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Renewable Energy in Sustainable Electricity and Economic Development: The Case of Nigeria

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ABSTRACT

This article explores the potential contribution of renewable energy to the grid for future power production and economic growth in Nigeria. The article goes on to note that, in order to make informed decisions about the future of Nigeria's electricity supply, it is crucial to consider the costs and benefits of a number of competing technologies, such as increased consumer demand, more adaptable power plants, and more efficient management strategies. While it's true that energy use has many advantages, storage to allow for deeper penetration of natural resources, the potential contribution of renewable energy in meeting the requirements and expectations of the electrical sector in Nigeria deserves careful consideration. Even though Nigeria has been an independent nation since October 1, 1960, it does not yet have reliable energy of its own. This article focuses on renewable energy since it can be used to power the economy indefinitely. The enormous need for power in Nigeria and Africa at large piqued the writers' interest in renewable energy. There are no boundaries in time or place that the earth's natural resources cannot transcend (surface). As a result, the essay explores the potential of renewable energy sources to ameliorate the electrical crisis. The essay elaborates on how vital natural resources are to the development of the contemporary economy and technological progress. The essay highlights renewable energy and the need for energy for power production as factors in national economic diversification. The renewable energy's dependency on the requirements of long-term power generation and economic growth is given significant weight.

INTRODUCTION

Nigeria, officially known as the Federal Republic of, is the crown jewel of contemporary Africa. Nigeria's population of around 200 million makes it almost the same size as Brazil's. Electricity's long

and winding past When two modest generating units were erected in 1886 to service the British Colony of Lagos, the history of electricity in Nigeria began. The Electricity Corporation of Nigeria (ECN) was created in 1951 by an Act of

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Parliament, and the Niger Dams Authority (NDA) was established in 1962 to further the development of hydroelectric power in Nigeria. The National Electric Power Authority (NEPA) was established in 1972 as a result of the merger of these two organizations. The rebranding of NEPA as the Power Holding Company of Nigeria in 2005 was a direct outcome of the Electricity Generation and Distribution Sectors of Nigeria's Power Reform Process (PHCN). Looking for a way out

The Nigerian government has inked a six-year power contract with the German energy giant Siemens Company to address the country's electrical crisis.

poor reliability of the nation's power infrastructure. The German energy business and the government of Nigeria have signed a power agreement that calls for the generation of at least 25,000 Megawatts of electricity by 2025.

The German government and Siemens AG have joined together to help solve Nigeria's power shortage, as stated by President Muhammadu Buhari. According to the DW Global Media Forum (2019), "more energy should be provided to companies and residences in Nigeria."

The Washington Post (2012) reported that in underdeveloped nations, approximately 25% of the total population lacked access to electricity. Seven out of every ten individuals in Sub-Saharan Africa do not have access to electricity. If we look at Nigeria's economy in comparison to others, we see that 55% of the population does not have access to power, as stated by Todd (2012).

Over the last two decades, renewable energy's popularity has skyrocketed across the world, thanks to the proven viability, dependability, and cost-effectiveness of this alternative in a variety of specific industries. In Nigeria, where the cost of bringing power to remote villages and towns is significant, localized renewable energy choices may often be cheaper than bringing electricity in from other states via measures like grid expansion. Nigeria has a plethora of natural resources, but the country still relies heavily on imported fossil fuels and gas to power its economy. About 70% (60%, excluding States capital and Federal Capital, Abuja) of Nigeria's population does not have access to electricity, thus doing something about it has been designated a priority among the country's

States. Businesses in Nigeria are struggling because most states lack access to reliable energy, making it difficult for both international and domestic investors.

Industrial, technical, and commercial operations in Nigeria have been paralyzed for the last two decades due to the country's severe energy problems, which have persisted for almost as long. The yearly loss due to power interruptions is estimated at 126 billion Naira (about \$984.38 million) by the Council for Renewable Energy, Nigeria (CREN, 2009).

