

Energy Security in Nigeria: Challenges and Way Forward

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ABSTRACT: *Nigeria's economy is mono-cultural as every economic activity revolves around oil and gas which is unsustainable. Oil and gas account for about 80% of government revenues, 90-95% of export revenues, and over 90% of foreign exchange earnings. Also, about 64% of the nation's electricity generation comes from oil and gas, and our transportation system is completely dependent on oil and gas. Energy is the lifeblood of economies around the world and global economic growth depends on adequate, reliable and affordable supplies of energy. However, energy availability, accessibility and utilisation has remained inadequate and inefficient as occasioned by the epileptic power supply, constant queues in our filling stations and the folding up of industries in the nation to neighboring African countries due to insufficient power supply resulting to unemployment. Thus, this paper underscores the dangers of solely depending on oil and gas as the source of energy to every sector of the economy despite the enormous renewable energy potentials in the nation. It also highlights the need for the nation to diversify its energy supply for power stability and energy security as any major breakdown in the sector will result to economic stalemate. It suggests an implementable policy framework that will add renewable energy technology which is clean and sustainable to the nation's energy sector.*

KEYWORDS: *Corruption, Energy Diversification, Energy Resources, Energy Security*

I. INTRODUCTION

The modern world relies on a vast energy supply to fuel all economic activities such as transportation, communication, industrial processes, food production, education, security and health delivery systems. Energy is the lifeblood of economies around the world and global economic growth depends on adequate, reliable and affordable supplies of energy [1]. Historical facts have established that industrialisation and growth rate of any country depend on energy available in that country, and the extent to which this energy is utilised.

In view of the significant role energy plays in national development any country that wants to be reckoned with in the comity of nations in terms of technological development must have robust energy base for sustainable development. The energy base should be able to meet the present and the future energy needs of the nation.

Energy resources are generally defined as anything that can be used as a source of energy. They are basically classified into two main groups, namely, conventional or non-renewable and renewable energy resources. Non-renewable energy resources are coal, oil and gas while renewable energies include wind, ocean wave and tides, solar, biomass, hydro, geothermal (heat of the earth). They are renewable because they are regularly replenished by nature.

Nigeria is endowed with enormous energy resources, non-renewable and renewable but most of its economic activities are oil and gas based which is finite and environmentally unfriendly. For example, oil and gas account for about 80% of government revenues, 90-95% of export revenues, and over 90% of foreign exchange earnings. Also, about 64% of the nation's electricity generation comes from oil and gas, and our transportation system is almost completely dependent on oil and gas [2]. Sole dependence on a particular energy option does not guarantee the energy security of the nation.

Energy Security entails: the availability of energy resources that are diverse, sustainable in quantities, affordable in prices, supports economic growth, assists in poverty alleviation measures, does not harm the environment and that takes note of shocks and disruptions. A 1999 UNDP report defines energy security as the continuous availability of energy in varied forms in sufficient quantities at reasonable prices [3]. Thus, energy security does not only entail sufficient energy reserve or potentials but also its availability, accessibility and affordability.

Nigerian energy sector has fallen short of these as it is often characterised by unstable fuel supply and prices fluctuations, epileptic electricity power supply to just about 40 percent of the population of the country [4], environmental polluting, and imports more than 85 per cent of her refined petroleum products because of low refining capacity [5].

The objective of this paper is to highlight the energy challenges of Nigeria and the danger it poses to the energy security of the nation most especially being a mono-cultural economy.

II. REVIEW OF ENERGY RESOURCES IN NIGERIA

Nigeria is endowed with sufficient energy resources to meet its present and future development requirements. The country possesses the world's sixth largest reserve of crude oil [4]. Nigeria is endowed with abundant supply of oil, natural gas and coal. It is estimated to have proven reserve of approximately 35 billion barrels of oil, about 2.7 billion tonnes of coal and 187 trillion barrels standard cubic feet (bscf) of natural gas according to the Draft National Energy Master Plan, 2007.

Nigeria is endowed with an annual average daily sunshine of 6.25 hours ranging between 3.5 hours at the coastal region and 9.0 hours in the northern region [6]. Nigeria receives about 5.08×10^{12} kWh of energy per day from the sun and if solar energy appliances with just 5% efficiency are used to cover only 1% of the country's surface area then 2.54×10^6 MWh of electrical energy can be obtained from solar energy and this amount of electrical energy is equivalent to 4.66 million barrels of oil per day [7]. Therefore, there is a greater accessibility and availability of solar energy for Nigeria to develop her solar energy technology [8].

