Assessment of Nigerian Renewable Energy Potentials and Energy Poverty: Challenges and Prospects[1]

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ABSTRACT

The global quest for sustainable development has dramatically increased in our modern times and this raises the issues of a sustainable economic development and growth. Therefore, sustainable energy has become one of the most promising means of handling the challenges of energy demand problems of many consumers worldwide. However, solar energy is a clean energy source and thus power generation through this energy source imposes little or no environmental hazards. Unlike most conventional source of power generation and even some renewables like wind energy technologies, PV technologies generate no noise though the inverter systems could produce a system humming noise which is normally absorbed by the domestic noise background. The research aim is to assess the problems and prospects of achieving sustainable energy in Nigeria through photo voltaic (PV) technology. Descriptive and correlation research design was used in this research work. The population of the study comprises of selected practitioners in top five (5) solar firms in Nigeria, such as Ecozar Technologies, Leks Environmental Ltd Lagos, Wavetra Energy Ltd Lagos, Solar Force Nigeria PLC Abuja, Astrum Energy Solutions Enugu. A sample of 136 respondents was randomly drawn from the population of the study using a purposive sampling procedure. Data was obtained through questionnaire survey. Oral interview was also used to get more information from the respondents. Questionnaires were distributed to the relevant staff in accordance with the sample size. The data analysis was carried out using multiple regression and correlation methods. The test was conducted at 0.05 level of significance. A computer software based multiple regression analysis called statistical program for social science (SPSS) version 21 was used in the data analysis. The study reveals that technical challenges and economic and financial challenges are the most striking barriers to sustainable energy in Nigeria. The study recommends that Nigerian Government should invest in the development of Nigerian made PV panels which will contribute to the Nations GDP and GNI. These panels will also be exported and foreign exchange will flow into Nigeria's economy.

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1.0 INTRODUCTION

Nigeria is endowed with significant renewable energy resources that includes large and small hydroelectric power resources, solar energy, biomass, wind, potential for hydrogen utilization and development of geothermal and ocean energy (Sambo, 2009). Renewable energy (RE) resources abound in Nigeria but have not been fully exploited. Nigeria is an energy resource rich country, endowed with abundance of renewable energy (RE) resources, providing her with great capacity to develop an effective national energy plan. However, Nigeria is yet to exploit these huge available energy potentials with less environmental and climatic impacts. On the contrary, the National energy supply is at present almost entirely dependent on fossil fuels and fuel-wood. These two are being depleted due to failure to harness other energy resources (Chigbo, 2010). Despite Nigeria's steady access to fossil based and renewable energy sources, its per capita electricity has been among one of the lowest in Africa. As power demand studies have projected a medium- to long-term electricity demand of 30,000MW and 192,000MW respectively, there will need to be substantial improvement in the energy production and supply sector if this demand is to be met (Nnaji, 2010). The current installed capacity of grid electricity is about 6000MW, of which about 67 percent is thermal and the balance is hydro-based (Council for Renewable Energy, Nigeria (CREN), 2009). Hence, the urgent need to optimally harness the renewable energy potentials available in Nigeria for the benefit of her citizens and Africa in general. Non-conventional renewable energy is a key element in the overall strategy of the Federal Government of Nigeria in rapidly expanding access to electricity services in the country. Beyond large hydropower, the total contribution of renewable energy in Nigeria's electricity industry is about 35MW composed of 30MW small hydropower and about 5MW solar PV. This represents about 0.06% of total electricity generating capacity in the country (Council for Renewable Energy, Nigeria (CREN), 2009). However all represents the motivation for this study.

1.2 Statement of the Problem

Popular perception of renewable energy in Nigeria tends to focus on solar and occasionally wind power. Renewables have a relatively short history in Nigeria, especially in the public view. However, renewable energy from hydropower has actually been at the core of Nigeria's grid electricity production since the 1960s. Until very recently, the Kanji and Jebba Dams (1300MW) accounted for around 50 per cent of Nigeria's stable power sources, only recently being overtaken by gas power stations whose role continues to be constrained by the poor state of the national grid and unstable gas supplies (Solangi, Islam, Saidur, Rahim, &Fayaz, 2011).

