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Article

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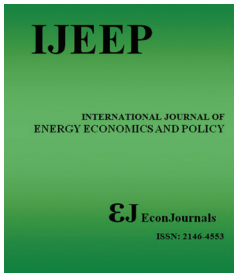

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Renewable Energy Financing and Sustainable Industrial Development in Nigeria

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ABSTRACT

Due to the inability of renewable and non-renewable sources of energy to meet the ever-increasing industrial energy need in Nigeria, there is therefore need to explore various financing option available to execute renewable energy project that will contribute to the energy basket which will sustainably impact industrial development in Nigeria. Obtaining secondary data from World development indicator from 1980 to 2021, the study utilized the auto-regressive distributed lag method to estimate the long run impact of renewable energy financing and sustainable industrial development in Nigeria. The findings reveal that the use of external debt for financing renewable energy as well the use of energy from Combustible waste source and alternate nuclear source significantly and positively determines the development of the industrial sector in Nigeria. While the use of taxation and donation to fund renewable energy as well as the use of energy source from hydroelectric were not contributing significantly to sustainable industrial development in Nigeria. The study further recommends that relevant framework that will make investment in renewable energy as well as the utilization of renewable energy to be attractive to various stakeholders in Nigeria should be established. The underlying downside risk in renewable energy utilization and financing must be address so as to mobilize sufficient private sector investment needed to drive sustainable industrial development in Nigeria.

Keywords: Sustainability, Renewable Energy, Financing, Industrial Development, Nigeria
JEL Classifications: H20, Q01, Q20, Q28, Q43

1. INTRODUCTION

Nothing wok in a society without the availability of energy. Energy has been regarded as the ability to do work. A nation without energy is said to be entirely disabled and lack the basic input for its productive activities that will lead to growth and sustainable development. The industrial sector is regarded as the heartbeat of any economy which requires continuous utilization of energy to keep the economy alive and buoyant. The need for renewable energy and a sustainable industrial sector cannot be dichotomized in a developing country, Nigeria being one that is characterizes with high unemployment rate, poor standard of living, unfavorable balance of payment, overdependence on primary sector (Agriculture and oil) and high population growth rate.

In a modern economy, energy is the most essential input needed to harness virtually all production and consumption activities (Asghar, 2008). No country will attain sustainable industrial growth and development without deploying adequate resources to its energy sector. Hence, energy availability and economic development can never be dichotomized (Oyedepo, 2012).

The Nigeria Industrial Revolution Plan (NIRP) of 2014 was initiated to drive intense industrialization of the agro-allied, solid mineral, oil and gas, construction, manufacturing and service sectors. This plan which is expected to bring about of multiple job creation, diversification of the economy and revenue sources and export, increase import substitution and enlarged the tax base of the government failed to see the light of the day not because of lack of available funding but due to unavailability and affordability of energy needed by the key sectors to thrive.

For Nigeria to attain sustainable industrial development there must be a continuously adjustment of its energy production

structures that will cater for current demand without jeopardizing the framework for future generation to execute theirs. Hence the need for elimination of energy scarcity through the utilization of renewable energy source which are naturally replenishing (Wind energy, solar energy, Geothermal energy, Hydropower, Biodiesel, Ethanol, etc.).

Nigeria has an untapped potential in utilizing its numerous sustainable energy sources to satisfy current and future energy need. However, the government is presently focusing on Hydropower energy, which is still not sufficient to cater for ever increasing demand. Hence, the need to explore and invest avidly in other form of sustainable energy that will spur economic growth and development (Onabote et al, 2020).

Energy from renewable sources is cheaper and far more environmentally friendly compare to that obatian from non-renewable sources that contribute grossly to global warming. Renewable energy that is needed for sustainable industrial development in Nigeria must be sustainably financed either from the private sector sources (Corporate funding in the form of debt or equity, sales before and after construction, investment and commercial bank), or public sector sources (Taxes, External debts, foreign aid and grant, and oil revenue).

Due to the inability of the available non-renewable energy to meet the current industrial energy need in Nigeria, there is therefore need to explore various financing option available for renewable energy sources that will sustainably affect industrial development in Nigeria.

Numerous empirics have been conducted extensively on renewable energy utilization and if effect on the growth of an economy across the globe. Okoye et al. (2020), Ibrahim, Bukola and Jamiu (2016), Iorember et al. (2020), Danmaraya and Hassan (2016), Matthew et al. (2018), Onabote et al. (2020), Venkatraja (2020), Silva et al. (2012), Alper and Oguz (2016) are examples of such studies. These studies have focus on the consumption of renewable energy and ignored the sources of finance that will be tailored to produce this renewable energy. Also, previous studies haven't examined how the consumption of theses renewable energy affect industrial sector alone but rather generalize their linkage and impact to the general economy.

