

## Solution to Power Generation Shortages Using Solar Energy

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### -----ABSTRACT-----

Power supply has been identified over the years as one of the key motivating factors for the development of manufacturing activities and all other industrial undertakings in Nigeria and all over the world. This study investigates two conditions namely: (1) Cost of Power supply backedup by energy from generator set and (2) Cost of Power supply backedup by solar energy. Data was collected through questionnaire and personal interview. In the previous research on the impact of poor electricity supply to the industries was limited to Power supply backed up by energy from generator set. Due to current needs and desire for renewable energy, because it is cheap and safe to exploit, this work investigates the difference in cost of Power supply backed up by energy from generator set and cost of Power supply backed up by solar energy. The research findings show that the average cost per unit of power consumption per KWh is between N59.29 for solar energy; N20.88 for grid electricity and N83.50 for energy from generator. Comparatively, results obtained from the investigations showed that it is much cheaper and safer to provide reliable power for manufacturing activities using power supply backed up by solar energy as better alternative to solve problem of power shortages in Nigeria. Finally, the study concludes with a number of recommendations that can assist Nigeria government in finding a lasting solution to the problem of power shortages in Nigeria.

**KEY WORDS:** solar energy, hydro power, photovoltaic cell, electricity consumption

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### I. INTRODUCTION

For over two decades, Nigeria has experienced problem in the area of electricity generation, transmission and distribution. The extent of this is underlined by the fact that Nigeria is the largest purchaser of standby electricity generating plants in the world. (Braimoh and Okedeyi 2010) A country where importing of electricity generators has become a traditional norm in the society shows the level of problem the Nigerian Government is facing. Recent reports show that highly placed political figures are behind the importation of electricity generators to Nigeria. The Nigerian Television Authority (NTA) recently reported that the Federal Government plans to eradicate and minimize the importation of generators. This potential eradication is tied to improving the current energy sector, although we can point out that the Government is more concerned with the effect of pollution and other hazardous harm the generators cause to the society. However, eradicating or minimizing generator importation is mainly not the solution to Nigeria's electricity problem. The Federal Government of Nigeria should gather resources and focus more on tackling the problem that leads to the importation of generators, which is power supply. In addition, the Federal Government of Nigeria should subsidize other alternative energy sources such as SOLAR, WIND POWER, HYDRO POWER, which can easily address pollution concerns. The key point is focusing on solution, not fringe issues that will not benefit the Nigerian society.

Political instability has also hindered any possibility of progression in the energy sector, with the sacking of numerous high profile figures that have the interest of the Nigerian masses at heart. This selfish act was seen by Nigerian masses as a way the political leaders in this country manipulate the citizens to press on their own self-interested agenda, while the society infrastructure remained in bad conditions and the people in abject poverty. Fundamentally, the power sector, a component of which is the electricity sector of the economy has a great importance to our lives and takes central role in the economic transformation process. Currently power generation capacity in Nigeria is estimated to be around 6,000 megawatts, with average working capacity of 2,000 megawatts, to provide electricity for over 150 million people while in Finland the current megawatts is estimated to be around 36,000 megawatts, providing electricity for 5.5 million people. Over the last two decades the Nigeria Energy Sector has been struggling to supply electricity in excess to the