Health risks have arisen from people's exposure to carbon emissions from the widespread usage of 'backyard generators' in Nigeria, which has led to an increase in unemployment and a general worsening of the country's standard of life.

Rapid progress in quality of life, industrialization, and investment have all contributed to a rise in the importance of relying on renewable energy resources for generating sustainable power and advancing economies. So, the globe is now well on its way to tackling that problem, while simultaneously pushing the boundaries of what can be achieved with natural resources (variable renewable energy). Therefore, Nigeria's reliance on oil for energy prevents it from making use of the country's plentiful renewable energy supplies, which are less harmful to the planet in terms of climate change.

This article's purpose is to help Nigeria make informed decisions on how to best invest in renewable energy development in order to boost the country's technical, environmental, and economic growth.

The essay also intends to help with the task of calculating the energy consumption and economic assessment of renewable energy in different nations.

The System Analysis Method has been used in this study to

It an effort to portray the Council for Renewable Energy, Nigeria (CREN), a governing body in the renewable energy industry, as an intricate and

multifaceted organ with its own unique network of connections and set of ideals.

When examining the current situation of renewable energy in Nigeria, the Structural Analysis Method might be used. This study compared Nigeria's usage of renewable energy to that of other African countries and Western nations using comparative and situational analysis methods. Energy consumption and demand in Nigeria may be measured quantitatively.

RESEARCH BACKGROUND

A country's sustainable electricity and economy reflect the nation's renewable energy resources. It is hard to get a complete understanding of the renewable energy resources in Nigeria.

without examining the finer points of her modernization and economic electrification. Nigeria won its freedom from the British in 1960. (UK). However, the country's economy has not taken a more creative route to growth; oil and agriculture still play significant roles, despite the fast expansion of the commodities sector. Almost all of Nigeria's export earnings and well over seventy percent of the country's general income come from the oil industry, which also represents the country's leading extractive industry. Among terms of oil output, Nigeria leads all of Africa and is in the top seven worldwide. Nigeria has a great deal of untapped creative labor potential, but the United Governments and other major Western states, who have access to the requisite technology and financial resources, are in a position to take advantage of this. Despite having a large oil and gas reserve, Nigeria only uses approximately 4500 of the 6000 MW of power it has installed due to shoddy maintenance and a lack of investment in renewable energy sources (lack of diversification of energy sources). Over 15,000 MW of energy is required to power it. Uninterruptible power is essential to the safety and development of technology in modern, industrialized societies. As a result, many industrialized nations' economy are predicated on the availability of energy from other nations, including renewable sources. To be sure, renewable energy and sustainable growth aren't mutually exclusive in Nigeria's economy. Hui (1997) argues that renewable energy will play a crucial role in providing for the energy demands of both rural and urban communities in the future. To

construct renewable energy markets using renewable energy technology and boost economic growth, Nigeria must make the most of the possibilities offered by the country's renewable energy resources in the field of sustainable power development.

What's more, there's a direct link between a country's level of energy consumption and its GDP, with higher-income nations using more energy overall. Job opportunities and wage increases result from the expansionary effects of renewable energy. Almost all of our economic operations, such as

Jobs for the underprivileged in our overcrowded society are mostly created by SMEs, or small and medium-sized businesses. Because of this, the nature of economic expansion that boosts employment and earnings relies on increased energy usage, and Nigeria shouldn't be an exception. In light of the country's rapidly expanding population and accompanying need for more electricity, Nigerians are increasingly interested in alternative forms of power.

A person's way of life can't function without energy (Mitchel, 1983). The capacity to manufacture food and other material items, as well as travel in comfort, are all made possible by it. It has been shown by Adeyemo (2001) that GDP (the market value of a country's entire production of goods and services) is exactly proportional to energy consumption. Therefore, the degree of economic activity and its structure would be assessed by total gross domestic product (GDP) in addition to the many sectors and sub-sectors of the Nigerian economy, with the interplay between the expanding population and energy consumption being the most significant factor.