Power supplies are very limited in Nigeria: electricity from the grid is available to only around 50 per cent of the population, and even then is erratic. This has been at the core of early renewable-energy development in Nigeria. It has provided a strong incentive to find something more stable and that does not result in the constant drain of cash associated with the high costs of power from the 'stand-by' generators which have become the main source of power for many basic rural services.

Wind and solar power in Nigeria are poorly understood by the public and even policymakers. The successes are much less well known than the shortcomings, which have been all too visible with failed solar street-light schemes dotted across Nigeria's major cities. In the public mind, solar power installations have largely joined the many failed projects initiated by government—testimonies to poorly installed technology associated with patronage and corruption.
Yet the successes for renewable energy in Nigeria should give pause to its critics.

Renewable energy should never be considered in isolation. Progress in the field goes hand in hand with improved energy efficiency, which has been vital in driving down costs and making new applications feasible. Compared with the existing costs of power in Nigeria (mainly generators), there is a very strong case for quite radical interventions. This is also in contrast with other developing countries which have a more stable grid electricity supply.This study seeks to assess the prospects and challenges of renewable energy potentials and energy poverty in Nigeria.

1.3 Objectives of the Study

The aim is to assess the prospects and challenges of renewable energy potentials and energy poverty in Nigeria. The specific objectives are to:

1. Ascertain the renewable energy potentials in Nigeria
2. Assess the Current Energy Yield in Nigeria
3. Identify the challenges of renewable energy in Nigeria

1.4 Research Questions

1. What are the renewable energy potentials in Nigeria?
2. What is the Current Energy Yield in Nigeria?
3. What are the challenges of renewable energy in Nigeria?

2.0 LITERATURE REVIEW

2.1 Concept of Renewable Energy

The term "renewable" is generally applied to those energy resources and technologies whose common characteristic is that they are non-depletable or naturally replenishable. Renewable energy, often referred to as clean energy, comes from natural sources or processes that are constantly replenished. Renewable energies (or renewables) are ways to generate energy from (theoretically) unlimited natural resources. These resources are either available with no time limit or replenish more quickly than the rate at which they are consumed (Sambo, 2009). Renewable energies are generally spoken of as opposed to fossil fuel energies. The fossil fuels' stocks are limited and non-renewable in the human timescale. The most known examples of these resources are coal, oil or natural gas. On the contrary, renewable energies are produced from renewable sources.

According to Stephen, Liu, Zhou, W. and Sun (2012), renewable resources include solar energy, wind, falling water, the heat of the earth (geothermal), plant materials (biomass), waves, ocean currents, temperature differences in the oceans and the energy of the tides. Renewable energy technologies produce power, heat or mechanical energy by converting those resources either to electricity or to motive power. The policy maker concerned with development of the national grid system will focus on those resources that have established themselves commercially and are cost effective for on-grid applications. Such commercial technologies include hydroelectric power, solar energy, fuels derived from biomass, wind energy and geothermal energy. Wave, ocean current, ocean thermal and other technologies that are in the research or early commercial stage, as well as non-electric renewable energy technologies, such as solar water heaters and geothermal heat pumps, are also based on renewable resources

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2.2.1 Solar Energy

Solar, or photovoltaic (PV), cells are made from silicon or other materials that transform sunlight directly into electricity. Distributed solar systems generate electricity locally for homes and businesses, either through rooftop panels or community projects that power entire neighborhoods. Solar farms can generate power for thousands of homes, using mirrors to concentrate sunlight across acres of solar cells. Floating solar farms—or "floatovoltaics"—can be an effective use of wastewater facilities and bodies of water that are not ecologically sensitive (National Renewable Energy Laboratory, 2008)

2.2.3 Wind Energy

The wind power is another renewable energy. Here, the wind's kinetic energy makes turbines spin and creates a mechanical movement. Afterward, a generator transforms this mechanical energy into electricity. There are several types of wind renewable energies: onshore wind turbines, off-shore wind turbines and even floating wind turbines. But the operating principles are basically the same for all these types of wind-generated energy.

