



An Assessment of Renewable Energy Impact on Economic Development in Nigeria

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ABSTRACT

Most business establishments and even homes that rely on public power sources even homes enjoy less than 10 hours of power supply per day and as such, power shortage is seen as a major hindrance to sustainable economic development. Additionally, the awareness of the environmental implications of producing energy through nuclear, fossils or hydro sources has increased considerably. The combined effect of this is that attention is shifting to the generation of energy (power) through renewable energy sources. However, the low exploitation of renewable energy sources, despite the profusion of these, as sources of power remains as source of concern. This research, through a review of existing works in this subject as well as analysis of relevant secondary data, sought to explore the prospects and challenges of renewable energy utilisation in Nigeria.

Keywords: *Economy, Economic Development, Fuel, Nigeria, Renewable Energy, Sustainable Development*

1 INTRODUCTION

There is a growing concern about the continued availability of fossil fuel sources such as oil, natural gas, coal, among others (Sari & Akkaya, 2016), even though the global energy demand has continued to increase, especially in the developing countries. The effect of this is that demand for power (in some countries) is more than that generated and distributed, such that many are without electricity. Although there are observations that development economies are characterized by constant power supply and any nation whose energy need is epileptic in supply, prolongs her development and risks losing potential investors (Okoro & Chikuni, 2007), Nigeria's energy need is still not met. It is noted that electricity demand is far more than supply, with the supply exacerbated by its epileptic nature (Abuabkar Sani Sambo, Garba, Zarma, & Gaji, 2012). According to a source quoted by Obasi (2015), Nigeria is estimated to be about 90 percent deficiency in electricity supply, with some off-grid areas where about 50% of Nigerians living having no access to electricity. Furthermore, Ohiare (2015), relying on data by International Energy Agency (IEA) (2013) notes that in the year 2013, Nigeria could not provide access to electricity to about 42% (85 million people) of her population dwelling in both the urban and rural areas.

Implications of inadequate energy supply have been highlighted variously. For instance, Oyedepo (2012) notes that Nigeria's energy crisis has paralyzed industrial and commercial activities, with power outages leading to a loss of about 126 billion naira (US\$ 984.38 million) annually (Council for Renewable Energy Nigeria (CREN), 2009).

Apart from the challenge of lack of access to electricity especially in the rural areas of Nigeria, there seems to be a lack of clear electrification plans or policy (Ohiare, 2015). Challenges of the electricity market in Nigeria include slow expansion of generation capacity, interference by government in the deregulation process of the market, vandalism of electrical transmission lines and distribution equipment, poor maintenance of existing facilities among others (Olugbenga et al., 2013).

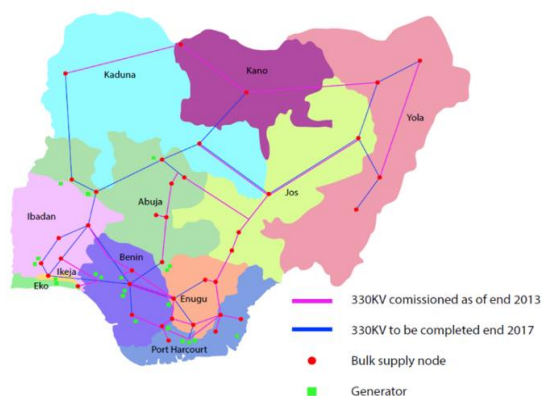
The restricted access to fuel for conventional generation in Nigeria require that alternative sources of power generation, mostly renewable energy sources, be explored (Energy Commission of Nigeria (ECN) & United Nations Development Programme (UNDP), 2005). Therefore, Nigeria should, as a matter of necessity join in the quest for cleaner, more diverse and more sustainable energy mix (Olugbenga et al., 2013, Dunmade, 2016).