Nigeria also has enormous hydro-electricity potentials. There are seven river basins in the country, namely Sokoto, River Niger, Hadejia-Jama're, Chad, Upper Benue, Lower Benue and Cross River having small-scale hydropower potentials estimated to be about 734.2 MW [7]. Power Holding Company of Nigeria (PHCN) has estimated that, the country's outstanding, total exploitable hydro potential currently stands at 12,220 MW [9].

The biomass energy resources of the country are 144 million tonnes per year approximately. Nigeria is currently consuming about 43.4×10^9 Kg of fuel-wood annually. The average daily consumption is about 0.5 to 1.0 kg of dry fuel wood per person [10]. Biomass contributes 37 per cent of total energy demand and energy of choice for the vast majority of rural dwellers and the urban poor [11].

Nigeria Metrological Services has shown that total actual exploitable wind energy reserve at 10m height, may vary from 8 MWh/yr in Yola to 51 MWh/yr in the mountain areas of Jos Plateau and it is as high as 97 MWh/yr in Sokoto [7] which are indications of wind energy potential.

III. ENERGY POLICY OF NIGERIA

The concept of energy security is not entirely new at the leadership level of the Nigerian nation, it has however, not been pursued with the sense of purpose, determination and consistency it deserves. In his foreword to the Proceedings of the Energy Policy Conference held in 1978, President Olusegun Obasanjo, then the military Head of State, declared that "Energy, in all its ramifications, has finally emerged in our consciousness as a crucial element in this unavoidable industrialisation and socio-economic development process." [12].

In 1984, the Federal Ministry of Science and Technology produced a Draft Energy Policy Guideline. The contents were however limited in scope and depth. The Energy Commission of Nigeria, in furtherance of its mandate, produced a Draft National Energy Policy in 1993. This was later reviewed in 2003 by an Inter-ministerial Committee, appointed by Mr. President, is presented in subsequent sections, [13].

When eventually a copy of the first Policy Guidelines on Energy for Nigeria was presented in 2003, it had as its cardinal goal, the achievement of a good mix in the development of Nigeria's energy resources, in an environmentally acceptable manner that would guarantee national self-sufficiency and security. The objectives of the guidelines include the development and maintenance of a regular inventory of the energy resources in Nigeria. It also aims at ensuring continuity and self-sufficiency in energy supply in the short, medium, and long-term, at economically favourable costs. The guidelines took cognisance of the need to protect the quality of the environment and the population from the hazards of energy exploitation and utilisation. It further aims at improving the nation's technical capabilities in the energy sector for State security, self-reliance and economic competitiveness, [13].

IV. CHALLENGES IN THE ENERGY SECTOR AND THEIR IMPLICATIONS

Laudable as the guidelines on energy policy may appear, about 25 years after the first energy policy was presented, Nigeria is unfortunately nowhere near her destination. The energy sector has been facing a lot of challenges ranging from corruptions to security problems from internal and external forces and of course these have ripple effect on the economy of the nation.

For example, in December 2011, the Nigerian government permitted a forensic report conducted by Kynveld, Peat, Marwick and Goerdeler (KPMG) International Audit Firm to be published. The audit, commissioned by the Ministry of Finance following concerns over the NNPC's transparency, detailed the NNPC's sharp business practices, violation of regulations, illegal deductions of funds belonging to the state, and failure to account for several billions of naira that should go to the federation account [14].

Nigeria's nominal refinery capacity exceeds domestic consumption; however, the four refineries have been bedeviled by low capacity utilisation leaving the country to import most of its refined products. The refineries have never operated at their nominal capacities. In recent years all capacity utilisation has been at 30-40% [15]. This has led to the frequent fuel shortages in Nigeria, culminating in long queues for petroleum at fuel stations and emergence of black markets in refined products with higher prices than the official prices [15].

Also, being a mono-cultural economy, oil and gas dependent and with over 85% of the domestic oil consumed being imported, predisposes the energy sector to the vagaries of the international oil market. The National revenue derived from oil in Nigeria is highly volatile as it depends on the global oil price. Fluctuations in the market price or resource stock will affect the government revenue which indirectly affects the entire economy since the national budget is usually planned against the oil revenue [16].

