DIVERSIFYING ENERGY SOURCE: A PROSPECT TO ACHIEVING STEADY POWER SUPPLY IN NIGERIA

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Abstract

Apart from land, labour, capital and entrepreneur, constant and steady electricity is the fifth modern day indispensable factor of production and hence inevitable for the development of any country. The rate of consumption of electricity is directly proportional to the production level and growth of any country. The study also examines the source, service delivery and problems associated with the present insufficient hydro power supply in Nigeria. Using secondary data, tables and graphs, the research discover that the demand for electricity in Nigeria in the past decade, outstrips the supply; and that the level of electricity production in Nigeria determines the rate of growth of GDP. The study postulates diversification from hydro source to alternative sources of solar and wind because the wind and solar sources are more abundant in Nigeria, cost less and are prone to lesser socio-political interference and restiveness. For programme implementation, the paper recommends a public – private sector collaboration based on a sound legal framework and a national resource survey. The author believes a carefully planned and executed diversification programme will translate Nigeria from an electricity-epileptic power country to that with a constant and consistent power supply and hence a basis and stimulus to growth and development.

Keywords: Energy, Electricity, Electricity Production, Electricity consumption, Scarcity.

1. Background

Energy affects all aspects of life. "Without energy, the entire industrial infrastructure of the world would collapse. Much of the conveniences taken for granted are powered by energy. Energy allows us live under diverse climatic conditions, in great numbers and often in comfort" (Agboegbulem, 2008). There is a good correlation between energy consumption and economic development; higher per capital energy correlates with a higher score on Human Development Index (IEA, 1992).

Development is a process of energy resource exploitation. The higher the level of development, the higher the demand for energy resources and consumption. Inadequate energy supply will put an unavoidable constraint on industrial output, distort artisantry and limit social activities thereby breeding many macroeconomic problems with the resultant high social and economic costs. (Nnanna et. al. 2003).

Nigeria is blessed with both renewable and non-renewable energy resources. The non renewable resource includes crude petroleum, natural gas, coal, tar sands and uranium. The renewable energy resources comprises of solar radiation, biomass, hydro and wind energy. Despite these, the electricity generation in Nigeria is abysmal and can hardly sustain any serious social or industrial adventure. This is regardless of Nigeria's abundant sources of electric-energy.

The African desert gets a lot of sun. The intensity of the sunlight pressing down on that desert makes the area ideal for generating solar power. Plans along this line were conceived in 1913 (by American Engineer Frank Shuman), and again explored in 1986 (by German Particle Physicist Gerhard Knies). They believed the solar energy harvested a few hours in the African Desert could power the whole world for a year (Michelsen, 2011). Nigeria by her privileged location at the fridge

of the Sahara stand the advantage of exploiting massive solar energy before *Desertec* harvest it for the world.

Electricity generation began in Nigeria in 1896 under the British colonial administration. The localized and rudimentary power generation and distribution system led to the development of the Electricity Corporation of Nigeria (ECN) in 1950. The first 132KV line was constructed in 1962 linking Ijora Power to Ibadan Power station. After independence, the Nigeria Dam Authority (NDA) was established in 1962 for the development of Kainji Hydro-Electric Project and some associated 330 kilovolts (kv) transmission lines and sub-stations which were completed in 1969.

The ECN transformed into the monopolistic National Electric Power Authority (NEPA) in 1972 (CBN, 1998) and until 2005, Electric Power Sector Reform Act (EPSR) repealed the NEPA Act and established Power Holding Company Nigeria (PHCN). The Act further provided for the creation of Successor Companies from PHCN and 18 Successor Companies compromising eleven distribution Companies, six generation Companies and one transmission company has since been created. All these are meant to ensure optimal energy resource use and steady uninterrupted electricity power supply which has remained a mirage till date.

The objective of this paper is to review the electricity situation in Nigeria, identify the various forms of energy available in Nigeria, examine the problems associated with the present energy regime and suggest the possibility of an efficient diversification of energy source from thermal and hydro source of power to wind and solar electricity supply. Following this introduction, section two presents the theoretical framework; examine the source, supply and problems of electricity in Nigeria, section three deals with solar energy and wind energy potentials in Nigeria. Section four present the advantages of wind and solar energy while section five concludes by providing recommendations for the implementation of the diversification process.

