Wind Power: An Untapped Renewable Energy Resource in Nigeria

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ABSTRACT —— Wind power is one of the untapped renewable energy resources in Nigeriawhich requires government, private and individual's participation to harness it, the utilization of this type of energy has been minimal in the country despite the abundance of its enormous resources in different part of the country. The wind speed in the southern and northern Nigeria ranges from 1.4 to 3.0 m/s and 4.0 to 5.12 m/s respectively. Apart from its environmental friendliness, it's also one of the lowest priced renewable energy technologies available today costing between 4-6 cent/KWh depending upon the wind resource and project finance. Windmills were used in Nigeria as early as the mid 1960s, in Sokoto and Garo over 20 homes and schools used windmills to pump water. The following decades saw the prices of fossil fuels drop and therefore with cheap energy, wind power was not an appealing alternative, investment in windmills ceased and the infrastructure deteriorated. Research into the feasibility of wind power in certain regions has suggested the potential for this type of energy sources for power generation, this paper review the situation of wind power in Nigeria and world in general, prospects of wind power and existing wind power project in Nigeria, their location, year of installation, capacity and current situation of the projects. From the review, only four existing project were found in the whole country A 5.0 KW/hWind Power Project in Sayya Gidan-Gada Sokoto, 0.75 KW/h Danjawa Village, 1KW/h, Hybrid Wind-Solar in NCCE, Benin, and finally A 10 MW Wind farm under construction in katsina state.

KEYWORDS: **Electricity Generation, Horizontal Wind Turbine, Renewable Energy, Vertical Wind Turbine Wind farm.**

1. INTRODUCTION

Wind is a natural phenomenon related to the movement of air masses caused primarily by the differential solar heating of the earth surface. Wind energy, a renewable energy source, is an alternative form of energy, which has stood out as the most valuable and promising choice. This is not only due to the fact that wind energy has a decentralized mode of operation that reduces transmission and distribution failures, but also because it is cheap, environmentally friendly, inexhaustible, price stable, free from control and virtually available in every part of the nation in some quantity [1]. If the mechanical energy is used directly by machinery, such as a pump or grinding stone, the machine is usually called a wind mill. If the mechanical power is converted to electricity, the machine is called a wind generator, wind turbine, wind power unit (WPU) or wind energy converter [1]. The wind turbines can be installed in a wind farm (an array of wind turbines) creating a wind power station, with hundreds of megawatt. Wind energy conversion systems are available in a wide range of sizes and can fit almost any applicationfor power production purposes [2].The various wind generator projects in Nigeria were neglected in the last decade due to increasing popularity and low price of crude oil. In recent times, the high price of Petroleum products leads to attempt at restructuring these wind turbines. However, difficulties in obtaining spare parts for models, which were no longer being manufactured, hindered the restoration. Also, some other factors that led to the failure of past wind generators are the assessment of wind energy potentials, feasibility studies on wind energy utilization, inadequate wind data base used as the bases for designing and building different prototypes that need to be considered in reducing locally manufactured windmills[3].In remote or rural areas, where purchased electricity is simply unavailable, wind energy may well be the only alternative. The use of wind energy will be suitable for rural farming companies that require lighting and some limited supply of electricity, which will be costly to get due to the location of farms. The use of wind power for the supply of electricity broadens the energy base and reduces environmental pollution [3]. It is particularly practical if it can be made economically competitive with conventional energy sources. It has been shown that in areas with annual mean wind speed of 3.5-4.0 m sec-1 or greater, wind power systems can usually deliver electricity or pump water at costs lower than photovoltaic, diesels, or grid-extension[4].

3. TYPES OF WIND POWER

The most common wind power generators are called windmills, or wind turbines. These have two major build types that distinguish them from each other. The first and most recognizable is the horizontal axis windmill, which has propeller blades similar to that of an airplane. The other type of wind power generator is the vertical axis wind turbine that is generally used in residential areas and for personal production of power.

4. CLASSIFICATION OF WIND POWER

Specifically in regions with an adequate wind presence, the amount of potential power is dictated by the size of the windmill. Windmills vary in size with small windmills used to pump water or provide power for cooking and refrigeration. Medium windmills provide electricity for one or more homes. Large windmills or utility scale windmills are capable of providing power for entire communities. Often these larger windmills are connected to a mini-grid as to reduce the overall necessity for fossil fuels.

5. WIND ENERGY IN THE WORLD

Worldwide there are now many thousands of wind turbines operating, with a total capacity of 194,400 MW [5]. Europe accounted for 48% of the total in 2009. World wind generation capacity more than quadrupled between 2000 and 2006, doubling about every three years. Wind power accounts for approximately 24% of electricity use in Denmark, 15% in Portugal, 14% in Spain, 10% in The Republic of Ireland, and 9 1/2% in Germany [5,10], Table 1 present the top ten wind power countries in the world.

