

Sustainable Energy Supply: Solar Energy Adoption as a Veritable Alternative for Economic Growth in Nigeria

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Abstract

The current electricity power supply to Nigerians has been grossly inadequate and does not meet the minimum international standards of electricity services. There have been power failures or outages which does not promote development in both the private and public sectors of the economy. This present study seeks to extend the existing literature by investigating the influence of solar energy adoption (SEA) on economic growth (EG) in Nigeria. Data was drawn through questionnaire from 180 employees of 4 Local Government Areas in Rivers State. The sample for the study was decided on through the use of the simple random sampling technique, and analysed by means of simple regressions method. The study found that solar energy adoption has significant influence on gross domestic products (GDP) and human development index (HDI). Therefore, the study concludes that, solar energy adoption significantly influence economic growth in Nigeria, and recommends amongst others that Policymakers should key in effectively to sustainable energy programs that will engender GDP and HDI in order to drive citizens towards positive creativity that will increase the country's GDP and HDI and accelerate economic growth.

Key Words: *Gross domestic product, Human development index, Economic growth, Solar energy,*

1. INTRODUCTION

The current electricity power supply to Nigerians has been grossly inadequate and does not meet the minimum international standards of electricity services. There have been power failures or outages which does not promote development in both the private and public sectors of the economy. The resultant effect of this is shortages in industrial outputs. *Allcott, Collard-Wexler and O'Connell (2014)* posits that "shortages reduces average output by five percent" *Mbunwe (2014)* submitted that this problematic energy supply situation has greatly reduced and undermined the country's sustainable economic growth. Extensive research has indicated that solar energy is one of the renewable energy sources that promote sustainable energy supply. *Bala (2013)* stated that sustainable energy is "the production of energy for the development in harmony with the economy, environment and the consumer". This study therefore, argues that the conventional electricity's ability to meet sustainability in energy supply remains minimal and that solar energy usage can be a veritable alternative to sustainable energy supply in Nigeria, by empirically examining the effect of Solar Energy on economic growth in Nigeria.

This paper comprises six sections. Section one briefly introduces the study, motivation for the study, and the problem statement. The second section focused on the review of related literature on the topic. Section three defined the research methods including how participants were drawn, method of data collection, data analysis techniques, and data validity strategy. Section four considered the results and interpretation. Section five dwells on an in-depth discussion of the results of the study. The last section (Section six) boards on conclusion recommendations, and a reference section.

Statement of the Problem

The Nigerian government have over the years rolled out a number of programmes directed at enhancing the productive capacity of the Nigerian economy, but these programmes have not produced the expected outcome of enhanced growth of the real GDP and Nigeria have been subjected to strenuous efforts to institute a nourished economic growth (*Oyeyemi & Awujola, 2014*). The existing electricity power supply mechanism for Nigeria has failed enormously in providing adequate energy for sustainable productive capacity, and this study emerges with the intention of proposing solar energy usage as a veritable alternative to attain adequate and sustainable energy supply in Nigeria. This paper therefore, empirically investigates solar energy as a veritable alternative to Nigeria's energy need by examining the effect of solar energy adoption on economic growth metrics as gross domestic product (GDP) and human development index (HDI) in Nigeria. The motivation for this paper is to explore the possibility of Nigeria attaining an energy system that services the requirement of the present without compromising the capability of future generations to meet their needs (*Renewable Energy and Efficiency Partnership, 2004*).

2. Literature Review and Hypotheses

Solar Energy Adoption

Globally, accessibility to energy supply ensures that economic growth accelerates in society. Sufficient and unadulterated energy is immediately associated with sustained

