West African Economic Size and Access to Electricity

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Abstract- ***This research paper seeks to assess the relationship between economic size measured as gross domestic product GDP per capita and access to electricity as percentage of population, in order to enhance both electrification and economic growth. The study statistically analyses electrification and economic growth trends and the relationship between them. The population of this study is the 16 Countries if West Africa. Secondary data were obtained from published World Development Indicators of the World Bank Group spanning 2012-2020. Using descriptive statistics, analysis of variance (ANOVA) and regression via the SPSS statistical software, the Study reveals that in the spatial distribution of access to electricity and GDP per capita, there is significant statistical difference across countries. Taken access to electricity as a function of GDP using derived electrification ranking index, The Gambia occupies the first position (with an index of 0.0860) and Nigeria the last with an index of 0.0225). The trend of West African access to electricity over the years of study depicts a steady rise of electricity consumption, while the trend of GDP per capita is awkwardly oscillating. Access to electricity is significantly related with GDP (p value = 0.000 < 0.05) and the relationship is positive (with t- value = 14.987). A reverse regression analysis also indicates that GDP is significantly positively related with access to electricity (p value = 0.000 < 0.05; t-value = 224.612). Thus access to electricity and GDP has a bi-directional positive significant relationship. This study recommends that the West African countries should place meaningful emphasis on electrification to boost economic growth, and that their economic viability should be commensurately felt in the electrification of their population.***

Indexed Terms- ***Access to electricity, GDP, West Africa, trend analysis, causal relationship***

I. INTRODUCTION

The technological age has given rise to energy demands expected to be commensurate with technological developments. It is proper that effective energy supply to a nation, state, region, local government area or community should relate positively with the economic size or performance of the country. The higher the economic growth (GDP) of the nation the more should be the quality, sufficiency and management of energy supply to the people; the lower the economic growth also, the weaker the impact of energy supply is expected. Access to electricity is expected to positively influence GDP as electrification is a booster of various forms of economic successes. With the advancement in technology, one key driver of technological progress is energy and hence access to electricity (N'zue and Iqbal, 2021).

Many businesses, organizations, institutions, households and individuals depend on electricity supply without which daily living will be frustrated. In the advanced countries access to electricity as a percentage to population is at a higher rate compared to less advanced nations. The situation of access to electricity supply for the people is notably poor in most underdeveloped or developing countries. The electricity access rate in Africa is substantially lower than it could be, considering the level of income and the electric grid footprint (Blimpo and Cosgrove-Davies, 2019).

Kauffmann (2005) citing African Development Bank and OECD Development Centre African Economic Outlook (2005) opines that with 35.5 per cent of the population with access to electricity in 2002, Africa has the lowest level of electrification in the developing world - Middle East 91.8 per cent, Asia, 42.8 per cent, East Asia 88.1 per cent and in Latin America 89.2 per cent. Adedokun (2015) postulates that the most populous country of West Africa – Nigeria, has only about 40% of the Nigerian population that has access

to electricity. Such poor supply of electricity in Nigeria, given its enviable economic status and richness in energy sources, has created one of the world's high concentrations of small-scale power supply using generators to produce electric power.

Sixteen countries make up West Africa with a population of more than 340 million, representing about 37% of Sub-Saharan African population. West Africa is endowed with rich energy sources of charcoal, firewood, electricity, petroleum and gas but the population's access to them, especially the global notable energy source - electricity is considerably limited.

This research paper, inevitably, seeks to assess the relationship between economic size measured as gross domestic product GDP per capita and access to electricity as percentage of population. Such gesture will reveal whether access to electricity is influenced by economic performance, or vice versa, in order to improve both electrification and economic growth. Four objectives will be focused on in this paper namely:

1. To ascertain the trend and extent of electrification in West African Countries
2. To ascertain the trend of GDP per capita in West African Countries
3. To ascertain the trend of electrification as a function of real GDP per capita
4. To determine the relationship between GDP per capita and access to electricity as a percentage of population

Two hypotheses are put forward:
H1: There is no significant difference in access to electricity and real GDP per capita across the West African Countries
H2: There is no significant relationship between real GDP per capita and access to electricity in the West African Countries.

