American International Journal of Business Management (AIJBM)
ISSN- 2379-106X, www.aijbm.com Volume 07, Issue 06 (June-2024), PP 85-98

Energy Access, Climate Change and Job Creationin Selected West African Countries: A panel investigation.

Polycarp Ihejirika[1], Alwell Nteegah[2]& Chijioke Nwaozuzu[3]
Emerald Energy Institute, University of Port Harcourt[1&3]& Department of Economics, University of Port Harcourt[2]

Abstract: This study examined the effect of energy access and climate change on unemployment levelin some selected West African countries. To achieve the purpose of this study, relevant theoretical and empirical literature on energy access, climate change, and economic development with focus on how unemployment level has responded to changes in the energy access and climate were reviewed. The selected six (6) countries of west African regionare: Benin, Ghana, Liberia, Nigeria, Senegal, and Sierra Leone based on energy consumption and population size. The period covered by the study is 1995-2022. Both statistical and econometric techniques were adopted for the analysis of the data. Based on the analysis of the data using the Arellano-Bond two-step GMM Dynamic Panel econometric technique, some key empirical findings were made are: Volume of electricity generated had positive and insignificant impact on unemployment rate. This shows that volume of electricity generated as measure of energy access was not a significant predictor of unemployment rate among the selected ECOWAS member countries during the period studied. Electricity consumed had a negative and significant impact on unemployment rate. This implies that electricity consumed as a measure of energy access reduced unemployment rate among selected ECOWAS member countries during the period reviewed. Access to electricity had a negative but insignificant impact on unemployment rate. This implies that access to electricity was not a significant predictor of job creation among selected ECOWAS member countries during the period reviewed. Carbon emission as the selected indicator for climate change impacted negatively but insignificantly on unemployment rate. This shows that climate change was not a significant predictor of unemployment rate and economic development among selected ECOWAS member countries during the period reviewed. Based on these findings the study recommended effective policies that will address electricity pricing, electricity subsidy and electricity metering in the selected west African countries and the sub region at large.

Key words: Unemployment rate, Energy access, electricity generated, electricity consumed, price of electricity and climate change

I. Introduction

Energy is required for all human activities and is hence essential for societal and economic development. Energy is a vital component for production, conversion, processing, and commercialization in all businesses. Energy, especially electricity, is generally recognised as a crucial factor in a nation's economic progress and development. It enhances productivity by augmenting inputs i.e. capital and labour. Hence, enhanced availability and utilisation of energy serve as a reliable measure of heightened economic activity, job creation and improvement in the general wellbeing of the people (Kayode, et al, 2016). Nevertheless, the use of fossil fuels as the primary source of energy production and consumption may substantially contribute to climate disparity owing to their substantial greenhouse gas (GHG) emissions. Energy access and climate change are closely interconnected, since the kind and accessibility of energy sources substantially influence the course of global climatic trends. The connection between energy availability and climate change is intricate, comprising the repercussions of existing energy practices and the opportunity for reshaping the energy landscape to alleviate climate effects. Essentially, the main link between energy availability and climate change is the release of greenhouse gases (GHGs) during the production and application of energy. Fossil fuel burning, comprising coal, oil, and natural gas, emits substantial quantities of carbon dioxide (CO2) and other greenhouse gases (GHGs) into the environment. These emissions contribute to the intensified greenhouse effect, which involves the retention of heat and results in global warming and climate change which may result in altering production activities and leads to job losses (Rodolfo & Drilona, 2022).

Globally, energy is essentially a key enabler of social and economic development and constitutes a basic requirement of nearly all productive economic activities. This implies that access to quality and reliable energy is desirable for social and economic development, and environmental sustainability. Sustain access transforms lives and economic structures in diverse ways including income generation, greater economic specialization, substitution of labour with capital that increases productivity,creation of business enterprises and employment generation. It

facilitates the reallocation of household time especially women from energy provision to improved education and access to veritable source of living; protection from extreme temperatures, access to greater market size due to lower transportation and communication costs; and potential health improvements due to reduced indoor smoke, cleaner water, improved refrigeration and improvement in general wellbeing of the people (Ekone&Amaghionyeodiwe, 2020).

According to Okeoma et al (2023) access to reliable and affordable energy is a cornerstone for enhancing employment and economic development, and the positive impact of improved energy access on many African countries is profound. A region with diverse economies and development challenges, west African sub region stands to benefit significantly from enhanced energy access. African Development Bank Group (2018) noted that improved energy access in African countries facilitates industrialization, allowing for the growth of manufacturing and energy-intensive industries. Reliable power supply is crucial for industrial processes, and increased energy access supports the development of a more diverse and resilient economy. Industries ranging from agro-processing to manufacturing can expand and contribute more substantially to the region's Gross Domestic Product and job creation. In addition,International Renewable Energy Agency (IRENA) (2019) stated that agriculture is a key sector in many west African countries, and improved energy access can significantly boost agricultural productivity and employment of labour. Access to electricity enables the deployment of modern agricultural technologies, such as irrigation systems and machinery, leading to increased yields and improved food security. Additionally, energy access supports the development of agro-processing industries, adding value to agricultural products which can in turn enhance job creation and economic development. In relation to this, enhanced energy access positively impacts Small and Medium Scale Enterprises (SMEs), which form the backbone of many west African economies. Reliable electricity supply allows SMEs to operate more efficiently, leading to increased productivity and competitiveness. This, in turn, contributes to job creation and income generation, fostering economic growth and development at the grassroots level.

World Bank (2017) stated that countries with improved energy infrastructure and reliable electricity supply are more attractive to foreign investors. Access to energy is a critical factor for industries seeking to establish operations in a region. The availability of energy can influence investment decisions, leading to increased Foreign Direct Investment (FDI) in west African countries, thereby contributing to economic growth and development. In the same vein, the development of the energy sector itself creates employment opportunities. From the construction of energy infrastructure to the maintenance and operation of power plants, job creation in the energy sector has a positive impact on overall employment rates in many African countries. Additionally, increased energy access stimulates economic activities, creating a conducive environment for job creation across various sectors (Armeanu, et al 2021). Dada (2019). Concluded that improved energy access has far-reaching positive impacts on the economic development of African countries. From driving industrialization and agricultural productivity to fostering SME growth, the benefits extend across sectors, contributing to inclusive and sustainable development. As African countries prioritize initiatives to enhance energy access, they are not only addressing a fundamental infrastructure challenge but also unlocking the economic potential that will propel the region toward greater prosperity. Drawing from the foregoing, the thrust of this paper is to empirically examine the effect of energy access and climate change on job creation in west African sub region. We shall continue our investigation by reviewing relevant literature, followed by the methodology of the study, results and discussions and concluding remarks.