This study is justified by examining the connection between various form of renewable energy, financing options for renewable energy and sustainable industrial development in Nigeria.

2. REVIEW OF THEORECTICAL AND EMPIRICAL LITERATURE

Onabote et al. (2020) emphasis the importance of using green energy to reduce global warming effect by investigating the long run interaction between various source of sustainable energy, green energy financing option and growth of Nigeria economy from 1982 to 2014 using the Johansen- Joselius and Engle granger method of Cointegration. They observed that the contribution to the economy by the use of alternative nuclear energy as well hydroelectric source were negative. On the other hand, the financing option adopted in their reveals that net official development assistant received contributed positively to the economy growth in Nigeria while Net tax on products less subsidy and external debt utilized did not lead to growth in the country economy.

Olusola Akinbo (2017) asserted that the lack of sufficient funding accounted for the bane of small and medium scale industries in Nigeria. He then went further to explore various mechanism for financing renewable energy project by using T-statistical test to derive inferences from both financier and developer of renewable energy and found out that the pecking order model was adopted. His research made use of the ordinary least square method to ascertain that variable such as project size, technology, financial instrument, policy mechanism and financial mechanism and strategies are the relevant factors that drives private investment in renewable energy project in Nigeria. He further to suggest that government should seek the support of international development bank and donors for the funding of renewable energy that will bring about development in the financial market and growth in the economy.

Donastorg et al. (2017) were of the opinion that developing countries can attain economy sustainability if it has constant access to clean and reliable energy which will overtime eliminate the over dependence of fossil fuel that are depleting in nature. They identify access to financing renewable energy, absence of key technical knowledge and management of renewable energy, weak legal and political framework as the major obstacle to renewable energy transformation. They went further to explore private, public and financial market source of funding for renewable energy. They concluded that it is not possible to leave the decision making regarding the utilization of various technologies for renewable energy as well as funding then appropriately in the hands of government alone as other key stakeholders must participate in the process.

Venkatraja (2020) justify the global pursuit for renewable energy utilization and production which contribute to sustainable growth with the fulfilment of kyoto protocol agreement of 1997. Using a panel regression model to analyse data collected from BRIC (Brazil, Russai, India and China) from 1990 to 2015 to ascertain the nexus between of renewable energy and economic growth. His findings reveal that increasing share of renewable energy represented by share of the consumption of renewable energy to total energy consumed and share of renewable energy from electricity source to the total energy output negatively affected growth of the BRIC economy within the study period.

Silva et al. (2012) made use of Structural Vector Autoregressive techniques to examine the impact of sources of renewable energy on the Gross Domestic Product and carbon dioxide emission of USA, Denmark Portugal and Spain for 45 years ending 2004. Their findings depict that thus use of renewable energy sources accounted for the increasing economic growth and reduction of carbon dioxide emission per capita during the study period.

Matthew et al. (2018) employed vector error correction and Johansen co-integration estimation techniques to analyse the connection between sustainable development in Nigeria, electricity consumption and government expenditure. Data were collected for 38 years starting 1980 and their findings reveals that government recurrent expenditure and sustainable economic development was moving in same positive direction as well as significant while Government capital expenditure, and electricity consumption was negative and significantly related to sustainable economic development. They further recommend the adoption of strategies that will improve the effectiveness of government expenditure on electricity and people-oriented project.

Danmaraya and Hassan (2016) set out to provide both short and long run relationship and causal connection between manufacturing output and the consumption of electricity in Nigeria using autoregressive distributed lag techniques to analyses data collected from 1980 to 2013. Their findings confirms that they exist a bidirectional causality between electricity energy consumption and manufacturing productivity. They recommended that a relevant policy that will eliminate embargo on electricity consumption should be adopted to bring about increasing manufacturing output.

From the above empirical review, the study identifies and fill the gap of the connection between various source of financing renewable energy that will ultimately lead to sustainable industrial development in Nigeria.

Theoretically, this study hinges on the Keynesian growth theory which posit that there will be a multiplier effect on demand aggregately when there is continuous increase in government expenditure in the energy sector which will ultimately lead to sustainable industrial development. The Solow-swan growth theory also support this study and it argues that overtime, general output in an economy will positively change leading to sustainable industrial development as a result of exogenous factors such as constant population growth rate which is the labour needed to be channeled to productive sectors as well as available capital stock needed to acquire the relevant technology.