However, in order to reposition renewable energy as a key driver for sustainable economic development, there is a need to change the future energy mix towards more sustainable and renewable sources of energy (United Nations Conference on Trade and Development, 2010). This, would, among other strategies, involve the harmonization of energy policies to enhance access to sustainable renewable energy in developing countries. The need to harmonize and put in place an energy policy is hinged on the fact that many developing countries, often characterized by poor or ineffective governance, struggle to generate enough power that would stimulate economic growth and enhance the well-being of its citizens. A good energy policy leads to sustained power generation, and this also creates job opportunities (Valodka & Valodkienė, 2015).

The assessment of the impact of renewable energy on economic development and how national institutions respond to emerging energy challenges in developing countries particularly Nigeria is of research interest. This is important for developing nations where energy plays important role in economic development by reducing poverty through better access to energy (Kanagawa & Nakata, 2007, 2008). The importance of access to energy is further highlighted by Rai and Rai (2004) who observe that per capita energy consumption is not only a measure of the per capita income but also a measure of the prosperity of a nation. Thus, the attainment of sustainable development especially in developing countries needs concerted efforts to provide effective and reliable electricity networks. It is acknowledged that many economies are experiencing negative growth that has caused cash crunch. Faced with this challenge of inadequate capital, it is advisable that governments enter into partnership arrangement with the private sector (Müller, Brown, & Ölç, 2011). And current research highlights the most efficient and cost-effective way to achieve this in developing countries, 80% of which are typically rural communities, is to build mini electricity grids that are linked (Resource Centre for Energy Economic and Regulation, 2006).

2 NIGERIA'S RENEWABLE ENERGY PROFILE

Nigeria's blessed with abundant natural resources such as natural gas, tin, iron ore, coal, limestone, niobium, lead, zinc among others (Organization of the Petroleum Exporting Countries - OPEC, 2017, Organisation for Economic Co-operation and Development). Influenced by available natural resource data, authors such as Dosunmu and Omayone (2003) observe that Nigeria's estimated 25 billion barrels reserve of oil,



3.4 trillion cubic meters natural gas reserve, and 2.7 billion tones as the total estimated reserve of coal make her with huge energy resources, even though the level of utilization of these resources (crude oil, natural gas, coal, solar power, hydro, wind, and nuclear) is below

expectation. Figure 1 illustrates the vast spread of the network in Nigeria

Despite its rich renewable energy shared across the different geographical regions, it has largely dependent on non-renewable sources. The estimated energy profile of the country is given in Figure 1 below

TABLE 1: ESTIMATE OF ENERGY SOURCE RESERVES IN NIGERIA

Energy Source	Reserves
Oil	36.5 billion <i>barrels</i>
Natural Gas	187.44 trillion <i>scf</i>
Bitumen & Tar Sands	30 billion <i>barrels</i> of oil equivalent
Coal & Lignite	Over 4 billion <i>tonnes</i>
Nuclear	Not readily available
Large Hydropower	11,250 <i>mw</i>
Small Hydropower	3,500 <i>mw</i>
Fuel wood	13,071,464 <i>Hectares</i>
Animal waste	61 million <i>tonnes/yr</i>
Crop Residual	83 million <i>tonnes/yr</i>
Solar Radiation	3.5-7.0 <i>Kwh/m²-day</i>
Wind	2-4 <i>m/s @ 10m height</i>

Source: Ekechukwu and Akuru (2013)

The above Table 1 includes energy reserves from both renewable and non-renewable sources. Renewable energy, which is energy generated through natural processes and that are continuously replaced, includes sunlight, geothermal heat, wind, water, as well as various forms of biomass (Valodka & Valodkienè, 2015). Table 2 below is the renewable energy reserves profile of Nigeria

In Nigeria's communities, over 70% these depend on fuel wood as a source of energy, so much so that over 50 million tonnes of fuel wood is consumed annually (Oyedepo, 2012). However, this dependence on wood as a source of energy has far reaching implications on the environment, sourcing fuel wood for domestic and commercial uses is a major cause of desertification, with a deforestation rate of about 350,000 ha/year (Federal Ministry of Environment, 2000).