2.2.4 Hydroelectric Power

Hydropower is the largest renewable energy source for electricity in the United States, though wind energy is soon expected to take over the lead. Hydropower relies on water—typically fast-moving water in a large river or rapidly descending water from a high point—and converts the force of that water into electricity by spinning a generator's turbine blades.Nationally and internationally, large hydroelectric plants—or mega-dams—are often considered to be nonrenewable energy. Mega-dams divert and reduce natural flows, restricting access for animal and human populations that rely on rivers. Small hydroelectric plants (an installed capacity below about 40 megawatts), carefully managed, do not tend to cause as much environmental damage, as they divert only a fraction of flow (Sherwani, Usmani and Varun, 2010)

2.2.5 Biomass Energy

Biomass is organic material that comes from plants and animals, and includes crops, waste wood, and trees. When biomass is burned, the chemical energy is released as heat and can generate electricity with a steam turbine. Biomass is often mistakenly described as a clean, renewable fuel and a greener alternative to coal and other fossil fuels for producing electricity. However, recent science shows that many forms of biomass—especially from forests—produce higher carbon

emissions than fossil fuels. There are also negative consequences for biodiversity. Still, some forms of biomass energy could serve as a low-carbon option under the right circumstances. For example, sawdust and chips from sawmills that would otherwise quickly decompose and release carbon can be a low-carbon energy source.

2.2.6 Geothermal Energy

The Earth generates and stores geothermal energy. In other words, radioactive materials decaying inside the Earth are emitting energy. Electricity can be created using directly or indirectly this energy, depending on the technology implemented. There are 3 main ways to use geothermal energy:

- Generating electricity directly from the Earth's heat
- Producing heat directly from hot water boiling on the planet's surface
- Using pumps over the shallow ground to heat (and also to cool) buildings

2.3 Renewable Energy Applications

Renewable energy applications generally break down into two categories or applications, **"on-grid"** and **"off-grid".**

According to Oseni (2012), a **"grid"** may be defined as an integrated generation, transmission, and distribution system serving numerous customers. Characteristically, a grid is a portfolio of generating units operating under the control of a central dispatch center. Grids may be national, regional or local (in the latter case they are typically referred to as *"mini-grids"*).

"On-grid" and **"off-grid"** are terms which describe how electricity is delivered. Technically, every one of the commercial renewable resources can be and have been installed both on-grid and off-grid. Furthermore, although larger megawatt installations tend to be on-grid, large renewable plants may profitably be built *"inside the fence"* - *a* term describing a self-generator, a plant built to supply a single customer such as a mine, a manufacturing plant or an agribusiness. Hydroelectric, biomass and geothermal facilities tend to be economical at capacity levels well in excess of one megawatt (1 MW) and, therefore, are typically - but not necessarily - developed and financed as *"base load"* electricity resources (*i.e.,* the normally operated generating facilities within a utility system) and connected to a grid. Solar arrays and "wind farms" also can be grid-connected.

"Off-grid" applications, in general, serve only one load, such as a home or small business. Off-grid applications can take many forms, from photovoltaics for an individual village home to

centralized windmills to power a village water pump or a commercial battery charging facility. These off-grid applications are most generally used in remote or rural settings.

"Mini-grids" have begun to be developed by system engineers over the past few years, for isolated communities. These systems may integrate wind, solar energy and, in some cases, diesel generators and/or storage systems to provide power from a mix of resources to more than one customer, typically a village or cooperative.

2.4 Energy Poverty in Nigeria

Nigeria's crude oil reserves are currently estimated at 35 billion barrels; its natural gas reserves an estimated 185 trillion cubic feet. Though import levels have since dropped dramatically, in March 2007 the United States imported 41,767 barrels of Nigerian crude oil and petroleum products. Despite this, 44 percent of Nigerian households have no access to electricity (Okafor& Joe-Uzuegbu , 2010).