3. METHODODLOGY AND DATA

To establish the long run connection between sustainable industrial development and renewable energy financing in Nigeria, the study adopted a descriptive and regression research design. Data utilized for this study was sources from World Development Indicators (WDI) for 41 years spanning from 1980 to 2020.

Standing with the Keynesian view on the role of government in facilitating industrial growth, the study adopted a model derived from the work of Onabote et al. (2020) and shown in the explicit form as:

$$MANVA = f(COREW, ALNUE, EPFHS, NODA, NTOP, EXTD) \quad (1)$$

Where:
MANVA is manufacturing value added measure in Nigeria which is a percentage of the Gross domestic product,

COREW is combustible renewable and waste measured as a percentage of the total energy produced in Nigeria during the study period,

ALNUE (Alternate Nuclear Energy) represent energy from other non-nuclear source such as solar and it is measured as a percentage of total energy produce and use in Nigeria during the study period from non-nuclear source.

EPFHS (Energy from hydroelectric source) which is measured as a percentage of total energy source from hydro power plant in Nigeria.

NODA represent the total Net official assistance received for development which is measured as a percentage of Nigeria gross income.

NTOP is the Net taxes on products and is measure in constant Naria.

EXTD is External debt which is measure as a percentage of gross national income.

The study model is expressed in its explicit form below using the production function postulated by Cobb-Douglas.

$$MANVA_t = \alpha_0 + \alpha_1 COREW_t + \alpha_2 ALNUE_t + \alpha_3 EPFHS_t + \alpha_4 NODA_t + \alpha_5 NTOP_t + \alpha_6 EXTD_t + \varepsilon_t \quad (2)$$

The above equation is therefore log in order to fulfil the linearity assumption to aid estimation of all the variables

$$nlMANVA_t = \alpha_0 + nlCOREW_t + nlALNUE_t + nlEPFHS_t + nlNODA_t + nlNTOP_t + nlEXTD_t + \varepsilon_t \quad (3)$$

where α_0 is the intercept, while α_1–α_6 are the coefficients/ estimators. ε_t is the Residual or error term.

4. EMPIRICAL RESULTS

Table 1 presented the results for stationarity test necessary to be conducted on time series data to avoid spurious output. Using the Augmented Dickey Fuller (ADF) Test, it was observed that only Net official development assistance was stationary at level form while MANVA, COREW, ALNUE, EPFHS, NTOP AND EXTD where all stationary at first differencing. There is a possibility of the values of the variable to revert to long-run constant variance and mean at both level form and first order differencing, therefore the ARDL cointegration approach is the best estimation technique to be employed to achieve the objective of analyzing the long-run connection between renewable energy financing in Nigeria and sustainable industrial development.

Table 1: Unit root test results

Variables	ADF at level	5% test critical level	Probability value	ADF at 1st differences	5% test critical level	Probability value	Result
MANVA	−1.247755	−2.938987	0.6438	−7.463461	−2.941145	0.0001	I (1)
COREW	−2.115126	−2.951125	0.2402	−5.441350	−2.954021	0.0001	I (1)
ALNUE	−2.947014	−2.951125	0.0504	−5.230939	−2.957110	0.0002	I (1)
EPFHS	−1.096293	−2.948404	0.7063	−4.065425	−3.595026	0.0189	I (1)
NODA	−3.091423	−2.938987	0.0355				I (0)
NTOP	−0.515002	−2.943427	0.8769	−5.816687	−2.943427	0.0000	I (1)
EXTD	−1.258305	−2.938987	0.6390	−5.871951	−2.941145	0.0000	I (1)

Source: Authors' computation with EViews (2022)

Table 2: Bound test results

Critical value	Lower bound value 1 (0)	Upper bound value 1 (1)
1%	3.15	4.43
5%	2.45	3.61
10%	2.12	3.23
F-statistic=4.358227	K=6	

Source: Authors' computation with EViews (2022)

Table 2 depicts the cointegrating characteristic of the variables for renewable energy financing and industrial development. Bound test for cointegration was conducted to ascertain if the variables in the long-run will vary together. There exist Cointegration which is the rejection of the null hypothesis when the F-statistic have a greater value than the critical values of upper 1(1) bounds and Lower bounds 1(0). The result reflects that the F-statistic of 4.358227 is above critical values at 5% of 1(0) and 1(1) regressors at a stated degree of freedom of (k=6) which thereby suggest a long-run co-integration between renewable energy financing and sustainable industrial development.