2.1Theoretical Framework

This work is based on the economic principle of scarcity. Essentially, the concept of scarcity means limitedness of resources in supply relative to the demand for them. There is scarcity of most resources needed for human satisfaction and national development. Many of these resources are natural like land while some are man-made like money. Lipsey (1985), acknowledging Adam Smith, viewed scarcity in terms of money and quotes that "No complaint is more common than that of scarcity of money". Robbin Williams in Lipsey (1985) viewed that "ends are scarce and wants are unlimited". One obvious reason for the non-satisfaction of unlimited wants is the scarcity of means at the disposal of mankind. The time and means available for satisfying these ends are scarce or limited. The ends are of varying importance, which necessarily lead to the problem of choice or selecting the uses to which scarce resources can be put to" (Jhingan 2007).

It is increasingly becoming clear that two basic resources necessary for development in today's world are technical acumen or technology and electricity. For most countries, these resources are either in smaller quantities or hardly available and hence scarcer than the demand for them. The scarceness of these factors that facilitate production and necessitate increase welfare and development varies from country to country (Lipsey, 1985).

The issue of scarce resources is made the more interesting because these resources have alternative uses and for maximum utility, alternative uses must be carefully identified and analysed for the best choice to be made. Scarcity consequently gives rise to choice. Choice therefore may be seen as the act of selecting from alternatives. The economists therefore, chronicles the alternatives in the order of priority and on the basis of the ability to implement, create the facility or demand. This list is called the scale of preference.

Electricity plays an important role in the development of any nation. The rate of energy consumed by any nation is directly proportional to the rate of production and consumption and subsequently the rate of economic development. The electricity demand in Nigeria far outstrips the epileptic supply. Thus energy, which is a scarce resource in Nigeria should be considered a national priority on the national scale of preference.

2.3 Source of Hydro Electricity in Nigeria

Nigeria is endowed with abundant water resources. Annual rainfall decreases from 3400 mm depth in the south central shores of the Niger Delta to 500 mm over the northern boundaries of the country, with a perched increase to 1400 mm over Jos Plateau region. Similarly, the eastern ranges of Adamawa and Cameroon boundaries experience elevated precipitation as high as 2,000 mm relative to contiguous low areas of the country. Rainfall duration is longest in the south and decreases progressively northwards. In the southern areas, precipitation lasts over eight months of the year, whereas, at the extreme north annual rainfall duration can be less than three months. It is clear that the country is blessed with a huge hydropower potential (Okoro et al, 2004).

The current installed electricity capacities in Mega Watts are the Kaiji (760), Jebba (540) and the Shiroro (600). Other hydro power stations in the country are; Zungeru (500), Lokoja (1950), Markudi, Katsina-Ala (600), Mambilla (1000), Jamtari Bali (253), Ikom (400), Dasin-Hausa (350), Manya, Onitsha (750), Afikpo (180), Atan (180), Sutai (45), Langalanga (100), Kam (115) and Gurara (10) etc. The thermal power stations include; Egbim, Sapele, Detta, Onitsha (Obosi), Afam Oron and Makurdi.

A census of estimated resource base from National Electric Power Authority's outstanding total exploitable hydro potential stands at 12,220 MW in the 2000s. Current hydropower generation is about 14% of the nation's hydropower potential and represents some 30% of total installed grid connected electricity generation capacity of the country. (Manohar & Adeyanju, 2009)

Independence power generation is uncommon in Nigeria. The Nigerian Electricity Supply Corporation Ltd. (NESCO), Jos exists. NESCO projects were completed between 1923 and 1964 and have continued to provide virtually uninterrupted power to not only supply the Jos metropolis and meet local consumption, but also feed into the national grid. NESCO operations are a clear example of a very successful Independent Power Production (IPP) that should be replicated in other parts of the country. It should be noted though that, the database on small hydro in Nigeria is quite limited, incomplete and substantially obsolete. In the economic competitiveness, the IPP of hydro source of energy is well placed. Although the small hydro may require a moderately high capital cost, its low operation and maintenance (O and M) requirements coupled with long life spans are its major advantage over other prospective sources of power to small and medium sized local communities and settlements.

The petrol/diesel generators which may be installed at a relatively moderate cost are prone to such serious limitations as unreliability of fuel supply, frequent breakdown, high O and M requirements, short service lives, noisy operation and environmental pollution. (National Energy Plan Vision 2010). They are however becoming very popular for obvious reasons in Nigeria.