Saboteurs, political opposition and terrorists use vandals, kidnappers, trade unions and the cartels in oil and gas to frustrate the energy sector thereby causing energy insecurity since oil and gas is known to be the economic life line of the nation. Also, Nigerian Oil and Gas downstream sector is dominated by cartels who manipulate prices, through artificial supply restriction. These cartels determine volume of importation and the proportion that should be released to the market thereby creating artificial scarcity. The activities of vandals have been a challenge on the energy sector. For example, the vandalisation of the major pipeline that transports gas to Egbin and Applied Energy Service (AES) thermal stations in February 2006 led to a reduction in power generation from 1 620 MW to 403 MW for more than two weeks [17]. The disrupted and dismal power generation contributes to the low inflow of foreign direct investments and the growth of local businesses in Nigeria. Due to epileptic power supply about 70 per cent of the industries in Nigeria are dead, 10 per cent are dying and about 20 per cent are trying to survive, and most of them are multi-nationals [18]. The ripple effect of this is unemployment which results to youth restiveness.

Apart from the environmental pollution by oil and gas due to oil spillage and gas flaring, which has generated unrest in the oil producing region, the response to the Kyoto protocol which demand a cut-down in greenhouse gases emission by developed countries such as North America and Europe who account for over 60% of Nigerian oil exports [19] will affect the energy sector and subsequently the economy of the nation since there is an exclusive reliance on fossil fuels for foreign exchange and other economic activities such as electricity generation and transportation [2].

The Nigerian electricity problem is legendary which seem to defy all solutions. With the advent of the democratic dispensation, Nigerians were promised by the former President, Olusegun Obasanjo that power generation will hit the 10,000 megawatts mark in six months to solve the electricity problems. When it became apparent that was not feasible, it was extended to 18 months and later to the end of 2007[12]. When the Late President Umaru Musa Yar'Adua was inaugurated in 2007, he made the provision of electricity a major priority of his Seven-Point Agenda. He later promised to declare a state of emergency on a project which by his own admission had cost the Nigerian people \$10 billion under the Obasanjo administration, with nothing to show for it. At present, Nigeria with a population of over 150 million generates no more than 4,000 megawatts of electricity. In comparison, the US, with roughly twice as many people as Nigeria, has a capacity nearly 280 times larger than Nigeria's. Even South Africa with a far lesser population of about 48 million generates about 40 thousand megawatts of electricity, ten times more than the sleeping giant of Africa [12]. President Goodluck Jonathan is also making promises to improve on the electricity supply of the nation. We hope it will not be the same stories as were the case of his predecessors.

V. LESSONS FROM OTHER COUNTRIES

Fundamentally, improving energy security is about ensuring availability of reliable energy services to the economy. As such, diversification has been at the heart of the strategies embarked to achieve these [15]. For example, countries such as Japan, France, South Korea and Singapore, provided a set of strategies that have proved successful in most circumstances[20]:

- increasing the number of fuels and technologies that are in the energy mix (for example, oil and gas, solar, wind, biomass, nuclear, geothermal and tidal)
- increasing the number of suppliers for each fuel (especially if imported);
- increasing energy efficiency and conservation; and
- developing storage capacity for different fuels (e.g., strategic reserves).

Vulnerability due to a lack of diversity in oil suppliers was well demonstrated in the first oil crisis. The price hikes in 1973 led to active and successful search for oil reserves away from the Middle East and by non-OPEC countries. The resulting diversity of supply reduced the power of Organization of the Petroleum Exporting Countries(OPEC) as an oligopoly [21].The oil shocks of the mid- and late-1970s spurred considerable spending on alternative fuels and energy resources — including solar, geothermal, wind, clean coal, synthetic fuels, alcohol-based fuels — and technologies to improve the efficiency of energy use. As a result of the shocks, regulations were developed to improve the efficiency of home appliances and to incorporate more energy-efficient designs in buildings.

In the U.S., a fairly diverse set of fuels for the electricity sector has come from a century of investment decisions in generation technologies that have been relatively uniform nationwide but have shifted from primary reliance on one technology to another with each pulse of system renewal and expansion starting with hydroelectric, then coal, nuclear, and, now, gas-fired plants [20].

