ENTREPRENEURSHIP OPPORTUNITIES IN THE POWER SECTOR OF NIGERIA ECONOMY

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Abstract
The most critical challenge of Nigeria real sector is the infrastructure problem. This single factor has been the clog in the wheel of industrialization in Nigeria. The paper postulates diversification of the energy portfolio to help create a structural change in the electricity generation industry while providing Nigeria with sustainable, competitive energy alternatives and entrepreneurs with enormous wealth creation opportunities. The aim of the study is to understudy the alternative sources of energy to boost electricity generation and entrepreneurial opportunities that abound in the power sector. The study adopted a descriptive approach. The study recommended that government should privatize and liberalize the energy sector.

Keywords: Entrepreneurship, Opportunities, Power, Sector and Economy.

Introduction
Most infrastructural developmental project in Nigeria is included in the exclusive and concurrent list. But in recent times the state and federal government of Nigeria have failed in its duty to its citizens which have created a poor state of infrastructure in the country. Nevertheless, the development have been the bane of industrialization in Nigeria as well as the resultant spiral growth in the cost of production have refuse to attract a lot of foreign investment in the Nigerian real sector. Since the fourth republic till date successive governments in Nigeria have spent over one billion Naira in Nigeria power sector and implemented a couple of strategies like segmentation of NEPA (National Electric Power Authority) operational structure but all their effort to achieve optimal supply of power is still a mirage. The inadequate development and inefficient management of the energy sector has led to a supply-demand gap, despite the abundance of resources in the sector. It is important to note that the present government is engrossed on how to shore up the energy supply in the country due to poor epileptic power supply. Many observers, scholars and technologist have lent their weight on structural market change which they believe will increase the sustainable competitive energy alternatives. In this context, the study will focus on alternatives source of energy which indeed goes a long way to create a diversified energy portfolio to increase electricity generation in the industry.

Literature Review

Concept
According to Pearce (1998) as was captured in Ibeabuchi et al (2003) liberalization involves deliberate policies that promote the efficient workability of market and completion to coordinate economic activities. Liberalization also promotes external participation in the economy as the much needed foreign private investment is attracted to some area of public enterprise, especially when government policies in such areas become flexible, while privatization involves the sales of equities in public enterprises to private investors with or without the loss of government control in these organizations. It may take the form of deregulation of the state monopolies.

Electricity Situation in Nigeria
According to International Centre Energy, Environment and Development (2006), Nigeria is highly endowed with sufficient energy resources to meet its present and future development requirements. The country possesses the world sixth largest reserve of crude oil. It is increasingly an important gas province with proven reserves of nearly 5000 billion cubic metres. Coal and Lignite are estimated to be 2.7 billion tons, while Tar and Sand reserves represent 31 billion barrels of oil

equivalent. Identified hydroelectricity sites have an estimated capacity of about 11,000 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 of 3.5 – 7.0 kwh/m2/day. Wind resources in Nigeria are however poor-moderate and efforts are yet to be made to test their commercial competitiveness. The current installed capacity 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 a substantial government underfunding of the utility for both capital projects and routine maintenance operations. Generating plant is low and the demand and supply gap is crippling. Poor services have forced most industrial customers to install their own power at high cost to themselves and the Nigerian economy. See Table I

By 2005, the transmission network consisted of 5000km of 330 KV lines, and 6000km of 132 KV lines (PHCN, 2005). The 330 KV lines fed 23 substations of 330/132kv rating with a combined capacity of 6000MVA or 4600MVA at a utilization factor of 80%. In turn, the 132KV lines fed 91 substations of 132/33kv rating with a combined capacity of 7800 MVA or 5800 MVA at a utilization factor of 75%.See Table II