The economic value of small hydro schemes would be further enhanced when more units come on stream, local service areas are established and system components, operators and managers are predominantly locally trained. Their Economic competitiveness would increase and improve with more use (Small Hydropower Technology, 2004).

2.4Electricity Situation in Nigeria

Nigeria is endowed with massive energy resources. She is the world's sixth largest reservoir of crude oil, with proven reserves of nearly 5000 billion cubic meters. Coal and lignite reserves are estimated to be 2.7 billion tons, while tar sand reserves represent 31 billion barrels of oil equivalent. Identified hydroelectricity sites have an estimated capacity of about 14,250 MW. Nigeria has significant biomass resources to meet both traditional and modern energy uses, including electricity generation. The country is exposed to a high solar radiation level with an annual average of 3.5 – 7.0 kWh/m2/day (Federal Ministry of Power and Steel 2009).

The current installed capacity of grid electricity is about 6000 MW, of which about 67 percent is thermal and the balance is hydro-based. Between 1990 and 1999, there was no new power plant built and the same period witnessed substantial government under-funding of the utility for both capital

projects and routine maintenance operations. Generating plant availability is low and the demand – supply gap is widening. Poor services have forced most industrial customers to install their own power generators at high costs to themselves and the economy. By 2005, the transmission network consisted of 5000 km of 330 kV lines, and 6000 km of 132 kV lines. In addition, there were 1,790 distribution transformers and 680 injection transformers. The transmission network is overloaded with a wheeling capacity of about 4,000 MW. It has a poor voltage profile, inadequate dispatch and control infrastructure, radial and fragile grid network, frequent system collapse and exceedingly high transmission losses. PHCN's business operations are inefficient. The system suffers from chronic under-investment, poor maintenance, un-recorded connections and under- billing arising from a preponderance of un-metered connections. The utility's financial performance, as well as its ability to serve customers satisfactorily has been consistently poor. Access to electricity services is low. About 60 percent of the population i.e over 80 million people are not served with electricity. (Federal Ministry of Power and Steel 2009).

Summarising the situation in terms of electricity production, the CIA (2013) asserts that electricity production by source in Nigeria is 61.9% fossil fuel, 38.1% hydro, 0% nuclear and 0% others. Nigeria's modern sector is powered by the 38% hydro source. This depicts that nuclear, solar and wind sources of energy are untapped in Nigeria.

Year	**Prd**	**Con**	**Dis**	**GDP**
2000	14.75	13.72	1.03	43.46
2001	18.7	17.37	1.33	3.12
2002	15.9	14.77	1.13	46.29
2003	15.67	14.55	1.12	22.78
2004	15.67	14.55	1.12	34.45
2005	19.85	18.43	1.42	27.7
2006	15.59	14.46	1.13	27.4
2007	19.09	17.71	1.38	11.27
2008	22.11	15.85	6.26	17.62
2009	22.11	15.85	6.26	2.05
2010	21.92	19.21	2.71	6.58
2011	21.92	19.21	2.71	8.85
2012	20.13	18.14	1.99	

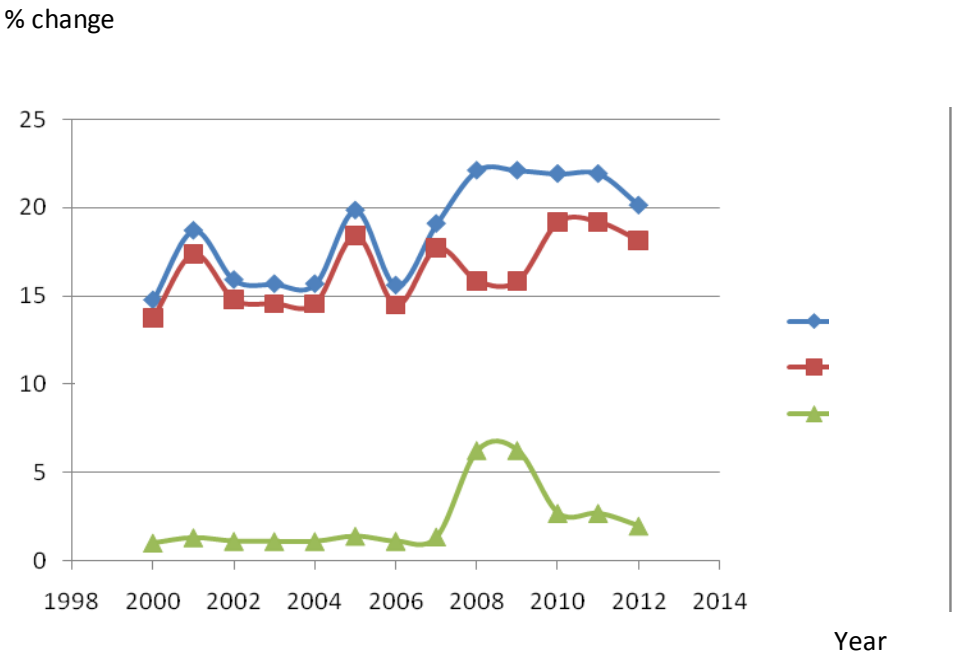
Source: CIA World Factbook. (2012)

