

# An Overview Of Power Sector Laws, Policies And Reforms In Nigeria

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**Abstract**—This paper is concerned with Nigeria’s energy sector challenges and reforms put forward by the Government to tackle the challenges. Laws and policies aimed at addressing the various energy generation, transmission and distribution challenges bedevilling the energy sector are stated and explained. Various strategies were employed by the Government which include encouraging private sector participation, diversification of the energy generation sources and promoting energy efficiency for sustainable development. The Government has spent billions of dollars since 2003 in the construction of new power generation facilities, transmission lines and distribution centres to boost the power supply and at the same time initiated the process of selling off the existing facilities to private investors. Also, the Energy Commission of Nigeria embarked on programs and strategies aimed at boosting energy generation from renewable sources. On the other hand, the commission focus on the need for energy efficiency on both demand and supply side to reduce greenhouse gas emissions and viability of energy systems. The renewable energy sector was boosted by the implementation of various renewable energy generation projects such as the Lekki biogas plant, the Katsina wind farm and the establishment of renewable energy research and development centres across the country.

**Index Terms**— Electrical energy laws; Energy policies and reforms; Energy potentials; Nigeria.

## I. INTRODUCTION

NIGERIA is endowed with abundant renewable and non-renewable energy resources like solar, wind, biomass, crude oil, coal, natural gas and bitumen.

The country’s oil production is currently 2.5 million bbl /day but less than 17% of total oil produced is allocated to the country’s three oil refineries with total installed capacity of 445,000 bpd [1].

The International Monetary Fund (IMF) estimated that revenue from crude oil and natural gas export accounted for 96% of the country’s total export revenue in 2012 [2].

This means that only a fraction of Nigeria’s total oil and gas production is made available for domestic use, making the majority of the country’s population who cannot afford to buy generators to rely heavily on wood fuel for their energy needs. The absence of reliable energy supply rendered the rural populace socially backward and their economic potentials untapped. The country’s proven energy reserves are shown in the table below.

Table 1. Nigeria's energy reserves and potentials (2005) [3].

Resources type	Reserves
Crude oil	40.0 billion barrels
Natural gas	5.2 trillion Nm <sup>3</sup>
Coal and lignite	2.7 billion tonne
Tar sands	31 billion barrels of oil equivalent
Hydropower (large scale)	10,000 MW
Hydropower (small scale)	734 MW
Wood fuel	43.1 billion tonnes/year
Animal waste	61 million tonnes/year
Crop residue	8.3 million tonnes/year
Solar radiation	3.5 to 7.0 Kwh/m <sup>2</sup> /day
Wind	2 to 5 m/s (annual average) at 10m height

Nigeria is the largest oil producer in Africa and holds the largest natural gas reserves on the continent. It was the world's fourth leading exporter of liquefied natural gas (LNG) in 2012.

However, its gas-dominated electricity grid still experiences frequent collapse due to inadequate gas supply, obsolete infrastructures and inconsistent Government policies.

Despite the availability of these resources, majority of Nigerians continue to experience epileptic power supply. An estimated 62% of Nigerians rely on wood fuel for their entire energy needs resulting in massive deforestation [3] [4]. This trend is worsening in rural areas due to the communities having no access to electricity and increase in poverty. The National Electricity Survey carried out in 2006 indicated that majority of the southern zones are connected to the national grid. More than 60% of households in the South-East were connected to the grid while South-South’s figure was 61.2% and South-West’s 78.1%. The households in the North-East had the least access to electricity among the six zones in the country. The study further revealed that 38.1% of the rural populace, 12.1% of the rural poor and 29.8% of the urban poor in Nigeria had access to electricity.

The epileptic nature of the country’s electricity propelled the rich to rely heavily on generators which caused the use of petroleum products to increase by 75% in 2012, but the less privileged had no option rather than wood fuel for their energy needs [5].