From 2015 to 2030, the Nigerian population was predicted to increase from 181.18 million to 281.81 million, a yearly growth rate of 2.86%. Nigeria's overall GDP growth forecasts indicate a significant uptick in economic activity, which in turn would drive a rise in energy consumption. Table 1 shows Nigeria's anticipated annual energy consumption in metric tons of oil equivalent (MTOE).

Sunday According to Table 1, anticipated energy consumption is expected to increase rapidly in the near future, as discovered by Olayinka Oyedepo (2012). If Nigeria's GDP keeps growing at its current pace of 10% per year, the residential sector

would account for the bulk of the country's overall energy consumption by the year 2020. From the baseline year of 2020 through 2030, in all four of the growth scenarios that were accepted, the demand for electricity (which was derived from the overall energy demand) exhibits an upward trend, showing a strong economic growth rate that resulted in a large rise in power demand.

We will compare the overall energy consumption by economic sectors in Nigeria, Brazil, and South Africa based on data from the Nigerian Energy Support Program (NESP), which will be used throughout the rest of this study. Figure 1 depicts this phenomenon.

Figure 1 illustrates that homes take up around 78% of Nigeria's total final energy consumption, with industries using up about 9% and the fast growing transportation sector taking up the rest.

Table 1: Total projected energy demand (MTOE) in Nigeria

Scenario	2020	2025	2030
Reference (7%)	118.14	169.18	245.19
High Growth (10%)	190.73	259.19	414.52
Optimistic (11.5%)	245.97	331.32	553.26
Optimistic (13%)	312.61	429.11	715.7

When compared to its peer group, Nigeria has rather high home energy consumption rates. Meanwhile, data from other nations has shown far lower

portion of total energy usage that comes from homes. Most of the world's total energy consumption is also accounted for by the two other nations that have showed significant interest in industrial sectors. Because domestic energy consumption is so much higher than industrial usage in Nigeria, the latter has been negatively impacted by the former.

With such a large population, Nigeria has to prioritize the development of renewable energy sources to power industrialisation and electrification.

Renewable energy in Nigeria makes use of market processes and decentralization strategies to minimize costs and maximize efficiency. According to Alam (2006), all economic operations need energy. As a result, we agree that renewable

energy as a field of human endeavor will have an impact on almost every facet of human flourishing. Consequently, a stronger economy might be expected to develop in countries where energy consumption is high.

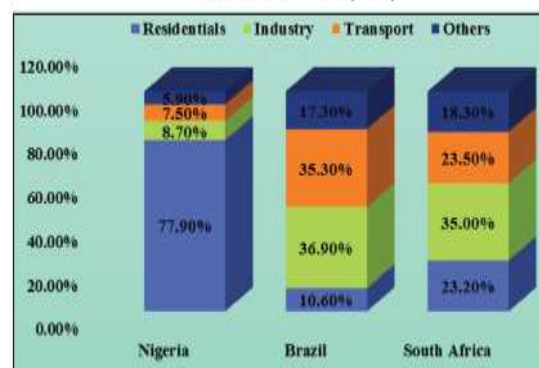
Key areas for Nigeria's growth in international innovation collaboration in the power industry were created in response to current trends in the global energy market's development.

According to Stern (1997a), energy is always a necessary element of production since all economic activities need it.

There has been a lack of productivity in Nigeria's power industry, necessitating efforts at market reform to boost energy generation and distribution. Essentially, this means that electricity generation and distribution in Nigeria will become subject to market competition via privatization. For the power industry to expand in a way that protects the environment for future generations, economic growth and the pursuit of renewable energy must take precedence over the preservation of the present. As such, the writers recognize or regard renewable energy supplies as fundamental to power diversification for long-term electrical and economic growth. Renewable energy that is both efficient and well-developed may have a profound impact on the economy and the level of living of the people, as well as on the growth of the society as a whole.