Where Prd = electricity production (This is the annual electricity generated expressed in

kilowatt-hours); Con = electricity consumption (This is the total electricity generated annually plus imports and minus exports, expressed in kilowatt-hours) and Dis = discrepancy between the amount of electricity generated and the amount consumed and is accounted for as loss in transmission and distribution.

It is obvious from table 1 that the amount of electricity produced in Nigeria is consumed. Except for 2008 and 2009, the discrepancy between the amount of electricity generated and the amount consumed is insignificantly less that 13% of production. This shows that it is production that determines the quantity consumed of electricity in Nigeria. Thus, a shortage of electricity supply is due to insufficient production from a mono-cultural base.

Figure 1: Annual Electricity Production, consumption and the Disparity



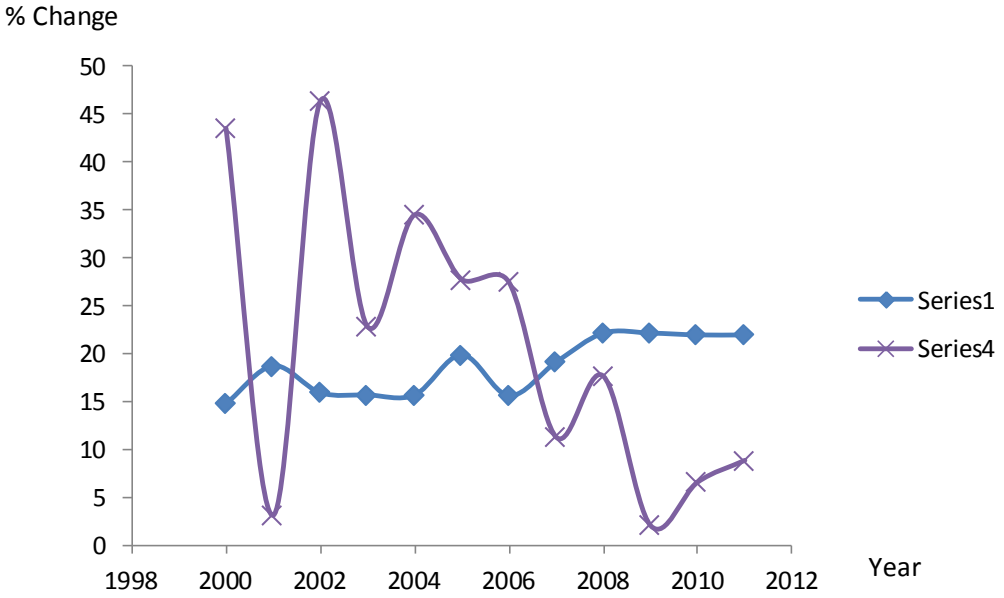
Source: Author (from table 1)

Where series 1 = electricity production; series 2 = electricity consumption and series 3 = disparity.

Observing the electricity production, consumption and their disparity on graph show positive linearity of production and consumption. Production and consumption follow the same trend and the disparity is almost constant except for 2008 and 2009 which depicts a higher than normal loss due to militia and excess vandalisms. Seeing that almost all that is produced is consumed, and is unable to satisfy the over 140 million Nigerians; and that produce is zero % nuclear, solar and wind, there is obviously a serious need for diversification if the demand for electricity must be satisfied in Nigeria.