Indeed, even in Nigerian homes with electricity, the quality of service provided is often intermittent while growing increasingly unaffordable. In an op-ed in the International New York Times, published August 8, 2014, author AdewaleMaja-Pearce explained that in February 2014 his monthly bill jumped from $30 per month to nearly $185 per month, despite the fact that he was receiving roughly three hours per day of power. This price increase occurs at a time when 92.4 percent of Nigerians live on less than $2 per day, and 70.8 percent live on less than one dollar per day.The problem of energy poverty is not exclusive to Nigeria. According to the International Energy Agency, "over 1.3 billion people are without access to electricity and 2.6 billion are without clean cooking facilities. More than 95% of these people are in sub-Saharan Africa or developing Asia and 84% are in rural areas" (CBN, 2019). Though the problem is not unique to Nigeria, it does bring to light the global inequality behind the phenomenon of energy poverty despite Nigeria's status as a major energy exporter. It is seemingly paradoxical for a nation which began exporting large amounts of liquid petroleum gas through Chevron in 1997 to have a per capita liquid petroleum gas usage rate of 0.4 kilograms per second, one of the lowest in the region.

Addressing energy poverty is a key point in the fight against global poverty. Greater access to alternative energy sources will reduce unnecessary deaths, such as the 95,300 Nigerian deaths which occur annually from smoke created by the use of solid biomass fuels. It will enhance the financial capabilities of those nations currently struggling to provide power to businesses. This, in turn, will expand the global community of consumers (CBN, 2019). Regardless, the importance of treating energy exporters as nations, and not simply as trade partners, remains a primary challenge moving forward in the fight against global inequality.

2.6 Potential of Renewable Energy Sources in Nigeria

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 (Energy Commission of Nigeria (ECN), 2005). Nigeria is blessed with a large amount of renewable energy resources, based on the resource situation and the technological base of the country, the Policy Guideline focuses on hydropower, biomass co-generation, solar PV and wind energy for electricity production.

2.7 Prospects of Renewable Energy in Nigeria

The prospects of renewable energy in Nigeria are as follows (Energy Commission of Nigeria (ECN) (2008):

I **Integrated Rural Village Energy Supply, IRVES:** Renewable energy resources such as solar radiation, wind, small-scale hydropower and biomass are, in general, well distributed over the country, The concept of the IRVES programme is to study the energy needs of a rural community for various socio-economic activities, the energy resources available to the community, energy related environmental problems, as well as the skills and trainability of its manpower. An energy supply and consumption system for the village is then developed, utilizing the available energy resources, which are mostly renewable, to meet the identified needs in a sustainable way. Capacity building programmes and post-project management are provided for, to enhance sustainability. Key features of the post-project management arrangements are:

- Provisions for community participation in the management and
- payment, by beneficiaries, for centrally provided energy services, to cover operation and maintenance costs

II **Rural Electrification:** Distributed Power Supply Solar-PV, wind and micro-hydro systems have proved more cost-effective on a life-time basis, than grid electricity or diesel generators in situations where loads are low and far from the grid.. The threshold distances depend on the technology, power level and prevailing costs of equipment, fuel, electricity, operating and maintenance costs. The dotted nature and low power demand levels of rural load centres suggest the use of decentralised and small-scale power supply systems to which solar-PV, wind, micro-hydropower and other renewable energy power generators are adequately suited. Deliberate policies and programmes are required to identify and implement the above concept

in rural areas that are unlikely to be grid connected in the long term (15-20 years). This will require the joint participation of government, the private sector and consumers.

III **Alternatives to Fuel-wood :** The large scale and predominant consumption of fuel-wood has been identified as contributing significantly to the environmental problems of soil erosion and desertification. Other serious hazards include respiratory and visual disorders. There is great potential in alternatives to traditional fuel-wood based technologies. The 1992 Presidential Task force on Alternatives to fuel-wood recommended the large scale introduction of biogas technology and solar cookers, (as well as the use of coal briquettes, natural gas and kerosene) in order to reduce the share of fuel-wood in the energy mix. Solar water heaters and improved wood stoves ought to be added to these set of technologies.

2.8 Challenges of Renewable Energy in Nigeria

The challenges of renewable energy potentials in Nigeria are outlined as follows (National Bureau of Statistics (NBS), 2007):

I **Technical challenges:** Lack of technical competence remained and may continue to be a major challenge towards the development of renewable energy systems in Nigeria. The technical failures of RE systems can be traced to lack of understanding of local energy requirements; lack of research and development to adapt technologies to local government conditions, resources and requirements; lack of local skilled labour to install, operate and maintain the equipment properly; and lack of access to spare parts

These are the basic technical reasons behind the failure of most pilot programmes on the development of RE systems in Nigeria. It is on record that most of the pilot programmes are carried out in rural communities. These communities are quite remote that most initial installers will not be willing to get back there to render maintenance services. Even when they do, the professional charges are beyond the capabilities of the beneficiary rural dwellers. The concept, design, application and use of most RE devices are conceived without any local input, and there is little or no effort to update the systems to various usage requirements. The result is that anytime it becomes difficult to get assistance in terms of component or intellectual property, as may be required to maintain or update the energy systems, the energy systems will simply face redundancy and finally abandonment by the user.