Following the existence of a long-run cointegration amongst the study variable, Table 3 displas the result from the estimate which shows that the effective utilization of renewable energy source from combustible renewable and waste as well as alternative nuclear energy positively and significantly lead to the growth of the industrial sector in Nigeria while the use of electricity from hydroelectric source negatively impairs development of the industrial sector in Nigeria. In addition, the estimated regression result reveals that the financing source from eternal debt positively impact the growth of the industrial sector in Nigeria while the use other source capture in this study for financing renewable energy which include Net official development assistance received as well as Net tax on product negatively impact on the sustainable industrial development in Nigeria. This finding is at variance with the findings of Onabote et al. (2020)., Olusola Akinbo (2017) but support the findings of Matthew et al. (2018), Donastorg et al. (2017), Taghizadeh-Hesary and Yoshino (2020), Silva et al. (2012) and Al-Mulali et al. (2014) The study model shows an R-squared value of 0.872 which indicates that 87% variation in sustainable industrial development in Nigeria is explained by the regressor. The F-statistic (11.62879) also indicate joint significance of the regressors in determining industrial development in Nigeria while the absence of auto correlation is revealed by the Durbin Watson Statistic of 2.689970.

Table 3: Long-run regression results

Variables	Coefficeint	SE	t-statistic	Prob.*
COREW	0.092334	0.327810	0.281671	0.7834
ALNUE	7.491161	8.003579	0.935976	0.3694
EPFHS	–0.128186	0.191945	0.667824	0.5180
NODA	–5.74E-11	2.88E-10	–0.199383	0.8456
NTOP	–1.41E-10	8.25E-10	–0.171323	0.8671
EXTD	0.009938	0.032364	0.307059	0.7645
R-Squared	0.954840			
Adjusted R-Squared	0.872730			
F-statistic	11.62879			
Prob (F-statistic)	0.000090			
Durbin-Watson	2.689970			

Source: Authors' computation with EViews (2022). *,**,***1%, 5%, 10% significance level

5. CONCLUSION AND RECOMMENDATION

This study estimates the extent to which the use and financing of renewable energy influence industrial development in Nigeria on a sustainable basis. The result of the findings reveals that the use of External debt for financing renewable energy as well the use of energy from combustible waste source and alternate nuclear source significantly determines the development of the industrial sector in Nigeria. On the contrary, the use of taxation and donation to fund renewable energy as well as the use of energy source from hydroelectric were not contributing significantly to sustainable industrial development in Nigeria.

The use of combustible energy and waste contributed positively to industrial development due to the utilization of waste which is a cheaper source of energy and simultaneously keep the environment clean reducing global warming while producing clean energy. The positive contribution of alternative nuclear energy source to sustainable industrial development in Nigeria may be attributed to the recent installation and utilization of solar energy sources in various urban and rural areas in Nigeria particularly with the current solar home system program embarked on by the Rural Electrification Agency in Nigeria. The negative contribution of the use of energy source from hydroelectric to sustainable industrial development in Nigeria is traced to the administrative inefficiency between the generating, transmitting and distributing companies in Nigeria. Nigeria has enough capacity to generate energy from both the old and newly built hydro power plant but this this generated energy is yet to get to the necessary end users at an affordable rate and consistent supply needed to drive industrial development optimally.

The negative contribution of net tax on Product to sustainable industrial development may be due to the great number of inefficiencies that characterize the entire Nigerian Tax structure and system. The case for foreign donation and grant as source of funding renewable energy in Nigeria is said to be at variance with expectation as most of this fund are either diverted to non-productive sector or embezzled due to the inability of these foreign donors to adequately monitor the utilization and administration of these funds. It is revealed that the contribution of EXTD to Sustainable industrial development was positive. This is because of structure of the external debt tied to renewable energy project and executed by the lenders themselves rather than giving the funds directly to the government. Most of these foreign lenders tied both the debt servicing and final principal repayment to the feasibility, profitability and sustainability of the project.

From the findings depicted above, the study recommends that relevant framework that will make investment in renewable energy as well as the utilization of renewable energy to be attractive to various stakeholders in Nigeria. The underlying downside risk in renewable energy utilization and financing must be address so as to mobilize sufficient private sector investment needed to drive sustainable industrial development.

Having and effective tax system to generate sufficient fund to be channel towards renewable energy production as well as implementing tax incentives on renewable energy and issuance of Green Bond should be embark on to harness the market for renewable energy in Nigeria leading to sustainable industrial development.

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