

ENERGY CRISIS IN NIGERIA; THE WAY FORWARD

Anthony C. Nnaji¹

Abstract

The path to economic development and rapid industrialization for any country is hinged on the sustained drive by the various stakeholders to provide a robust energy sector to drive the change. The current energy crisis situation in Nigeria has continued to nose-dive to a critical situation with increasing infrastructural deterioration to unacceptable levels. This is in spite of the fact that the country is endowed with enormous human and natural resources for energy generation and sustainability. This paper energy crisis in Nigeria; the way forward therefore provides a critical analysis of the energy situation and solutions to the problem ranging from technical and infrastructural provision to the political will to implement and review the current energy policy were proffered. For Nigeria to meet the Millennium Development Goals (MDGs) and National Economic Empowerment and Development Strategy (NEEDS) target, adequate attention must thus be given to this ailing sector of the economy.

Keywords: Sustainable energy, Energy crisis, Renewable energy sources, Fossil fuels, Power generation.

Introduction

The International Energy Agency (IEA) 2009 forecast indicates that between now and 2030 world energy demand will increase annually by 1.5% from just over 12,000 mtoe (million tonnes of oil equivalent) to about 16,800 mtoe. The report also showed that for most developed economies of the world, the major sectors consuming the most energy are; transport, manufacturing, and the domestic sectors in the order. The energy sector has always been the bedrock upon which the wheels of industrialization is driven, the absence or short supply of which grounds manufacturing and development to a halt. Energy is so critical that every other sector of the economy depends directly or indirectly on it. For any country aspiring to develop and grow her manufacturing and industrial sectors, energy generation, transmission and distribution must be given adequate attention to ensure sufficient supply to all other sectors. It is an important contributing factor to the development of any country, region or community. It is also fundamental for the realization of basic individual and community needs such as education, health, food, transportation, lighting and cooking. Given that all these are the indices to gauge any nation's economic and social development and prosperity. That is, how well a country fares in terms of development in industry, education, transport and domestic sectors can be measured by how strong and robust their energy sector is. Top economies of the world have developed a huge energy base to drive their economic activities. Unfortunately Nigeria has not been so fortunate in this critical area. Power generation in Nigeria still stands at below 4,000MW serving a population of over 140 million people. The country's economy in the light of energy use patterns according to [1] can be divided into industrial, transport, agricultural and domestic sectors. Of these the share of domestic sector accounts for about 65% of total energy consumed in Nigeria. This is indicative of the low level of development in other sector such as industry, manufacturing, transport, services when compared to what is obtained in developed countries. Nigeria's major energy consuming activities in the domestic sector are cooking, lighting and use of

* Department of Electrical and Electronics Engineering, Enugu State University of Science and Technology, Enugu State Nigeria.

electrical appliances. Cooking constitutes 91% of domestic energy consumption, lighting 6% while 3% is attributed to use of basic domestic electrical appliances such as refrigerators, television, pressing irons and radios. The domestic sector in the country is primarily sustained by fuel wood, kerosene, liquefied petroleum gas and electricity, in that order [1]. Wood is most widely used and meets about 80% of domestic energy needs.

The outline of the paper is as follows; in section II Nigeria's energy crisis situation is described in terms of her power generation capacity against her energy needs. The way forward to a robust power sector is detailed in section III, section IV centered on discussion. Finally section V contains the conclusion.

Nigeria's Energy Crisis Situation

Nigeria as the most populous black country in the world is endowed with an enormous human and material resources capable of transforming the fortunes of the country if adequately harnessed and developed. With a workforce of over 100 million and a material resource base for power generation standing at; crude oil reserve estimated at 37.2 billion barrels, natural gas reserve estimated at 197 trillion cubic feet while coal reserve is estimated at 2.75 billion metric tons [2], the country has within her all she need to transform the energy sector. These fossil fuels

Table I: A List of Power Plants in Nigeria with their Installed and Generating Capacities