economic growth. Notably, the consumption pattern of energy stands at approximately 4.1×10^{20} joules/yr equals to a steady power consumption of 13 trillion watts, or 13 terawatts (TW) (*Basic Energy Science Workshop, 2005*). The supply of energy is an impetus for acceleration in economic and growth in a country, however, the current consumption of electricity power as provided by the current energy providers have not been able to match the expectation of people. Solar energy therefore, stands imperative as an alternative source of power supply that will enhance sustainability in energy supply for Nigerians. It is possible for Nigerians to attain sustainability in energy supply through the use of solar energy. *Bradford (2006)* alludes to solar energy as sources of energy that can be ascribed to the light of the sun or heat that comes from sunlight. *Chu. and Meisen (2011)* communicate that solar energy descends on the earth's surface at a rate of 120 petawatts and this solar energy refers to sources of energy that emanates from the light of the sun and the heat of the sunlight produced (*Bradford, 2006*). Solar energy is therefore, the most pronounced renewable energy source amongst others as it can be exploited on the required scale to meet consistent energy supply for Nigerians. Solar electricity depends on man-made stratagem such as solar panels used to generate a good source of cheap renewable energy. *Divya and BulomineRegi (2014)* postulate that it is appraised that about 0.4 square miles of land takes 4 megawatts of solar energy daily, sufficient for the needs of an average sized town.

Economic Growth

Economic growth refers to a country's expected increase in the market value of goods and services provided by specific economy overtime. Agarwal (2018) alludes to economic growth as an estimate of a country's total output or real gross domestic product (GDP) or gross national product (GNP). Economic growth is a significant indicator of well being of a country. In this study, gross domestic product (GNP) and human development index (HDI) are adopted as the proxies of economic growth.

Gross Domestic Product (GDP)

A country's GDP is the total value of all final goods and services produced within a country over a period of time. An increase in a country's GDP entails enhanced productive activity which leads to more employment for the people.

Human Development Index (HDI)

The human development is a statistic composite of life expectancy, education, and per capita income indicator employed to classify countries into four tiers of human development. A country is said to attain a higher HDI when life span is higher, education higher and the GDP per capita higher. Olawoyin (2017) reveals that the 2016 report of the United Nation Development Programme (UNDP) saw Nigeria retaining her 2015 status with a computing of 0.0527, two points above 2014 computing of 0.0525.

From the review of literature, the following conceptual framework was developed:

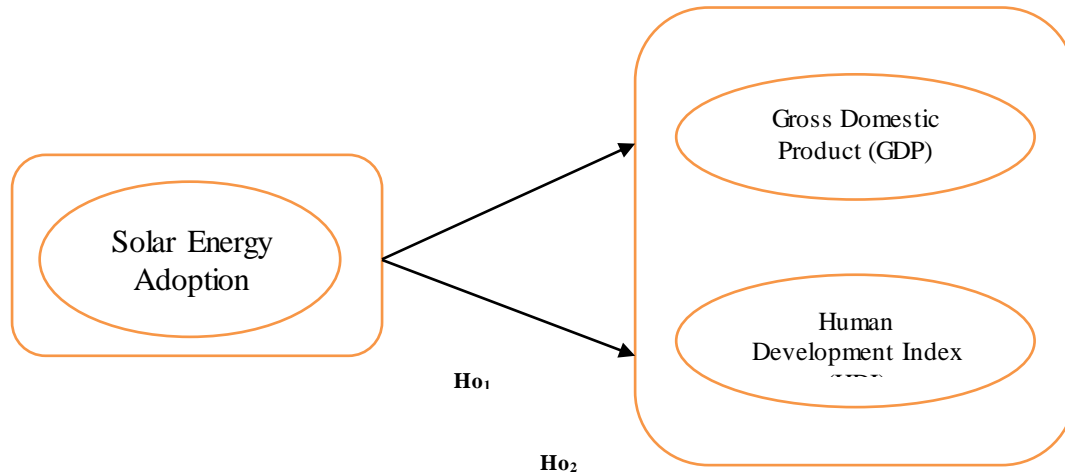


Figure 1: Conceptual Framework of Solar Energy and Economic Development

Source: Designed by the Researchers, (2022).

Based on the objectives of the study two variables are apparent. They are solar energy which constitutes the independent variable and economic growth which is dependent variable. Furthermore, indicators of economic growth measures (Gross Domestic Product (GDP) and Human Development Index (HDI) are adopted as the dependent variable of the study. The diagram in figure 1 is used to illustrate the interaction of independent variable Solar Energy (SE) and the dependent variables Economic growth (EG). As shown in Figure 1, these concepts have interwoven relationships with one another. Hence, the following hypotheses were tested:

Ho₁: Solar energy adoption does not significantly influence gross domestic product.