II. REVIEW OF LITERATURE

- Economic Size of a Nation

The economic size or performance of a country is measured as Gross Domestic Product (GDP). It describes what a country's economy produces and has four components namely: personal consumption expenditures (divided into goods and services), business investment (includes purchases made by companies to produce consumer goods), government spending and net exports of goods and services (what the government contributes to the economy). Gross domestic product (GDP), according to Ulfah, 2015 spells economic viability and is considered as one of the prominently known indicators in the world. It is continuously widely used both to measure economic performance and also to generally measure the development progress of a country as well. Opposite effects are impacted on GDP by imports and exports. In other words imports subtract from GDP while exports add to GDP. GDP being a notable indicator of the health of a country's economy gives economists an idea of the viability of the nation's financial status. The GDP calculates the economic value of the whole goods and services produced or generated by the country. GDP is a measure of the national income/ national output and national expenditure, and basically measures the total volume of goods and services produced in an economy (Pettinger, 2021). Inevitably, when the real GDP of a nation is considerably growing the economic wellbeing of the people improves (Dynan and Sheiner, 2018)

- Access to Electricity

Access to electricity, which can be referred to as "electrification or the electrification rate" refers to the proportion of the population with access to electricity over a specified time period or geographic area (Tracking SDG 7, 2022). It can also be referred to as the end user's ability to consume electricity for desired services. SDG 7 (2022) opines further that Most of the top 20 access to electricity deficit countries are in Sub-Saharan Africa with the largest being Nigeria , then Democratic Republic of Congo and Ethiopia, where population growth failed to meet up with electrification demands.

Availability and affordability are two things that define electrification. In a number of areas actions of the electricity supply agencies or government fall below the demands of the population. In other words there are shortfalls of supply and this can be caused by a number of factors – economic hardship of government, negligence, corruption that undermines progress, technical and technological limitations, and climatic and environmental factors. On the other hand,

supply may be evident but the financial capability to consume is absent or limited. This can also be caused by factors like poverty, insensitivity to electrification because of availability of local and crude sources of energy, lack of proper education of the needs and use of electrification, theft and vandalism and unnecessary apprehension of electrification hazards.

III. EMPIRICAL REVIEW

A correlation between the income per capita and the access rate to power energy in Sub-Saharan Africa was mentioned by Dagnachew et al. (2017) who identified technology, off-grids and central grid extension levels as determinants for improving the access rate of power energy. Benjamin (2022) carried out a study which explored renewable energy and inclusive growth. The outcome of the study replicated the findings of current researchers by revealing that economic growth is increased by renewable energy. In a research carried out by Morrissey (2019) he postulates that consumer income, infrastructures investment, education and raising awareness, financial service and policy coordination are important elements that positively impact access to power energy.

Research on developed and developing countries by Apergis and Payne (2011), using heterogeneous panel co-integration studies found out that an increase in renewable energy usage influences increase in renewable energy consumption. A panel of 21 countries considered by Poloamina & Umoh (2013), using the ordinary least square method, reveal that income per capita, density of the population, performances of the grid and the ratio of rural and urban population are notable factors enhancing the rate of access to power energy. Shengfeng, Sheng, Tianxing and Xuelli (2021) examined the causal relationship between electricity consumption and economic growth using Chinese data through vector error correction model (VECM). The study reveal that there exists unidirectional causality from electricity use to economic growth (real GDP) indicating that electric energy supply can to some extent become the limiting factor to economic growth and thus, the shortage of electric power can resist economic growth in China.

Long term equilibrium and short term dynamic relationship between electricity consumption and economic growth was analyzed by Zhu, et.al (2006) applying co-integration and vector error correction model and reveals that long-term equilibrium relationship exists between them. Kasperowicz (2014), in a study analyzed the causal relationship between economic growth and electricity consumption in Poland. The analysis was based on Granger-causality test that allows a bidirectional analysis of the relationship of variables and produced empirical results that shows economic growth of Poland as electric energy-dependent and vice versa. Using Cobb-Douglas growth model covering time series data from 1970 to 2014, Vector Error Correction Model, and Granger Causality test in a study conducted by Ameyaw, Oppong, Abruquah and Ashalley (2017) to determine the direction of causality between electricity consumption and economic growth, obtained an empirical finding that there exists a unidirectional causality which runs in the direction of GDP to electricity consumption. This suggests that in Ghana electricity consumption does not adversely impact on economic growth.

In a study conducted by Twerefou, Iddrisu and Twum (2018) employing a panel co-integration techniques and data on total energy consumption, to establish the causal relationship between energy consumption and economic growth for West African, produced results which showed in the long run that electricity and petroleum consumption have a positive and significant impact on economic growth.