The distribution grid consisted of 23,753km of 33kv lines and 19,226km of 11kv lines. In turn, these fed 679 substations of 33/11kv rating and 20,543 substations of 33/0.415 and 11/0.415kv ratings. In addition, these 1790 distribution transformers and 680 injection transformers (ECN, 2004).The transmission network is overloaded with a wheeling capacity less than 4,000MW. It has a poor voltage profile in most part of the network, especially in the north. Inadequate dispatch and control infrastructure, radial and fragile grid network, frequent system collapse, exceedingly high transmission losses. PHCN's business operations are inefficient. The system suffers from chronic under investment, poor maintenance, unrecorded 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 service is low in Nigeria. About 60% of the population – approximately 80 million people are not served with electricity. Per capital consumption of electricity is approximately 100kwh against 4500kwh, 1934kwh and 1379kwh in South Africa, Brazil and China respectively. Under a business as-usual scenario, the proportion of Nigeria without access to electricity service will continue to increase overtime. The rural electrification program began in 1981 focuses exclusively on grid extension; cost per connection remain high and annual rate of connection is low with the chronic shortage of generating capacity and low tariffs for rural areas, there is little incentive for PHCN to champion an expansion program. In all, rural electricity capital assets continue to deteriorate through neglect, vandalism and theft. The federal government is undertaking comprehensive reforms to address the electricity situation in the country. The enactment of the Electricity Power Sector Reforms Acts (2005), establishment of the Nigeria Electricity Regulatory Commission, Rural Electrification Agency and the unbundling of PHCN are concrete legal, regulatory and institutional steps that will begin to address the challenges of the sector.

The rational for Liberalization and Privatization of the Energy Sector

National Electric Power Authority was among the public enterprises marked for full privatization to ensure an efficient and sustainable power supply and promote fair competition as it was generally believed that the generation and distribution of electricity in Nigeria would be more efficient under Private Sector Management. In addition, there was this increasing difficulty in funding NEPA's operation solely from government source according to Ibeabuchi et al (2003).The major objective highlighted by the Privatization and Commercialization Decree No. 25 of 1988 including the following;

(i) Reducing the size and scope of government through restructuring and privatization to lessen the dominance of unproductive investment in public enterprise.
(ii) Refocusing the enterprise slated for privatization to enhance performance, viability and overall efficiency.
(iii) Promoting a favorable climate for domestic investment and creating a positive attitude towards private investment for both local and foreign enterprises.

(iv) Promoting equity ownership among employers of privatized businesses in order to motivate them towards higher productivity.
(v) Providing consumers with improved services, better product quality, wider choices, new products and lower prices.
(vi) Improving the profitability of the privatized firm through energy sources and potentials.

In Nigeria there are two sources of energy; the non renewable energy sources comprises of petroleum, natural gas, coal and fuel wood and the renewable energy sources which include hydro-power, solar, biomass and wind energy.

Non-renewable Energy Resources

Petroleum:

According to Ajayi.et al (2003), Crude petroleum is the dominant energy resource being exploited in Nigeria. The estimated reserve is 33 billion barrels of predominantly low-sulphur, light crude as at 2006. The reserves were spotted at major basins in the country namely, the Niger Delta, Anambra Basin, Chad Basin, Dahomey Basin, Sokoto Basin and the Benue trough while the condensate deposits were spotted mainly in the south-eastern continental shelf. However, both on shore and off-shore exploration and commercial activities have largely been concentrated in the Niger Delta area and the continental shelf. But unfortunately, this is an expensive source of generating electricity for the growing need of energy consumption in the country and it has put pressure on the scarce resources of petroleum and caused some environment challenges. The energy vain chain is illustrated thus:

Input	Conversion Process	Output
Fossil explored and processed into fuel and gas	Generating set makes use of the fuel or gas to generate the needed energy	Electricity

Figure I: Source: Authors modification

Natural Gas

According to Ajayi.et al (2003) the source of major energy in the country is gas, 60 percent of which is located east of river Niger and 40 percent west to it. This form of energy exists in two form which is associated and non-associated gas. Associated gas which is mostly of thermal origin is found and produced along crude oil. It constitutes 50 percent of total gas reserve. It is important to note generating electricity have less environmental effect compared to petroleum. The estimated gas deposit is 159 trillion standard cubic feet, 71 percent of Nigeria's proven gas is found on-shore while 29 percent is off-shore. The energy vain chain is illustrated thus:

Input	Conversion Process	Output
Fossil explorations are converted or processed into fuel or gas or excavation of coal	Gas turbine plant; diesel plants and gas fired steam plants are adopted to generate	Electricity (thermal energy)

Figure II Source: Authors modification

Coal

According to Ajayi et al (2003) there is also large deposit of coal which is a solid fuel mineral. According to Renewable Energy Master Plan of 2006, the proven reserve of coal in Nigeria is 2.7 trillion tones. However, Nigeria Coal Corporation (NCC) estimates indicates 638 million tonnes of proven reserves by direct drilling and 2.75 billion tones of inferred reserves. Coal deposits are found in the Enugu escarpment running from north to south in Anambra state, Otukpo in Benue state, Okaba in Kogi state, Obi-Lafia basin in Plateau state and south of Gombe state.