II. Literature Review

The energy transition theory encompasses the theoretical framework and guiding concepts that facilitate the shift of energy use from conventional, fossil fuel-based sources to more sustainable, low-carbon, and environmentally friendly alternatives. The impetus for this transformation stems from the acknowledgment of the need to tackle urgent global issues i.e. climate change, energy security, job creation and environmental sustainability. Energy transition theory is a comprehensive approach that incorporates several disciplines, comprising economics, technology, politics, and social dynamics. The concept of connecting consumption of energy to economic prosperity is mostly owing to the energy transition hypothesis. Hosier and Dowd (1987) and Leach (1992), who support the energy transition hypothesis, established a connection between the kind of energy utilized, job creation and income level. Energy is often considered to be a primary catalyst for the contemporary economy, particularly in nations that have had fast expansion in recent years. The idea posits that access to energy and consumption of energy patterns of a nation are closely correlated with job creation and per capita income. Owing to consumer theory, this idea suggests that as people's wealth rises due to employment, they are more likely to switch from traditional or lower-quality energy sources to contemporary energy sources because of the convenience and comfort these provide. As attested by the idea, there is a clear correlation between economic level

and consumption of energy. Wealthy nations prefer to use a greater amount of high-quality energy compared to poorer ones. Moreover, Energy Transition theory asserts that a nation's ability to alleviate poverty and achieve sustainable prosperity is hindered by inadequate access to modern energy. The reason for this is that having access to energy is crucial for any effort to reduce poverty (Pachauri & Spreng, 2004), as a lack of energy hinders output and restricts economic activity levels (Kaygusuz, 2011; Sovacool, 2012). Though this theory seems to be more relevant to present day development reality given the high level of environmental degradation caused by the reliance on fossil fuel. However,the low access to diverse energy sources due to limited energy sources and dearth of energy infrastructure in sub-Sahara Africa appear to exclude the region from this development trajectory.

Umoidem, Nteegah and Osokogwu (2024) investigated the impact of energy prices on the unemployment rate in Nigeria from 1981 to 2021. The study obtained data on unemployment rate, hydro energy price, crude oil price, natural gas price, electricity tariffs, and electricity consumption from the World Bank and the International Energy Agency. These data were then analysedutilising the Autoregressive Distributed Lag (ARDL) approach to fulfil the study's objective. The findings of the research and conclusions indicate that: The use of hydro energy in Nigeria's economy has had a little impact on reducing unemployment in the long term, but it does not have any immediate influence on the unemployment rate in the near term. The long-term impact of crude oil price on unemployment in Nigeria is little, but in the short term it has a substantial effect on reducing the amount of unemployment. The long-term impact of the decline in natural gas prices on the unemployment rate was only somewhat favourable, but in the near term, it had a mixed effect on the level of unemployment, which was also considerable. Electricity tariffs had a long-term impact on the unemployment rate, leading to an upturn. However, in the near term, their influence on unemployment was varied and substantial. Electricity consumption had a favourable impact on job creation in the long term, but its effects on unemployment in the near term were varied and not substantial. The findings also demonstrated a persistent nexus between energy cost and unemployment levels in Nigeria throughout the research period.

Mohammad and Mufidur (2023) investigated the interplay between renewable energy development, unemployment and GDP growth within Bangladesh, India, Pakistan and Sri Lanka. The research underscores the significant role of renewable energy plays in stimulating economic growth and mitigating unemployment, offering crucial policy insights for sustainable growth in South Asia. By utilizing the autoregressive distributive lag (ARDL) framework and Toda Yamamoto causality through the vector autoregressive (VAR) approach, the study analyzed the longterm and short-term impacts of these variables from 1990 to 2019. The result of the study revealed a significant co-integration among renewable energy consumption, unemployment and GDP growth in selected South Asian countries. The long-term estimation showed renewable energy consumption influences negatively economic progression in Bangladesh, with no notable correlation with unemployment. In contrast, Sri Lanka demonstrated an optimal relationship among all the variables. Short-run assessments reveal a significant positive relationship between renewable energy consumption and economic growth in India, while an inverse relationship is evident in Pakistan. Moreover, the relationship between unemployment and economic progression, the result shows a negative and significant relationship in India and Sri Lanka.

Mawunyo, Philip and Andrea (2022) examined the nexus between unemployment and energy efficiency, conditioning for heterogeneities in education. The study applied the stochastic frontier approach and the generalized method of moments to an unbalanced panel dataset for 51 African countries, spanning 1991–2017. The study conducted several robustness checks to assess the stability of the estimated relationship. The results confirmed the theoretical prediction that, directly, energy efficiency reduces unemployment. However, further empirics showed that economies with better human capital experience greater reduction in unemployment than those with less-developed human capital. This implies that investing in education is a key complementary factor to enhance the unemployment-reducing effects of energy efficiency.

Adamu and Maijama'a (2021) investigated the connection among electricity energy consumption, unemployment, inflation and transport in Nigeria using annual data over the period of 1990 to 2019. Zivot-Andrews (1992) break point unit root test was used for stationarity test. Structural break is accounted for after Chow (1960) test and CUSUM of Square plot confirmed the existence of the break. Theoretical Philips curve was rejected by both Fully Modified Ordinary Least Square (FMOLS) and Ordinary Least Square (OLS) regression as the relationship is positive. Impulse response function further affirmed the positive response of unemployment to inflation. Transport energy consumption has significant negative impact on unemployment; the same is obtained by its interaction term also. End of both short-run and long run periods of variance decomposition indicated electricity and transport energy consumptions better explained unemployment than the inflation in Nigeria. While transport explained 5.3% and 3.8% of unemployment at respective end of short-run and long-run period, electricity explained 7.4 and 8.0% of unemployment leaving 0.9% and 3.2% accounted by inflation. Unemployment better explained inflation both end of

short run and long-run followed by transport energy by the end of short run and electricity by end of long-run. The study recommended the need for provision of sufficient and affordable electric and transport energy to address the menace of unemployment in Nigeria.

Muktar and Abdullahi (2021) examined the impact of electricity supply on unemployment in Nigeria. It focused on how the epileptic power situation inhibits industrialization and at the same time fuels unemployment in the country. To this end, annual time series data were collected for a period of 36 years from 1986-2020; and were analysed using the Ordinary Least Squares (OLS) technique. Findings from the study revealed a strong positive linear correlation between unemployment reduction and electricity supply, while it established a negative correlation between unemployment reduction and government policy. This suggest that reduction in unemployment is a function of both adequate and reliable power supply particularly to the industrial sector of the country. It therefore, recommends that the government invest more in the power sector of the country through improved budgetary allocation.

Chama, Yahya and Hindou (2021) carried out a study on the role of renewable energy sector in reducing unemployment: The Moroccan case. The objective of this study is to highlight the benefits of green economic recovery policies, on the employment in Morocco, especially for the renewable energy sector. The causality between renewable energy consumption and unemployment will be tested using the VAR model, the Johansen co-integration test, and the Granger causality test, for the period 1990-2017. The results suggested that there is causality running from renewable energy consumption to unemployment. In fact, renewable energy sector can contribute to reduce the employment rate in Morocco. Investments in the sector can then be made to create jobs, particularly after the Covid-19 pandemic, that caused many jobs losses.