Site name	Type	Installed capacity (MW)	Available capacity (MW)	Number of units
Egbim	Thermal	1320	650	6
Shiroro	Hydro	600	450	6
Ughelli	Thermal	812	320	20
Kainji	Hydro	760	450	12
Sapele	Thermal	1020	63	10
Afam	Thermal	980	-	20
Afam VI	Thermal	650	450	3
Jebba	Hydro	540	482	6
Geregu	Thermal	440	92	-
Omotosho	Thermal	304	35	-
Olorunsogo	Thermal	304	-	-
AES	Thermal	270	-	5
Okpai	Thermal	450	361	5
Omoku	Thermal	150	60	-
Trans-Amadi	Thermal	136	-	-
PGeometric	Thermal	140	140	-
Total	-	8,876	3,653	93

(crude oil, natural gas and coal) contribute over 75% of total world energy needs. Despite this enormous energy deposits the combined installed capacity of all the power plants in the country stands at about 9,000MW as at Dec 2009. Of this capacity the generated power is less than 3,500MW due to the average utilization factor of 41%. In table I [3], a summary of the installed and available electric energy at Nigeria's power generating plants is presented. The total power available for distribution from the table to a teeming population with energy needs estimate of about 10,000MW is less than 2,500MW due to transmission and distribution losses of between 30% - 35% [4] [5].

Today more than 40% of Nigerians live in the rural areas without access to electricity supply. For those in the cities and areas with electricity, the supply is so epileptic and erratic lasting on average less than 8 hours per day [6]. Economists have long established that increased provision and utilization of energy services is part and parcel of economic development. It has been shown in [7] that the electricity demand in Nigeria far outweighs its supply. The country is thus faced with an acute shortage of electricity supply to power her aspirations for industrial transformation notwithstanding the availability of vast resources for power generation.

Table II: A Statistics of Current Power Generating Capacity of Some Countries and their Per Capita Energy Capacity

Country	population (millions)	power generating capacity (MW)	per capita power capacity	Country's GDP (billions)
USA	293.6	848,300 (yr 2002)	2,889.3	11,750
Germany	82.6	115,000 (yr 2002)	1,392.25	2,362
U.K.	59.7	76,300 (yr 2002)	1,265.25	1,782
S.A.	42.7	44,650	1,046.7	491.4
Brazil	179.1	86,020	480.3	-
China	1,300.1	338,300	260.0	7,262
India	1,086	115,520	106.31	3,319
Ghana	20.7	1,762	85.12	48.27
Nigeria	140	4,000	28.57	125.7

The level of power generated to meet demand has not been commensurate with the increasing population. This sorry scenario created by the limited scarce resources (fossils) used to generate power has led to energy crisis situation due to critical shortage in supply to meet demand. Because of this Nigeria's energy capacity per capita is very low in the light of what is obtainable globally. Table II captures this vividly according to [8]. The per capita energy and gross domestic product are indices used to measure the economic wellbeing of a country and her people [11] and this figures are very low for Nigeria [9]. Little wonder why over 70% of the population live below the poverty line with less than \$2 per day [10].

A. The National Integrated Power Project (NIPP)

In its bid to tackle the present precarious energy generation in Nigeria, the present administration re-injected funds into ongoing and new power projects in various parts of the nation through the National Integrated Power Project (NIPP) initiative. As a result some new power generating plants are underway which when completed will help boost energy generation in the country. Table III lists some of these

power projects, their locations and capacity [12], [13]. This definitely is a step in the right direction with the hope that these projects would not be abandoned before completion.

Table III: A Summary of Ongoing Power Plants Projects in Nigeria

S/n	Name (Location)	Installed capacity (MW) phase 1	Installed capacity (MW) phase 2
1	Calabar	561	-
2	Ihovbo (Benin)	451	-
3	Sapele	451	-
4	Egbema	338	-
5	Gbarain	225	-
6	Omoku-B	230	-
7	Ibom-power	193	450
8	Geregu	414	414
9	Olorunshogo	335	754
10	Alaoji	504	1000
11	Omotosho	335	754
12	Okpai	-	450
13	Eket (Mobil JV)	500	-
14	Obite (Totalfina Elf)	450	-
15	Ijede (Chevron)	250	800
16	Mambilla	2600	-
	Total	7837	4622

