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# Building-Up Local Capacity for Renewable Energy Development In Nigeria

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***Abstract:*** *Nigeria and indeed all societies require energy services to meet basic human domestic and communication needs and to serve productive processes. Growth and the general welfare of any community require that energy be readily available and that energy delivery be secure and reliable. The fact of climate change and the need to reduce emissions from fossil fuel combustion requires sustainable energy development and that delivery of energy services needs to be secure and have low environmental impacts. Sustainable social and economic development requires assured and affordable access to energy resources necessary to provide essential and sustainable energy services. Nigeria has been facing an extreme electricity shortage. Our experience is that electricity availability is always erratic and abysmally low. This deficiency has been attributed to multi-faceted causes like lack of grid and transmission infrastructure and the funds to equip the sector, dependence of electricity production at the generation plants on timely and sufficient supply of oil and gas needed to run the plants as well as destructive acts of vandalism of both electrical installations and oil and gas supply pipelines. Nigeria enjoys abundant renewable energy resources based on its latitudinal location near the equator. The region consequently enjoys enormous solar energy resource, huge resources in biomass as well as a fair wind regime which can be harnessed to ensure consistent energy availability. The need for the reduction of Green House Emission (GHE) supports the quest for concerted effort towards the development and better utilization of renewable energy both in Nigeria and in other parts of the world. This paper recognizes the critical role local capacity would play in the development of renewable energies in the country and makes a case for the building up of local capacity towards renewable energy development in Nigeria.*

***Keywords:*** *Energy, Renewable, Electricity, Local Capacity, Sustainable*

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## I. Introduction

Energy is needed in every sphere of human activity. Pertinent areas include: (a). Industries for mining, milling, smelting, forging of primary metals, electricity generation, raw material transformation (into plastic, fertilizers, solvents, lubricants, and other chemicals for commercial uses), manufacture (of cement, glass, tiles, paper, bricks), processing of food etc.; (b). Agriculture for powering of machines and equipment as well as for storage; (c). Construction for powering of machines and equipment; (d). Residential and commercial buildings for heating, air conditioning, lighting, powering of electronic equipment (such as computers, copy machines, CCTv. , television and radios), refrigerating etc; (e). Transportation of humans, goods and services; (f).Schools for powering of electronic boards and conducting of research; and (g). Hospitals for powering of electrical and electronic equipment used for medical examination (Mbalisi and Offor, 2015).

Nigeria's demand for energy is estimated to be 7,600 (MW). However, the country only has a total installed generating capacity of 6,000MW, which is far from being optimized as the country is only able to achieve 3,000MW output. A highly-placed government official responsible for the Power Ministry has blamed their inability to utilize fully the installed generating capacity on the shortage of gas of which they currently get a supply of 230mmscf/day. An additional supply of 600mmscf/day is needed to be able to generate the maximum capacity at 6,000MW. It is ironic that a country where gas is wasted through flaring is blaming lack of gas supply for its power problems. The costliest energy need in Nigeria is lighting - similar to the pattern in other African countries where nearly 10-15 percent of the poorest households' income may be spent on kerosene lamps, stoves or candles. The case is not different in Nigeria where the poorest households earn about 1-2 US dollars per day and spend about 0.4 dollars per day on energy needs. Kerosene lamps provide poor lighting and are expensive, inefficient, highly polluting and dangerous (Olise and Nria-Dappa, 2009).

Obadote, (2009) reports that the history of electricity in Nigeria dates back to 1896 when electricity was first produced in Lagos, fifteen years after its introduction in England and that the total capacity of the generators used then was 60KW. In other words, the maximum demand in 1896 was less than 60KW. In 1946,

the Nigerian government electricity undertaking was established under the jurisdiction of the Public Works Department (PWD) to take over the responsibility of electricity supply in Lagos state. In 1950, a central body was established by the legislative council which transferred electricity supply and development to the care of the central body known as the Electricity Corporation of Nigeria, ECN. Otherbodies like Native Authorities and Nigerian Electricity Supply Company (NESCO) had licenses to produce electricity in some locations in Nigeria. The study further states that there was another body known as Niger Dams Authority (NDA) established by an act of parliament and that the Authority was responsible for the construction and maintenance of hydro dams and other works on the River Niger and elsewhere generating electricity by means of water power, improving navigation and promoting fish brines and irrigation. The energy produced by NDA was sold to ECN for distribution and sales at utility voltages.