II **Economic and Financial Challenges:** Coupled with low income per capita stigma of most African countries, it is observed that economic and financial barriers might be another major issue to contend with the development of renewable energy systems in Nigeria. These challenges

arise from lack of access to capital; lack of means of life support; lack of information by appropriate financial institutions; lack of investment; scale of energy systems; inappropriate subsidies by the government or other agencies; size of organizations. Fear of the workability of new technologies as a result of lack of access to educational or information materials, many financial institutions are not normally willing to invest in the businesses relating to renewable energy. The result of this is that both the potential installer and the end user are starved of the funds for either initial procurement or upgrade of existing systems. The scales of the renewable energy systems are in most cases a barrier in themselves. The size in terms of the functions are appreciated in long term use, but the initial cost compared with the immediate derivable services are not in any way to be compared with the similar services from the equivalent equipment using fossil fuel. Conviction for most intending end users has therefore become an uphill task, thereby slowing down the rate of patronage. Investments in new technologies are very expensive. The cost for renewable energy systems in Africa may continue to be high because of high financial input and low profit margin in the course of manufacturing the component parts caused by low patronage and high cost of research and development.

III National Policies and Awareness Programme Challenges: Activities of the government are highly instrumental to the success or failure of any matters of national interest including the programmes that will tend to enhance the very life status by introduction of new ways of living. Introduction of renewable energy systems is in the deployment programme for most African countries. The rate of growth of the programme can only increase or decrease within the context of the government interest. Till the end of year 2005, there was no known government policy on renewable energy in Nigeria. This made it almost impossible for proper co-ordination of renewable energy activities in Nigeria. The growth before 2005 was largely dependent on individuals, societies and few corporate interest and activities. Absence of functional government fiscal policies and integrated planning on renewable energy in Nigeria was traced to government instability and inconsistency in policy formulation, with personal interest at decision making level having priority over national goals. The resultant effects of all these are that the growth in the deployment of renewable energy in Nigeria may be slow with the system costs remaining comparatively high and a high percentage of Nigerians not being aware of the gains of the renewable energy systems.

The focus of national policy has consistently been on centralized conventional sources of electric power. Several incentives were established to promote investments in conventional power generation. Subsidizing grid power has so far penalized investments in alternative energy solutions. This lack of a level playing field for all energy sources and technologies has constituted a formidable barrier to the growth of alternative electricity services.

IV Social, cultural and environment constraints: Social acceptance of the renewable energy technology is very important, as its absence can be a major challenge. If the local Community does not accept the technology; there will be no demand for its services. For example, it may not make much sense to install solar cookers in communities which forbid women to cook in the middle of the day. Most renewable energy installations failed because the beneficiaries are not carried along during the decision making to deploy the energy systems to them. Involving the end users may generate more interest as they tend to benefit more, having been given the chance to express their very need or convinced on what is being provided.

V Political, institutional and legislative challenges: Massive deployment of renewable energy systems in Nigeria has great future if only the right political and legislative framework can be put in place. Since the technology is foreign, there is need to put proper legislation in place, to prevent turning the country into a dumping ground by the technologically advanced nations. Proper legislation may see Nigeria imposing zero taxes to renewable products, since with zero taxes and large subsidy, the poorest of the poor are the targets. Also the importation of sub-standard goods will be adversely reduced Challenges based on the security of the installation, Insecurity of installations is not only an African problem. Globally, the security of the installation is paramount in the decision as to how and where to install the systems. In most cases, the security provisions will simply make the cost grow unreasonably high. Most known major projects have suffered one level of vandalism or the other. Installed equipment in one site can be found in the market within 24 hours after its commissioning. This challenge cuts across all nature of installations, from personal solar home stations to community mini solar and solar street lights.