Nigeria population, as a result of this problem, to generate, transmit and distribute electricity has fallen short of the required standard. However, the shortage of electricity supply cannot be placed into a general context. Other factors include the present state of Nigerian Economy, which mainly focused on agricultural production and crude oil extraction. The poor or near absence of physical infrastructure was also identified as a major problem of the power sector. Based on several years of electricity research on the need of the nation, the idea to assess the supply of constant electricity to improve industrial development in Nigeria would greatly benefit the Nigerian energy sector in achieving industrial development and national electric power supply goals which entail raising the capital energy consumption over a period of 10 years. Energy is a vital and important necessity for all earthly processes. The socio-economic activities of modern society revolved around the hub of energy availability. The 1973 oil crises, chaos caused by the Arab oil embargo, in western countries brought a sudden global realization to use renewable energy resources such as solar energy, hydropower, wind energy, wave energy, biomass and biofuels (Animalu and Adekola, 2002). This campaign for using renewable energy resources is becoming stronger today because of the finite nature of fossil fuel energy resources as well as the greenhouse gases emission which many scientists believe cause global warming. (Nwoke et al, 2008). Effective applications of renewable energy resources to augment energy supply from fossil fuel energy resources (using cleaner for fossil fuel technologies) will enhance availability of energy with minimum environmental effect. In response to global demand for applications of renewable energy resources, the Energy Commission of Nigeria (ECN) was established in 1979. The Energy Commission now has six centres spread across the country. The centres are: (1) National centre for energy research and development (NCERD) at University of Nigeria, Nsukka. (2) Sokoto energy research centre (SERC) at Usman Dan Fodiyo University, Sokoto. (3) National centre for petroleum research and development (NCPRD), Abubakar Tafawa Balewa University, Bauchi. (4) National centre for energy efficiency and conservation (NCEEC), University of Lagos, Lagos. (5) National centre for hydropower research and development (NCHRD), University of Ilorin, Ilorin. (6) National centre for energy and environment (NCEE), University of Benin, Benin City. The energy research centres have mandate to conduct researches and develop renewable energy technologies as well as to popularize the applications of renewable energy resources. The aim of this paper is to investigate Power supply backed up by electricity from generator set, Power supply backed up by solar energy and to suggest which combination will help to end the acute power shortage in the country.

## **II. PRESENT ENERGY SITUATION**

Commercial electricity generation in Nigeria currently comes from 7 power stations and various independent Power Projects around the country. Thus, the current nation's available electricity generating capacity is about 3,920MW with per capita power capacity of 28.57 Watts and this is grossly inadequate even for domestic consumption (Ibidapo-Obe and Ajibola, 2011). For Nigeria to meet up its energy needs, it requires per capital power capacity of 1000 Watts or power generating/handling capacity of 140,000 MW as against the current capacity of 3,920 MW. Consequently, availability of power in the country varied from about 27% to 60% of installed capacity, while transmission and distribution losses accounted for about 28% of the electricity generated in the country (Omokaro, 2008). The energy consumption mix in Nigeria is dominated by fuel wood (50.45%); petroleum products (41.28%) and hydro electricity (8%). Coal, Nuclear, geothermal, tidal, wind and solar energy are currently not part of Nigeria's energy mix, as they have either been neglected, not discovered or are currently at their early stage of development (Omokaro, 2008). The energy utilization pattern in Nigeria can be grouped into industry, transport, commercial, household and agricultural sectors. Fuel wood is used by over 60% of people living in the rural areas and 80% of Nigerians as energy source. Nigeria consumes over 50 million metric tonnes of fuel wood annually, which is a major cause of desertification and erosion in the country. The rural areas are generally inaccessible due to absence of good road networks, even with the ongoing power reform and privatization of the electricity industry; it is obvious that for logistic and economic reasons, rural areas which are remote from the grid and/or have low power purchase potential will not be attractive to private power investors. Meanwhile electricity is required for basic developmental services as well as economic growth. The absence of reliable energy supply has left the rural populace socially backward and their economic potentials untapped. The transport sector is another consumer of oil accounting for 60% of total consumption. Despite the vast oil and gas reserves; small amount is used in Nigeria. The country imports more than 70 percent of domestic fuel requirements because none of the four refineries have functioned efficiently. The high oil import bill exposes Nigeria's energy sector to the external energy price shocks. Nigeria has the 9th largest natural gas reserve in the world and exports large quantities of liquefied natural gas (LNG) to other countries, but her gas-dominated electricity grid still experiences frequent collapse due to inadequate gas supply and obsolete infrastructures. Nigeria flares 75% of its natural gas for lack of processing facilities and that amounts to 12.5% of all globally flared gas (CREDC, 2007).