As time progressed the power need increased geometrically and expansions and reforms were also made. On 1st of April 1972, ECN and NDA merged to form a unified body known as National Electric Power Authority (NEPA) with the actual merging taking place on the 6th of January 1973 when the first manager was appointed (Awosope, 2014). Since inception of NEPA, (renamed Power Holding Company of Nigeria (PHCN), in year 2004); the authority expands annually in order to meet the ever-increasing demand. Unfortunately, majority of Nigerians have no access to electricity and the supply to those provided is not regular (Obadote, 2009). it is estimated that the Nigerian population connected to the grid system is short of power supply over 60% of the time. Additionally, less than 40% of the population is even connected to the grid. On a fundamental level, there is simply not enough electricity generated to support the entire population (Obadote, 2009).

To address the twin issues of NEPA's poor operational and financial performance the Nigerian government moved to privatize the power sector with the Electric Power Sector Reform Map of 2005 and the launch of the Roadmap for Power Sector Reform in 2010. The former National Electric Power Authority (NEPA) was replaced by the Power Holding Company of Nigeria (PHCN), which was unbundled into separate generation and distribution companies and the Transmission Company of Nigeria (TCN). Beginning in 2013, the generation and distribution companies were handed over to private owners with the FGN retaining a minority stake. The TCN is still 100% owned by the FGN but is currently under a management contract with Manitoba Hydro International (MHI) (Osinbajo, 2015).

Energy plays the most vital role in the economic growth, progress, and development, as well as poverty eradication and security of any nation. Uninterrupted energy supply is a vital issue for all countries today. Future economic growth crucially depends on the long-term availability of energy from sources that are affordable, accessible, and environmentally friendly. Security, climate change, and public health are closely interrelated with energy. Energy is an important factor in all the sectors of any country's economy.Access to clean modern energy services is an enormous challenge facing the African continent because energy is fundamental for socioeconomic development and poverty eradication. Today, 60% to 70% of the Nigerian population does not have access to electricity. There is no doubt that the present power crisis afflicting Nigeria will persist unless the government diversifies the energy sources in domestic, commercial, and industrial sectors and adopts new available technologies to reduce energy wastages and to save cost (Oyedepo, 2012).

Renewable Energy Resources are energy resources that are available in unlimited amount in nature. They can reproduce themselves in nature over relatively short period of time and can be harvested continuously through a sustained proper planning and management. They include fuel wood (firewood), animal dung, solar energy, wind energy, water energy, geothermal energy etc. Non-Renewable Energy Resources are energy resources that are available in limited amount in nature and develop over a long period of time. As a result of their limited nature, they are likely to be exhausted one day. These include coal, crude oil, natural gas, nuclear power etc. Coal, crude oil, natural gas, the common energy resources being organic (biotic) in their origin are also called fossil fuels (Mbalisi and Offor, 2015).

## II. Statement of the Problem

An estimated 60-70% of the Nigerian population does not have access to electricity. Energy demand in Nigeria is dominated by fuel wood and women and children are the most affected in the energy crisis. At present only 10 % of rural households and 30- 40% of the country's total population has access to electricity. The energy sector in Nigeria totally rely on government subsidized fuel and funding of major energy plants and energy capital projects by the federal government, states and government agencies. Perhaps it is only individuals that are neither living nor doing business in Nigeria who will not know that lack of adequate energy supply especially electricity, is the major challenge the country is facing to fully utilize its economic potentials in other to achieve economic development. This is also the most significant factor which is affecting the country's race to be one of the biggest and top twenty economies of the world by 2020 (Nadabo, 2010).