There are two types of reserve namely the sub-bituminous grade and lignite. However, Nigeria coal is mainly the sub-bituminous type, low in sulphur and phosphorus, but with a fairly high volatile comp orient petroleum, gas and coal can be harness to generate electricity and such process is regarded as thermal energy. The energy vain chain is illustrated thus:

Input	Conversion Process	Output
Fossil explorations are converted or processed into fuel or gas or excavation of coal	Gas turbine plant; diesel plants and gas fired steam plants are adopted to generate	Electricity (thermal energy)

Figure III Source: Authors Modification

Fuel Wood

According to Ajayi.et al (2003) Nigeria is a tropical country made of lush forest growth which is her major source of fuel wood. It is estimated that over 60 percent of the nation's population mainly depend on fuel wood supplies for her daily requirement of energy. The energy from this source is mainly for cooking and heating. It is also used for process staples food like garri, bean cake as well as for fish and grain drying among others. But the disadvantage out weight the advantage; the major effect of this is the increasing rate of depletion of forest reserves. The energy vain chain is illustrated thus:

Input	Conversion Process	Output
Wood	Burning of wood.	Heat energy

Figure IV Source: Authors Modification

Renewable Energy Sources

According to Renewable Electricity Action Program (REAP) 2006 refers to renewable energy as electric energy sources that do not result in the depletion of the earth resources. The renewable energy resources, notable among which are; solar, hydro, wind and biomass that have minimal environmental impact such as less intensive hydro and certain biomass combustion.

Solar Energy

The sun's energy is transmitted radially as electromagnetic radiation which is known as solar energy. This energy is transmitted at the rate of 3-5-7.0kwh/m^2 per day. According to Sambo (1991), if solar appliances with 5 percent efficiency were used to cover 1 percent of Nigeria's surface area it then follows that 2.541 x 10^6 Mwh of electricity can be produced from the source alone. It is estimated that the solar energy that could be converted into electrical energy in the process will be equivalent to 4.656 million barrels of crude oil per day. The vain chain is illustrated thus:

Input	Conversion Process	Output
Sun	- Solar photo voltaic PV technologies a. Crystalline silicon technologies b. Thin film technologies - Solar thermal energy technologies	Electricity (solar energy)

Figure V Source: Authors modification

Hydro power

Hydro power is derived from the potential energy available from water due to the height difference between the storage level and the tail water to which it is discharged. Hydro power varies in size depending on the volume of water discharge and height of fall (or heel).Small, mini, micro hydro power: According to Renewable Energy Master Plan (2006) small hydro power is defined by the renewable energy master plan as all hydro electricity schemes below 30MW, mini below 1MW, micro below 100KW and Pico 1KW. The vain chain is illustrated thus;

Input	Conversion Process	Output
Water	Power is generated by mechanical conversion of the energy into electricity through a turbine	Electricity (hydro power)

Figure VI Source: Authors Modification

Wind Energy

According to International Centre for Energy Environment and Development (2003), it is the energy contained in the movement of air in form of wind. Wind energy reserve at 10m height shows that some sites have wind regime between 1.0 to 5.1m/s. There is a general consensus that wind speed can be converted into wind energy for use in many parts of Nigeria (Ukong, 1998 and Iwu, 1998) as was pointed out in Ajayi et al (2003).Although wind speed is weak in the south, it is stronger in the coastal areas and the hilly regions in the Northern parts of the country. Wind energy has a variety of end users, including water pumping and green milling. According to international centre for energy, environment and development (2003) identified that high probability areas of harvesting strong wind energy throughout the year in areas like lagos, Ondo, Delta, Rivers, Bayelsa, Akwa Ibom, Sokoto, and Jos.The vain chain is illustrated thus:

Input	Conversion process	Output
Wind	Wind turbine drives electrical generators.	Electricity