Existing literatures suggest that the relationship between electricity consumption and economic growth can be grouped under any of these categories:

1. Causal relationship which indicates that electricity consumption positively impacts economic growth
2. Causal relationship which indicates that economic growth positively impacts electricity consumption.
3. Causal relationship between electricity consumption and economic growth that is bidirectional, impacting one another.

After careful empirical studies this research is apt to have a broader approach to the relationship study of GDP and access to electricity. Instead of being particular about the causal relationship only, there is

the need to assess the spatial distribution of values of the two variables in order to assess the existence of significant difference across the area of study (16 West African Countries). Further, there is the need to treat access to electricity as a function of GDP in other to obtain a ranking index of electrification based on GDP in order to see the effective electrification position each nation occupies. These innovations are integral to this study.

IV. METHODOLOGY

In this study the quantitative type of research method is used. The research design adopted is descriptive, hypotheses testing and ascertaining causal relationship. Secondary sources of data were used in this research and data were obtained from published World Development Indicators of the World Bank Group. The population and sample size in this study is the 16 (sixteen) countries of West Africa (about 350 million people). The period of study was 9years (2012-2020) being period of uninterrupted record availability. The proposed methods of data analysis used are the descriptive statistical analysis for basic trend analysis and analysis of variance (ANOVA) with SPSS for assessing the spatial distribution and the significant difference of access to electricity and real GDP per capita. Causal relationship is analysed by means of simple linear regression through the use of SPSS soft ware. The linear regression equation is as follows: $Y = b_0 + b_1X_1$

Where:

Y = predicted or expected value of the dependent variable

X_1 = distinct independent or predictor variables

b_0 = value of Y when the independent variables X_1 is equal to zero

b_1 = the estimated regression coefficients.

For descriptive statistical analysis involving ranking of countries based on electrification as a function of GDP per capita or vice versa, the following index calculation suffices:

Access to electricity (as percentage of population) over GDP per capita

$$= \frac{\text{Access to Electricity}}{\text{Population}} \times 100 \div \frac{\text{GDP}}{\text{Population}} \qquad = 100 \times \frac{\text{Access to Electricity}}{\text{GDP}} \qquad (1)$$

Considering the reverse relationship of GDP per capita over Access to Electricity

$$= \frac{\text{GDP}}{\text{Population}} \div \frac{\text{Access to Electricity}}{\text{Population}} \times 100 \qquad = \frac{\text{GDP}}{100} \times \text{Access to Electricity} \qquad (2)$$

Thus, index calculated on the basis of one independent variable (1) is the inverse of the calculation if the other (2) is taken as the independent variable. Whichever is the case, the ranking is the same.

V. DATA, RESULTS AND TESTS OF HYPOTHESIS

Table 1 shows the access to electricity (% of population) of the 16 countries of West Africa covering a period of 9 years (2012-2020). Objective 1 of this research intends to ascertain the trend and extent of electrification in West African Countries. It is seen in table 1 the position of countries in relation to access to electricity or extent of electrification, and in ascending order: Burkina Faso (16.82), Niger (17.02), Liberia (17.66), Sierra Leone (20.82), Guinea Bissau (29.84), Guinea (36.34), Benin (36.59), Mali (39.16), Mauritania (41.53), Togo (46.81), Nigeria (55.13), The Gambia (56.22), Senegal (63.11), Cote D'lvoire (64.10), Ghana (76.41) and Cape Verde (87.96). Burkina Faso has the lowest value and Cape Verde the highest.

Table 1: Access to Electricity (% of Population)