Nigeria energy demand growth would be approximately 3.5-fold between 2010 and 2020 and 7.5-fold between 2010 and 2030, respectively, at a growth rate of 7%, while the projected supply by fuel mix shows a similar trend with the demand at both growth rates of 7% and 13%. There is a wide disparity in the

energy demand to the supply ratio in Nigeria both in the present and the future. This necessitates an urgent need for alternative energy sources and efficient energy usage in order to avert looming energy crises. These projections for continued rapid energy growth imply some severe problems for the future resource depletion, energy degradation, associated environmental problems, fuel shortage, etc. Indeed, many of these problems are already happening; thus, energy conservation is concerned with ways to reduce energy demand, but yet achieve the same objective as before (Oyedepo, 2012).

The issue of finding lasting and permanent solutions to the problems of abysmal and erratic power supply in Nigeria has remained a priority of every successive government in the last ten years. The Nigerian government has not been able to find permanent solutions that will resolve the problems due to the adaptation of short term, hasty policies and also still undergoing energy projects which are detriment to long term energy policies that will help the nation to achieve sustainable energy and energy efficiency. For example, what the country have done is still usage of the various alternatives that are still within the limits of fossil fuels, which are the only source that currently powers the nation economy (Nadabo, 2010).

## III. Research Methodology

Data for this paper were derived from secondary sources: previous researches and analyses of scholars, government documents; as well as journal articles that are related to the subject as the study involved an extensive literature review which critically analyzed the present status, problems and prospects of energy and power in the country as well as renewable energy potential applicability in rendering solution to the energy crises in Nigeria. The work relies on facts of action as evidenced in reports and literary items. It lays down some road map for building local capacity for development of renewable energy technologies in the country.

## IV. Renewable Energy

Renewable energy sources are sources that can be replenished or produced quickly through natural processes. The rate at which they are used does not affect their availability in future and as such cannot be exhausted. All the regions of the world have reasonable access to one or more forms of renewable energy supply because the resources are generally well distributed all over the world, even at wide spatial and temporal variations. Many of the renewable resources can be depleted by human use, but may also be replenished thus maintaining a flow (Osueke and Ezugwu, 2011). To achieve its objective of sustainable development, Nigeria needs to substantially increase the supply of modern affordable energy services to all its citizens while, at the same time, maintaining environmental integrity and social cohesion. In addition, a robust mix of energy sources (fossil and renewable), combined with an improved end-use efficiency, will almost certainly be required to meet the growing demand for energy services in the country (Oyedepo, 2012).

Renewable energy resources and technologies are a key component of sustainable development for the following primary reasons:

i. They generally cause less environmental impact than other energy sources. The implementation of renewable energy technologies will help to address the environmental concerns that emerged due to greenhouse gas emissions such as carbon dioxide ($CO_2$), oxides of nitrogen (NOx), oxides of sulfur (SOx), and particulate matters as a result of power generation from oil, natural gas, and coal. A variety of renewable energy resources provide a flexible array of options for their use.

ii. They cannot be depleted. If used carefully in appropriate applications, renewable energy resources can provide a reliable and sustainable supply of energy almost indefinitely. In contrast, fossil fuel resources are diminished by extraction and consumption.

iii. They favor system decentralization and local solutions that are somewhat independent of the national network, thus enhancing the flexibility of the system and providing economic benefits to small isolated populations (Oyedepo, 2012).