Figure VII Source: Authors Modification

Biomass

According to International Centre for Energy, Environment and Development (2006:10) Biomass refers to green plants converting sunlight into plant material through photosynthesis to produce biomass energy. More than 40 million tonnes of sawdust, shaving, bark, waste, timber, and wood chips are estimated to be generated annually in Nigeria. These wastes are really substantial and can be economically deployed to generate electricity on or near the production sites in order to provide power. In addition, Ajayi et al (2003:109) emphasizes that biomass fuel has the advantage of being renewable and compacting it into briquettes provides a means of facilitating its use. As a result of the clean burning properties of wood briquettes, they have become very suitable for use as fuel in heavily populated area where smoke emission should be restricted. Rice husks and animal wastes including dungs are additional sources of biomass energy in Nigeria waiting to be exploited. The vain chain is illustrated thus:

Input	Conversion Process	Output
Sawdust, shaving, bark, waste, timber and wood.	Bagasse cogeneration technologies	Electricity energy

Figure VIII Source: Authors Modification

Objectives: The objectives of the study are as follows:

(i) Identify others energy sources that will serve as Grid based extension for proximate areas.
(ii) Identify independent mini-grids for remote areas with concentrated loads where good service is not economic or will take many years to come.
(iii) Identify Solar photo voltaic (DV) systems for remote area with scattered small loads
(iv) Identify energy potentials that can generate entrepreneurial opportunities.

Hypotheses: Diversified renewable energy portfolio is the panacea to epileptic power supply and sustainable energy supply.

Research Instrument: The study adopted a descriptive approach and made use of secondary data. Statistical tool (Product moment correlation of coefficient) was apply to test, if there is a positive correlation between projected demand for electricity and energy potentials and reserve.

Table III: Indicate the electricity generation from 2002-2007.it shows a progressive growth in electricity generation except for 2005 and 2006 where there was a drop in electricity generation.

Table IV: Indicate the electricity consumption by sector from 2002-2007.it shows a progressive growth in electricity consumption except for 2006 where there was a drop in electricity consumption.

Table V: Indicate the renewable energy reserve/potentials/the energy equivalent. This shows a diversified energy portfolio that can help ensure a sustainable electricity generation in the country. Hydro power is not yet fully maximise while other is yet untapped.

Table VI: Indicate the projected peak demand for electricity on non- renewable energy and renewable energy pari pasu with the estimated renewable energy reserve/potential in Nigeria.

Table VII: Indicate the environmental impact assessment of renewable energy, the assessment showed a positive outlook for Nigeria.

Table VIII: Indicate simple regression table to test the level of relationship between the projected peak demand for electricity and renewable energy reserve/potential.

Conclusion

The study concluded that there are a lot of entrepreneurial opportunities hidden in the energy potential/reserves in the country and Nigeria can generate a sustainable electricity supply by deregulating the energy sector to take advantages of the diversified energy portfolio.

Recommendations

The study recommended among the following to open up the sector:

1. The deregulation of the energy sector in order to attract foreign private investment.
2. The development and sustainess of alternative sources of energy to accommodate the growing demand for electricity in the country.
3. The establishment of a functional regulatory body to act as a check against much feared business hardships and exploitation in the implementation of a privatization policy.
4. The federal government should hasten the privatization of power holding company of Nigeria to give way to optimal pricing of electricity which is the key issue to cope effectively with the regular and adequate supply needs of consumer.
5. The federal electricity regulatory policy should promote environmental friendly source of energy.

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Table I: Nigeria Energy Reserves/Potentials

Resource	Reserve	Reserves Billions tons	% Fossil
Crude oil	33 billion bbl	4.488	31.1
Natural gas	4502.4 billion m^3 (159 trillion scf)	3.859	26.7
Coal & Lignite	2.7 billion tones	1.882	13.0
Tar sands	31billion bbl oil equiv.	4.216	29.2
Sub –Total(fossil fuels)		14.445	100.0
Hydropower, Large scale	10,000 MW		
Hydropower, Small scale	735 MW	Provisional	
Fuel wood	13,071,464 cubic meter (1981)	Estimate	
Animal waste	61 million tonnes/yr	,,	
Crop residue	83 million tonnes/yr	,,	
Solar radiation	3-5-7.0 kwh/m^2-day		
Wind	2-4 m/s (annual average)		

Figure I Sources: Renewable Energy master plan (2006)

TableII: Commercial Power Generation in Nigeria

Sources of Power	Afam	Egbin	Sapele	Delta	Thermal	Kainji	Shiroro	Jebba	Large Hydro	TOTAL
Capacity in MW	986	1320	1020	912	4238	760	600	570	1930	6168
%	-	-	-	69	-	-	-	-	31	100

Source: Agagu .O. (2002) Development in the Electric Power Sector. May 1999 – 2002.