TABLE 2: RENEWABLE ENERGY RESERVE OF NIGERIA

Resource	Reserves	Reserves Billion toe
Hydropower	10000MW	
Hydropower	734MW	Provisional
Fuelwood	13071464 has (forest land)	Estimate

	1981)	
Animal waste	61million tonnes/yr	Estimate
Crop Residue	83million tonnes/yr	Estimate
Solar Radiation	3.5-7.0kWh/m ² -day	Estimate
Wind	2-4m/s (annual average)	

Source: Energy Commission of Nigeria (ECN) and United Nations Development Programme (UNDP) (2005)

However, penetration of renewable energy into the Nigerian energy market is still in its nascent stage, with the only sources of renewable energy in the country being hydro-power and biomass. Wind and solar energy have only been used in small scale. Solar energy in Nigeria is majorly used in urban areas for street lighting, while in rural areas it is used for irrigation project and water pumping.

It could be argued that Nigeria had derived most of its energy from the hydro dams – a renewable source of energy, this is picture is rapidly changing as the hydro power stations are now being overtaken by gas power stations (Newsom, 2012). It is estimated that concentrated solar thermal power potential in Nigeria is over 427,000MW indicating with the current levels of power generation of around 5000MW, renewable power generation could prove transformational, offering energy independence for the majority with presently limited or zero access to reliable electricity (Newsom, 2012).

Several studies have assessed the viability of renewable energy resources in Nigeria. For instance, Onyebuchi (1989) established that at a conversion efficiency of 5%, there would be an annual electricity production of about 4.2×10^5 GW/h which is more than twenty folds higher than current annual electricity production in the country. With specific reference to solar energy, Chineke and Igwiro (2008) estimated that with a six and half hours average sunshine period, an average annual solar energy intensity of 1,934.5 kW h/m²/year would be achieved, equating to an average of 6,372,613 PJ/year (approximately 1,770 TW h/year) of solar energy falls on Nigeria, and this about 120,000 times the total annual average electrical energy generated in Nigeria. In a perhaps ambitious projection, Energy Commission of Nigeria (ECN) and United Nations Development Programme (UNDP) (2005) projected that the available solar energy resource would be about 23 times the total final energy demand for Nigeria by the year 2030.

Although a shift to renewable energy sources looks enticing, it is to be noted that it comes with significant costs (Oyedepo, 2012). Therefore, its adoption in Nigeria would require a strategic centralized control system in investment and implementation given the enormous cost implication. Therefore, its application across public sector would have ripples effect across major sectors for the economy. Many renewable energy sources are inherently intermittent. Thus, their integration

into a unified electricity grid can pose challenges, especially on a large-scale basis, and may make them less competitive with conventional generating systems. Furthermore, standalone renewable energy resources due to the constraints in transmission extension can be a challenge because these renewable sources are not cheap, and their scalability and integration into the major network of the population in the community can pose a challenge (Oyedepo, 2012).

2.1 NIGERIA'S ENERGY CONSUMPTION PROFILE

Energy consumption in Nigeria is low in comparison with other African countries with similar energy resources. This, observed low consumption according to Emodi (2016), could be linked to persistent scarcity of petroleum products at vehicle petrol stations, coupled with the frequent electricity “black-outs” that have resulted in a high reliance on personal electricity generators.