## V. Renewable energy Potential

Studies conducted by Idris et al, (2013) show that Nigeria is blessed with reasonably high quantities of a variety of primary renewable energy resources. The renewable energy resources of the country are well distributed throughout the country. These large bodies of water for hydro power generation, sunshine for solar power generation and strong winds for wind power generation. In the Hydro power source, the country is well endowed with large rivers and some few natural falls which are together responsible for the high hydropower potential of the country. The Rivers Niger and Benue and their several tributaries constitute the core of the Nigerian River system, which offers a renewable source of energy for large scale (greater than 100 MW) hydropower development. The Kainji (on river Niger) and Shiroro dams respectively are Nigeria's large scale reservoirs for hydropower generation. Others are Goronyo and Bokolori dams on rivers Sokoto and Rima respectively, and Mambila and Gurara falls. In addition, several sources of small rivers do exist and can be harnessed for small scale (less than 10 MW) hydropower projects. The total technically exploitable large scale

hydropower potential of the country is estimated at over 10,000 MW, capable of producing 36,000 GWh of electricity annually. Only about one fifth of this potential had been developed as at 2001. The small hydropower potential is estimated at 734 MW (Idris et al, 2013).

Investigations by Ley et al (2014) also posit that Nigeria has significant hydropower potential. It currently has 2.2 GW hydropower capacity installed, although some of that requires maintenance and is not being used for generation. A World Bank reference scenario following FGN plans and feedback from stakeholders suggests hydropower utilization could be increased to 7.2 GW by 2035. Also Nigeria has a potential for electricity production from Solar PV technology in the range of 207*1012 Wh per year or 207,000 GWh per year if theoretically only 1% of the land area (e.g. 920 km² = 920*106 m²) were covered with state-of-the-art poly-crystalline PV modules,46 with an electricity yield of 1,500 Wh/Wp per year (free field, fixed installation). This figure is tenfold the total electricity production of Nigeria in 2011. The potentials of some resources such as geothermal, nuclear energy, waves, tidal and ocean thermal gradient still remain untapped and unqualified. (Ley et al, 2014).

Solar energy is the most promising of the renewable energy resources in Nigeria due to its apparent abundance. Energy radiated from the sun is about $3.8 \times 10^{23}$ kW, which is 1.082 million ton of oil equivalent (mtoe) per day. This is about 4000 times the current daily crude oil production in Nigeria and about 13,000 times the natural gas daily production, based on standard energy units. The total energy demand of the nation could be met if only 0.1% of the total solar energy radiant on Nigeria's land mass is converted at an efficiency of 1%. Nigeria has an average of $1.804 \times 10^{15}$ kWh of incident solar energy annually based on Nigeria land area of $924 \times 10^3$ km$^2$ and an average of 5.535 kWh/ m$^2$/day. The sun shines on the average for 6.5 h/day. The annual solar energy value is about 27 times the country's total fossil energy resources in energy units and is over 115,000 times the electrical power produced. Therefore, it means about 3.7% of Nigeria's landed area is required to collect an amount of solar energy equal to the country's conventional energy reserves (Shaaban and Petinrin, 2014).

Explaining further, Ajayi (2010) notes that although Nigeria is blessed with abundant supply of wind energy resources for power generation, she is still engrossed with high level of energy poverty which have invariably affected development and impinged negatively on economic growth with some parts of the country especially the rural areas lacking access to modern resources which come with availability of electric power. However, latest results showed that the Southern and Northern states of the federation are capable of experiencing mean wind speeds of between 3.0 − 3.5 m/s and 4.0 − 7.5 m/s. On the beaufort scale, the country is rated between 1 − 3 in the southern states and between 3 − 4 in the northern states. Meaning that, there is huge prospect within the country for power generation through wind if associated challenges hindering wind energy technology (WET) advancement are overcome. (Ajayi, 2010).