The country’s electricity consumption per capita in 2012 was 12 watts/person which is very low compared with most

countries in the world like Brazil with 268 watts/person, Spain 645 watts/person and South Korea 1,038 watts/person in the same year [6]. The heavy reliance on wood fuel for energy makes Nigeria a country with high energy intensity of 0.36 koe/\$5p compared to Turkey with 0.11 koe/\$5p and Egypt 0.18 koe/\$5p [7].

The US Energy Information and Administration estimated that traditional biomass and waste accounted for 83% of Nigeria's total primary energy consumption in 2011.

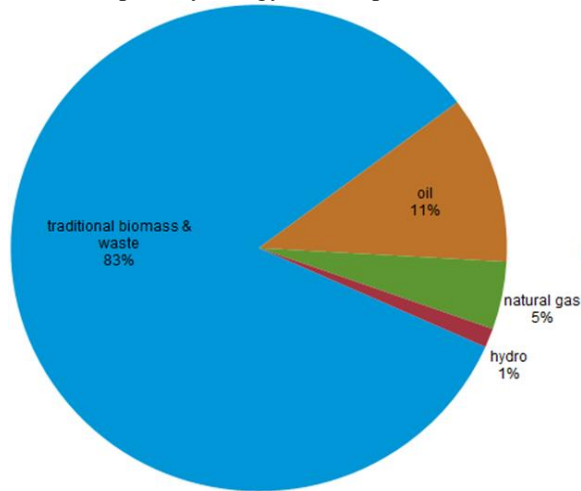


Fig. 1. Total primary energy consumption in Nigeria, 2011[2].

## II. LITERATURE REVIEW

According to Ladan (2009), Nigeria is blessed with abundant renewable energy sources like wind, solar, biomass, geothermal and hydro but the country continue to experience epileptic power supply. Over 60% of Nigerians rely on wood fuel for their entire energy needs resulting in massive deforestation. Babanyara and Saleh (2010) indicate that the country lost an average of 410,000 hectares of forest between 1990 and 2000 which culminated to an average deforestation rate of about 2.4% per annum.

Ikuponisi (2004) argues that based on Nigeria's land area of 924 x 103 km<sup>2</sup> with an average solar radiation of 5.535 kWh/m<sup>2</sup>/day, the country can generate power from solar energy that is 27 times the total conventional power generation capacity in the country.

Onakoya et al. (2013) points out that the commercialization and privatization decree No. 25 of 1988 which was aimed at addressing the acute power shortages at the time did not yield the desired result due to the inability of the government to implement the reforms. As a result, majority of Nigeria's power plants are working below 60% of their total installed capacity.

According to Aliyu et al. (2013), Low power factor and high transmission and distribution losses estimated at 28% are main factors causing large scale blackouts across the country. The problems bedevilling the power sector in Nigeria stem from decades of neglect, mismanagement and inadequate capacity improvement.

Most of the authors focused their attention on the challenges and potentials of power generation in Nigeria with limited details on the recent policies adopted by the Government to

contain the crisis.

In contrast, this study discusses the various challenges, reforms and policies recently adopted and are being implemented by the Government to improve the power sector performance in Nigeria.

## III. POWER SECTOR POLICIES AND REFORMS

The history of electricity in Nigeria dated back to 1898 when the first generating plant with a capacity of 60KW was installed in Lagos. In order to effectively coordinate the electricity development, the then-colonial government passed the ECN statute No. 15 of 1950 to establish the Electricity Corporation of Nigeria (ECN). By Decree No. 24 of 1<sup>st</sup> April 1972, The ECN and the Niger Dam Authority (NDA) were merged to form the National Electric Power Authority (NEPA) to enable a more effective management of the power sector in the country. In 1988, the Commercialization and Privatization Decree No. 25 was aimed at partial commercialization of power to address the acute power shortages. The reform did not produce the desired effect, since the country's power plants with total installed capacity of over 6,000MW as at 1998 have been operating below 60% of their total installed capacity [8].