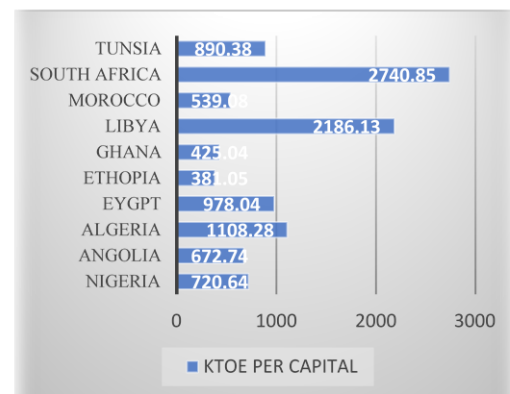


Figure 2: Energy consumption per capita in some African countries in 2012 (Source: Emodi (2016))

The sectorial distribution of energy consumption in Nigeria is shown in Figure 3 below. In spite of the low-level consumption when compared with other African countries as shown in Figure 2 above and the scarcity of petroleum products cited by Emodi (2016), local energy consumption is on the increase in Nigeria, a situation that A. S. Sambo, Iloeje, Ojosu, Olayande, and Yusuf (2006) attributed to population growth and the level of economic activity

Renewable energy is considered a viable solution to the energy challenges of Nigeria especially in the rural areas of the country. Although energy efficiency implementation is increasingly being recognized by policymakers worldwide as one of the most effective means to mitigating rising energy prices, tackling potential environmental risks, and improving energy security in developing country markets continues to be a challenge. However, energy plays the most vital role in the economic growth, progress, and development, as well

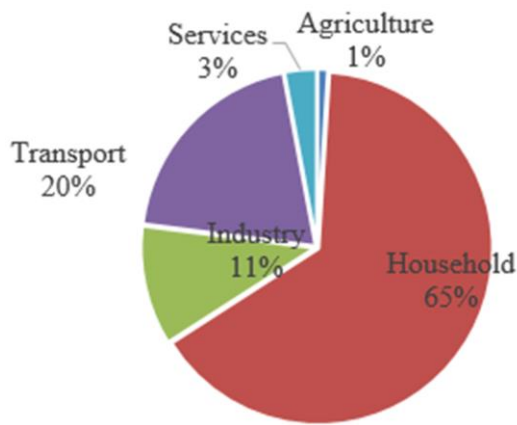


Figure 3: Sector Distribution of National Final Energy Consumption

as poverty eradication and security of any nation. Uninterrupted energy supply is a vital issue for all countries today (Oyedepo, 2012). However, with increased demand for energy sources with shortage of alternative renewable energy is becoming like a “silver bullet”.

2.2 BENEFITS OF RENEWABLE ENERGY

The benefits of adopting renewable energy are multifarious. It is renewable, sustainable and will never run out. It is constantly being renewed from natural. They have security of supply, unlike fossil fuels, which are negotiated on the international market and subjected to international competition, sometimes even resulting in wars and shortages. Renewable energy need less maintenance than traditional generators. Their fuel being gathered from natural and available resources reduces the costs of operation (Agbongiarhuoyi, 2015). However, within developing countries like Nigeria where developed systems have lagged behind Mini-grids are a potential solution. Mini-grids based on renewable energies play an important role to contribute to reaching the ambitious national Electrification targets as a vision shared by former UN Secretary-General Ban Ki-moon back in 2011, they are commonly seen as a key to providing universal access to sustainable energy by 2030 and since then supported through the Sustainable Energy for All (SE4all) initiative (Raisch, 2016). However, its development would involve having a strategic and energy policy resulting in efficient service delivery and increase revenue. The literature review explains that previous research on benefits of renewable energy projects have focused on environmental and economic benefits where metrics for costs, financial savings and environmental improvements were considered. Some of these studies showed possible improvements in discussions such as sustainability and social development. Also, renewable energy projects are mostly seen by decision makers as a tool to offset the effect of dropping energy and increasing pollution problems. The combined socioeconomic benefits of these projects are widely ignored (Shoaib & Ariaratnam, 2016).

The table 3 below estimates that Nigeria should be creating over 315,160 jobs from renewable energy along. Even if the country focus on the two high yields of solar and hydro alone, more than 200, 000 jobs would be created as a result.