Country	Year									Average
	2012	2013	2014	2015	2016	2017	2018	2019	2020	
Benin	38.4	34.7	34.1	29.6	37.1	34.5	39.2	40.3	41.4	36.5888
Burkina Faso	15.1	15.4	19.2	16.1	16.6	17.2	14.4	18.4	19	16.8222
Cape Verde	83.4	84.3	85.3	86.4	87.5	88.7	90.4	91.4	94.2	87.9555
Cote D'lvoire	55.8	61.4	61.9	62.6	64.3	65.6	67.1	68.5	69.7	64.1
Gambia, The	49.8	51.5	52.9	54.6	56.3	56.2	60.3	62.1	62.3	56.2222
Ghana	56.5	70.7	78.3	74.1	79.3	79	80.4	83.5	85.9	76.4111
Guinea	26.2	32	33.4	34.7	33.5	35.4	45	42.2	44.7	36.3444
Guinea Bissau	14.8	16.2	17.2	20.1	23	26	28.5	31	33.3	29.8444
Liberia	9.1	9.8	9.4	15.2	17.7	24.2	22.9	23.1	27.5	17.6555
Mali	25.6	32.3	34.1	37.6	38.8	34.8	50.9	47.8	50.6	39.1666
Mauritania	36.4	37.5	38.8	39.5	41.3	42.9	44.3	45.8	47.3	41.5333
Niger	14.4	15.2	15.8	16.6	17.3	18	17.6	19	19.3	17.0222
Nigeria	53.2	55.6	54	52.5	59.3	54.4	56.4	55.4	55.4	55.1333
Senegal	56.5	57	61	60.5	64.5	61.7	66	70.4	70.4	63.1111
Sierra Leone	17	13.5	18.7	19.5	20.3	23.4	26.1	22,7	26.2	20.8222
Togo	39	40.8	45.7	44.6	46.8	48	50	52.4	54	46.8111
Average	36.95	39.245	41.238	41.647	43.975	44.375	47.469	48.375	50.075	

Source: World Development Indicators, The World Bank Group, 2023 (Averages computed by author)

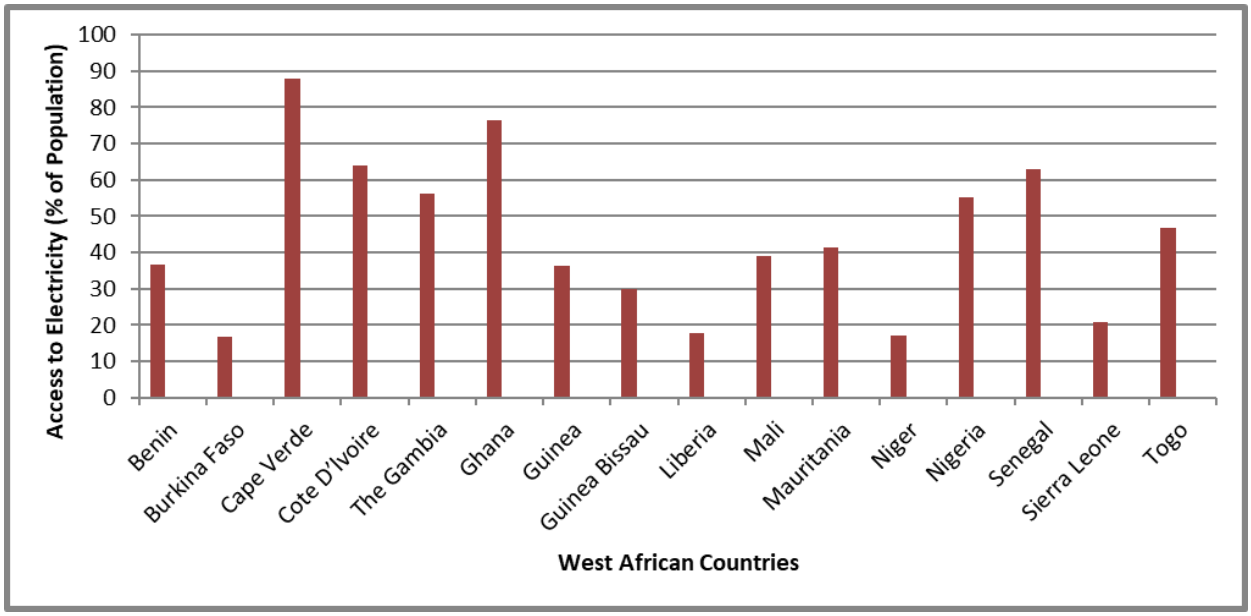

Fig.1: Access to electricity in West Africa

Figure 1 provides a chart expression of the extent of electrification in the West African Countries showing Cape Verde as highest and Burkina Faso as least.

Considering the 9 years span the trend of access to electricity in the West African States shows a gentle progressive, slightly undulating, pattern from 2012 to 2020. This is somewhat commendable as it depicts a steady rise of electricity consumption. Figure 2 depicts it clearly.