It is clear that electricity production determines its consumption and is related to output or GDP annual rate of change in Nigeria but in a one year lag form. A rise in electricity production gives rise to an increased GDP in the year that follows. The below graph demonstrates this

Graph 2: Annual Rates of Electricity Production and GDP



Source: Author (from Table 1)

Where series 1 = electricity production and series 4 = GDP growth rate

It can be observed that a low electricity output in 1999 results to a minimum of below 5% annual growth in 2001. A slight rise in electricity production in 2001 give a corresponding increase to a global maximum output of over 45% annual GDP increase in 2002. This logic is visible through most of the years until in 2008 when the electricity production was almost constant while GDP growth rate declined and started increasing from 2010. Here GDP is not constant like electricity because other factors like the activities of militants became wild and wide and seriously undermined the production activities in Nigeria. It is however clear that electricity production and output are positively related in Nigeria.

Following the deplorable state of hydroelectricity supply in Nigeria, the government to do 3 things: privatized the PHCN Distribution Companies (DISCOs) to core investors - 10 indigenous firms, sign a 3 year contract with Manitoba Hydro of Canada for repositioning of Transmission Companies of Nigeria (TCN) and facilitate a power and gas financing package which includes government guarantees and a proposed infrastructure bond of $i billion (Federal Ministry of Infrastructure, 2012). Enormous efforts, which perhaps if channeled to other sources of electricity production, are enough to guarantee steady and consistent power supply in Nigeria.

.2.5 Problems of Hydro, Thermal Source of Electricity in Nigeria

One inevitable problem is **environmental violation and pollution**. Hydroelectric plants customarily disrupt the original environment and ecology because they significantly alter the landscape or riverscape around them – the chemical reactions produce sulphur oxides, heavy metals, radio-active elements, hydro carbons and large quantities of carbon dioxide emitted subsequently leads to acid rain.

The output of the hydro plants is highly oscillatory according to the seasonal droughts. The large hydropower plants in Kainji, Jebba and Shiroro except for 2012 have produced significantly lower energy as a result of low water levels in their reservoirs due largely to excessive drought in the past decade (Eleri, 2007; Okoro et al, 2004).

Another problem is **Greenhouse Gases and Oxygenated Depletion**: When a reservoir is first impounded and the area flooded, the submerged plants decompose and release their carbon content in the form of the greenhouse gases CO_2 (carbon dioxide) and methane (CH_4) (Pinguelli, 1995). For every per unit of electricity generated, some reservoirs produce more equivalent units of CO_2 than a fossil fuel power station. The dissolved oxygen from the water and the CO_2 make the subsurface water hostile to aquatic life. (Gabriel, 1997).

The problem of **Methyl mercury Contamination** also exists. The reservoirs allows some toxic chemicals to leach into the water supply. The portable water mix with the mercury in the rock bed to form methyl mercury, which when accumulates in fish results to mercury poisoning to all consumers of the fish (Raphals, 1992). Also the pollution is aggravated in Nigeria because the river Benue and Niger is fed essentially by the Cameroon and Senegal sources.

Floodplain and delta regions contain very fertile farmland due to sedimentation which leaves rich nutrients and minerals, rejuvenating the farmland with each rainy season. However, floods from water released from dams could cause massive damage to people as witnessed recently in Nigeria. An associated problem is the Reservoir Induced Seismicity (RIS), which is the change in seismic activity that often occurs when large reservoirs first begin to fill. (McCully, 1996) Normally, increased seismic activity alters the environment leading to major damages to the usually fragile buildings of the poor riverside people.

There is technical problems of the right expertise for installation and maintenance of the process. Major portions of a nuclear plant are radioactive during and after operation, requiring special system designs to prevent radioactivity release. The PHCN poor technical knowledge leads to further loss through transmission. Between 30 and 35% of power generated in Nigerian power stations is lost in this way. Hence Nigeria's installed generating capacity of between 5000 and 6000 MW never exceeds 4000 MW actual production (Kennedy J. et al 2008).

The Managerial Problems in Nigeria have resulted to high maintenance cost and poor financial performance.; this results generally to low productivity, excessive debts, non-settlement of electricity bills by consumers and the high fixed costs associated with power production. (Kennedy, 2008). Not only this prior to entering Nigeria, the rivers pass through Niger and Cameroon. In order to obtain the maximum amount of energy from these rivers, Nigeria must provide incentives to prevent Niger from installing their own dams on the rivers. Thus, a portion of the energy generated by the hydro plants is exported to Niger to compensate for their agreement not to build dams along the river. Thus, Nigeria receives even less of the already dwindling electricity generated from existing hydropower (Kennedy J. et al 2008). There are many nefarious man-made problems associated particularly with hydro and thermal source of energy in Nigeria like vandalisation of transformers, embezzlement and mismanagement of funds.