VI Intermittency of resource availability: An underlying challenge affecting all renewable electricity resources is the intermittency of their availability. The challenge of energy storage and system management presents a major challenge and adds to the complexity and costs of renewable electricity.

VII Inadequate resource assessment: The growth of the renewable power industry will depend to a large extent on the availability of a solid resource database. Reliable and up-to-date sources of data will assist investors in making decisions on renewable electricity.

VIII Standards and quality control: A major constraint to the development of the renewable energy market in Nigeria is the poorly established standard and quality control of locally manufactured and imported technologies. Creating quality assurance is a precondition for building consumer confidence and in growing the market for renewable energy. Two important dimensions to issues of quality include the perception of potential users, poorly developed

regime for standards setting, testing and certification as well as professionalism among operators.

3.0 Research Methodology

The target population for the study is composed of professionals who are the primary participants who have substantial involvement and responsibilities in renewable energy in Nigeria. The sampling techniques adopted for the study is stratified sampling techniques, where the professionals are grouped based on their respective professional undertakings. Independent sample were drawn from each professional group according to the recommendations of Trochim (2007) of 10-30% sample frame for a small target population and 1-5% for a large target population. The sample size arrived at is 316 professionals directly involved in renewable energy projects in Nigeria. The main basis of primary data is obtained through the questionnaire, which was given to the professionals and experts. The statistical methods used is descriptive statistics of simple percentage. The simple percentage method helped in analyzing the demographics of respondents and other relevant research questions. A computer software called statistical program for social science (SPSS) version 23 was used in the data analysis.

3.1 Analysis of Data

3.1.1 Research Question One

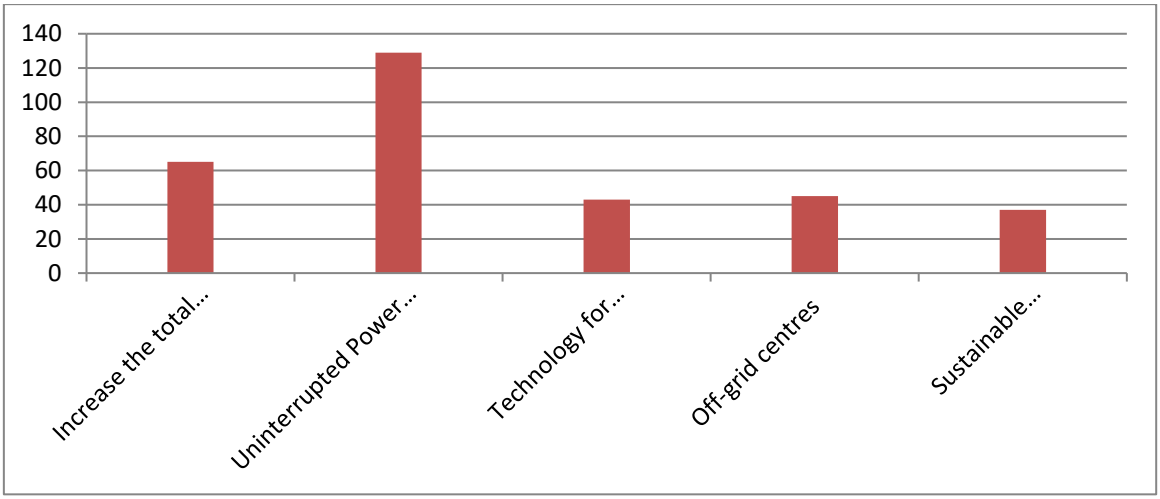
What are the renewable energy potentials in Nigeria?

Table 1: renewable energy potentials in Nigeria

POTENTIALS	FREQUENCY	PERCENTAGE (%)
Increase the total energy portfolio of the nation	65	20.6
Uninterrupted Power Supply	129	40.8
Technology for consumer-levelProducts	43	13.6
Off-grid centres	45	14.3
Sustainable Development	37	11.7
TOTAL	316	100

Source: Field data, 2020.

From table 1 the result above shows the identified potentials of renewable energy in Nigeria. The chart below gives a clearer pictorial representation of the outcome.



