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## **Sustainable Energy Supply: Solar Energy As A Strategic 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 (SE) on economic growth (EG) in Nigeria. Data were drawn through questionnaire from 180 employees of 4 Local Government Areas in Rivers State. The sample for the study was selected through the use of the simple random sampling technique. The study found that solar energy has a significant influence on economic growth through the gross domestic products (GDP) and human development index (HDI) Therefore, the study concludes that, if Nigeria adopts solar energy as an alternative energy supply for sustainability, she will achieve accelerated economic growth, 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.*

**Keywords:** *Economic growth, solar energy, Sustainable energy supply, Veritable alternative.*

## 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" Mbuwe (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 the solar energy 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 selected, 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, implication, limitations of the research study, future research requirement, 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 have failed enormously in providing adequate energy for sustainable productive capacity in Nigeria, and this study emerges with the intention of proposing solar energy 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).

## Objectives of the study

The objective of the study was to investigate sustainable energy supply: solar energy as a Strategic alternative for economic growth in Nigeria; with the following specific objectives:

1. To determine the relationship between the adoption of solar energy and gross domestic product in Nigeria.
2. To find out the relationship between solar energy adoption and human development index in Nigeria.

## Research questions

The following research questions guided the study:

1. How does solar energy relate to gross domestic product in Nigeria?
2. How does solar energy adoption relation to human development index in Nigeria?

## Hypotheses

The following null hypotheses guided the study:

H1: Solar energy adoption significantly influences gross domestic product.

H2: Solar energy adoption significantly influences human development index

## Literature review

### 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  $4.1 \times 10^{20}$  joules/yr equals to a steady power consumption of 13trillion watts, or 13terawatts(TW) (Basic Energy Science Workshop,2005). The supply of energy is an impetus for an 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) allude 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:

### Conceptual Framework of Solar Energy

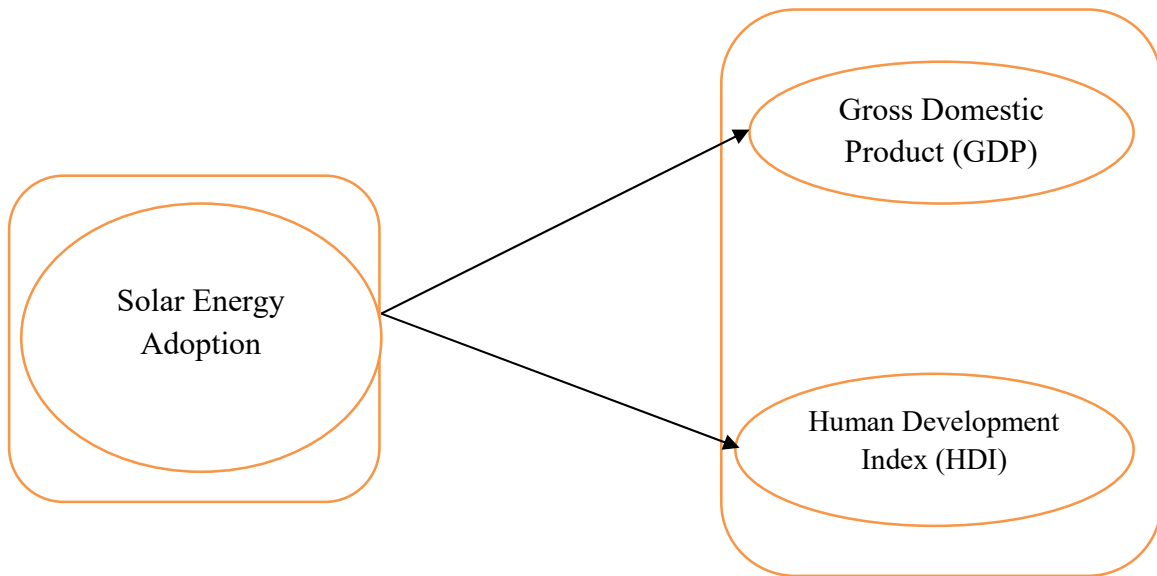


Figure1: Conceptual Framework of Solar Energy and Economic Development

Source: Authors review of literature, (2021).

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:

#### 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 in Rivers State. In this study, data were collected through the use of questionnaire. The questionnaire targeted four LGA,S ( Port-Harcourt, Obio-Akpor, Emohua and Ikwerre) reactions to power outages relative to their productive capacities in their respective LGA,S. Chairmen of the four LGA,S 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-warded 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 in the selection of respondents from the four LGA,S on whom two hundred closed ended questionnaire were randomly administered by trained research assistants. The trained research assistants were initially used for pilot survey for 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 were recorded.

The data collected is analyzed using the simple linear regression guided by a Regression Model to analyze the relationship of the variables identified.