Majority of the Government owned power plants in the country are performing below their installed capacity in 2010 as shown in figure 2. This is partly caused by lack of maintenance and underfunding by the Government [9] [10].

Table 2. Government owned power plants in Nigeria [9]

Power Plant	Installed capacity (MW)
Kainji	760
Shiroro	600
Jebba	540
Egbin	1,320
Sapele	1,020
Afam (IV – V)	726
Ughelli	900
Omotosho I	304
Olorunsogo I	304
Calabar	6.6
Orji river	10
<b>TOTAL</b>	<b>6,490.60</b>

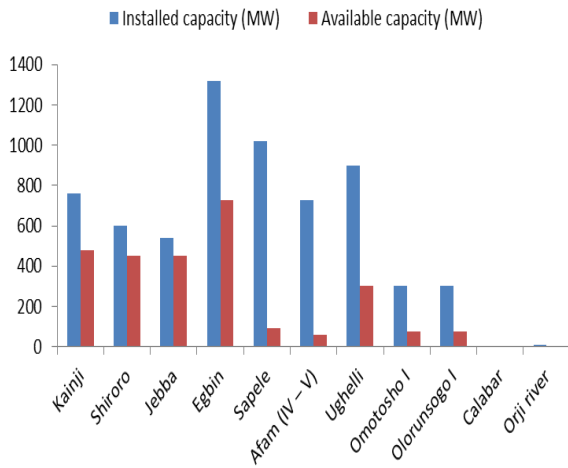


Fig. 2. Performance of federal Government’s power plants. There are independent power producers (IPPs) and state Governments currently generating electricity in the country as shown in table 3.

Table 3. Existing thermal power plants built by state governments and the private sector [9].

Power Plant	Installed capacity (MW)
AES	224
Shell - Afam VI	650
Agip - Okpai	480
*ASG – Ibom power	155
*RSG – Trans Amadi	100
*RSG - Omoku	150
<b>Total</b>	<b>1,759</b>

\*Power plants owned by state Governments

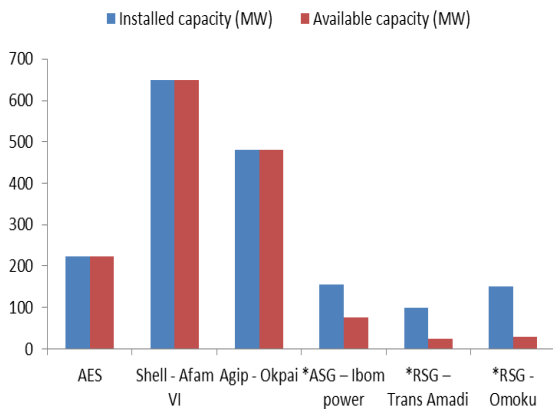


Fig. 3 Performance of IPPs in Nigeria[9]

The enormity of the problems in the power sector propelled the Government to form the Electric Power Implementation Committee (EPIC) in year 2000. This Committee prepared the National Electric Power Policy (NEPP) in 2001 and the National Energy Policy in 2003 with the overall theme of optimal utilization of the nation’s energy resources; from

fossil fuels and renewable sources, for sustainable development with the active participation of the private sector. The policy articulated the following decisions [11]:

- a) Extensive crude oil and natural gas exploration and development shall be pursued,
- b) Extensive development of electric power to make reliable electricity available to 75% of the population by 2020 and to broaden the energy generation options.

The committee established the National Independent Power Projects (NIPP) in 2004 as a fast-track government funded initiative to stabilize the power sector and drafted the Electric Power Sector Reform Act (EPSRA) 2005. The EPSRA proposed the incorporation of an initial holding company called Power Holding Company of Nigeria (PHCN) to assume assets and liabilities of NEPA. Between 2004 and 2007 contracts worth \$13.28 Billion for the construction of power plants, associated transmission lines and substations were awarded under the NIPP [12]. Majority of the power plants conceived in 2004 mentioned below, are sited in the oil producing states of the Niger delta to help stem gas flaring by the oil companies [13].