3.1 Solar Energy Potentials in Nigeria

Electricity from solar energy may be obtained through solar thermal process and solar Photovoltaic (PV). Nigeria enjoys abundant sunshine because of her location between latitudes 5^0S and 15^0N of the equator. It has nearly 290 days of sunlight in a year and a mean annual average solar radiation of about 3.5 kWhm and about 7 k W hm in the far north. On the average, the country receives solar radiation at the level of about 19.8 MJm. Average sunshine hours per day are estimated at 6. Solar radiation is fairly well distributed. For instance, the minimum average is about 3.55 kWhm–2day-1 in Katsina in January and 3.4 kWhm–2day-1 for Calabar in August and the maximum average is 8.0 kWhm–2day-1 for Nguru in May. If solar collectors or modules were used to cover 1% of Nigeria's land area of 923,773km^2, it is possible to generate 1850x103 GWh of solar electricity per year. This is over one hundred times the current grid electricity consumption level in the country. (Kalu et al, 2010)

A research by Karolis K. et al (2008) on Solar Energy Implementation confirmed the obvious of the shortage of this energy supply over demand. After thorough analysis of climate in Nigeria, they asserted that solar energy is the most suitable energy source and concluded that solar energy plant is both economically and environmentally sound and could be a solution to the shortage of electricity in Nigeria.

3.2 Wind Energy Potentials in Nigeria

The wind resource is available in Nigeria at annual average speeds of about 2.0 m/s at the coastal region and 4.0 m/s at the far northern region of the country. Wind dynamos are devices which convert the kinetic energy of the moving air to rotary motion of a shaft, that is, mechanical energy (Sambo, 2009). Electricity from wind energy is produced using an aerogenerator, which is an electro-mechanical system. Wind electricity can be generated from both the shallow and deep offshore waters for single unit capacities greater than 5MW, because of higher wind. Wind turbines have life spans of 20 – 25 years (Okafor, *et al* 2010).

Wind is a viability supplementary source of energy supply to electricity. Oriaku et al. (2007) found that there was a 98 % probability of having 2.0 meter per second/ hourly wind speed available in Umudike, Abia State. Ngala et al. (2007) discovered that there is enough wind speed to generate power economically in Maiduguri, Bornu state. The estimated energy densities at 25 meters in height were between 4.712 and 27.449-megawatt hours per month. This will reduce fuel consumption by 40 percent. Kennedy J *et al*. (2008) measured the average wind speed in various parts of the country for periods ranging from three to ten years and discovered that the prevailing wind speeds of 3.5 m/s could provide cheaper energy in Sokoto in the northwest, Borno State in the northeast, and Owerri in the south.

In a similar vein Okoro et al (2004) discovered that the annual wind mean speed at a height of 10m above the ground ranges between 2.3m/s to 3.4m/s for sites along the coastal areas and 3.0m/s to 3.9m/s for high land areas and semi-arid regions. Therefore, using wind energy conversion systems for electric power generation and supply in Nigeria especially around coaster areas and the Sokoto axis will be cost effective. Okoro *et al* (2004) conclude it will be economically more viable to use wind energy in Jos too.

For economic viability, 75-80% costs of wind power electricity generation are upfront costs of physical capital and installation. The remaining costs are dispersed over the life of the wind power system and are comprised of operating, maintenance, and insurances costs. Although the wind power generation is financially competitive with grid extension and diesel generators in most regions, the costs are declining every time the installed capacity doubles.

4.1 Salient Advantages of Wind and Solar Energy

There are some prominent facts that need to be revealed in the adoption of solar source of energy in Nigeria. Solar power systems generate no air pollution during operation except during installation, which is an advantage over the hydro and thermal sources. This energy source is safe. The hazard associated with it is not much different in quality or magnitude from the innumerable hazards people face routinely in an industrializing society like Nigeria. (Brower, 1992).