Veli, et al (2020) examined the relationship between unemployment rates and renewable energy consumption: Evidence from Fourier ADL Cointegration Test. To this end, the study used a recently introduced cointegration test that allows structural breaks whose number, location, and form do not affect the accuracy of the test, to examine the long - term relationship between unemployment rates and renewable energy consumption for selected countries of the Organisation for Economic Co-operation and Development (OECD). The study found answered the question that whether new energy technologies create new employment areas or not and help to solve unemployment problem. The results showed that there is a cointegration relationship between the variables for Australia, Austria, Chile, France, Germany, Japan, Mexico, Portugal, Spain and United States. The results also showed that renewable energy consumption positively affects the unemployment rates for Austria, Portugal, and Spain, while it negatively affects the unemployment rates for Australia, Chile, France, Germany, and Japan.

Hlalefang, et al (2020) examined the relationship between renewable energy consumption and unemployment in South Africa over the period 1990-2014. The autoregressive distributed lag model was employed to test the long-run and short-run impacts of renewable energy consumption on unemployment. The results revealed that renewable energy consumption has a negative and significant effect on unemployment in the long-run. However, in the short-run, the variables have an insignificant relationship. The study therefore advocates for an increase in the production and consumption of renewable energy in order to boost employment levels.

Musa and Maijama (2020) have also studied the causality between renewable energy consumption and unemployment in Nigeria for the period 1991-2015. The authors used the Toda and Yamamoto causality test. The result of long-term causality confirms that there is a bidirectional causality between renewable energy consumption and unemployment as well as between foreign direct investment and renewable energy consumption. The study recommended the deployment of energy production from renewable sources, and confirms the impact of the sector on reducing the country's unemployment rate.

Shuddhasattwa, Ruhul and Sgro (2018) also studied the relationship between renewable energies consumption and unemployment over a sample of 41 countries and over a period from 1980 to 2014. The study used ordinary least squares estimates Fully Modified by Panel (FMOLS) and Dynamic Ordinary Least Squares (DOLS) as well as Granger causality test. According to the results of the FMOLS and DOLS estimators, there is positive role of industrialization, service sector, public expenditure and trade openness in reducing unemployment. However, the results have showed that agriculture and renewable energy consumption increase unemployment.

George and Oseni (2012) addressed the question of the impact of electricity power on unemployment rates in Nigeria. This study, using an ordinary least square regression model examined the influence of electricity power outputs, supply and consumption in addressing the high rate of unemployment in Nigeria. The study which covered the period of 1970 to 2005 discovered that power supply to the industrial sector was lower than the supply for residential consumption. The study also established that the major cause of unemployment in Nigeria can be traced to inadequate and unstable power supply to the industrial sector. The study advised the government and the policy

makers to invest more in electricity power generation and ensures that the industrial sector is given a higher priority in the supply of electricity if the high unemployment rate is to be abated.

Williams et al (2022) utilised the Johansen co-integration method and the Vector ECM (VECM) to empirically determine the outcome of electricity prices on the growth and development of small and medium enterprises (SMEs) in the Ashanti Region of Ghana. Electricity costs have a detrimental and long-term effect on the growth and development of SMEs, as attested by the study's findings. The finding also reveals that there is a unique and unfavourable correlation between power costs and the development of SMEs over the long term. There was an unfavourable correlation between higher energy rates and the creation and expansion of SMEs. Research indicated that there is a 0.68% lag between a 1% rise in ELEC (average electricity price upturns) and a corresponding decrease in PRO. In addition, a 1% rise in PPI is 1.2% behind PRO, as seen in the VECM results.

Kahn et al (2021) evaluated how climate change would affect the economy in the long run. Although they did not find any statistically substantial impacts for variations in precipitation, they did find that consistent rise in temperature had a detrimental result on per-capita real production. As attested by their hypothetical study, the world's real GDP per capita would fall more than 7% by the year 2100 if the average global temperature were to rise by 0.04°C year without any mitigating measures. However, if we stick to the Paris Agreement and keep the annual temperature rise to 0.01°C, we can drastically cut the loss to about 1%. Depending on the rate of temperature rise and the diversity of weather conditions, these impacts seem to vary considerably among nations. With the application of time series data (1980–2017), Adejumo (2021) appraised how climate change may affect the expansion of the Nigerian economy. For this purpose, it has utilised a growth model that is an adaptation of the Solow model and econometric technique. The study concluded that average yearly rainfall substantially affects economic growth in the short and long terms. Carbon emissions, FDI, gross fixed capital formation, and economic growth are all favourably and substantially correlated with one another. This relationship between weather and GDP growth becomes more apparent over longer time periods, the study found. Furthermore, long-term data showed an unfavourable association between forest loss, populace growth, and economic growth. Last but not least, the link between average yearly rainfall and economic upturn in Nigeria is unidirectional. It therefore recommended that Stakeholders and the public at large should work towards a green economy that supports carbon sinking and the development of a carbon market

Employing yearly time series data from 1965–2015, Muhammad, (2020) examined the interplay between energy use, GDP growth, and CO_2 emissions in Pakistan. Both the short-term and long-term estimates from ARDL pointed to rising CO2 emissions in Pakistan as a consequence of rising consumption of energy and economic upturn. The predicted upshots led to the recommendation that Pakistani policymakers embrace and support energy sources which are renewable to assist satisfy the nation's growing energy demand, rather than relying on fossil fuels. Recycling energy from renewable sources may help Pakistan's economy grow sustainably while cutting down on carbon emissions.

Geetilaxmi and Giri (2020) utilised yearly time series data for India from 1981 to 2017 to empirically study the link between energy use, economic progress, energy pricing, and technological advancement. The research confirmed the existence of a long-run equilibrium connection among the variables by utilising the ARDL limits testing technique to co-integration. While technical progress has an unfavourable impact on power consumption in the short and long term, the research found that economic expansion has a favourable and substantial effect on power consumption. As attested by the Granger causality studies, there is a one-way link between India's rising power consumption and the nation's improving economy and technology. It therefore recommended that policymakers in India should, as attested by the report, spend more money into the nation's electrical infrastructure if they want to sustain its rapid economic expansion and Government officials and policymakers should also push for more technical innovation to reduce reliance on fossil fuels and boost renewable energy production.