Table 2. Power stations funded through the NIPP in 2004 [12] [13].

S/n	Power plant	Capacity
1	Calabar Power Station	561 MW
2	Ihovbor Power Station	450 MW
3	Sapele Power Station	450 MW
4	Egbema Power Station	338 MW
5	Gbarain Power Station	225 MW
6	Omoku Power Station	250 MW
7	Alaoji Power Station	1,074 MW
8	Geregu II Power Station	434 MW
9	Omotosho II Power Station	500 MW
10	Olorunsogo II Power Station	750 MW

Four out of the ten power stations listed in table 2, have recently been commissioned but some of them are still not operating at full capacity. Geregu II with an installed capacity of 434 MW, is only generating 144 MW and also Olurunsoo II with installed capacity of 750 MW is currently generating 562.5 MW.

In late 2007, two more hydroelectric power projects were initiated by ministry of power. They are the Zungeru Hydroelectric Power Project with a capacity of 950 MW and Mambila Hydroelectric Power Project with a capacity of 2600 MW.

The EPSR Act, 2005 has 3 components [13] [14]:

- 1) The creation of the Power Holding Company of Nigeria (PHCN) to assume the assets, liabilities and employees of NEPA.
- 2) The breaking up of PHCN's three hydro and seven thermal generating stations, a radial transmission grid (330 kV and 132 kV); and eleven distribution companies (33kV and below) and the partial transfer thereto of the assets, liabilities and staff of PHCN to these companies and preparing them for privatisation
- 3) The establishment of the Nigerian Electricity Regulatory Commission (NERC).

The absence of a cost-reflective tariff is one of the reasons for the failure of the power sector to serve Nigerians in the past three decades. Fully efficient cost recovery is mandated by S.76, EPSR Act, 2005. The NERC drafted the Multi Year Tariff Order (MYTO) which envisages an efficient tariff system that gives the consumer right to a reliable electric service and transparent billing at the same time ensuring that the investor has reasonable return on investments. Grid metering at various identified points in the transmission grid shall be installed, tested and commissioned [15] [16].

Between August 2006 and June 2007, twenty licenses were issued to Independent Power Producers (IPPs) in different parts of the country. Altogether, they are expected to add about 8,000 MW of electricity to the national grid when they are completed.

The Government completed the privatisation of 11 distribution and the generation companies and handed them over to their respective buyers in phases between November 2013 and February 2014. As stipulated in the EPSR Act, 2005 both the generation and distribution companies were sold to private investors and the Nigeria Bulk Electricity Trading Plc. (NBET) was established as part of the roadmap for Power Sector Reform of August 2010 to act as a broker between the independent power producers (IPPs) and the distribution companies. The NBET's role is to purchase power from the IPPs and resale it to the distribution companies [17].

As part of its plan to improve the power supply, the Government established the National Atomic Energy Commission (NAEC) in July 2006, which upon its inception drafted the country's nuclear roadmap. The roadmap is a three-phase framework which aims to generate 1,000 MW of electricity through nuclear power by 2017 and to increase this to 4,000 MW by 2027 [3] [13] [14].

#### IV. RENEWABLE ENERGY POTENTIALS IN NIGERIA

Nigeria has high potential to harness energy from renewable sources since it lies within the tropic of Cancer where there is abundance of sunlight. The country's annual average daily solar radiation is about 5.535 kW/m<sup>2</sup>/day, varying between 3.5 kW/m<sup>2</sup>/day at the coastal areas in the south and 7.0

kW/m<sup>2</sup>/day at the northern boundary [18] [19]. The country receives about 4.851x 10<sup>12</sup> kWh of energy per day from the sun. This is equivalent to about 1.082 million tons of oil equivalent (mtoe) per day, and is about 4 thousand times the current daily crude oil production and 13 thousand times that of natural gas daily production based on energy unit. Based on the country's land area of 924 x 10<sup>3</sup> km<sup>2</sup> and an average of 5.535 kW/m<sup>2</sup>/day, Nigeria has an average of 1.804 x 10<sup>15</sup> kWh of incident solar energy per annum. This annual solar energy insolation value is about 27 times the country's total conventional

energy resources in energy units.