3.2.2 Research Question Two

What is the Current Energy Yield in Nigeria?

Table 2: Current Energy Yield in Nigeria

Estimated gross energy yield			
Site	**Gross energy yield measurement (MWh)**		
	Model FL 100, 100/20 Rotor dia. 21.0 m Hub height 34.5 m 100/20	**Model FL 250, 250/50 Rotor dia. 29.5m Hub height 42.0 m 250/50**	**Model V52, 850/52 Rotor dia. 52.0 m Hub height 44.0 m**
Enugu	92.9	217.9	734.20
Jos	129.6	299	1025.80
Pankshin	117.1	272.1	936.60
Sokoto	153.5	358.8	1235.80
Kano	116.3	281.2	963.60
Gumel	73.4	197.2	681.40
Maiduguri	102.7	262.2	906.10
Ibi	49.8	141.3	481.20

Gembu	112.9	253.9	855.30
Lagos	129.3	386.1	1402.80

In table, comparing the energy yield and energy distribution index in Nigeria, the results reveal that the energy yield in Nigeria amidst abundant natural resources is not adequate to serve the energy need of the country, thereby resulting to a high energy poverty level in Nigeria.

3.2.3 Research Question Three

What are the challenges of renewable energy in Nigeria?

Table 3: Challenges of renewable energy in Nigeria

Effects	FREQUENCY	PERCENTAGE (%)
Economic and Financial Challenges	46	16.5
Legislative/Institutional and Political	81	20.3
Social, Cultural and environment challenge	20	5.0
Inadequate Resource Assesment.	25	11.3
Technical Challenges.	45	6.3
Corruption	99	8.3
TOTAL	316	100

The result above clearly depicts that among the identified challenges of renewable energy in Nigeria, corruption and Legislative/Institutional and Political is the visible challenge of renewable energy in Nigeria.

4.0 CONCLUSION

In this study, the researcher has shown the energy potentials and energy poverty level in Nigeria. To reveal the challenges and prospects from the findings, however the study concludes that:

1. Uninterrupted Power Supply: Increasing the total energy portfolio of the nation, Technology for consumer-level Products, Off-grid centres and meeting Sustainable Development Goals are the major potentials of renewable energy in Nigeria.
2. The estimated gross energy yield in Nigeria amidst abundant natural resources is not adequate to serve the population of the country, thereby resulting to a high energy poverty level in Nigeria.
3. Among the identified challenges of renewable energy in Nigeria, corruption, Legislative/Institutional and Political are the visible challenges of renewable energy in Nigeria.

4.1 Recommendations

The study recommends as follows:

1. Multinationals, Private sector and individuals should be given the right environment and encouragement in the form of incentives and subsidized investments by the Government of Nigeria to embark on energy efficient projects through the utilization of renewable energy solution

2. Resource survey and assessment should be carried out to determine the total renewable energy potential in the various Geo-political zones of the country. And also identify local conditions and local priorities in various ecological zones.

3. Renewable energy related projects have a greater likelihood of success if implemented together with activities in these sectors to ensure sufficient demand for the energy services providers.

4. To create awareness, renewable energy resources exploration and utilization should be introduced in the school curriculum at primary, secondary and tertiary Education levels.

5. Demonstration projects on various renewable energy forms should be widely established so that the performance and efficiency with which services are delivered can be made known to consumers.

6. The standard organisation of Nigeria should have a wing dedicated to testing renewable energy technologies that are presently imported and available in the country to see if these products meet international standard.

7. Nigeria should take advantage of global partnerships with NGOs at both local and international levels to help the country fulfil a creative integration of renewable energy systems.

8. Government at various levels should pay more attention to renewable energy projects by allocating more resources to it in their budget. Renewable energy funding/financing agency should be established and co-financed by the variuos tiers of Government.

9. Entrepreneurship and managerial skills development training programmes and technical courses in RETs with a view of developing Energy Service Companies (ESCOs) providing services to rural areas need to be introduced to support the total integration of RETs Technologies.

10. The Federal Government should establish agency to promote the use of renewable energy efficient products and ensure energy efficiency practices

11. Capacity building both at institutional and personnel level for acquiring technical, organizational, and managerial skills required for increased development of renewable energy should

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