François and Mignon (2008) examined the link between oil prices and a number of macroeconomic indicators for a number of nations, comprising both those that import and export oil. Their goal was to determine the outcome of oil prices on the economy. Share prices, the unemployment rate, consumer price index (CPI), GDP, and household spending were all comprised in the research. The upshots showed that oil prices and macroeconomic factors interact with one another. The correlation between oil and stock prices is strongest in the near term. There was also the discovery of long-term interaction with a causal chain connecting oil prices to macroeconomic factors. In 2004, Barrios, Ouattara, and Strobl evaluated how developing nations in Sub-Saharan Africa (SSA) and non-SSA (NSSA) are adjusting to climate change in terms of overall agricultural output. Within the context of agricultural output, the research made application of a novel cross-national panel meteorological dataset. The research found that agricultural productivity in NSSA nations seems to be unaffected by climate change, in contrast to SSA nations where it has had a substantial consequence on agricultural output (as assessed by changes in nationwide rainfall and

temperature). Furthermore, the estimates-based simulations reveal that the unfavourable climatic changes since the 1960s may explain a substantial chunk of the disparity in agricultural output between SSA and the other emerging nations.

Boxal, Chan, and McMillan (2004) utilised two variables—the hazard effect and the amenity effect—to examine how crude oil and natural gas infrastructures affected the value of residential properties in rural areas. Within four kilometres of residential homes, they found that flaring platforms and natural gas wells reduced the property's value. The survey also found that the sourer gas wells there were, the lower the property values were. These upshots demonstrate the dangers to human health that come together with hydrogen sulfide's detrimental consequence on property values. Natural gas contains hydrogen sulphide. The health risks associated with hydrogen sulphide have led the World Health Organisation (WHO) to ban its inhalation. Exposure to hydrogen sulphide has short-, medium-, and long-term unfavourable health consequences, as attested by the World Health Organisation (2003). People may become infertile, poisoned, or even die from prolonged exposure to hydrogen sulphide. Long-term exposure to hydrogen sulphide may cause a variety of health problems, comprising but not limited to: eye illness, respiratory stress, neurological disorders, cardiovascular disease, metabolic syndrome, and a lack of appetite (WHO, 2019).

The review done above shows that a lot of works have been done on nexus between access to energy, climate change and job creation. However, empirical works on energy access and climate change affect the economy of less developed countries especially sub-Saharan Africa seems to be paltry. The few available tend to have contentious findings. This study seeks to fill these gaps.

III. Methodology

Theoretically, the analytical framework of this study is built on Energy-Led Growth Hypothesis due to its relevance and application to this study. The Energy-Led Growth Hypothesis posits that energy access and consumption plays a pivotal role in driving economic performance like: growth, job creation and price stability and development. According to this hypothesis, an increase in energy access and consumption leads to higher levels of economic activity and development (reduction in unemployment and poverty). Empirically, the model for this study isadapted from the work of Ishioro (2020). This model is adapted in line with the purpose of this study with slight modifications. The modified model is expressed in its functional, pooled, fixed effect and random effect forms respectively:

FunctionalModel Specifications

$UMR = f(EPR, VEG, ELC, CES)$ 1

Pooled Regression Model Specifications

$UMR_{it} = \beta_0 + \beta_1 EPR_{it} + \beta_2 VEG_{it} + \beta_3 ELC_{it} + \beta_4 CES_{it} + U_{it}$ 2

Fixed Effect Model Specifications

$UMR_{it} = \beta_0 + \beta_1 EPR_{it} + \beta_2 VEG_{it} + \beta_3 ELC_{it} + \beta_4 CES_{it} + \sum_i^9 = 1\beta_i idum\varepsilon 1_{it}$ 3

Random Effect Model Specifications

$UMR_{it} = \beta_0 + \beta_1 EPR_{it} + \beta_2 VEG_{it} + \beta_3 ELC_{it} + \beta_4 CES_{it} + \mu i + \varepsilon 1_{it}$ 4

Where: f=function of,β_0= intercept, UMR = Unemployment rate, EPR= Electricity price, VEG= volume of electricity generated, ELC= Electricity consumed, CES= Carbon emission, β_1, β_2,β_3&β_4 = Coefficient of the independent variables, $\varepsilon 1_{it}$ = Stochastic/disturbance term.

The data on the variables in the equations above were obtained from International Energy Agency, International Monetary Fund (IMF) Statistics and World Development Indicators of World Bank. These sources of data are considered reliable and dependable. The data covers the period from 1995 to 2022 indicating twenty-eight years sample observations.

Panel Unit Root Test

For a direction in our estimation, it is imperative to assess if the fundamental processes that produced the data series may be considered unchanging across time. Representing a time series with equations that have fixed coefficients can be challenging when the process is non-stationary (Pindyck&Rubinfeld, 1998). Various panel unit root tests have been introduced to analyse the stationary characteristics of panel data. In this work, we will use unit root tests developed by Levin, Lin and Chu (2002), ImPesaran and Shin (2003), and the Fisher-type test of Maddala and Wu (1999) and Choi (2001). Building on the work of Dickey and Fuller (1979, 1981), Levin, Lin and Chu (2002) examined a panel extension of the null hypothesis that each individual time series in the panel has a unit root, as opposed to the alternative hypothesis that all individual series are stationary (Hsiao, 2003). The study conducted by ImPesaran and Shin (2003) incorporates a diverse co-efficient of y_{it-1} and suggests an alternate method for testing, which involves averaging the unique unit root test results. Pesaran and Shin (2003) proposed utilising the

average of the ADF tests where the error term (u_{it}) exhibits serial correlation with varying properties across distinct cross-sectional units. The ADF regression model is generally defined as follows:

$\Delta y(t) = \alpha + \beta t + \gamma y(t-1) + \Sigma\varphi^*\Delta y(t-i) + \varepsilon(t)$ 5

Where; $\Delta y(t)$ = the first difference of the time series variable, α and β = the intercept and slope co-efficients, $y(t-1)$ = the lagged level of the variable, $\Sigma\varphi^*\Delta y(t-i)$ = the lagged differences, $\varepsilon(t)$ = the error or disturbance term.

IV. Results

Summary Statistics

These were computed using the real values of the variables under study. The descriptive statistics assists in explaining the properties of the data both individually and collectively. Table 1 shows the summary of the dataset and the details of the observations (i.e., N =168, n = 6, and T = 28). This table presents source of all variables means, standard deviations (overall, between and within countries), and minimum and maximum values. The statistical description of the variables is crucial to observe the distribution and variability of the studied variables. This is done to circumvent the likely problems associated with time series and cross-section data. All the variables display considerable variation both between and within countries. For example, the between and within standard deviation statistics of unemployment rate are 1.98 and 1.42 respectively. Moreover, the between and within standard maximum statistic for access to electricity are 60.23 and 64.01 respectively. This suggests that the use of panel estimation techniques, which allows the identification of the various parameters of interest, is reasonable.