For Nigeria to meet up with its energy needs, it must look for alternative energy source especially for the rural populace. While it is recognized that RE cannot solve all of Nigeria's energy problems, RE technology is still seen as having a significant unexploited potential to enable the countries to meet their growing energy requirements. If RE is properly harnessed, it could meet a significant proportion of energy demand with less deteriorating effects on the environment.

### III. RESEARCH METHODOLOGY

A questionnaire was designed and data was acquired after an extensive search that involved personal interviews with the managers of the selected firms. Apart from distribution of questionnaires, a few visits were organized to major firms. The data obtained from the survey were analysed using descriptive and econometric approaches. The descriptive approach involves the use of the tools of percentages, and simple analysis of perception.

**Table 1: Electricity Generation and Consumption**

Year installed	Capacity (MW)	Total generation	Capacity utilized (%)
2007	5580.0	1859.8	33.3
2008	5580.0	1738.3	31.2
2009	6180.0	1689.9	27.5
2010	6180.0	2237.3	36.2
2011	6130.0	2378.4	38.8
2012	6130.0	2763.6	45.1
2013	6538.3	2494.9	40.5

**Table 2: Nigeria's Renewable Resources**

Energy sources	Capacity
Hydropower, large scale	10,000MW
Hydropower, small scale	734MW
Fuelwood	13,071464hectares (forest and land 1981)
Animal waste	61million tones/yr
Crop Residue	83million tones/yr
Solar Radiation	3.5 – 7.0KWh/m <sup>2</sup> -day
Wind	2.4m/s (annual average)

**Table 3: Average cost of power consumption per KWh**

Cost per unit of power of renewable energy (solar)	₦43.42 – 75.15/KWh
Cost per unit of grid electricity	₦16.70 – 25.05/KWh
Cost per unit of standby electricity from generator	>₦83.50/KWh

#### Solar Power

Nigeria has high potential to harness energy from sun (Timothy, 2005). The country falls within the tropics of Cancer and Capricorn where the abundance of sunlight is inevitable. This energy whose reservoir is the Sun is one of the energy resources whose availability is infinite if it is developed. Furthermore, unlike the conventional energy resources, solar energy development is not as capital intensive. Therefore, it is fundamental to proffer the strategy of diversifying energy resource development outside the conventional energy resource (Timothy, 2005). This means that the proceeds of the sale of the conventional energy resources which are in high demand should directly be channeled towards the development of other non-conventional, less capital intensive and non-hazardous energy resources in the Country (Energy Commission of Nigeria, 2003). With the abundance supply of solar energy in Nigeria, efforts need to be geared towards research and development of solar electricity conversion by both direct and indirect methods (Energy Commission of Nigeria, 2005). Over the years, the sun's energy had been wasting without utilization towards renewable energy harnessing from it. Solar energy is estimated worldwide to be average power potentials of 24W per square meter of the earth's surface. Solar energy is the most promising of the renewable energy sources in view of its apparent limitless potential. Most of this energy is transmitted radially as electromagnetic radiation which comes to about 1.5kW/m<sup>2</sup> at the boundary of the atmosphere. It has been confirmed that Nigeria receives  $5.08 \times 10^{12}$  kWh of energy per day from the sun. This is equivalent to about 258.62 million barrels of oil produced annually and about  $4.2 \times 10^3$  GWh of electricity production annually in the country (Akinbami, 2001).