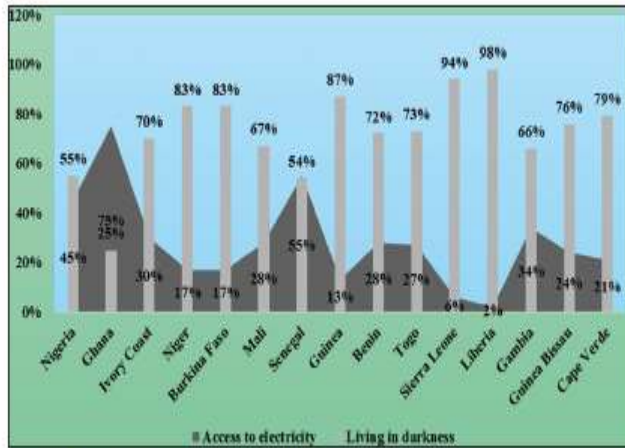
Therefore, the fundamental responsibility of global free energy is to guarantee

Figure 1: Total energy consumption by economic sectors for Nigeria, Brazil and South Africa (2012)



Source: IEA

Figure 2: ECOWAS, seven out of ten people do not have access to electricity



Source: The Washington Post, 2012

consistent, high-quality power to homes and businesses, with few outages, reasonable rates, and no interruptions; this, in addition to safety and reliability.

METHODOLOGY AND DATA

The government and the power industry should work together to find solutions to the aforementioned issues in order to improve the position of renewable energy resources for sustainable electricity and economic growth.

March (1991) argues that in order to innovate, a group or society must be skilled at both using previously acquired information and discovering novel approaches to knowledge generation. To avoid electricity problems that prompted the need to improve renewable energy resources in Nigeria, the Russian government issued Decree 449, titled "Renewable Energy Source Development Measures," which expressed the view that the development and support of usage of renewable energy depends on a detailed innovation knowledge of the past.

Organizing the process of drafting future policy papers should include the creation of acts and by-laws that address rural electrification. If we choose the "Innovation in technical systems" path, for instance, we can look to engineering and other technical fields within the context of the national innovation system. Incorporating this strategy will pave the way for a steady framework for investigating Nigeria's renewable energy sources. A

well-structured energy research program also makes it simple to develop new skill sets.

How much time and effort they put into their planning determines how effective they are at solving problems and how much power they need to make things. As a result of surveying the percentages of power production in ECOWAS nations, the authors provide a structural-functional model of Nigeria's energy requirements (Figure 2).

By analyzing and using Gbadebo and Okonkwo's (2009) research, the authors show that more models in natural resource consumption may be utilized to assess, track, and enhance energy's monetary impact. Calculating the dynamics of estimating the importance of renewable energy in the Nigerian economy requires a certain technique. Here is the model's formula representation:

$$Y = F(K, L, E) \quad (1.1)$$

Where; $Y = \text{RGDP} = \text{aggregate real output (aggregate real gross domestic product)}$; $K = \text{Gfcf} = \text{Gross fixed Capital formation}$; $L = \text{Laf} = \text{Labour force}$; $E = \text{Total Energy Consumption}$.

Let's energy (E) in the model is disaggregated into four energy types, which includes: Solar, wind, hydro and biogas. Splitting the energy into four types, the model could be rewrite as follows:

$$\text{RGDP} = f(\text{Gfcf}, \text{Laf}, \text{SE}, \text{WE}, \text{HE}, \text{BIOGE}) \quad (1.2)$$

Where; $\text{SE} = \text{Solar energy}$; $\text{WE} = \text{Wind energy}$; $\text{HE} = \text{Hydro energy}$; $\text{BIOGE} = \text{Biogas energy}$.