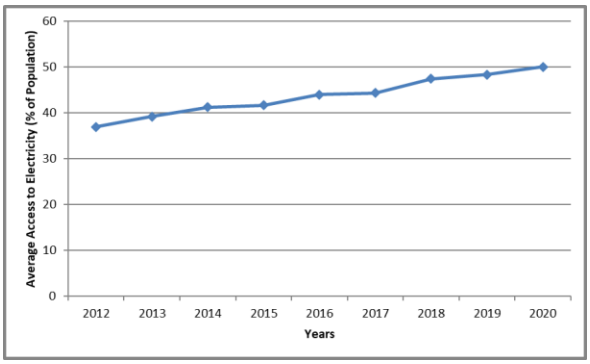

Fig.2: Average access to electricity of West Africa (2012-2022)

Table 2 shows the GDP per capita (current USS $ in Billions) of the 16 countries of West Africa covering a period of 9 years (2012-2020). Objective 2 of this research tends to ascertain the trend of GDP per capita in West African Countries. It is seen in table 2 the position of countries in relation to GDP per capita, and in ascending order: Niger (534.44), Sierra Leone (593.44), The Gambia (654.56), Guinea Bissau (678.00), Liberia (685.56), Togo (734.67), Burkina Faso (740.33), Mali (793.11), Guinea (847.00), Benin (1153.22), Senegal (1399.11), Mauritania (1747.89), Ghana (1988.67), Cote D'lvoire (2054.67), Nigeria (2448.11) and Cape Verde (3211.33). Niger has the lowest value and Cape Verde the highest.

Figure 3 gives a chart of the trend of the economic size (GDP per capita) in the West African Countries showing Cape Verde as highest and Niger as least. Given the 9 years span the trend of real GDP per capita in the West African nations shows an uneven, divergent profile from year to year.

Table 2: GDP Per Capita (Current US $ in Billions)

COUNTRY	YEAR									Average
	2012	2013	2014	2015	2016	2017	2018	2019	2020	
Benin	1114	1216	1253	1045	1046	1095	1198	1170	1242	1153.22
Burkina Faso	735	764	766	633	665	713	779	774	834	740.33
Cape Verde	3265	3426	3407	2899	2975	3133	3450	3431	2916	3211.33
Cote D'lvoire	1650	1903	2188	1941	1982	2080	2275	2184	2289	2054.67
Gambia, The	689	650	562	613	639	630	683	722	703	654.56
Ghana	1536	2282	1943	1712	1901	1999	2180	2168	2177	1988.67
Guinea	708	758	775	756	721	843	945	1043	1074	847
Guinea Bissau	599	618	602	587	643	718	779	847	709	678
Liberia	644	718	715	700	723	707	700	666	597	685.56
Mali	753	779	818	723	750	796	856	840	823	793.11
Mauritania	1850	1929	1715	1564	1579	1635	1749	1841	1869	1747.89
Niger	525	548	561	481	497	515	567	551	565	534.44
Nigeria	2729	2972	3208	2680	2141	1937	2130	2207	2029	2448.11
Senegal	1334	1391	1417	1236	1291	1385	1586	1462	1490	1399.11
Sierra Leone	560	706	703	577	790	485	520	507	493	593.44
Togo	559	608	627	559	787	815	884	876	897	734.67
Average	1203	1329	1329	1169	1196	1218	1330	1331	1294	

Source: Collated by author from World Development Indicators, The World Bank Group, 2023 (Averages computed by author)

The sharp dovetailing from 2014 to 2015 is notable showing the worst economic period for the region. An encouraging economic growth trend is noticeable between 2012 and 2013; and 2017 and 2018. These are visibly showcased in Figure 4. GDP per capita is here used to assess the effective status of electricity consumption in the West African nations. Table 3 depicts the ranking index (access to electricity per GDP per capita) and shows clearly that The Gambia occupies the first position with an index of 0.0860) and Nigeria the last (with an index of 0.0225).

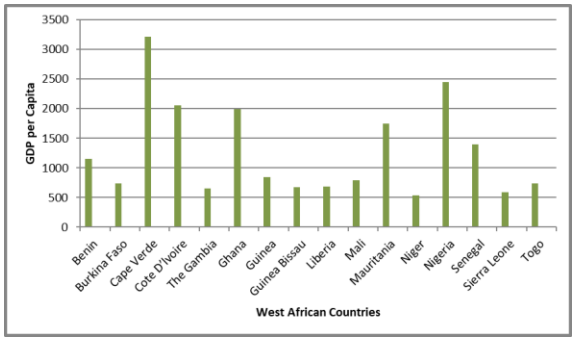

Fig.3: GDP per capita in West Africa

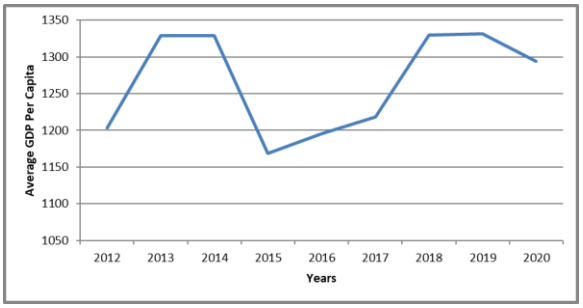

Fig.4: Average GDP per capita of West Africa (2012-2022)