Among renewable resources, solar power is regarded as the leading choice for off-grid power generation. There are a number of reasons for this (Sambo, 2008). Firstly, its versatility; solar technology can be installed in almost any location - including mountains, deserts, jungles and off-shore locations - and can suit any power requirement, so long as enough photovoltaic (PV) panels are installed. Secondly, its reliability; solar systems utilize the latest technology but perform a relatively simple operation where little can go wrong. Solar power's ability to provide efficient on-site power production means it is suitable to a wide range of applications and industries, ranging from the oil and gas sector to rural electrification. Solar power is ideally suited to humanitarian applications. The most common of these is rural electrification, the process of bringing power to remote off-grid areas. According to the International Energy Association, nearly 1.5 billion people do not have access to electricity, of which 83% live in rural area. Bringing sustainable electricity to rural communities is highly rewarding and challenging task. However, effective harnessing of solar radiation using solar energy technologies to augment energy supply from hydro energy would enhance availability of energy for socio-economic activities and to improve the standard of livelihood of the people.

### **Generators**

Due to the lack of reliable electricity, many people and companies supplement the electricity provided by the grid system with their own generators. In fact, most everyone who can afford a generator owns one. According to one approximation, well over 90% businesses have generators [Energy Sector Management Assistance Program, 2005]. The electricity from private generators is more expensive than that from the national power grid, thus raising the price of domestic goods. Efforts to alleviate this strain are met with opposition from the companies who import generators, as they have created an extremely lucrative industry. There is suspicion that some of the grid system sabotage is from members of this industry.

## **IV. DISCUSSION**

Table 2 shows that Nigeria presents an array of varied energymix, from natural to renewable resources. The common question is why is the Country still in darkness?. This shows that Nigeria does not haveencouraging models of renewable energy utilizations. Table 2 also shows the abundance supply of solar energy in Nigeria, and ability to optimally put into use itsrenewable energy potential will invoke the emergence ofrenewable energy markets in other African countries. One importanteconomic growth catalyst is energy and a lack of it puts a lot ofconstraint to development in many strata of life from domestic, agricultural, educational, health to foreign investmentopportunities. Table 3 shows that the cost of maintaining personal power generating sets as isthe case in Nigeria has an impact on the price of most locallymanufactured goods and makes them much more costly thatsimilarly imported goods. Comparatively, table 3shows that it is much cheaper and safer to provide reliable power for manufacturing activities using power supply backed up by solar energy.The abundant energy resourcesavailable in Nigeria should guarantee her a place of prideamong other nations not only in Africa but in the wider comityof nations but her incompetence and poor management policieshave deprived her of that role (see table 2). In other words if Nigeria gets itright, Africa is sure to get it right.

## **V. CONCLUSION**

Electricity is a known catalyst for economic growth anddevelopment. Therefore proper provision of adequate, affordable, accessible and sustainable electricity supply iscrucial to development in Nigeria. Almost five decades afterindependence, Nigeria is still grappling with problems ofgenerating enough electricity to meet demand, with averageelectricity consumption still approximately 100 kWh/capita. The lack of electricity over the years has resulted in economiclosses and entrenchment of poverty. Poverty reduction effortsin Nigeria will only be meaningful if the electricity problem issolved. The high unemployment rate in the country can betraced to the epileptic supply of electricity.This paper reviewedthe electric industry in Nigeria specifically the electricityproduction and consumption pattern. Furthermore this paperexplored the vast renewable energy potentials that Nigeriapossesses and came to this irrefutable conclusion: The solutionto energizing Nigeria lies solely in integrating renewableresources into her streams of non- renewable sources of powergeneration. The result shows that if Nigeria gets itright, Africa is sure to get it right.In this respect, the followingare suggested framework in the harnessing and optimizing of renewable energy resources in Nigeria:

- Since solar radiation in Nigeria is fairly well distributed, a rural electrification drive based on Photovoltaic powersystems should be pursued for supplying energy to homes, schools, clinics, small and medium scale farms, and smallbusinesses.
- The Law that prohibits a state from developing its ownelectricity generation should be reviewed and if possible repealed
- The Universities of technology across the country should be empowered financially to act as renewable energy R&D centres for the country

- The government should partner with leading countries in the area of renewable technology
- Development of workable strategies to integrate energy and sustainable development concerns into decision making in Nigeria

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