Table 1: Summary Statistics Result

Variable		Mean	Std.Dev.	Min	Max	Observations
UMR	overall	4.03	2.30	0.69	10.46	N = 168
	between		1.98	1.35	6.67	n = 6
	within		1.42	0.22	8.76	T = 28
VEG	overall	33.75	41.06	0.03	100	N = 168
	between		44.76	0.82	97.35	n = 6
	within		2.48	22.11	44.31	T = 28
ELC	overall	130.24	102.57	18.97	409.45	N = 168
	between		105.57	40.92	316.78	n = 6
	within		34.30	24.08	222.90	T = 28
CES	overall	3841.01	4645.81	33.15	19902.56	N = 168
	between		4154.59	46.44	10352.44	n = 6
	within		2667.13	-3327.03	13391.13	T = 28
ACE	overall	35.75	22.17	1.11	88.49	N = 168
	between		20.99	9.26	60.23	n = 6
	within		11.06	7.97	64.01	T = 28

Source: Author's Computation, 2024

Figure1 shows that while unemployment rate is worse (i.e., higher) in Ghana, Senegal and Nigeria while Benin and Liberia recorded the lowest rate of unemployment during the period under review.

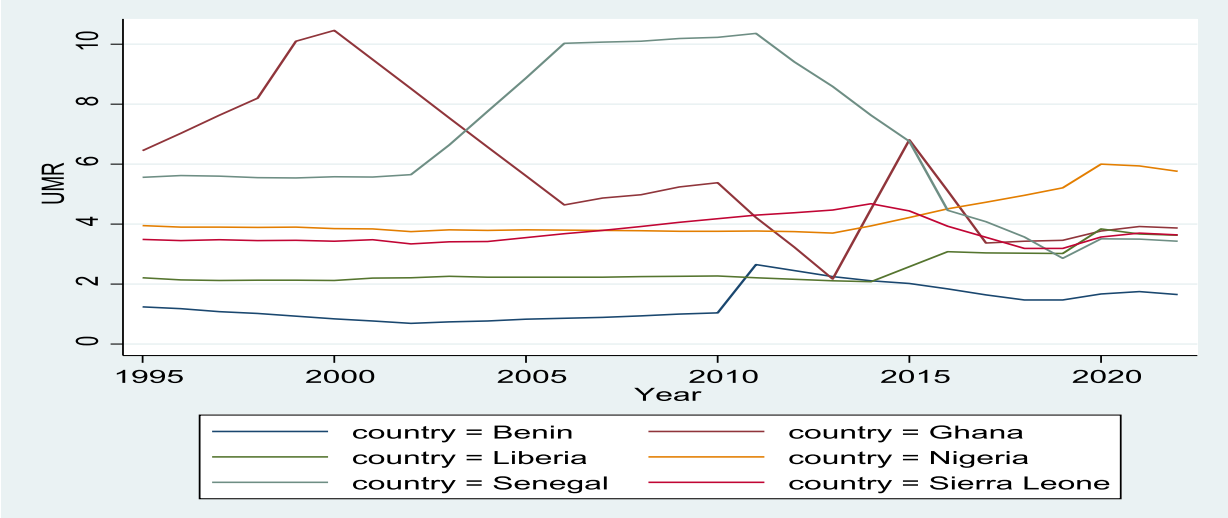

Figure 1: Line graph showing trend in Unemployment Rate (UMR)
among theSelected African Countries
Source: Author's Plot, 2024.

Table 2. Pesaran (2015, 2021) Panel Cross-Sectional Dependence (CSD) Test Results

Variable	CD Test Statistic	P-value	Decision
UMR	-1.45	0.146	Weak CSD
VEG	0.51	0.613	Weak CSD
ELC	7.43**	0.000	Strong CSD
CES	9.02**	0.000	Strong CSD
ACE	18.41**	0.000	Strong CSD

Note: (**) and (*) indicates significant at 1% and 5% respectively.
Source: Authors' computation, 2024.

The cross-sectional dependence (CSD) test is another necessary preliminary test. In panel data analysis, the usual assumption is that disturbances in panel models are cross-sectionally independent, especially when a large cross-section (*N*) is involved. Meanwhile, in reality, the cross-sectional dependence in panel analysis appears to be the rule of the game; thus, it cannot be underestimated (Adams & Klobodu, 2017; Beckmann &Czudaj, 2017; Pesaran, 2004, 2015). Therefore, assuming cross-section independence may pose serious problems that may result in estimator inefficiency and invalid test estimates. The result of the Pesaran (2015, 2021) cross-sectional dependence (CD) test in Table 2 showed the existence of cross-sectional dependence as the test strongly rejected the null hypothesis of cross-sectional independence at a 1% significance level in majority of the selected variables with failure to reject the null hypothesis of cross-sectional independence in the case of only two variables namely unemployment rate (UMR) and volume of electricity generated (VEG). This finding highlighted the importance of accounting for cross-unit lagged interdependence across countries of the study.

Since Pesaran's CSD test revealed strong cross-sectional dependence across units for majority (i.e., four), indicating that the panel was heterogeneous; and weak cross-sectional dependence across units for two variables; the study, therefore, examined further the stationarity of the variables with panel unit root tests, assuming heterogeneous slopes for the four variables. While the Im, Pesaran& Shin test (IPS) and Levin–Lin–Chu (LLC) heterogeneous panel unit roots tests were employed for the four variables that exhibited strong CSD across all units, the Pesaran CIPS and ADF-Fisher were employed for the two variables (namely unemployment rate and volume of electricity generated) that shows weak cross-sectional dependence across units. The results in Table 3 showed that while volume of electricity generate was stationary at level under the first-generation panel unit roots tests results panel, unemployment rate only became stationary after first difference. The result in Table 3. also shows that the second-generation heterogenous panel unit root test shows that that while two of variables were stationary at levels, the other two only became stationary after first difference under Pesaran CIPS and ADF-Fisher tests results.

Table 3. Panel data unit root tests results

Unit Root Tests	**Panel A: First generation panel unit root tests results**				
	UMR	VEG	ELC	CES	ACE
Im-Pesaran-Shin (IPS)					
Level	-1.59 (0.42)	-2.45** (0.00)	-	-	-
First Difference	-3.48** (0.00)	-	-	-	-
Status	I(1)	I(0)	-	-	-
Levin-Lin-Chu (LLC)					
Level	-1.32 (0.09)	-7.30** (0.00)	-	-	-
First Difference	-3.46** (0.00)	-	-	-	-
Status	I(1)	I(0)	-	-	-
Unit Root Tests	**Panel B: Second generation panel unit root tests results**				
	UMR	VEG	ELC	CES	ACE
Pesaran CIPS					
Level	-	-	1.55 (2.33)	2.72** (2.57)	3.18** (2.57)
First Difference	-	-	5.19** (2.57)	-	-
Status	-	-	I(1)	I(0)	I(0)
Fisher-type					
Level	-	-	2.63** (0.00)	0.50 (0.31)	0.22 (0.41)
First Difference	-	-	-	20.75** (0.00)	22.89** (0.00)
Status	-	-	I(0)	I(1)	I(1)

Note 1: (**) and (*) indicates significant at 1% and 5% level respectively. Note 2: While p-values are in bracket (...) under the IPS, LLC and the Fisher-type unit root tests statistics,the critical values are in bracket (...) under the Pesaran CIPS unit root test statistics.
Source: Author's Computation, 2024.