This reveals that despite Nigeria's enviable GDP size, electrification of its population is not commensurately met. On the other, hand The Gambia that has a weak GDP (3rd position from bottom) is having a laudable access to electrification (the 5th highest) and ranks 1st in electrification as a function of GDP. _Figure 5 is a chart display of the ranking position of the countries.

Table 3: Access to Electricity per GDP per Capita (ranking index)

Country	Access to Electricity (% of Population)	GDP Per Capita	Access to Electricity Per GDP Per Capita	Ranking
Benin	36.58889	1153.22	0.0320	10th
Burkina Faso	16.82222	740.330	0.0227	15th
Cape Verde	87.95556	3211.33	0.0270	12th
Cote D'lvoire	64.10000	2054.67	0.0310	11th
The Gambia	56.22222	654.560	0.0860	1st
Ghana	76.41111	1988.67	0.0380	7th
Guinea	36.34444	847.000	0.0430	6th
Guinea Bissau	29.84444	678.000	0.0440	5th
Liberia	17.65556	685.560	0.0260	13th
Mali	39.16667	793.110	0.0490	3rd
Mauritania	41.78750	1747.89	0.0240	14th
Niger	17.02222	534.440	0.0320	9th
Nigeria	55.13333	2448.11	0.0225	16th
Senegal	63.11111	1399.11	0.0450	4th
Sierra Leone	20.82222	593.440	0.0350	8th
Togo	46.81111	734.670	0.0640	2nd

Test of Hypothesis 1a

Hypothesis 1 states that there is no significant difference in access to electricity and real GDP per capita among the West African Countries. Thus, Hypothesis 1a concerns access to electricity and 1b real GDP per capita. Table 5 below shows the ANOVA test result indicating an F value of 156.235 and p value of 0.000 which is less than 0.05. This suggests that the result is significant at 5% level and the null hypothesis can thus be rejected at 95% confidence interval. It means that there is a statistically significant difference in the distribution of access to electricity across the 16 Countries of West Africa. The ANOVA analysis was based on a spread sheet data matrix of 16 Countries x 9 years.

Test of Hypothesis 1b

Hypothesis 1b states that there is no significant difference in real GDP per capita among the West African Countries. Table 6 below shows the ANOVA test result indicating an F value of 193.685 and p value of 0.000 which is less than 0.05. This suggests that the result is significant at 5% level and the null hypothesis can thus be rejected at 95% confidence interval. It means that there is a statistically significant difference in the distribution of real GDP per capita across the 16 Countries of West Africa.

Objective 4 is to determine the relationship between GDP per capita and access to electricity as a percentage of population. The corresponding

hypothesis states that there is no significant relationship between real GDP per capita and access to electricity in the West African Countries. To achieve this, linear regression statistical technique is used with the help of SPSS version 22. The report of the

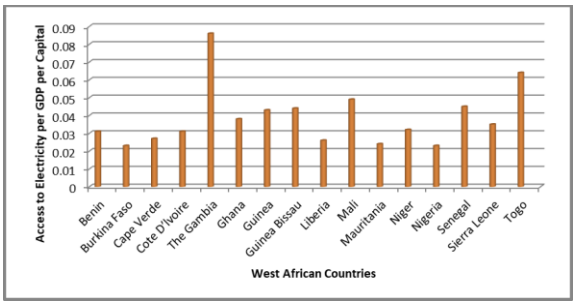

Fig 5: Average access to electricity per GDP per capita in West Africa

Table 5: ANOVA Test Result for Differences in Access to Electricity Distribution in West Africa

Accessto Electricity			Anova		
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	65689.36	15	4379.29	156.24	.00
Within Groups	3587.87	128	28.03		
Total	69277.23	143			

Table 6: ANOVA Test Result for Differences in real GDP per capita Distribution in West Africa

GDP			Anova		
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	86314093.993	15	5754272.933	193.685	.000
Within Groups	3802802.000	128	29709.391		
Total	90116895.993	143			

SPSS analysis is shown in Tables 7 - 9. The adjusted R square is shown in Table 7 as 0.610 which implies that only 61.3% of the GDP variance can be explained by access to electricity as an independent variable. This is suggestive of an above average relationship between access to electricity and GDP per capita. Table 7 shows an F-statistics value of 224.612 and p-value of $0.000 < 0.05$. This is indicative that access to electricity is significantly positively related with GDP in West Africa. Thus the null hypothesis is rejected. The coefficients Table 8 below suggests that access to electricity is significantly related with GDP ($0.000 < 0.05$) and the relationship is positive (with t- value 14.987).