	<b>G D P</b>	<b>H(Billion N)DI</b>
<b>Y e a r</b>	<b>(Billion N)</b>	
<b>2 0 0 6</b>	67,931.24	0 . 5 0 7
<b>2 0 0 7</b>	69,023.93	0 . 5
<b>2 0 0 8</b>	67,152.79	0 . 4 9 2
<b>2 0 0 9</b>	63,218.72	0 . 4 8 7
<b>2 0 1 0</b>	59,929.89	0 . 4 8 1
<b>2 0 1 1</b>	57,511.04	0 . 4 7 7
<b>2 0 1 2</b>	54,612.26	0 . 5 2 7
<b>2 0 1 3</b>	49,856.10	0 . 5 2 7
<b>2 0 1 4</b>	46,012.56	0 . 5 2 5
<b>2 0 1 5</b>	42,922.41	0 . 5 2 1
<b>2 0 1 6</b>	39,995.50	0 . 5 1 4
<b>Total</b>	<b>618,166.44</b>	<b>5 . 5 6</b>

**Source:** Central Bank of Nigeria Statistical Bulletin and Annual Report (2019).

### 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 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 GDP**

#### Model summary

<b>M o d e l</b>	<b>R</b>	<b>A d j u s t e d R Square</b>	<b>R Square</b>	<b>Std error of the estimate</b>	<b>R Square Change</b>	<b>df1</b>	<b>df2</b>	<b>Sig. F Change</b>
1	.681 <sup>a</sup>	.464	.459	2.391	.464	1	179	.000

**Source:** SPSS 22.0 window output (based on 2021 field survey data)

#### ANOVA<sup>b</sup>

	<b>M o d e l</b>	<b>Sum of squares</b>	<b>D f</b>	<b>Mean square</b>	<b>F</b>	<b>S i g .</b>
1	Regression	4 8 5 . 4 8 2	1	4 8 5 . 4 8 2	8 4 . 9 2 5	.000 <sup>b</sup>
	Residual	5 6 0 . 2 2 8	1 7 9	5 . 7 1 7		
	T o t a l	1 0 4 5 . 7 1 0	1 8 0			

#### Coefficients<sup>a</sup>

		Unstandardized		Standardized			
		Coefficients		Coefficients			
Model	B	Std. error	Beta	T	Sig.		
1	(constant)	6609			1.124	5.880	.000
	Solar Energy	.789	.086	.681	9.215		.000

Source: SPSS 22.0 window output (based on 2021 field survey data)

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 .681. This implies that the combined effect of the predictor variable (Solar Energy Adoption) explains 68.1% of the variables in GDP product in Nigeria. The correlation coefficient of .464 indicates that the predictor variable have a moderate 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 GDP in Nigeria. 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 standandardized 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 HDI**

**Model Summary**

Model R	Adjusted R square	R Square	Std error of the estimate	R Square Change	df1	df2	Sig. F Change
1 .613 <sup>a</sup>	.376	.306	12192.446	.301	1	179	.000

**ANOVA<sup>b</sup>**

	Model	Sum of squares	D f	Mean square	F	Sig.
1	Regression	804490422.178	1	804490422.178	5.412	.000 <sup>b</sup>
	Residual	1337901600824	178	148655738.425		
	Total	1045.710	180			

**Coefficients<sup>a</sup>**

		Unstandardized		Standardized			
		Coefficients		Coefficients			
Model	B	Std. error	Beta	T	Sig.		
1	(constant)	21302.937			5.862	3.767	.000
	Solar Energy	.602	.259	.613	2.326		.000

Source: SPSS 22.0 window output (based on 2021 field survey data)

Table 2 shows the coefficient of determination also called R square as .613. This implies that the combine effect of the predictor variable (Solar energy adoption) explains 61.3% of the variables in HDI in Nigeria. The correlation coefficient of .376 indicates that the predictor variable have a weak and positive correlation with GDP. The analysis of variance (ANOVA) on Table 2 shows that the effect of solar energy 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 0.005. 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.

### **Discussion of findings**

#### **Influence of solar energy adoption on GDP.**

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 GDP and HDI 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. Thus, H1 sought to determine the effect of solar energy adoption on GDP using the Regression analysis technique. The hypotheses was stated in the alternative form, statistically tested and accepted. 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 and HDI 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 and HDI. Our findings agree and support the findings of Divya and Bulomine Reji (2014) that solar energy plays significant role in economic growth.

#### **Influence of solar energy adoption on HDI**

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 acceptance of the second hypothesis. 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 is in line with Jhingan (1997) and who found that economic growth occurs when a country's productive capacity rises and this leads to the production of goods and services.

### **Conclusion**

This work focused on investigating the effect of solar energy adoption on economic development in Nigeria. The following conclusions can be drawn from the discussion of our findings and from the hypotheses. The study attempted to assess the extent to which responses from the respondents on solar energy adoption explains measures of economic growth (GNP and HDI). It was assumed that such information would facilitate the formulation of appropriate solar energy adoption policies and strategies by the Nigerian government. It is evident from the findings that there is implicit influence of solar energy on measures of economic growth.

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

### 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 implication is necessary because the study revealed that solar energy adoption significantly influence GDP and HDI that predicts economic growth.
1. 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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