VI. THE WAY FORWARD ON ENERGY SECURITY

A robust and secure energy base requires a strategic and deliberate government policy both short and long terms that will guarantee the present and future energy needs of the nation. The energy sector of the economy is greatly inefficient and this has affected every other sector of the economy. Corruption has being identified as one of the major challenges bedeviling the energy sector and this has to be tackled if the nation is to make any head way in energy security.

- A sincere compliance of The Federal Government of Nigeria and its agencies with the World Bank, IMF and Extractive Industry Transparency Initiatives (EITI) urging governments in oil-rich countries to disclose all their transactions with foreign extractive firms (Multinational oil companies) and those foreign extractive firms and also publish whatever they pay to the host governments will ensure prudence, transparency, accountability and serve as a catalyst for growth and development if fully institutionalised into the oil and gas sector [16]. Nigeria has complied with the principle of EITI, by setting up Nigeria Extractive Industry Transparency Initiative (NEITI) by the government which composed of government representatives, private sector, media, civil society representatives and this has started yielding results as seen in the NNPC audits. With proper accountability, transparency and good policy the income generated from the oil and gas sector can be channeled towards diversification of the energy sector to guarantee the energy need of the future generations as asserted by Intergenerational equity and allocation of natural resources theory, which implies that as natural resource of a country is being depleted, rent received should be invested in order to maintain a constant consumption stream in the future [22],[23]. The authors believed that by doing this, current generations will not be able to short change the future generations by over consuming the proceeds from the resources [15].
- The state of the energy sector where it is monopolised by one government agency does not give room for growth and efficient services; an example is the electricity power supply which is under the exclusive control of PHCN. Thus, for energy security, such policy has to be reformed. This explains why the FGN enacted the Electric Power Sector Reform Act (EPSRA) in May 2005 and launched the National Integrated Power Projects (NIPP) initiative in 2006. The goal of the EPSERP is to contribute to providing access to affordable and reliable electricity to all Nigerians and that of the NIPP is to bridge the immediate supply/demand gap and reduce the bottlenecks in the delivery system [20]. The purpose of the reforms is to create an environment that would attract and retain much needed private sector finance and long-term participation.These reforms were also extended to NNPC, since most of the power generation is to be driven by gas turbines. The Nigerian National Petroleum Corporation (NNPC) which is responsible for developing a strategy for the sustainable exploitation of Nigeria's natural gas reserves was mandated to

begin work on a Gas Master Plan in 2005, with the aim of: (i) attracting private sector participation in the development of Nigeria's gas resources; and (ii) securing a quota of natural gas for the domestic market at cost-reflective prices[20]. Thus, there should be a modification of the current energy generation and distribution monopoly in Nigeria and allow decentralized investment.

- There should be in place a deliberate effort towards increasing Nigeria's Energy independence. This can be done by increasing Investment in New Energy Technologies (INET) and setting new fuel Economy standards for both passengers' cars and heavy-duty trucks.
- The high price of oil is a strong incentive to the private sector and government to make the investments needed to develop and deploy new technologies. Investment in biomass technology will be revolutionary and will transform the urban and rural communities of Nigeria from the depths of filth and trash to a healthy and sanitary country i.e. turning waste to wealth. At the same time, it will generate sustainable biogas that will be used to power gas generators for the everyday community's energy needs. Also, the establishment of Solar Electricity Generating Enterprises will offer opportunities to rural community to have access to electricity. This will enhance water pumping from wells; health care delivery, exposure to modern education technology and lighting; catalyse the development of cottage businesses; and Stem urban migration, which in itself will help to decongest the cities.
- Renewable energy sources such as solar, wind and biomass technology are developed so as to create maximum benefit at the grassroots level in both the rural and urban communities of Nigeria. The Federal Government should establish a Renewable Energy Business Incubators at several selected research institutions in Nigeria that will develop renewable energy technology and its benefits and create a technical culture in Nigeria. The centres will (i) stimulate renewable energy inventions and innovations, (ii) develop academic courses on inventive design in the context of renewable energy at technical colleges and universities, (iii) coordinate inventive and innovative ideas in sustainable energy from other local technical colleges and universities, and (iv) solicit financial and logistic support for inventors to develop their patentable/patented inventions for mass production and marketing.
- The creation of a joint research synergy between a foreign research institution, two or more research institutions in Nigeria and a renewable energy development professionals who will bring about the execution and implantation of research results into practice especially on renewable energy;
- Financing models through banks and NGOs that will help in diversifying the energy sector through stimulating renewable energy development and making it affordable to citizens.