Panel Cointegration Test

Two panel data cointegration tests were conducted to determine the presence of absence of a long run relationship between the variables in each of the models of interest in this study. They are the Kao and Pedroni cointegration tests. While the results of the Kao cointegration test is presented in panel A of Table 4 below, the results of the Pedroni cointegration test is presented in panel B.

Table 4Panel data cointegration test results

Panel A: Kao Pedroni cointegration test results

Dep. Var	Modified Dickey-Fuller t	Dickey-Fuller t	Augmented Dickey Fuller t	Unadjusted Modified Dickey-Fuller t	Unadjusted Dickey-Fuller t	Comments
UMR	-1.0201 (0.1538)	-0.7758 (0.2189)	-1.6078 (0.0539)	-0.6388 (0.2615)	-0.5724 (0.2835)	No cointegration
Panel B: Pedroni cointegration test results						
Dep. Var	Modified Phillips-Perron t		Phillips-Perron t	Augmented Dickey Fuller t		Comments
UMR	2.3091** (0.0105		0.7822 (0.2171)	0.7015 (0.2415)		No cointegration

Note: (**) and (*) indicates significant at 1% and 5% level respectively.

Source: Author's Computation, 2024

The panel cointegration test result is presented in Tables 4 shows that we cannot fail to reject the null hypothesis of no cointegration between the variables in the unemployment model and under the both tests conducted. The results show that at no point did all the statistics under the unemployment model prove to be statistically significant. Though some of the statistics proved significant under both test in the model (e.g., the Modified Phillips-Perron t under the Pedroni test for the unemployment rate model), it was not sufficient to decide that a cointegrating relationship exist between the variables in the model. Hence, the econometric technique adopted for estimating the models ignores the estimation of an error correction term.

Dynamic Panel Data (DPD) Generalised Method of Moments Estimation of the Unemployment Rate Model

Dynamic panel data (DPD) methodology offers some advantages in comparison to the static version. The possibility to address the heterogeneity of the individuals also serve as one of the advantages of DPD. Several empirical studies on the economy have used databases with long time period and smaller number of individuals like this study.

Table 5: Arellano-Bond *one-step* GMM Dynamic Panel Data (DPD) Unemployment Rate Model (Dependent Variable = Unemployment rate)

Explanatory Variables	Coeff.	St. Error	Z	P>|z|
UMR L1	0.6939***	0.1328	5.23	0.000
LNVEG	0.0674	0.0854	0.79	0.430
LNELC	-0.8058***	0.3648	-2.21	0.027
LNCES	-0.5058	0.3235	-1.56	0.118
LNACE	-0.1033	0.2700	-0.38	0.702

Note 1: (***), (**) and (*) indicates significant at 1%, 5% and 10% level respectively. Note 2: The internal instruments employed are LNVEG, LNELC, LNCES, and LNACE.

Source: Author's Computation, 2024.

Though some authors have proposed methodologies like seemingly unrelated regression (SURE) and generalized least square (GLS) (Pesaran, 2006), Kripfganz (2014) recommended the Arellano-Bond one-step GMM estimator with strictly exogenous covariates and curtailed/collapsed instruments technique as most appropriate for a panel that with an extremely small cross-sectional units N (i.e., $N = 6$ in this case), irrespective of T. The presentation and interpretation of the estimation of the Arellano-Bond one-step GMM follows next. The Stata*xtdpdgmm*commandwas used for analysing the panel data.

Table 5 shows the results of the Arellano-Bond one-step GMM dynamic panel estimation of unemployment (using unemployment rate as the dependent variable). First, the result shows that the coefficient of one-period lag of unemployment rate (UMR) appeared with a positive sign (i.e., 0.6939). This implies that one-period lag of unemployment ratehad a positive impact on the level UMR. The standard error (i.e., 0.1328), z-score (i.e., 5.23), and the p-value (i.e., 0.000) shows that the coefficient of one-period lag of UMR is statistically significant at 1% level of significant error. Second, the estimator of natural log of volume of electricity generated appeared with a positive sign (i.e., 0.0674). This implies a positive relationship between volume of electricity generated and unemployment rate. The standard error (i.e., 0.0854), z-score (i.e., 0.79), and the p-value (i.e., 0.430) shows that the coefficient of volume of electricity generated is not statistically significant at any level of significant error. Third, the estimator of natural log of electricity consumed appeared with a negative (i.e., -0.8058). This implies the volume of electricity consumed impacted negatively on unemployment rate among the selected African countries during the period under review. Also, standard error (i.e., 0.3648), z-score (i.e., -2.21), and the p-value (i.e., 0.027) shows that the coefficient of volume of electricity generated is statistically significant at 5% level of significant error. Fourth, the estimator of natural log of carbon emission appeared with a negative (i.e., -0.5058). This implies the level of carbon emitted impacted negatively on unemployment rate among the selected African countries during the period under review. But the standard error (i.e., 0.3235), z-score (i.e., -1.56), and p-value (i.e., 0.118) shows that the coefficient of level of carbon emitted is not statistically significant at any level of significant error. Lastly, the estimator of natural log of access to electricity appeared with a negative (i.e., -0.1033). This implies the percentage of population with access to electricity impacted negatively on unemployment rate among the selected African countries during the period under review. But, the standard error (i.e., 0.2700), z-score (i.e., -0.38), and p-value (i.e., 0.702) shows that the coefficient of level of carbon emitted is not statistically significant at any level of significant error.

Post-Estimation Diagnostics Results for Arellano-Bond One-step GMM Dynamic PanelUnemployment Rate Model

The results of the post-estimation diagnostics tests for the unemployment rate model are presented in Table 6. First, the result of the autocorrelation test (Arellano & Bond, 1991) shows that while the study fails to reject the null hypothesis of no first-order autocorrelation (i.e., p-value = 0.4280>0.05) in the error term, it rejects the null hypothesis of no second-order serial correlation in one-step GMM dynamic of the main model at the 5% level. Moreover, as also shown in table the p-value result of the Sargan-Hansen test implies not rejecting the null hypothesis of joint validity in the dynamic panel model in at least one of the steps weighting matrix (i.e., under the 2-step weighting matrix as p-value > 0.05). Hence, the instrument variable is valid and can be used to estimate the unemployment rate model using the Arellano-Bond one-step GMM dynamic estimation approach.