For purpose of estimation we rewrite equation (1.2) above in the linear form, as:

$$\text{RGDP}_t = a_0 + a_1 \text{Gfcf}_t + a_2 \text{Laf}_t + a_3 \text{SE}_t + a_4 \text{WE}_t + a_5 \text{HE}_t + a_6 \text{BIOGE}_t + U_1 \quad (1.3)$$

α_1 to α_3 represent the slope coefficients
 α_0 is the intercept
 $U1_t$ Is the stochastic term or the error term at time (t).

The priori expectations are as follows:

$$\alpha_1 > 0, \alpha_2 > 0, \alpha_3 > 0, \alpha_4 > 0, \alpha_5 > 0, \alpha_6 > 0$$

In the non-linear form we also estimated

$$\ln RGDP_t = \beta_0 + \beta_1 \ln GFCF_t + \beta_2 \ln LAF_t + \beta_3 \ln SE_t + \beta_4 \ln WE_t + \beta_5 \ln HE_t + \beta_6 \ln IOGE_t + U2_t$$

Where;

β_1 to β_6 are elasticities and β_0 is the intercept
 $U2_t$ Is the error term.

4. RESULTS AND DISCUSSION

Slow and unreliable energy production over a period of time (t), notably in the industrial sector, is blamed for Nigeria's low productivity and human empowerment. Due to the impact of.

The influence of renewable energy on the efficiency of power production is substantial, and it plays a crucial role in bolstering the national economy. The Nigerian renewable energy sector must introduce a new specialist model, ways to assess their level of training, and take on themselves responsibility for risks from cooperation with industry and energy business if it is to realize its potential in any field of technological advancement for the benefit of the national economy. In such a scenario, the government, industry, and the energy sector will all be eager to work together. Individuals and society as a whole would gain from such a partnership since it would lead to marketable advances in the energy sector. The potential for enhancing energy to boost the efficiency of the Nigerian power and economic growth are particularly significant in the context of the massive development of the renewable energy resources in Nigeria. Advantageous and Modern industrial economies across the world provide employment that pay a livable wage, and power production relies on the effective use of renewable energy sources.

Renewable energy has real-world relevance because it shapes and guides technological growth while keeping tabs on the status of critical areas

including power production, security, communication, transportation, and infrastructure.

The importance of renewable energy sources in maintaining Nigeria's economic competitiveness cannot be overstated at the current time. The study found that the quality of electricity generation in Nigeria is hampered by a number of issues. These include: • a lack of well-organized workshops for training specialists and hands-on training; • an underdeveloped innovation technology for renewable energy; • a problem with security; • a lack of technical knowledge; • a shortage of electrical equipment; • a delay in the payment of salaries to workers; • imperfect policy and management; • religious factions and political instability.

5 - SUMMARY

Since Nigeria's renewable energy sector is characterized by both electrification and technology lag, a shift toward energy creation within a national innovation framework is recommended. As a result, the Nigerian economy as a whole, not just the electricity sector, will benefit from the increased competition, improved technology, revitalized core industries, fortified social and economic stability, and energized creative processes that this reform would enable.

A sustainable power and economic development may be achieved by forming an integrated system of renewable energy resources with a primary emphasis on youth training in energy innovation.

General energy innovation training programs, workshops, and schools make up the first level, while technical colleges, research institutions, and universities make up the second. The government, in conjunction with relevant businesses, must indisputably make this a part of the curriculum. Politicians make up the third and final phase. Lawmakers should enact measures that expand access to electrical generation resources and promote the use of decentralized, locally generated power.

It is crucial for Nigeria to form alliances with advanced energy producers abroad like Russia and Germany.

Producing power for use in homes and businesses. Spending in renewable energy not only reaps

financial benefits but also sparks the development of novel commodities, new technological feats, and even new human endeavors.

Revitalization and major investment in the nation. Renewable energy research and practice should be well-organized and widely implemented. Carbon dioxide (CO₂), nitrogen oxides (NO_x), sulfur
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oxides (Sox), and particulate matters are only some of the greenhouse gases released into the atmosphere when bioenergy is used to generate electricity, and this helps alleviate some of the related environmental problems.

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