VII. CONCLUSION

Adequate and affordable energy mix supply is essential in the 21st century, and there cannot be any pretense about it. It is one means to achieve energy security. Energy security can only be achieved through adequate investments that are coherent and consistent. In order to address challenges that Nigeria is facing, and those ahead in term of energy security, adequate attention has to be paid to diversification of the energy sector. However, corruption cases in the oil and gas sector have to be tackled first before implementing any policy frameworks and reforms that can give a robust energy base for the nation.

REFERENCES

- [1] E. Eleri, Nigeria: Energy for sustainable development. *Journal of Energy and Development* 19(1), 1993,97-122.
- [2] J. Ikeme, Assessing the Future of Nigeria's Economy: Ignored threats from the global climate change debacle. *African Economic Analysis*, De Montfort University, Leicester, UK, 2008
- [4] R. Parimal, S. Arpit and G.Shashank, Energy Security an Indian Perspective: The Way Forward. 8th Biennial International Conference and Exposition Petroleum Geophysics Pandit Deendayal Petroleum University, India, 2010, 137-145
- [5] FMPS, Renewable Electricity Action Program (REAP), Federal Ministry of Power and Steel, 2006.
- [6] Chika, Can Nigeria End Fuel Importation in 24 Months? This day Live,June, 19, 2012.
- [7] E. Bala, J. Ojosu and I. Umar, Government Policies and Programmes on the Development of Solar-PV sub-sector in Nigeria. *Nigeria Journal of Renewable Energy*,8(2), 2000, 1-6
- [8] Sambo, Renewable Energy for Rural Development: Nigerian Perspective. *Science and Technology Vision Journal*, 1, 2005, 12-22
- [9] AMika'ilu and K. Kamaluddeen,Economics of renewable energy systems: The case of solar energy for Nigeria, *Nigerian Journal of Renewable Energy*,1, 1990, 87-92,
- [10] K. Manoha and A. Adeyanju, Hydropower Energy Resources in Nigeria, *Journal of Engineering and Applied Sciences*, 4(1), 2009, 68-73.
- [11] K. Ajao, H. Ajimotokan, O. Popoola and H. Akande, Electric Energy Supply in Nigeria, *Decentralised Energy Approach*, New York Science Journal, 2(5), 2009, 200-215
- [12] Akin, Nigeria's Dual Energy Problem: Policy and Challenges. *International Associations for Energy Economics Journal*, Fourth Quarter, 2008, 20-27
- [13] C. Orazulike, Energy Crisis: The Bane of Nigeria's Development, *Oilgas Magazine*, December, 12, 2013.
- [14] M. Musikili Mojeed, Monumental Oil Subsidy Fraud and Corruption at the NNPC: The Damning KPMG Report: Premium Times,Sahara Reporters. December, 9, 2011.

- [15] Adenikinju, West Africa Energy Security Report. Center for Energy Economics, University of Texas, (2008), 1-25.
- [16] Y. Akinwale, Empirical Analysis of Resource Curse in Nigeria, International Journal of Economics and Management Sciences, 1(6), 2012, 19-25
- [17] Godwin and O. Ezeobi, Blackout may linger till May. The Punch, March 7, 2007
- [18] Okparaocha, Alternative power sources: Panacea for Nigeria's greatest problem.Nigerian Tribune, June, 24, 2010.
- [19] Oppewal, Energy Security in Nigeria, ISPI Analysis, 86(1), 2011
- [20] Adenikinju, Energy Sector Reform: Prices and Private Sector Response. Centre for Petroleum, Energy Economics and Law University of Ibadan, Nigeria (2010), 1-30.
- [21] Farrell, H. Zerriffi and H. Dowlatbadi, Energy Infrastructure and Security, 2004
- [22] J. Hartwick, International equity and investing of rents from exhaustible resources,Journal of Economic Theory,17(1),1977, 114-129
- [23] R. Solow, On the Intergenerational allocation of natural resources, Scandinavian Journal of Economics, 88 (1), 1986, 141-149