Ho₂: Solar energy adoption does not significantly influence human development index

3. Research Methodology

The study adopted the review of relevant literature in combination with the quantitative method of data collection in order to access the views of senior staff of Local Government Authorities (LGAs) in Rivers State. In this study, data were collected through the use of questionnaire. The questionnaire targeted four LGAs (Port-Harcourt, Obio-Akpor, Emohua and Ikwerre) reactions to power outages relative to their productive capacities in their respective LGAs,. Chairmen of the four LGAs were politely approached to seek their consent and that of their staff to participate in the study. Data collected was properly protected through secure storage in a pass-worded personal computer system. It was ensured that during the data collection process, care was taken not to reveal participants information to others. The quantitative method measured the

data in numerical terms, while the relevant literature allowed for in-depth knowledge of the variables under discussion. A simple random sampling method was used to draw fifty (50) management staff from the four LGAs under study as respondents, on whom two hundred closed ended questionnaire were administered by trained research assistants. The trained research assistants were initially used for pilot survey to check for possible problems. This was necessary to ascertain reliability, entire structure and substantiate that the questionnaire met the expectation for usefulness. In the questionnaire, respondents opinions were measured on a Likert scale of 5 points, where 5 denotes strongly agree, and 1 denotes strongly disagree. At the end of the survey, a total of one hundred and eighty questionnaires were returned completed, thus a response rate of ninety percent was recorded.

Measurement of Variables

Although the conceptual framework found in section two of the study (fig 1.) clearly identifies the dependent variable as well as the independent variable, however, we develop the model as a framework for testing here. Dependent variable is Economic Growth (EG), whilst the independent variable is Solar Energy Adoption (SEA). Furthermore, the GDP and HDI are measures for Economic Development as this study highlighted Regression equation, which represents the function is a statistical technique used to explain or predict the behaviour of a dependent variable". Generally, a regression equation takes the form of

$$Y=a+bx+c,$$

Where X is the dependent variables and in the case of this study is (Economic Growth measured by GDP and HDI), that the equation tries to predict,

Y as the independent variable which in this case is (Solar Energy Adoption), that is being used to predict X,

a is the Y-intercept of the line, and c is a value called the regression residual.

Using the Ordinary Least Square multiple regression formula which states:

$Y_i = b_0 + b_1X_{1j} + b_2X_{2j} + \dots + b_kX_{kj} + e_j$, where y_i is the dependent variable from the population of the interest, b_0, b_1, \dots, b_k are the population partial regression coefficients and $X_{1j}, X_{2j}, \dots, X_{kj}$ are observed values of the independent variables X_1, X_2, \dots, X_k , respectively.

In view of the above, the following models are developed for this study:

$$EG = f(SE) \text{----- (1)}$$

$$GDP = f(SE) \text{----- (2)}$$

$$HDI = f(SE) \text{.....(3)}$$

In the linear form, Equation (2)&(3) convert to:

$$GDP = b_0 + b_1(SE) + e$$

$$HDI = b_0 + b_1(SE) + e$$

Method of Data Analysis

The data collected was analyzed using the simple linear regression guided by a Regression Model to analyze the association of the variables identified, and by means of Statistical Package for Social Sciences (SPSS) software, the variables were subjected to complementary statistical test and the results were used for analysis and hypotheses

verification. The data for GDP and HDI were derive from the Central Bank of Nigeria Statistical Bulletin and Annual Report (2009- 2016).

	GDP	H(Billion N)DI
Year	(Billion N)	
2006	67,931.24	0.507
2007	69,023.93	0.5
2008	67,152.79	0.492
2009	63,218.72	0.487
2010	59,929.89	0.481
2011	57,511.04	0.477
2012	54,612.26	0.527
2013	49,856.10	0.527
2014	46,012.56	0.525
2015	42,922.41	0.521
2016	39,995.50	0.514
Total	618,166.44	5.56

Source: Central Bank of Nigeria Statistical Bulletin and Annual Report (2009).

