

## Renewable Energy Sources in Nigeria – An Overview.

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### Abstract

Electricity plays a vital role in the economic development of any nation and Nigeria cannot be an exception. Nigeria like any other developing nation have made frantic efforts at improving quality access to uninterrupted power supply, but her effort is not yielding any result either. This shortfall in the availability of stable power supply affects the country's development. This shortfall in power over the years has resulted in load shedding with no end in sight. Any nation whose power is epileptic scares away prospective investors. This paper looks at renewable energy sources as a panacea for this epileptic nature of power supply in Nigeria.

**Keywords:** Biomass Energy, Renewable Energy, Small Hydropower

### 1. Introduction

Electricity is one of the basic needs for economic development. There is a relationship between stable electricity and economic growth of a country. Nigeria with a population of about 180 million people is faced by industrial, economic and human development challenges as a result of epileptic power supply. As a result of all these challenges, Nigeria is seen as one of the poorest nations in the world [1]. The relevance of stable and affordable electricity to a country's development cannot be overlooked [2].

Nigeria's greatest challenge is one of providing stable, affordable and efficient electric supply to its teeming population by the utility company for domestic, institutional and industrial use. The country is facing a challenge of inadequate electricity supply, this has made Nigerians to be wallowing in total darkness despite the abundant natural resources [3]. In this age of dependence on electricity, rural dwellers are relocating to the urban areas and because of this; the demand for electricity in the urban areas has increased drastically. This has made the supply companies to resort to load shedding, power outages lasting for days, sometimes even weeks. And even when it is provided, the voltage is always very low [4].

Nigeria as a country is endowed with a lot of natural resources. Having all these resources should have made all Nigerians to have access to uninterrupted power supply. The inability of the supply authorities to give adequate and affordable supply has greatly affected many sectors of the economy [5].

This paper tries looking at the current electricity status in Nigeria. And also a look at renewable energy sources, as a solution to Nigeria's energy problems.

### 2. Literature Review

The history of electricity can be traced back to 1896. That was the first time electricity was generated in Nigeria and it was in Lagos. The installed capacity of the generators then was 60kW. The Nigerian government in 1946 established the electricity undertaking under the authority of the public works department (PWD) to handle anything that has to do with electricity supply in Lagos [6]. A central body was established in 1950, with a legislative backing to transfer electricity supply and development under the care of a central body, the Electricity Corporation of Nigeria (ECN). Nigerian Electricity Supply Company (NESCO) and Native Authorities were given licenses to also produce electricity in other places across the country. A body known as the Niger Dams Authority was established with the sole responsibility for the construction and maintenance of dams, in River Niger and other places generating electric power through hydro means [6].

In 1972, Electricity Corporation of Nigeria (ECN) and Niger Dams Authority (NDA) were merged to form National Electric Power Authority (NEPA) [6]. This was later transformed to Power Holding Company of Nigeria (PHCN) in 2005 as a result of the Electric Power Sector Reform Act of 2005. Policies of government in

the power sector in the 1980s and 1990s did not envisage a rapid increase in the demand for power supply. The Shiroro power station was installed in 1990. Since then no new generating unit was added to the existing ones. Kainji dam hydropower plant was installed and put into use in 1968. It was made to deliver 960Mw from 12 turbines. Of these 12 turbines, only 10 have been installed, giving an output power of 760Mw [7].

The epileptic nature of reliable energy has deprived those living in the rural areas of basic economic activities. Nigeria is blessed with a lot of renewable energy sources, some of which are wind, solar, biomass and small hydropower [8].

Global warming has forced developed and developing nations to shift focus to the use of renewable energy sources [9]. The use of renewable energy has helped to provide stable power supply. There are basically two types of energy sources. The conventional energy sources include crude oil, coal and natural gas. While the non-conventional energy sources also referred to as renewable sources include biomass, wind, solar and hydro energy.

There is every need for Nigeria to key into the progressive path of nations to solve her power supply problem through the use of renewable energy sources. Investing in renewable energy like solar, wind, hydro and biomass can greatly contribute to reliable electricity generation [3]. Nigeria is among countries of the world blessed with a large amount of renewable energy sources and if properly harnessed will go a long way in reducing poverty. The absence of reliable energy supply has left some Nigerians out of businesses that rely on power supply [8, 10].