Transforming Nigeria's Energy Sector

In the light of the present energy crisis, the one question that readily comes to the minds of intellectuals and concerned citizens is; what ought we to do to initiate, establish and sustain a robust energy sector characterized by acceptable international standards of service delivery, reliability, and accessibility that will propel sustainable human capacity development and industrial revolution in Nigeria? It is a well-known fact that sustainable and rapid economic growth, creation of employment opportunities and reduction in the poverty level are hinged on the substantial expansion in quantity, quality and availability of adequate levels of power generated. Proffering answers to the question above provides the pathway through which the country can achieve a stable, robust energy sector fit for purpose. Some of the issues and factors that must be holistically addressed are briefly highlighted hereunder:

• Structured maintenance planning and spare parts supply

Current utilization of the installed generating capacity of the power stations is about 41%. This implies that the stations presently operate much below their expected level of operation.

One of the reasons for this low level of utilization is lack of structured maintenance, spare parts availability and poor planning strategy. Performance of planned preventative maintenance would see the plants operating optimally up to a utilization capacity of about 65-75%. For example the Egbin power station has an installed capacity of 1,320MW but there has not been a planned systematic turn around maintenance of the plant. Hence most of the units have never been retooled, maintained. Therefore the current output from the station is less than 650MW. Effecting these repairs and maintenance will inject additional 220MW into the national grid readily. Most of the operating parts of these plants are already worn out and need replacement but these spare parts are in low or no supply thus negatively affecting generation level. On the overall the current production level can be boosted by over 40% through a well-structured maintenance and planning. This amount will really translate to more economic activities in the country. To achieve increased production and a robust energy sector therefore, a radical reform and overhaul of the sector is paramount to achieve results in the immediate future.

• Proper energy resource management

This is also a factor capable of impacting positively on the energy sector in the short term.

Inefficient use of energy resources has major implications on availability [11] such as;

- Investment in energy supply infrastructure is in excess of what is required if more efficient equipment and practices are adopted.
- Increased environmental hazards as a result of energy waste, and
- Increased cost of goods and services since both used and wasted energy must be paid for.

The potential for energy saving in Nigeria is great in the three main areas of demand namely; domestic, industry and transport. In the domestic sector, use of traditional three stone stoves for cooking provide only about 10% of its energy for direct cooking wasting about 90%, lighting using the normal incandescent bulbs wastes greater percent of its energy (over 60%) as heat. So adopting the use of energy efficient bulbs for lighting will see a huge saving of energy for domestic activities. Energy audit studies have shown that up to 25% of industrial energy can be saved through simple housekeeping measures. In the transport sector much opportunity exists for efficient usage of the scarce energy resources. Efficient energy resource management can be achieved through the provision of user education on energy saving measures, technologies and practices such as simple switching off the light bulbs when not in use should be encouraged.

• Private sector participation and deregulation of the energy sector

Full deregulation of the telecommunications sector brought tremendous improvement to the industry and revived it from its moribund state to a vibrant and thriving industry with great prospects. The financial demands of the energy sector are so great and may not be fully shouldered by the federal government alone. Private sector participation is imperative if the current crisis will be surmounted. Up until now the energy sector is run primarily by the federal government with little or no involvement of the state, local government and the private sector. The ongoing process of deregulation of the sector by the present administration is definitely a bold step in the right direction [14]. When implemented, this process will usher in a new era and inject the needed resources and expertise required to boost and reposition the

sector before the end of 2020. So for a full participation of the private sector in the energy industry in Nigeria, according to [15], there need to be

- An improvement in the financial performance of the sector to prove that investing in the sector is a viable and profitable option.
- A stable environment and right institutional and regulatory framework must be provided for investment
- Security of investment both human and material must be addressed

• **Articulate energy policy, regulatory and institutional framework**

Well formulated policies are very essential for the successful implementation of any technology in the country. The issue goes beyond having a written down policy statement to the implementation of same. Nigeria's policy on energy is not only inadequate to meet twenty first century energy needs since it was last reviewed in 2003, it also does not address key areas like uptake of renewable energy alternatives. The policy document is not implemented to the letter to see meaningful improvement in the sector. This thus defines the basis for private sector participation. The energy sector will be better positioned with the review and implementation of the policy on energy. Efficient and strong institutional framework is one key element which will provide direction, co-ordination as well as regulation for all energy sector activities in Nigeria. It will serve as the implementation machinery of all social and technological innovation in this area. This will include all stakeholders in the sector. Hitherto, the energy commission of Nigeria (ECN) has not made any inroads at state and local government levels. It only exists at the federal level. As such it is impossible for it to operate like that and achieve any meaningful impact on the sector. This institution

(ECN) is expected to champion energy development in the country.