The advantages of Solar Energy is highly favourable to Nigeria since we have a good ecology for it and it does not cause any environmental pollution like the fossil, hydro, thermal and nuclear power. As applicable to solar source of energy, wind energy produces no air or water pollution, involves no toxic or hazardous substances (other than those commonly found in large machines), and poses no threat to public safety. Another outstanding matter in relation to wind is the fact that there has been yet a serious obstacle facing the wind industry. Few have expressed concern over the visibility and noise of wind turbines but this can be solved with simply installing these turbines meters away from households or residential areas.

One of the most misunderstood aspects of wind power is also its use of land. Most studies assume that wind turbines will be spaced a certain distance apart and that all of the land in between should be regarded as occupied. This leads to some quite disturbing estimates of the land area required to produce substantial quantities of wind power. The truth however is that, the wind turbines themselves occupy only a small fraction of land area and the land in between them can be used for other purposes like farming.

Perhaps the greatest potential for wind power development is consequently in the the north and south east where wind is plentiful and vast stretches of farmland could support hundreds of thousands of wind turbines. In other heavily populated areas like Lagos early and careful planning should surmount such associated problems.

Another salient issue to be noted in the exploration of the wind energy option is the dependence on fossil fuels, which are often subject to rapid price fluctuations and supply problems. Nigeria's increase dependence on gas-fired electric generating capacity because of its low capital cost is obviously a myopic

perception, As world gas demand increases, the prospect of supply interruptions and fluctuations will grow, making further reliance on it unwise and increasing the value of diversity (Fagbenle and Karayiannis, 1994).

Diversification will also minimise the socio-economic upheavals in the polity (Medugu and Malgwi, (2005). The restiveness in the Niger Delta area which shake Nigeria and also had a spiral effect on the world oil market would have been flagged if the wind energy option is developed (Lavagninni *et al*., 2006). It is also worthy of mention that more jobs per unit of energy produced is possible from wind energy than from other forms of energy (International Energy Outlook, 2006).

An important issue to be noted in wind energy is that selection of a suitable site is a key to the economics of wind energy. The power available from the wind is a function of the cube of the wind speed, which means that all other things being equal, a turbine at a site with 5 meters/second (m/s) winds will produce nearly twice as much power as a turbine at a location where the wind averages 4 m/s. In the electric power business, where technology options often hinge on very small economic differences, good wind resource assessment and siting is critical (Chineke, 2000).

The numerous coastal areas in Nigeria give credence to wind energy advocates. The resource is extremely large along the coastal areas, the energy costs, although initially higher than for onshore, are cheaper than other renewable technologies in the long run (Diab, 1988). Sitting wind turbines at sea will also reduce the constraints that can be found on land (Lavagnini et al, 2006). The Asaba, Port-Harcourt, Yenegoa, Calabar, Ikeja and Lokoja coastal sites are locations in Nigeria that can have optimal wind energy utilization using the offshore option. Kaduna that has a river is another suggested location (Mohsen and Akash, 1998).

The technologies for harnessing this energy have, over the years been tried in the northern Nigeria mainly for water pumping from open wells in many secondary schools in Sokoto, Kano, Katsina, Bauchi and Plateau States. A 5 kW wind electricity conversion system for village electrification has been installed at Sayyan Gidan Gada, in Sokoto State. The technology is an old friend that could be revived with ease and familiarity.

5 Summary and Recommendations

This paper elucidates on key issues surrounding the present electricity sector of Nigeria; the potentials of hydro, solar and wind energy and the problems associated with each of the sources. Wind and solar energy seems much more economic in Nigeria. Based on this, a renewable energy policy and legislation should be enacted. The government should set up an independent private – public sector parastatal to determine the total renewable energy potential in the various ecological zones of the nation.

Three phases should be involved in the implementation process: (1) The formulation phase entails the reformulation of policies and a good resource and survey assessment of the energy potentials in the country according to the various ecological zones. (2) The next phase involves mobilization of human and financial resources. Enlightenment programmes on the new electrification policy. The existing Research and Development Centers and technology development institutions should be adequately strengthened to support the shift towards increased renewable energy utilization. (3) The last phase is the implementation phase which should be carried out with great consideration to other sectors of the economy such as agriculture, small scale industrial enterprises and poverty alleviation. A Monitoring and Evaluation unit should be set up with clearly spelt out duties and periodic reports. It is feasible that the country can attain the objective of stable power supply by the year 2020.

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