### 3.0 Renewable Energy Sources in Nigeria

Nigeria has large reserve of renewable energy sources as seen in the above table [10]. If these are properly harnessed, it will cushion the effect of epileptic power supply being experienced in Nigeria. The country's ability to raise the standard of living of its citizens is tied on the increase in energy. This should start from the grassroot, since there is migration from the rural areas to the urban areas. The country must diversify into the use of renewable energy sources [12].

In the last twenty years, power outages have turned Nigeria a country once known for its stable power to a country whose economic life is now a mirage [12]. Renewable energy sources are potent in checking the epileptic energy situation currently experienced in Nigeria [9].

Table 1. Some the renewable energy sources in Nigeria [11].

S/No.	Renewable Energy Sources	Capacity
1.	Small Hydropower	3500Mw
2.	Large Hydropower	11,250Mw
3.	Wind	2 – 4m2 annually at 10m height
4.	Solar Radiation	3.5 – 7.0kmh/m2/day
5.	Biomass	13,071,464 hectares of forest and wood land
6.	Fuel wood and Crop Residue	83 million tons/year

The Nigerian government need to act fast on the energy policies to check the unstable nature of power. Alternative energy sources are the only solution to the dwindling power situation. Countries like Kenya, Ethiopia, South Africa, Bloomberg New Energy Finance has been confirmed to be a leading name when it comes to renewable energy revolution in Africa. Nigeria which is called the “Giant of Africa” is left behind [3].

With respect to this paper, the renewable energy sources in Nigeria to be considered are hydropower, solar power, wind, small Hydropower and Biomass energy.

**3.1 Biomass Energy:** this refers to the energy gotten or derived from plant origins such as trees, grasses, agricultural crops and their derivatives and also from animal wastes [8]. In other words, biomass energy are energy gotten from garbage of dead trees, it could also be gotten from left – over crops, yard clippings, wood chips and household trashes [12]. Other sources of biomass energy include animal dung / poultry droppings, industrial effluents / municipal solid waste [8]. The composition of these biomass materials in the landfills from domestic animals and excreta from little children who are too small to use the village open – air toilet over the years. Especially those untreated open landfills become health hazards especially with their proximity to the village. With the use of biomass technology, it will reduce greatly the health hazard posed by biomass materials [12].

Biomass resources are seen as being renewable because they are naturally occurring in nature and when properly harnessed can be harvested without significant depletion like conventional energy sources [8].

There are several ways biomass technology can be used to produce electricity. The two basic ones are as discussed below.

The first method, waste from different sources such as from wood, tree branches, and other scraps are brought together to the biomass plant where the biomass is put into a large hopper, where it is fed to a furnace to burn. The heat from this burning biomass is then used to boil water in a boiler. The energy of the steam is used to turn turbines and then generators to produce electricity [12]

The second method is to tap biomass resources straight from the landfill with the burning waste products. When these garbage's decompose, they give out methane. The methane produced is then channelled through pipes into the power plant to generate electricity [12]

Investing in biomass technology will revolutionize and transform our urban and rural communities in Nigeria from communities of trash and filth, to healthy and sanitary environments. It will also transform the community from one of “waste” to a community of “wealth” [12]. Table 2 below shows the estimated biomass resources.

Table 2. Biomass Resources and the estimated quantities in Nigeria.

Resources	Quantity (million tonnes)	Energy value (‘000MJ)
Fuelwood	39.1	531.0
Agro-waste	11.244	147.7
Saw Dust	1.8	31.433
Municipal Solid Waste	4.075	-

**3.2 Wind energy:** wind energy comes about as a result of the uneven heating of the earth’s surface by the sun. The wind energy potentials vary from region to region in Nigeria. The annual average speeds of about  $2.0\text{m/s}^2$  at the coastal region and  $4.0\text{m/s}^2$  at the far northern region of the country. This wind assumes an air density of  $1.1\text{kg/m}^3$ , wind energy intensity, perpendicular to the wind direction, ranges between  $4.4\text{W/m}^2$  at the coastal areas and  $35.2\text{W/m}^2$  at the far northern region of Nigeria [8].