• **Deploying the right technology, research, development and training**

Currently, majority of the finished goods and services consumed by Nigeria are imported from Asia and Europe. Our engineers are not well exposed and trained on the appropriate energy technology. As a result they are not conversant with the best applications and limitations of different technologies in the sector. Adequate measures must be put in place to acquire the right technology required to drive the energy sector and as well domesticate these technologies. The Petroleum Training Development Fund (PTDF) and Education Tax Fund (ETF) are doing commendable job in manpower training, development and skills acquisition. They should thus be encouraged and empowered to do more especially on energy based technology. Due to this lack of technology exposure, there is a general lack of knowledge about acceptable quality and standards of technology. This implies that users and installers alike are not likely able to distinguish between good and bad equipment and thus make informed decisions. Proper research on new technologies should be properly funded by government and private sector concerns. Institutions such as Universities should be adequately funded and mandated to create department of energy to encourage research activities in the area. This department should comprise of seasoned scientists, engineers, economists, managers and the like to be at the forefront of the drive for a sustainable energy future. The present energy based research centers namely; The National Center for Energy, Research & Development (NCERD), Nsukka, Enugu state and the Sokoto Energy Research center (SERC), Sokoto state are too small in number and grossly underfunded to make any meaningful impact. Development of indigenous energy based technology (equipment) will go a long way in transforming the sector. Virtually all equipment and systems used in the sector are imported. Apart from their high costs, lack of

experienced personnel to operate and maintain those equipment renders their usage even more expensive. Moreover, most of these imported equipment are not suited and adapted to our environment.

• **Improved security infrastructure**

Security concerns have been on the rise for some time now. The current activities of the Boko Haram Islamic sect in the northern part of the country has rendered some part of the country ungovernable and highly insecure. There is also the activities of the Niger-Delta militants in the southern part. These security issues have made investment (local and foreign) very difficult [16]. Efforts therefore should be geared towards the provision of much needed security of life and property and thereby create enabling environment upon which private sector driven economy will be built.

• **Adoption of energy mix approach**

The adoption of a diversified energy sector from the old conventional sources (fossils), to an energy mix that integrates other sources of energy which are non-fossil based such as; solar, wind, geothermal, small hydro, biomass and tidal waves will positively drive the sector towards a more stable sector. These alternative sources of energy largely abound in the country. Below is given estimates of some of these alternative sources [17] also referred to as renewable energy sources given the fact that they do not really get used up in the process of power generation.

Solar radiation - estimated at $3.5-7.0\text{KWh}/\text{m}^2/\text{day}$

Wind energy - estimated at 150,000 Terrajoules per annum

Geothermal energy - no estimate for this currently exists known to the author

Biomass energy - estimated at 144 million tons per annum

Nuclear energy - no estimate for this currently exists known to the author

These energy sources are largely environmental friendly as the attendant environmental degradation and pollution associated with fossil fuels are minimal where not absent. Renewable energy sources have the capacity of lifting poorest of nations to great heights of prosperity and growth according to the United Nations Secretary-General, Ban Ki-Moon in his Colorado speech. This is definitely true for many Asian countries (China, Malaysia and Singapore) which few years back were referred to as under developed but today are among the fastest growing economies of the world. This can also be true for Nigeria.

Discussion

In the light of the foregoing it is very important that a holistic and dogged approach laced with determination to move and deepen Nigeria's energy sector for the repositioning of the country be adopted. Moving the country's energy sector forward requires that urgent attention be given to these key areas;

- The review of the existing national policy on energy especially as it relates to renewable energy alternatives with a view to implementing them.
- Encourage and create the right environment for the adoption of renewable alternatives to augment the present fossil fuel based sources which are not environment friendly. This may include implementing energy buy back and incentives to individual and investors who use standalone energy sources such as solar power to enable them secure good return on investment.
- The government and institutions should invest in research and development in this sector and also provide support to local manufacturers of supporting technologies.
- The establishment of an energy fund to serve as an instrument for providing adequate financial support and incentives for local manufacturers and suppliers of related components.