4. Results and Interpretations

The regression analysis is between independent and dependent variables: The independent variable is solar energy adoption, while the dependent variable is economic growth. The researchers sought to ascertain the effect of solar energy adoption on economic growth (GDP and HDI). The simple linear regression was applied to each of the hypothesis and the decision taken depended on the P Value obtained. Where the P value is less than 0.05, a significant effect exists between the variables. Where the P Value is more than 0.05, a significant effect does not exist between variables. The test of hypotheses is given below.

Effect of Solar Energy Adoption on Gross Domestic Product

Table 1: Effect of Solar Energy Adoption on Gross Domestic Product (n=180)

Model Summary						
Model	R	Adjusted	Std error of	R	df1	df2
R	R square	.Square	the	estimate	Sig. F	

			Change	Change	
1	.464	.459	2.391	1	179
.681 ^a			.464	000	

ANOVA of Solar Energy Adoption and Gross Domestic Product

Model	Sum of squares	Df	Mean square	F	Sig.
1 Regression	485.482	1	485.482	84.925	.000 ^b
Residual	560.228	179	5.717		
Total	1045.710	180			

Coefficients of Solar Energy Adoption and Gross Domestic Product

Model	Unstandardized Coefficients		Standardized Coefficients		Sig.
	B	Std. error	Beta	T	
1 (constant)		6609	.1124		5.880
	.000				
Solar Energy Adoption	.789		.086		9.215
	.000				

Source: SPSS 22.0 window output, 2022.

In order to establish the statistical significance of the independent variable on the dependent variable (GDP), regression analysis was employed to show the coefficient of determination also called R square as .464. This implies that the combined effect of the predictor variable (Solar Energy Adoption) explains 46.4% of the variables in GDP product in Nigeria. The correlation coefficient of .681 indicates that the predictor variable has a strong and positive correlation with GDP.

The Analysis of Variance (ANOVA) on Table 1 shows that the effect of solar energy adoption was statistically significant in explaining changes in GDP. This is demonstrated by a P value of 0.000 which is less than the acceptance critical value of 0.05.

There is also a standardized coefficient of .789 which is perfect, as well as corresponding P value (sig.) of 000 which is less than alpha 0.05. Therefore, we conclude that solar energy adoption significantly influences gross domestic product.

Effect of Solar Energy Adoption on Human Development Index

Table 2: Effect of Solar Energy Adoption on Human Development Index (n=180)

Model Summary							
Model	R	Adjusted R Square	Std error of the Estimate	R	df1	df2	Sig. F
R	R square	.Square	Change	estimate	Change		
613 ^a	.376	.306	12192.446		1	179	000
			.301				

ANOVA of Solar Energy Adoption on Human Development Index

Model	Sum of squares	Df	Mean square	F	Sig.
1 Regression	804490422.178	1	804490422.178	5.412	.000 ^b
Residual	1337901600824	178	148655738.425		
Total	1045.710	180			

Coefficients of Solar Energy Adoption on Human Development Index

Model	Unstandardized Coefficients		Standardized Coefficients		T	Sig.
	B	Std. error	Beta			
1 (constant)		21302.937	.5655.862			3,767 .000
Solar Energy Adoption	.602		.259		.613	2.326 .000

Source: SPSS 22.0 window output, 2022.

Table 2 shows the coefficient of determination also called R square as .376. This implies that the combine effect of the predictor variable (Solar energy adoption) explains 37.6% of the variables in Human Development Index (HDI). The correlation \coefficient of .613 indicates that the predictor variable has a strong and positive correlation with HDI

The analysis of variance (ANOVA) on Table 2 shows that the effect of solar energy adoption was statistically significant in explaining changes in HDI in Rivers State. This is demonstrated by a P value of 0.00 which is less than the acceptance critical value of 0.05. There is also a standardised coefficient of .602 which is perfect as well as corresponding P value (sig.) of 000 which is less than alpha (0.05). Therefore, we conclude that solar energy adoption significantly influences human development index.