To produce electricity, a wind turbine which converts the kinetic energy of the wind into electrical energy is used [12]. The devices which convert this wind energy into kinetic energy of the moving air to rotary shaft motion that is mechanical are wind turbines, wind generators, wind plants, wind machines and wind dynamos [8]. Over the years, the technologies that are used for harnessing this wind energy in the country were mainly for pumping of water from wells. This can be seen in many secondary schools in the old Sokoto and Kano states as well in Katsina, Bauchi and Plateau states. An average annual wind speed of not less than  $5\text{m/s}^2$  at a height of 10m above ground level is the feasible speed for the exploitation of wind energy today. A 5kw wind energy conversion system for village electrification is currently in use in Sayyan Gidan Gada in Sokoto state [8]. Figure 1, shows the various wind energy location in Nigeria.

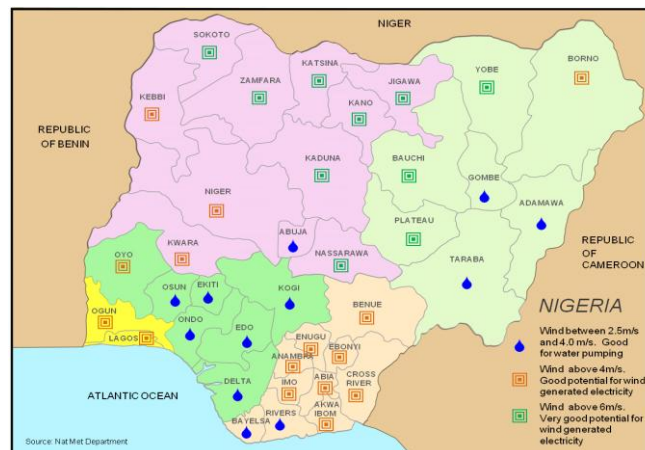


Figure1. Wind Energy Locations in Nigeria ([http://www.neenigeria.com/Nigeria\\_wind\\_NEW.png](http://www.neenigeria.com/Nigeria_wind_NEW.png))

**3.3 Solar Energy:** Nigeria is situated within a high sunshine area and blessed with an enormous solar energy potential. The mean yearly average of total solar radiation varies from about 3.5kwh/m<sup>2</sup>/day in the coastal areas to about 7kwh/m<sup>2</sup>/day along the semi arid areas in the far north. On the average, Nigeria receives solar radiation at the level of about 19.8MJ/m<sup>2</sup>/day. The estimated sunshine average per day is 6hours. Solar radiation is equally distributed. The minimum average is about 3.55kwh/m<sup>2</sup>/day in Katsina in the north in January and 3.4kwh/m<sup>2</sup>/day for Calabar in the southeast in August and the maximum average is 8.0kwh/m<sup>2</sup>/day for Nguru in May [8].

Concentrated solar power is converted into electricity using photovoltaic (PV) and other viable technologies [12]. With an average solar radiation of close to 5.5kwh/m<sup>2</sup>/day and taking into cognisance the efficiency of commercial solar – electric generators, if solar collectors (Panels) or modules are used to cover 1% of Nigeria’s land area of 923,773km<sup>2</sup>, then there is every possibility of generating close to 1850×10<sup>3</sup>Gwh of solar electricity in a year. This is above one hundred times the current grid electricity consumption in Nigeria.

Solar energy if properly harnessed may be used to supply electric power to remote villages not connected to the national grid. It may also be used to supply power into the national grid, thereby adding to the already existing generated power [8].

Other areas where solar technology can be applicable in Nigeria include, solar cooking, solar water heating for industries, hospitals for vaccine refrigeration, solar crop drying, solar incubators and also for solar chick brooding [8]. The yearly average of daily sunshine in Nigeria is as shown in figure 2.