Table 7: Regression - GDP per Capita Vs Access to Electricity

Model Summary[b]										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.783[a]	.613	.610	495.792	.613	224.612	1	142	.000	2.026

a. Predictors: (Constant), Electricity
b. Dependent Variable: Gross Domestic Product

Table 8: Coefficient of GDP per Capita and Access to Electricity

Coefficients[a]											
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	33.102	92.087		.359	.720					
	Electricity	28.231	1.884	.783	14.987	.000	.783	.783	.783	1.000	1.000

a. Dependent Variable: Gross Domestic Product

Taking a reverse regression analysis by keeping Access to electricity as dependent variable on GDP (independent variable), the adjusted R square is shown in Table 8 as 0.610 which implies that only 61.0% of the Access to electricity variance can be explained by GDP. This is suggestive of an above average relationship between GDP per capita and access to electricity. Table 9 shows an F-statistics value of 224.612 and p-value of $0.000 < 0.05$. This is indicative of the fact that GDP is significantly positively related with access to electricity in West Africa. Thus the null hypothesis is rejected.

Table 9: Access to Electricity vs GDP per Capita

Model Summary[b]										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.783[a]	.613	.610	13.7465	.613	224.612	1	142	.000	1.650

a. Predictors: (Constant), Gross Domestic Product
b. Dependent Variable: Electricity

VI. FINDINGS AND DISCUSSION

The findings of this research in relation to the objectives of the study show that in the spatial distribution of access to electricity (as a percentage of population) and GDP per capita in the 16 countries of West Africa, there is statistical significant difference. Burkina Faso has the lowest value of access to electricity (16.82), and Cape Verde the highest (87.96). In relation to GDP per capita, Niger has the lowest value (534.44), and Cape Verde the highest (3211.33). Taken access to electricity as a function of GDP using the derived electrification ranking index, The Gambia occupies the first position (with an index of 0.0860) and Nigeria the last with an index of 0.0225). Clearly, Nigeria's enviable GDP size is not commensurate with the electrification of its population.

The Gambia however, with a weak GDP (3rd position from bottom) is having a laudable access to electricity (the 5th highest) and ranks 1st position in effective electrification. The trend of West African access to electricity over the years of study depicts a steady rise of electricity consumption, while the trend of GDP per capita is awkwardly oscillating. Access to electricity is significantly related with GDP (p value = 0.000 < 0.05) and the relationship is positive (with t- value = 14.987). In other words access to electricity positively influences GDP.

A reverse regression analysis by keeping Access to electricity as dependent variable on GDP (independent variable) also indicates that GDP is significantly positively related with access to electricity in West Africa. This means GDP positively influences access to electricity (p value = 0.000 < 0.05; t-value = 224.612). The relationship is to the extent that 61% of each variable can be explained by the other (adjusted R square = 0.610 for both variables). Thus access to electricity and GDP has a bi-directional positive significant relationship.

CONCLUSION AND RECOMMEN DATION

Analysis of the relationship between access to electricity and economic growth has been achieved. Access to electricity (as % of population) is significantly positively related with GDP per capita and vice versa. A model regression equation to predict one variable from the other cannot be formed from the results because of the insufficient strength of the relationship (adjusted R square value = 0.610 = 61%). The study affirms that access to electricity is a booster of GDP and GDP a booster of access to electricity. In other words the variables relate positively with each other and of course influence each other. This reiterates findings of previous empirical studies.

Because of the significant statistical difference in the spatial distribution of access to electricity and GDP per capita in the 16 countries of West Africa across the chosen years, forecasting one variable in a country from another country is limited. In ranking of effective electrification based on GDP per capita, this study affirms that The Gambia is rated highest and Nigeria least. However, in rating of electrification or access to electricity without due respect to GDP per capita, Burkina Faso is least and Cape Verde the highest. In the assessment of economic viability, Cape Verde is in the highest position and Niger least.