5. Discussion of Findings

Influence of Solar Energy Adoption on Gross Domestic Product

The study sought to determine the effect of solar energy adoption on GDP using the Regression analysis technique. The hypothesis was stated in the null form (*Solar energy adoption does not significantly influence gross domestic product.*), statistically tested and rejected, while the alternative hypothesis that Solar energy adoption significantly influences gross domestic product was accepted. Ideally, solar energy adoption is a prime factor or driver of economic growth. Solar energy is employed as a sustainable energy alternative for contribution to a country’s economic growth through rendered energy services with projected income. A very vital step in guaranteeing enhanced is to understand the essence of solar energy adoption and address it appropriately. As it is in our expectation and indeed supported by our findings, solar energy adoption has a significant influence on GDP.

The concept of solar energy adoption as measured in this study dealt with issues on employing solar energy as an alternative source of energy supply in Nigeria for an all

embracing sustainable energy policy for a potent and effectual economic growth that would be able to enhance GDP maximally for productive activities that will enhance accelerated economic development. From our findings, we understand that when the country's energy supply is positively handled, it rubs on positively on the country's ability to experience impressive growth in GDP. Our findings agree and support the findings of Divya and BulomineReji (2014) that solar energy plays significant role in economic growth.

Influence of Solar Energy Adoption on Human Development Index

The second hypothesis sought to determine the influence of solar energy adoption on HDI using the regression analysis. Statistical evidence provides that the influence of solar energy adoption on HDI is significant leading to the rejection of the second null hypothesis and the acceptance of the alternative hypothesis that solar energy adoption significantly influences human development index. Therefore, it is possible to argue that, the adoption of solar energy in Nigeria will enhance economic activities in all sectors of the economy. This will certainly accelerate economic growth. This is clearly seen in the fact that sustainable energy supply through the adoption of solar energy is focused toward the provision of cheap, regular and unperturbed energy supply that will power productive mechanism and address positively, the entrepreneurial skills of Nigerians who desire steady supply of power to operate their businesses and contribute to the country's productive output in line with economic growth. This evidence supports Jhingan (1997) study that economic growth occurs when a country's productive capacity rises and leads to the production of goods and services.

It is logical to contend that solar energy adoption has the potential to improve upon the productive capacities of Nigerian citizens, which in turn positively affects the measurement metrics of economic growth. Therefore, it is appropriate to state that, if Nigeria adopts solar energy as an alternative energy supply for sustainability, she will achieve accelerated economic growth

6. Conclusion

This work focused on investigating the effect of solar energy adoption on economic growth in Nigeria. The study attempted to assess the extent to which responses from the respondents on solar energy adoption explains measures of economic growth (GDP and HDI). It was assumed that such information would facilitate the formulation of appropriate solar energy adoption policies and strategies by the Nigerian government. The H_{01} and H_{02} were all statistically measured and rejected accepted, while the alternative hypotheses indicating that solar energy adoption significantly affect GDP and HDI were accepted. It is evident from the findings that there is implicit influence of solar energy on measures of economic growth, as the results of the quantitative analysis demonstrate that these is sufficient evidence to show that solar energy adoption by Nigeria will affect her citizens creativity positively through productive activities that will accelerate economic growth. Equally, the significant influence observed between solar energy adoption on measures of economic growth (GDP and HDI), justify the fact that the level of awareness of the effect of inadequate power supply in Nigeria clamors for an

alternative spring of energy supply, with solar energy as a veritable source. Therefore, this study concludes that, solar energy adoption significantly influences economic growth.

7. Recommendations

Based on the findings of the study, we proffer the following recommendation:

1. Government administrators should be skilled in packaging sustainable energy policies and relate it genuinely to economic growth. This suggestion is necessary because the study revealed that solar energy adoption significantly influence GDP and HDI that predicts economic growth.
2. Policymakers should key in effectively to sustainable energy programs that will engender GDP and HDI in order to drive citizens towards positive creative activities that will increase the country's GDP and HDI and accelerate economic growth.

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