Data covering biomass projects or companies active in the sector is unavailable, since there is no central body responsible for this segment, which cuts across various ministries as well as federal, state and local government levels.However, a variety of biomass resources exist in Nigeria in large quantities with opportunities for expansion. Biomass resources include agricultural crops, agricultural crop residues, forestry resources, municipal solid waste and animal waste. Agricultural crop residues include those produced from the processing of crops. The agricultural crops that have potential as biomass feedstock for biofuel production include sugar cane, cassava, rice, maize and sorghum for ethanol and oil palm, groundnut, coconut, cotton, soybean, Jatropha and sesame (locally called biniseed) for biodiesel. From the perspective of available land and wide range of biomass resources, Nigeria has significant potential to produce biofuels and even become an international supplier. Bioenergy feedstock is not only abundant in Nigeria, it is also widely distributed. Nigeria is the largest producer of cassava in the world. It is interesting to mention that Nigeria could also be a major player in the biofuel industry given the enormous magnitude of various waste/residues (agricultural, forestry, industry and municipal solid) available in the country (Ley et al, 2014).

## VI. Recommendations

Renewable energy has an important role to play in meeting the future energy needs in both rural and urban areas. The development and utilization of renewable energy should be given a high priority, especially in the light of increased awareness of the adverse environmental impacts of fossil-based generation. The need for sustainable energy is rapidly increasing in the world. A widespread use of renewable energy is important for achieving sustainability in the energy sectors in both developing and industrialized countries (Oyedepo, 2012).

It is however pertinent to cite the key elements in the National Policy Position on Renewable Energy Development before charting a way forward to the realization of the objectives of the national policy. Idris et al, (2013) enunciates the key elements in the national policy position on the development and application of renewable energy and its technologies as follows:

i. to develop, promote and harness the renewable energy (RE) resources of the country and incorporate all viable ones the national energy mix

ii. to promote decentralized energy supply, especially in rural areas, based on renewable energy resources
iii. to de-emphasize and discourage the use of wood as fuel
iv. to promote efficient methods in the use biomass energy resources
v. to keep abreast of international developments in renewable energy technologies and applications (Idris et al, 2013).

Nigeria Energy forum must be commended for steering the initiative to address the country's energy crises from all fronts. Apart from efforts at stabilizing infrastructure in the typical areas of fossil fuel energy generation concerted effort must be directed towards ensuring the development of renewable energy technologies using local capacity. Technologies for renewable energy harnessing from the most basic resources of hydro, solar, wind and biomass are not far-fetched in the sense that many of the technologies fall into the mandate of some research and development institutions in the country. Universities and other tertiary institutions are assuredly into R&D s related activities covering such technologies. The five key elements in the renewable energy policy position are very pertinent and if addressed shall certainly lead to increased renewable energy utilization and invariably assuage the effects of the current energy difficulties. But local capacities for each of the technologies must be enhanced. Existing fabricators, engineers, technologists and technicians as well as graduating technicians and technologist from our polytechnics and other institutions must be invited into a Nigeria Renewable Energy Bureau which duty shall be the assessing and dissemination of renewable energy technologies as well the enhancing and promotion of the development of renewable energy technologies across the length and breadth of the country.

I shall call on Nigeria Energy Forum to liaise with Energy Commission of Nigeria, the Federal Ministry of Science and Technology, individual State Ministries of Science and Technology, Nigerian Association of Craftsmen, relevant research institutions, relevant international agencies and other stake holders to establish Nigeria Renewable Energy Bureau in order to fast track development efforts in these areas.

## VII. Conclusion

Our failure in power generation, transmission and distribution using fossil fuel technology could be attributed to lack of local capacity in the sector. Our oil drilling and refining are hitherto handled by foreign companies. Nigeria should start today to build local capacity in the area of renewable energy development. Technology transfer and the establishment of spin-off companies from renewable energy development based research works are permissible and should be encouraged but effort must be geared towards building local capacity to effectively handle renewable energy growth in the country. The National Board for Technology Incubation (NBTI) was established in 2005 to coordinate the activities of Technology Incubation Centres across the country, where start-up and spin –off companies are nurtured through administrative, technological and financial support to grow and stand free as an independent profitable enterprise. We shall welcome any collaboration that shall enable the board to incubate many renewable energy development enterprises as our contribution to the renewable energy development in the country.

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