Table III: Electric Power Generation (Kwh to Mwh)

POWER STATION	2002	2003	2004	2005	2006	2007
HYDRO POWER	16008.26	7447.60	923.04	695.05	712.29	1900
THERMAL	80.44	12735.6	1840.56	1992.05	1530.098	5111.6
TOTAL	16088.7	20183.2	2763.6	2687.1	2638.1	7011.6
INDEX OF ELECTRIC GENERATION	-	0.2545	0.717	0.670	0.639	3.358

Source: Central Bank of Nigeria Annual Report.
Note: In 2004 revised standard of measurement changed from (kwh to Mwh)

Table IV: Electric Consumption by Sector (Kwh to Mwh)

SECTOR	2002	2003	2004	2005	2006	2007
INDUSTRIAL	1938.85	1659.79	429.28	430.14	383.44	494.01
COMMERCIAL	2330.18	3538.32	523.03	528.79	465.35	599.55
STREET LIGHTING						
RESIDENTIAL	4624.78	7668.49	1009.10	1014.17	894.11	1151.91
TOTAL	8893.8	12866.6	1825.5	1973.1	1742.9	2245.5
INDEX OF ELECTRIC CONSUMPTION (2002=100)	-	0.446	1.052	1.218	0.959	1.524

Source: Central Bank of Nigeria Annual Report.
Note: In 2004 revised standard of measurement changed from (kwh to Mwh)

Table V: Estimated Renewable Energy Reserve/Potentials for Nigeria

ENERGY TYPE	RESOURCE ESTIMATE	ENERGY EQUIVALENT
HYDRO POWER	10000MW	0.32×10^{12} MJ/year
SMALL HYDRO POWER	735MW	26.4×10^{5} MJ/year
WIND POWER	2.15 X 10 Mwh	7.7×10^{16}MJ/year
SOLAR RADIATION	2.1 X 10 Kwh	6.0×10^{9}MJ/year
ANIMAL WASTES & CROP RESIDUE	144 X 10 Tonnes/year	13.4×10^{6} MJ/year

Source: National Centre for Energy Research and Development (NERD) University of Nigeria Nsukka

Table VI: Projected Peak Demand for Electricity in Nigeria (MW) Renewable.

YEAR	PROJECTED PEAK DEMAND ON NON-RENEWABLE ENERGY	PROJECTED PEAK DEMAND ON RENEWABLE ENERGY.	TOTAL PROJECTED PEAK DEMAND FOR ELECTRICITY	ENERGY RESERVE/POTENTIAL
2007	7000	60	7060	32060264
2010	10000	155	10155	7700032061604
2016	15000	735	15735	7700032061604

Source: International Centre for Energy, Environment and Development.

Table VII: Environment Impact Assessment of Renewable Energy

TYPES OF PLANT	MULTIPURPOSE	EMISSIONS	RADIOACTIVE RADIATION	SOCIAL IMPACT	EARTH QUAKE
HYDRO	YES	NO	NO	YES	YES
SMALL HYDRO	YES	NO	NO	YES	NO
FOSSIL FUEL	-	YES	NO	LESS	NO
NUCLEAR	-	YES	YES	NO	NO
WIND	-	NO	NO	YES	NO
SOLAR	-	YES	NO	YES	NO

Source: National Energy Plan Vision 2010.

Table VIII: Simple Regression Table

YEAR	X	Y	X^2	Y^2	XY
2007	7060	32060264	49843600	1027860527749696	226345463840
2010	10155	7700032061604	103124055	59290493749729546451052816	78193825585588620
2015	15735	7700032061604	247590225	59290493749729546451052816	121160004489338940
3	32950	15400096183472	400557880	11858098756048695342985532	320513834564266500
N	∑X	∑Y	$\sum X^2$	$\sum Y^2$	∑XY

Source: International Centre for Energy, Environment and Development and Authors modification.