TABLE 3. NATIONAL POLICY PROGRAM AND TARGET

Renewable Energy	2015	2020	2030
Solar Energy	600mw	6136mw	48132mw
Wind Energy	23mw	40mw	50mw
Hydro Energy	4100mw	9760mw	14750mw
Biofuel Energy	5mw	30mw	100mw
Total	4728mw	15966mw	63032mw
Jobs Created	23640	79830	315160

2.3 BARRIERS TO RENEWABLE ENERGY IMPLEMENTATION

Energy plays an important role in driving economic development (Oji, Soumonni, & Ojah, 2016), and could be regarded as the foundation of modern economies. For instance, it could be inferred from conclusions in a study by Stern and Kander (2012) is that while scarce energy services impacts on output growth and results in a low-income steady-state, abundant energy services on the other hand, displays the behaviour of the modern growth regime. It is, thus, a precondition for economic growth, improvement in living conditions and alleviation of poverty. Therefore, access to energy is considered an important development goal and obstacles such as high energy costs, unaffordable energy grid infrastructure and dispersed population makes providing access to a majority of the world’s population in developing countries a daunting task. It is therefore, logical, that options that can offer unique opportunities for the provision of affordable and sustainable energy to millions of people be encouraged. Renewable energy technologies, in particular, offer diverse and economically attractive options for rural electrification (Shoaib & Ariaratnam, 2016).

The attainment of the above is however affected by certain factors. Notable barriers to renewable energy implementation include financial investment, power purchase agreement, legislation and regulation, politics, policy and strategies, technology and innovation, public awareness, environmental support program (Emodi & Ebele, 2016). The challenges to the widespread deployment of renewable energy technology are a combination of factors which include the impact of decreasing economic growth and decreasing public financing for infrastructural project often impacting renewable energy. Effective use of resources is a major challenge facing countries like Nigeria managing the energy mix and improving economic issues.

Lack of acceptable policies supporting developing these renewable energy sources like subsidies which are still been given to players in the oil and gas sector. Similarly lack of adequate investment for deployment of renewable energy because of budgetary constraints. These barriers put renewable energy at an economic, regulatory

and institutional disadvantage compared to other forms of energy. Researchers have to compete with more pressing government priorities. Also, there is a scarcity of relevant technical knowledge domicile with the country to handle the technical issues needed in making strategic decision like site location and operating the suitable renewable energy technology for the eventual benefit of the country. This involves having skilled and qualified workforce to handle these projects.

3 METHODOLOGY

This study adopted a multi-method approach. It specifically entailed the review of existing studies and secondary data on energy and renewable energy. The data used were obtained from the Small and Medium Enterprises development agency of Nigeria (SMEDAN) and collaboration with the National Bureau of statistic and Central Bank of Nigeria with other relevant data from literature were included (NBS & SMEDAN, 2012).

4 RESULTS AND DISCUSSION

The information contained on Table 4 is the response by small and medium sized companies, across the various sectors, that were interviewed about their usage of alternative sources of energy across various sector of the economy.

The endemic power shortage which has impacted negatively on the ease of doing business in Nigeria (Figure 4 below) has increased the need for alternative sources of energy.

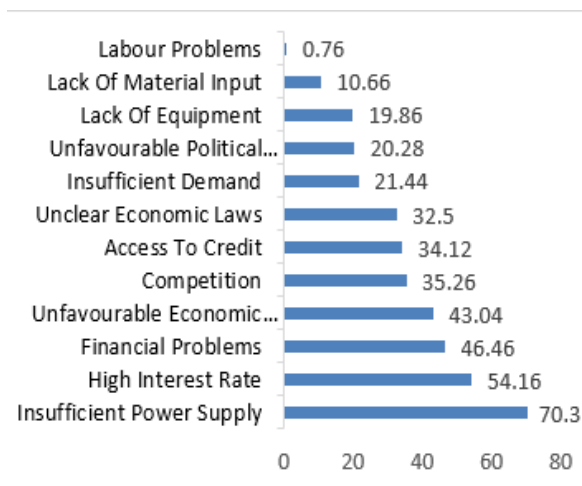


Figure 4: Business constraints percentage ranking result-national

Given the nature of jobs in Nigeria where a sizeable portion of the many work between 8.00am and 6.00pm, more than 75 percent of the over 22,918 respondents across various sectors said that they use alternative sources of energy between 1 and 10 hours a day.