Table 6: Result of post-estimation tests onUnemployment Rate Model

Arellano-Bond test for autocorrelation of the first-differenced residuals		Sargan- Hansen test of overriding restrictions	
Order 1 z [Pr > z]	Order 2 z [Pr > z]	1-step moment function, 1-step weighting matrix chi2 [Pr > chi2]	1-step moment function, 2-step weighting matrix chi2 [Pr > chi2]
-0.4280 [0.6687]	-2.9045** [0.0037]	9.1433* [0.0274]	6.0000 [0.1116]

Note 1: (***), (**) and (*) indicates significant at 1%, 5% and 10% level respectively.
Source: Author's Computation, 2024.

Discussion of findings

Significant findings could be found from the data analysis to examine the effect of energy access and climate change on unemployment rate in west African sub region. Therefore, analysing the results following the literature review is a valuable endeavour. First, the study investigated the effect of energy access on economic development using unemployment rate. Moreover, three variables were selected for measuring energy access. From the analysis of data, only one of the energy access variables (i.e., electricity consumed) had a negative and significant impact on unemployment rate. The finding on the effect of energy access on unemployment rate as an indicator of economic development conforms with the study by Ikpe and Oyedeji (2023) and Wang et al (2022) who found that electric power consumption had a negative effect on unemployment rate. Also, the finding of this study disagrees with the studies by Okonkwo and Ogbonna (2018) which found a linear (direct) relationship between crude oil price and unemployment rate in Nigeria.

Lastly, the study investigated the effect of climate change on unemployment rate countries in West African sub region. Though the climate change variable (i.e., carbon emission) had a negative and impact on unemployment rate, an insignificant effect was revealed in this study. The findings of this study did not conform to the findings of the study by Kahn et al. (2021) and Babatunde and Ayodele (2015) who found that climate change to have a significant negative effect on per-capita real output and economic growth.

V. Concluding Remarks and Recommendations

This study examines the effect of energy access and climate change on unemployment level in some selected West African countries. To achieve the objectives of this study, the researcher reviewed relevant theoretical and empirical literature on energy access, climate change, and economic development with focus on how unemployment level has responded to changes in the energy access and climate. Moreover, this study selected six (6) member countries of ECOWAS namely Benin, Ghana, Liberia, Nigeria, Senegal, and Sierra Leone based on energy consumption and population size. The period covered by the study is 1995-2022.

Both statistical and econometric techniques were adopted for the analysis of the data. Based on the analysis of the data using the Arellano-Bond two-step GMM Dynamic Panel econometric technique, some key empirical findings were made are: Volume of electricity generated had positive and insignificant impact on the selected economic development indicators (i.e., unemployment rate and poverty index). This shows that volume of electricity generated as measure of energy access was not a significant predictor of economic development among the selected ECOWAS member countries during the period reviewed. Electricity consumed had a negative and significant impact on unemployment rate. This implies that electricity consumed as a measure of energy access reduced unemployment rate among selected ECOWAS member countries during the period reviewed. Access to electricity had a negative but insignificant impact on unemployment rate. This implies that access to electricity was not a significant predictor of job creation among selected ECOWAS member countries during the period reviewed.

Carbon emission as the selected indicator for climate change impacted negatively but insignificantly on unemployment rate. This shows that climate change was not a significant predictor of unemployment rate and economic development among selected ECOWAS member countries during the period reviewed.
Based on these findings the study recommended effective policies that will address electricity pricing, electricity subsidy and electricity metering in the selected west African countries as possible measures toward job creation and improve living standard in the region.

References

[1]. Adamu, S., &Maijama'a, D. (2021). Investigation of the nexus among electric energy consumption, unemployment, inflation, transport in Nigeria. *Journal of Economics, Management & Social Science, 7*(1), 61-79.

[2]. Adejumo M.O. (2021). Climate change and economy in Nigeria: A quantitative approach. *ActaEconomica, 19*(34), 167-179.

[3]. Armeanu, D. S., Joldes, C. C., Gherghina, S. C., & Andrei, J. V. (2021). *Understanding the multidimensional linkages among renewable energy, pollution, economic growth and urbanization in contemporary economies*: Quantitative Assessments across.

[4]. Arellano, M. & Bond, S. (1991). Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. Econspapers58(2) 277-297

[5]. Babatunde O. A., & Ayodele, F. O. (2015). Climate change and economic growth in Africa: An Econometric Analysis. *Journal of African Economies,1*(1), 1–25.

[6]. Barrios, S., Ouattara, B., & Strobl, E. (2004). *The impact of climatic change on agricultural production: Is it different for Africa*? MPRA Paper No. 6240.

[7]. Boxal, P. C., Chan, W. H., & McMillan, M. L. (2004). The impact of oil and natural gas facilities on rural residential property values: A spatial hedonic analysis. *Laurier Business & Economics*, 1-22.

[8]. Chama, E. M., Yahya, S. &Hindou, B. (2021). The role of renewable energy sector in reducing unemployment: The Moroccan case. *E3S Web of Conferences 234*, 01-10.

[9]. Choi, I. (2001) Unit Root Tests for Panel Data. *Journal of International Money and Finance, 20, 249-272.*

[10]. Dada, M. A. (2019). Energy consumption and economic growth dynamics in Nigeria (1981-2018). *The Journal of Energy and Development, 44*(1/2), 237-258.

[11]. Dickey, D.A. and Fuller, W.A. (1979) Distribution of the Estimators for Autoregressive Time Series with a Unit Root. *Journal of the American Statistical Association, 47, 427-431.*

[12]. Dickey, D.A. and Fuller, W.A. (1981) Likelihood Ratio Statistics for Autoregressive Time Series with Unit Root. *Econometrica, 49, 1057-1072.*

[13]. Ekeocha, P. C., Penzin, D. J., &Ogbuabor, J. E. (2020).Energy consumption and economic growth in Nigeria: A test of alternative specifications.*International Journal of Energy Economics and Policy,10*(3), 369-379.

[14]. Ekone, F. A., &Amaghionyeodiwe, L. (2020). Renewable energy consumption and economic growth in Nigeria: any causal relationship? *The Business and Management Review, 11*(1), 59-76.

[15]. François, L., & Mignon, V. (2008). *The influence of oil prices on economic activity and other macroeconomic and financial variables*. CEPII Research Centre.

[16]. Geetilaxmi, M., & Giri, A. K. (2020). Examining the relationship between electricity consumption, economic growth, energy prices and technology development in India. *The Indian Economic Journal, 68*(4), 89-97.

[17]. George, E.O. and Oseni, J.E. (2012) The Relationship between Electricity Power and Unemployment Rates in Nigeria. *Australian Journal of Business and Management Research, 2, 10-19.*

[18]. Hlalefang, K., Nwabisa, K., Clement, M., Izunna, A., & Siyasanga, D. (2020). renewable energy consumption and unemployment in South Africa. *International Journal of Energy Economics and Policy, 10*(2), 170-178.