- Security concerns must adequately be addressed.

V. Conclusion

Energy is the mover of technology, economy and industrialization. Thus its relevance to any nation can never be over-emphasized and no level of attention given to it may be too much since it directly impacts on all other sectors such as education, health, industry, services and others. Nigeria's energy crisis may persist if adequate attention is not given to it. In this paper the energy crisis situation was discussed in the light of present power generation and need of the nation. In the same light, the way forward to a robust, viable and stable energy sector has been presented. The road to economic emancipation and rapid development and industrialization hinge on the sustained drive by the government and stakeholders both present and future to provide at all levels a healthy energy sector by creating the enabling environment for the full deregulation of the sector.

References

- [1] Oladosu, G. A., and Adegbulugbe, A. O. (1994). Nigeria Household Energy Sector: Issues and supply demand frontiers. *Energy Policy*, 22 (6), 538-549.
- [2] World energy review. Bp Statistics of World Energy. www.bp.com
- [3] Emovon, I., Kareem, B. & Adeyeri, M. K., (2011) April. International Conference of Nigerian Association of Energy Economics, (NAEE), Abuja.
- [4] Ikeme, J. and Obas, J. E., (2005). Nigeria's Electric Power Sector Reform: The Key Objectives. *Energy Policy*, 33, pp 1213-1221.
- [5] Kola, S. and David, M. O., (2008). Privatization and trends of Aggregate consumption of electricity in Nigeria: An Empirical Analysis. *African Journal of Accounting, Finance and Banking research*, Vol.3 (3) pp 21-32
- [6] Okoro, O. I., and Chikuni, E. (2007). Power Sector Reforms in Nigeria: Opportunities and Challenges. *Journal of Energy in Southern Africa*, 18 (3), 52-57
- [7] Ajao, K. R., Ajimotokan, H. A., Popoola, V. T. and Akande, H. F. (2009). Electric Energy Supply in Nigeria, Decentralised Energy Approach. *Cogeneration and Distribution Journal*. Vol.24, (4)
- [8] Ibidapo-Obe, O. and Ajibola, O. O. E., (2011) August. Towards a Renewable Energy Development for Rural Power Sufficiency. *International Conference in Engineering and Technology*,
- [9] Okafor, E. E., (2008). Development Crisis of Power Supply and Implications for Industrial Sector in Nigeria. *Journal of Studies of Tribes and Tribals*, 6 (2): 83-92
- [10] Iwayemi, A. (2008). Nigeria's Dual Energy Problem: Policy Issues and Challenges. *Association for Energy Economics*, Fourth Quarter 17-21
- [11] Sesan, T. (2008). Status of Renewable Energy Policy and Implementation in Nigeria; www.gbengasesan.com/temidocs/REPStatusNigeria.pdf.
- [12] Makoju, J. O. (2007). A Presentation to the Presidency on Power Sector Status: Issues and Way Forward. *International Journal of Engineering and Advanced Technology*, 2 (3), 230-287
- [13] Sambo, A. S., Garba, B., Zarma, I. H., and Gaji, M. M., (2009). Electricity Generation and the Present Challenges in Nigerian Power Sector. *Energy Commission of Nigeria*. Abuja, Nigeria
- [14] Akpan, I., (2005). Deregulating the Nigerian Power Sector: The Case of Privatization. *South-South Journal of Culture and Development*, 7 (1), 87-108.
- [15] Energy Commission of Nigeria (2003), National Energy Policy
- [16] Sule, A. H. (2010). Major Factors Affecting Electricity Generation, Transmission and Distribution in Nigeria. *International Journal of Engineering and mathematical Intelligence*, 1 (3), 159-164
- [17] Ibitoye, F. and Adenikinju, A., (2007). Future Demand for Electricity in Nigeria. *Applied Energy* 84. pp 492-504