TABLE 4: DAILY USAG EOF ALTERNATIVE SOURCES OF POWER BY SECTOR

Sector	1 - 5 Hours		6 - 10 Hours		11 - 15 Hours		16 - 20 Hours		Total
	Num.	%	Num.	%	Num.	%	Num.	%	
Agriculture, Hunting, Forestry and Fishing	303	39.4	226	29.4	131	17.1	108	14.1	768
Mining and Quarrying	62	36.6	67	39.8	16	9.7	24	14	168
Manufacturing	2,166	36	2,247	37.4	801	13.3	794	13.2	6,009
Building and Construction	81	34	97	40.6	29	12.3	32	13.2	239
Wholesale and Retail Trade; Repair of Motor Vehicles and Household goods	2,046	48.6	1,501	35.7	383	9.1	280	6.6	4,210
Hotels and Restaurants	573	25.2	700	30.8	579	25.5	421	18.5	2,272
Transport, Storage and Communication	473	56.5	245	29.2	38	4.5	82	9.7	838
Financial Intermediation	906	39	906	39	256	11	256	11	2,323
Real Estate, Renting and Business Activities	399	40.4	402	40.8	124	12.5	62	6.3	987
Education	972	56.9	486	28.4	184	10.8	67	3.9	1,709
Health and Social Work	889	32.1	876	31.7	426	15.4	576	20.8	2,767
Other Community, Social and Personal Service Activities	255	40.7	240	38.2	87	13.8	46	7.3	627
TOTAL	9,124	39.8	7,993	34.9	3,054	13.3	2,747	12	22,918

The major alternative energy resources abundant throughout the African continent are solar energy (thermal and photovoltaic), wind energy, wood and biomass, and biogas production (Bugaje, 2006). It is inferable from Table 4 that many business enterprises rely on alternative (precisely 39.8 percent) make daily usage of alternative source of power in the range of 1to 5 hours, while about 35% of the enterprises rely on alternative power sources between 6 and 10 hours a day. Some other businesses (about 12%) of participating businesses) claimed that they use alternative sources of power for upwards of 16 to 20 hours a day. It worth noting that within the productive section of the economy (that is the manufacturing sector), rely heavily on alternative energy sources to sustain their business. (NBS & SMEDAN, 2012). The cascaded impact of this on the economy of the nation is huge.

5 CONCLUSION

Inference drawn from conclusions in a study by Stern and Kander (2012) is that while scarce energy services impacts on output growth and results in in a low income steady-state, abundant energy services on the other hand, displays the behaviour of the modern growth regime. It has been shown variously that the energy requirements of



Nigeria have not been met using the current energy generation sources. However, renewable energy sources such as solar and wind energy (both of which are grossly unexploited) provide very good sources (opportunities) to increase energy generation in Nigeria. But in order to fully harness the potential economic benefits from the use of renewable energy, there is need to review and strengthen the energy policy of Nigeria to make it more responsive.

The impact of renewable energy on Nigeria's economy growth and stability was analysed using existing data. This above finds, there is need to improve our investment in the much-needed renewable energy technology through training skilled professional providing the current best practice for the industry. The Federal government of Nigeria through the relevant organ and agencies show introducing renewable energy friendly policies which including but not limited to tax incentives would encourage local and foreign investment that potentially as projected can spur job creation of over 300,000 jobs within the in just over a decade.

It is recognized that in because of the complexity of gathering data, the result of this paper is not perfect, especially considering the challenges involved in the deployment of renewable energy which include, inadequate technical capacity as well as weak policy and regulatory function. However, improving assessment study would enable decision makers. The paper presents the result of the data existed from relevant sources, however further studies on the economy to understand the impact of renewable energy is needed.

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