6. WIND ENERGY IN NIGERIA

Nigeria falls into the poor/moderate wind regime with a generally weak wind speed in the South except for the coastal regions and offshore, which are windy7. Wind speed ranges from 1.0-5.1 m s-1 at 10 m altitude (classified as >4.0 , 3.1-4.0, 2.1-3.0 and 1.0-2.0 m s-1). The most attractive sites are the coastal areas, the offshore states, namely Lagos, Ondo, Delta, Rivers, Bayelsa, Akwa -Ibom, the inland hilly regions of the North, the mountain terrains in the middle belt and the northern part of the country [5, 11]. Peak wind speeds are experienced between April and August for most sites except in the offshore which have strong winds throughout the year. Total actual exploitable wind energy reserve may range from 8 MWh/Year in Yola to 51 MWh/Year on Jos Plateau and 97 MWh year-1 in Sokoto [5]. Contribution of wind energy to the total energy consumption has been very insignificant. The first wind farm is to be built in Katsina and will be commissioned in 2011 with a capacity of 10 MW. Prior to this project, the two pilot wind electricity projects in existence have been the 5 kWp Sayya Gidan-Gada and a 0.75 kWp wind electricity project atDanjawa villagesokoto, respectively[6,9].

Table 1: Top Ten Wind Power Countries

Country	Wind power capacity (MW)
China	42,287
United States	40,180
Germany	27,214
Spain	20,676
India	13,065
Italy	5,660
France	5,660
United Kingdom	5,204

Source:

7. PROSPECTS OF ENERGY IN NIGERIA

Only 20% of the nation's hydro-power potential is tapped for use, and the amount of solarradiation in the country is about 5.5KW-hr/m2-day [9]8, representing hugeprospect for energy generation if a total capacity can be developed for that purpose. Despitethis infrastructure energy supply has remained grossly inadequate. The four refineries inthe country operate at about 30% of their installed capacity of 445,000 bpd [7]. Domestic consumption is buffered with importation, making the energy need of the nation tend towards state of crisis. The nation has been reported to have high utilizable potential capacity for wind energy. Research data for stations in the geopolitical from different stations five zones showed that Nigeria has potential for wind power generation, which rank in the order north, central, south-east, south-south and south-west respectively [8,12]. Offshore areas in the coastline area of the country such as Lagos, Ondo, Delta, Rivers, Bayelsa and AkwaIbom States also have potentials forharvesting strong wind energy from the lagoon and ocean throughout the year [7].

8. EXISTING WIND POWER PROJECTS IN NIGERIA

The existing winds power projects, their location, year of installation, capacity and current situation are presented in Table 1.

Table 2: Existing wind energy projects in Nigeria

S/N	Location	Year of Installation	Capacity	Current Situation
1	**Sayya Gidan-Gada, Sokoto State.**	**1988**	**5 KW/h**	**Working**

2	**Dan-Jawa Village, Sokoto.**	**N.A**	**0.75 KW/h**	**Working**
3	**Katsina, Katsina State**	**2012**	**10 KW/h**	**Under Construction**
4	**Energy research center, Benin**	**N.A**	**1kw/h**	**working**

Key: N.A: Not Available

9. ECONOMIC VIABILITYAND COST PROJECTION.

Wind Power Economic Viability; the costs of wind power electricity generation are significantly less in regions with a high average wind speeds. 75-80% of these costs are upfront costs of physical capital and installation [11]. The remaining costs are dispersed overthe life of the wind power system and are comprised of operating, maintenance, and insurances costs [12]. Although the wind power generation is financially competitive with grid extension and diesel generators in most regions, the costs are declining. One paper estimates the effects of the experience curve in Nigeria to reduce the costs of windpower between 9% and 17% every time the installed capacity doubles.

Cost Projection; Larger systems range from 4 to 8 kilowatts with towers up to 100 feet tall. These will generally produce enough electricity to completely satisfy the needs of most homes with average energy efficiency [11]. This may cost between 22000 to 50000 dollars [11]. A 10 kilowatt system may go for 80000 to 120000 dollars []. This is a very substantial wind turbine system requiring a 90- to 120-foot tower [11, 12].

CONCLUTION

In view of the erratic supply of electricity in Nigeria and the near non-existence of power supply in the rural centers, the need for alternative energy source cannot be neglected and as such, wind turbine technology plays a vital role in contributing to the search as an alternative source. The country most has a well-rounded energy mix, mixing the availablerenewable energy with the non-renewable fossil fuel. The gas being flared at the different crude oil refining sites can be used to generate abundant electric power for the nation instead of the wastage and deleterious impact of its burning on the environment. The government therefore needs to develop capacities and infrastructure for harvesting wind for power generation from sites within regions having high wind capacity, trapping the abundant solar energy freely available in the nation, increase the capacities of the present hydro-power stations and also establish various power stations that will use the natural gas from crude oil exploitation to drive turbines for electricity generation. When this is done, the result will then be to feed all the energy generated into the national grid, creating adequate mix of energy from the different sources and having a compact energy development process which will be suitable, sustainable, constantly available, environmentally friendly and economically viable in the long term national energy plan.

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