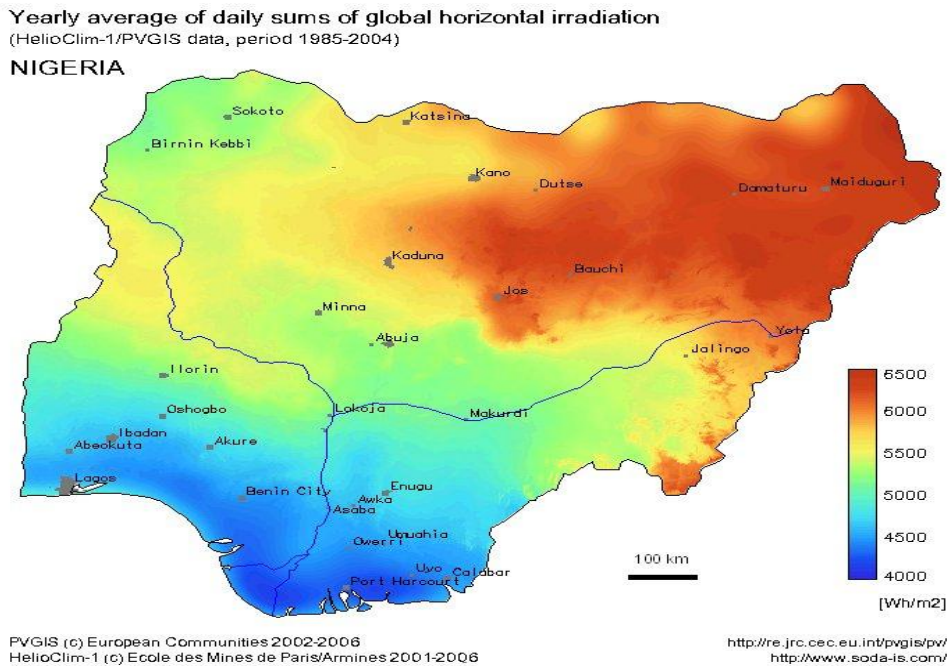


Figure 2. Yearly average of daily sun in Nigeria ([http://www.soda-is.com/eng/nigeria\\_en.html](http://www.soda-is.com/eng/nigeria_en.html)).

**3.4 Small Hydropower (SHP):** Nigeria is a country so blessed with high hydropower potentials. This can be seen in her natural endowment of large rivers, dams and waterfalls. Hydropower can be regarded as a major source of electric power in Nigeria [10].

Small Hydropower (SHP) is a system of hydropower with an installed capacity of about 2Mw to 10Mw. Studies carried out in 12 states and 4 river basins showed about 278 small hydropower sites with total power of 734.3Mw [14]. Small hydropower potential sites exist in almost all parts of Nigeria with an estimated capacity of 3,500Mw [8].

In November 2002, the Energy Commission of Nigeria (ECN) in collaboration with the United Nations Industrial Development (UNIDO) together with other relevant government ministries and agencies organised a stakeholders Forum on renewable Technologies specifically for small hydropower for rural industrialization. The sole aim for organising the workshop was to come up with strategies that will provide access to clean and reliable energy services to the rural areas and also for promoting rural industrialization. If this picks up, it will generate employment for the rural populace and also rural development [8].

There is no standard definition as to size of hydropower whether small or large. The table 3, below shows a classification of hydropower with their capacities.

Table 3: Classification of Hydropower by size [13, 14]

S/No.	Classification	Rated Power	Consumer
1.	Large hydro	>100 MW	usually feeding into a large electricity grid
2.	Medium hydro	15 -100 MW	usually feeding a grid
3.	Small hydro	1 – 15 MW	usually feeding into a grid
4.	Mini- hydro	100Kw – 1MW	either stand-alone schemes or more often feeding into the grid
5.	Micro- hydro	5Kw – 100kW	usually provided power for a small community or rural industry in remote areas away from the grid
6.	Pico- hydro	<5kW	

#### 4.0 Conclusion

Renewable energy sources are considered as viable solutions to the energy challenges bedevilling Nigeria. Though, the initial cost of the installation of renewable energy devices is very high in the short term, but in the long term the cost can be compared with the conventional energy sources. If properly harnessed, renewable energy sources can go a long way in addressing the energy problems of the country. A deliberate attempt must be made by the government to invest in renewable energy development before she can achieve great goal in the integration of renewable energy into the national grid. Whereby isolated rural communities can be connected to the national grid through renewable energy technologies. Millions of naira have been spent by the Nigerian government in recent years to put the existing power stations in good shape. This has not yielded any fruitful results. Each passing day comes with its own challenge. It is our sincere believe that this paper will contribute immensely to the aspiration of Nigeria in tackling the epileptic power supply that has plagued the nation for decades now.

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