Also wind energy is available at an annual average speed of 2.0 m/s near the coast to 5.0 m/s at the height of 10m in northern parts of the country. Nigeria possesses enormous potential to utilize energy from the wind and the sun for electricity generation. The potential for bioenergy development is equally high because roughly 74 million ha of Nigeria's total land (98 million ha) is arable and about 60% of the arable land is lying idle [3] [20] [21] [22] [23].

#### V. ENERGY EFFICIENCY AND RENEWABLE ENERGY POLICIES

The national energy policy of 2003 came up with the Renewable Energy Master Plan for Nigeria (REMP) in 2006 [11] [13] [14]. The REMP articulates:

- Nigeria's vision for achieving sustainable development,
- A road map for renewable energy to help achieve this vision;

The plan recognized the need to strengthen and diversify the country's energy sources and encourage the participation of the private sector in energy production and supply. The ECN which was established by Act No. 62 of 1979 and amended in 1988 and 1989 was consequently reinvigorated with a statutory mandate for strategic planning and co-ordination of national policies in the field of energy in all its ramifications.

By this mandate, the Energy Commission of Nigeria is the apex government organ empowered to carry out overall energy sector planning & policy implementation, promote the diversification of the energy resources through the development and optimal utilization of all the sources, including the introduction of new and alternative energy resources like Solar, Wind, Biomass and Nuclear Energy [18].

Based on recommendations from energy commission, the Government established national inventories to estimate the annual emissions of greenhouse gases in the country for every 3 years starting from 1988. The estimates indicated that CO<sub>2</sub> emissions have been dominated by the energy sector. Gas-flaring, electricity generation and transport sectors are the most significant ones. Nigeria's CO<sub>2</sub> emission is the highest

in Africa, contributing 3% of global emission while the whole of Africa contributes only 4% [24].

Energy Commission of Nigeria established five energy research centres across the country to carry out research on renewable energy. The centres are [3]:

- 1) The University of Nigeria Nsukka National Centre, responsible for research in renewable energy and solar.
- 2) The Usman Danfodiyo University Sokoto Energy Research Centre, responsible for research in renewable energy and solar.
- 3) The University of Lagos, National Centre for Energy Efficiency and Conservation
- 4) The University of Ilorin National Centre for Hydropower Research and Development
- 5) Abubakar Tafawa Balewa University Bauchi Centre for Petroleum Research and Development.

The present total contribution of renewable energy to the energy mix as a result of concerted efforts by the energy commission in collaboration with the research centres grew up to about 35 MW composed of 30 MW small hydropower and 5 MW solar PV which is still relatively low compared to what is obtained in most developing countries around the world. But the Government has several targets it aims to achieve by 2025: Wind: 40 MW, Solar PV: 500 MW, Biomass-based power plants: 400 MW, Small-hydro: 2, 000 MW [24].

Also the energy commission has been collaborating with several donor agencies, multinational companies, environmental agencies, ministries and some non-governmental organisations to raise awareness on energy efficiency and renewable energy systems in Nigeria. Some of these projects are as follows:

#### A. Urban mass transit

The phenomenon of rapid urbanization in Nigeria's big cities creates a mobility problem for the cities' residents. Nigeria's vehicle importation has been increasing at the rate of 15 to 20% annually from 2004 and increased to 45% in 2012 [25]. To improve the capacity to manage the transport sector in the Lagos metropolitan area and to enhance efficiency and effectiveness of the public transport network in Lagos, the Lagos State Government got funding from the world bank and some donor organisations to provide mass transit buses on special lanes along the major streets in the City known as Bus Rapid Transit "lite" systems, commonly referred to as "BRT-lite". The system provide better and more sustainable travel options at a low cost for commuters around the city ferrying around 20,000 people per day. It has been very successful and had contributed to a considerable reduction in transit time, traffic and GHG emissions [26].