This study recommends that the West African countries should place meaningful emphasis on electrification or electricity consumption as a way of positively impacting the economic growth of a country. On the other hand, countries should ensure that their economic viability should be commensurately felt in the electrification of their population. Country like Nigeria with enviable economic growth in the region should avoid all the limitations of poor access to electricity and wake up to a better electrification for its people.

REFERENCES

[1] Adedokun, Luqman (2015). The Implication of the West African Power Pool (WAPP) to the Electricity Supply Industry (ESI) in Nigeria, Munich, GRIN Verlag, https://www. grin.com /document/356773

[2] Ameyaw, B., Oppong, A., Abruquah L. and Ashalley, E. (2017) Causality Nexus of Electricity Consumption and Economic Growth: an Empirical Evidence from Ghana. *Journal of Business and Management*, **5**, 1-10

[3] Apergis N, Payne JE. (2011). On the causal dynamics between renewable and non-renewable energy consumption and economic growth in developed and developing countries. Energy Systems, 2(3): 299-312.

[4] Benjamin, A. A. (2022). Renewable energy consumption and Inclusive Growth: Evidence from 20 African countries. *An Environ Sci Toxicol* 6(1): 097-104.

[5] Blimpo, M. P and Cosgrove-Davies, M. (2019). Electricity Access in Sub-Saharan Africa:Uptake, Reliability, and Complementary Factors for Economic Impact. International Bank for Reconstruction and Development /The World Bank, Washington DC.p.11. https:// openknowledge. worldbank.org/server/api/core/bitstreams/a6cfde8d-0224-5546-8062-5c2e69b741cb/content

[6] Dagnachew, A.G., Lucas, P.L., Hof, A.F., Gernaat, D.E.H.J., de Boer, H.-S. and van Vuuren, D.P. (2017) The Role of Decentralized Systems in Providing Universal Electricity Access in Sub-Saharan Africa—A Model-Based Approach. *Energy*, 139, 184-195

[7] Dynan, K. and Sheiner, L. (2018) GDP as a Measure of Economic Well-being. Hutchins Center Working Paper #43. https://www.brookings.edu/wp-content /uploads/ 2018/08 /WP43-8.23.18.pdf.

[8] Kasperowicz, R. (2014) Electricity Consumption and Economic Growth: Evidence from Poland. *Journal of International Studies*, 7 (1), 46-57.

[9] Kauffmann, C. (2005) Energy and Poverty in Africa. Policy Insights No. 8, African Economic Outlook , a joint publication of the African Development Bank and the OECD Development Centre.

[10] Morrissey, J. (2019) Linking Electrification and Productive Use. Oxfam, Oxford.

[11] N'zue, F. F and Iqbal, B. (2021). Access to Electricity and Economic Performance in West Africa: How do they relate? *Journal of Humanities and Social Science (IOSR JHSS)* 26(1), Series 10, 01-14.

[12] Pettinger, T. (2021) Difference between economic growth and development. Economic Help, https:/ /www. econo micshelp.org/ blog/ 1187/ development /economic-growth-and-development/.

[13] Poloamina, I.D. and Umoh, U.C. (2013) The Determinants of Electricity access in Sub-Saharan Africa. *The Empirical Econometrics and Quantitative Economics Letters*, 2, 65-74.

[14] Shengfeng, X., Sheng, X. M., Tianxing, Z. and Xuelli, Z. (2012) The Relationship between Electricity Consumption and Economic Growth in China. Sciverse ScienceDirect, Physics Procedia 24 (2012) 56 – 62.

[15] Tracking SDG 7 (2022). The Energy Progress Report 2022, Chapter one. https:/ /trackingsdg7.esmap.org/data/files/download-documents/sdg7-report2022-ch1-access_to_ electricity.pdf

[16] Twerefou, D. K., Iddrisu K. S. and Twum E. (2018) Energy Consumption and Economic Growth: Evidence from the West African Sub Region. *West African Journal of Applied Ecology*, vol. 26(SI), 217 - 233

[17] Ulfah, R. (2015) Understanding the Prevalent Use of GDP as an Indicator of Development Progress – The Case of Indonesia's National Development Plan. MSc Thesis Environmental Policy Group. https:// edepot. wur.nl/337084.

[18] Zhu, Y., Ma, X., Li, X. (2006) A co-integration analysis on the relationship between electricity consumption and economic growth in China. *China electric education*, 6, 21-28.