of electricity generated, electricity consumed, and access to electricity significantly negatively impact the unemployment rate, suggesting that an increase in power generation, consumption and an affordable pricing of electricity have serious implication on job creation in Nigeria.

Nigeria has been battling with very high level of unemployment and low power generation. Most researchers and policy makers have attributed the rising unemployment and poverty to dearth in basic infrastructure like electricity generation and consumption. This study has shown that one of the ways to solving the rising trend in unemployment is the improvement in power generation, consumption and access (pricing). This could be achieved through increase investment in power generation, diversification of electricity generation source from the traditional fossil fuel to gas and renewable energy, mass metering of electricity consumption and an affordable and competitive pricing of electricity.

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