#### B. Pilot campaign for energy efficiency lamps

The ECN in collaboration with United Nations Development Program (UNDP) and the Federal Ministry of

Environment launched a grand campaign for energy efficient lamps. They distributed one million Compact Fluorescent Lamps (CFLs) to households, businesses and public service buildings leading to peak reduction of 38 MW of electricity in Abuja and Lagos. The project also launched a unique end-use metering campaign across Nigeria to better assess the current level of efficiency of appliances used in the country [24].

#### C. Energy generation from waste-materials

The locally made biogas plant is constructed in Lekki Local Council Development Area of Lagos state with funding from the Federal Ministry of Environment and United Nations Development Programme. The plant converts water hyacinth and other local organic waste to produce fertiliser and at least 10KVA electrical energy. The main objective of the project is to establish a locally based waste management strategy in the area to reduce waste, generate energy and improve livelihoods [27].

#### D. 10MW Katsina wind farm project

In line with the Government's policy of promoting renewable energy, a wind map for the entire country has been developed, indicating numerous viable sites for the deployment of wind turbines for power generation. A contract for the construction of a 10MW Wind Farm at Lamban Rimi Village in Katsina state was awarded by the Federal Government in 2009. The configuration consists of 37 x 275 kW wind turbine generators mounted at a height of 55m on an inclinable tower. The project has been fully funded until now and its implementation has progressed very smoothly [28].

As at October 2013, peak demand forecast by the federal ministry of power stood at 12,800 MW whereas the total power Generated fed into the grid was 3,418.60 MW. Nonetheless, the Government aims to generate about 10,000 MW of electricity by 2015.

## VI. CONCLUSION

Nigeria has been experiencing acute power shortages in the last three decades despite having enormous energy resources. It is estimated that only 38% of the country's population have access to electricity leaving the remaining 62% to rely heavily on wood fuel for their daily energy needs resulting in massive deforestation. The country's population more than doubled within the last three decades, from 75 million to 173 million. But the amount of power generated by all the country's power generation facilities made up of 22% hydro and 78% thermal power plants with total capacity of 6,976 MW is still less than 4,000 MW. This can barely serve even 10% of the country's growing population which is estimated to reach 300 million by 2030. Nigeria's electricity consumption per capita in 2012 was 12 watts/person which is very low compared with most countries in the world like Brazil with 268 watts/person, Spain 645 watts/person and South Korea 1038 watts/person in the same year. The heavy reliance on wood fuel for energy makes Nigeria a country with high energy intensity

of 0.36 koe/\$5p compared to Turkey with 0.11 koe/\$5p and Egypt 0.18 koe/\$5p. Although the Government took some steps to address the problems in the power sector such as; the enactment of the energy sector law of 2005 which resulted in the establishment of the Nigeria Electricity Regulatory Commission, the Nigeria Bulk Electricity Trading Plc and the privatisation of the generation and distribution companies owned by the Government. These steps taken by the Government have positive impact on the entire sector. But the desired goals can only be achieved if renewable energy generation is given more emphasis as the country is endowed with abundant renewable energy sources. For instance; the country's average annual solar radiation of 5.535 kWh/m<sup>2</sup>/day if harnessed properly, can generate 27 times the country's total energy generated by the conventional energy sources. Renewable energy sources like; solar, wind and biomass should be harnessed to compliment the conventional energy sources in power generation to help meeting the massive electricity demand in the country.

Further studies should be carried out to evaluate the performance of the power sector after the completion of the privatization process. This will shed more light on which of the policies and reforms implemented are yielding the desired effects.

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