[19]. Hosier, R., & Dowd, J. (1987). Household fuel choice in Zimbabwe: An empirical test of the energy ladder hypothesis. *Resources and Energy, 9*: 347–361.

[20]. Hsiao, C. (2003). *Analysis of Panel Data (2nd ed.).* Cambridge University Press.

[21]. Ikpe, V. & Oyedeji, E. (2023).energy consumption & economic growth in Nigeria (1971 - 2021): A multifaceted analysis using descriptive statistics, charts, logistic regression, and neural networks.*Asian Journal of Probability and Statistics, 25*(4), 56-76.

[22]. Im, K.S., Pesaran, M.H. and Shin, Y. (2003) Testing for Unit Roots in Heterogeneous Panels. *Journal of Econometrics,115,53-74.*

[23]. International Renewable Energy Agency (IRENA). (2019). *Renewable energy market analysis*. West Africa.

[24]. Ishioro, B. O. (2020). Energy consumption and economic growth in Nigeria: An Augmented Neoclassical Growth Model perspective. *Journal of Environmental Management and Tourism, 10*(7), 1637-1657**.**

[25]. Kahn, H., Mohaddes, N., Ng, Pesaran, H., Raissi, K., & Yang, G. (2021). Fossil fuel energy consumption and economic growth in Africa based on a PMG panel ARDL approach. *Journal of Cleaner Production,228*: 161– 174.

[26]. Kaygusuz, K. (2011). Energy and environment issues relating to greenhouse gas emissions for sustainabledevelopmentinTurkey. *Renewable and SustainableEnergyReviews*, 253-270.

[27]. Kayode, O., Akhavan F.M & Ford, A. (2016) *Analysis of household energy consumption in Nigeria.* In: Going north for sustainability: Leveraging knowledge and innovation for sustainable construction and development. International Council for Research and Innovation. IBEA Publications Ltd., UK, pp. 23-39. ISBN 9781326479510

[28]. Kripfganz, S. (2014). Unconditional Transformed Likelihood Estimation of Time-Space Dynamic Panel Data Models. *VfS Annual Conference 2014 (Hamburg): Evidence-based Economic Policy 100604, VereinfürSocialpolitik / German Economic Association.*

[29]. Leach, G. (1992). The energy transitions. *Energy Policy, 20*(2), 116-123.

[30]. Levin, A., Lin, C.F. and Chu, C.S.J. (2002) Unit Root Tests in Panel Data: Asymptotic and Finite-Sample Properties.*Journalofeconometrics,108,1-24.https://doi.org/10.1016/S0304-4076(01)00098-7*

[31]. Maddala, G.S. and Wu, S. (1999) A Comparative Study of Unit Root Tests with Panel Data and a New Simple Test. *Oxford Bulletin of Economics and Statistics, 61, 631-652.*

[32]. Mawunyo, A., Philip, K. A., & Andrea, V. (2022). Towards sustainability: Does energy efficiency reduce unemployment in African societies? *Sustainable Cities and Society 79*: 103-113.

[33]. Mohammad, R. R., &Mufidur, R. (2023). Renewable energy development, unemployment and GDP growth: South Asian evidence. *Arab Gulf Journal of Scientific Research*, 1-16.

[34]. Muhammad, K. K., Muhammad, I. K., & Muhammad, R. (2020).The relationship between energy consumption, economic growth and carbon dioxide emissions in Pakistan. *Financial Innovation, 6*(1), 1-13.

[35]. Muktar, I. & Abdullahi, Z. (2021). Impact of electricity supply on unemployment in Nigeria (1986-2020). *International Journal of Intellectual Discourse (IJID), 4*(4), 115-126.

[36]. Musa, K. S., &Maijama'a, R. (2020). Causal relationship between renewable energy consumption and unemployment in Nigeria: Evidence from Toda and Yamamoto causality technique. *Energy Economics Letters, 7*(1), 46-60

[37]. Okeoma, T. F., Nwachukwu, E. I., Ezeonye, C. S., &Osatemple, M. (2023).A study on the impact of energy consumption on the Nigerian economy.*Journal of Energy Technology and Environment, 5*(1), 40 – 52.

[38]. Okonkwo, I. V., & Ogbonna, M. K. (2018). Crude oil price fluctuations and Nigeria economic growth: 1997-2015. *International Journal of Research in Business, Economics and Management, 2*, 44-61.

[39]. Pachauri, S. & Spreng, D. (2004). Measuring and monitoring energy poverty. *Energy Policy 39(12***)**7497-7504

[40]. Pesaran MH (2015) Testing weak cross-sectional dependence in large panels. *Economic Review 34:1089–117*

[41]. Pesaran, M. H. (2021). General diagnostic tests for cross-sectional dependence in panels. Empirical Economics, Springer, 60(1) 13-50,

[42]. Pindyck, S.R. and Rubinfeld, L.D. (1998) *Econometric Models and Economic Forecasts*. Irwin/McGraw-Hill, New York.

[43]. Rodolfo, M., & Drilona, E. (2022). *Climate change and economic development in Sub-Saharan Africa's fragile states: Evidence from panel estimations*. International Monetary Fund (IMF) Working Paper WP/22/54.

[44]. Shuddhasattwa, R., Ruhul, S., & Sgro, P. M. (2018). Energy, unemployment and trade. *Applied Economics 50*(47), 22-34.

[45]. Sovacool, B. J. (2012). The political economy of energy poverty: A review of key challenges. *Energy for Sustainable Development*, *16*(3), 272–282.

[46]. Umoidem, J. E.; Nteegah, A. and Osokogwu, U. (2024). Does energy prices trigger unemployment? empirical evidence from Nigeria. *International Journal of Economics, Commerce and Management, 12*(2), 288-308.
[47]. Veli Y., Emel, İ., Sinem, Y., & Gökçe C. (2020). the relationship between unemployment rates and renewable energy consumption: Evidence from fourier ADL cointegration test. *The Journal of Operations Research, Statistics, Econometrics and Management Information Systems, 8*(1), 18-28.
[48]. Wang, Q., Wang, X., & Li, R. (2022). Does urbanization redefine the environmental Kuznets curve? An empirical analysis of 134 countries. *Sustainable Cities and Society, 76*, 103-382
[49]. Williams, A., Edem K. A., Francis, S., Marie-Stella, S., &Nadjath, K. Y. (2022). Impact of electricity prices on growth and development of SMEs in Ghana: A case of selected pharmaceutical industries in Ashanti region. *International Journal of Economics, Commerce and Management United Kingdom,10*(2), 257- 272.
[50]. World Bank (2017). *Energy access outlook* 2017.
[51]. World Bank (2017). *Power Africa: Tracking the impact of electrification in Sub-Saharan Africa*.
[52]. World Health Organization (2004). *Global burden of disease: Update*, WHO.