A robust energy policy review of selected African countries: An impetus for energy sustainability in Nigeria

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A robust energy policy review of selected African countries: An impetus for energy sustainability in Nigeria

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Abstract. Power rationing has become the bane of the Nigerian power sector, plunging the nation into prolonged periods of darkness and costing about 2.5 percent of her GDP annually. Although, installed generating capacity is almost 13 GW, the situation worsened by an overdependence on thermal and hydro generation, high losses, and a poor tariff structure. In the face of these challenges, Nigeria seeks to achieve universal access by 2030 with sustainable power having a share of 30 per cent in her energy mix. Despite the existence of frameworks supporting this target, Nigeria's policies are still weak; indicated by her low Regulatory Indicator for Sustainable Energy (RISE) score of 30. To reach universal access by 2030 and fulfil SDG 7; Nigeria needs the right mix of policies. This study aims to review, draw lessons from the successful and unsuccessful implementation of similar policies in five countries and give recommendations.
Keywords: Energy policy, SDG 7, Sustainability, Energy Access

1 Introduction

Energy poverty is an inadequate supply of energy in residential regions; it is the degree of difficulty faced by households in getting adequate access to affordable, suitable, and reliable modern energy services [1]. Energy poverty is a challenge in many parts of the world, especially in many developing countries; where it manifests as low access to energy. According to data obtained by the United Nations (UN), over 12.6 percent of the world's population is without access to electricity, while about 40 percent of these depend on traditional cooking methods such as biomass [2]. Although energy poverty patterns are uneven globally, Sub-Saharan Africa (SSA) and South Asia are the largest access deficit regions and account for 79 percent of the global access deficit [2]; with over 80 percent of the energy-poor residing in rural areas.

Although recent attempts to increase access, have been uneven, with approximately 60 percent of headway witnessed since 2011 focused in only four nations (Kenya, Ethiopia, Tanzania and Nigeria), these nations together represent about 31 percent of the population without electricity access in Sub-Saharan Africa. In contrast to this, the International Energy Agency (IEA), predicts that about 674 million people would continue to live without electricity by 2030 if current energy and population policies are not amended [3].

Around 74 million Nigerians do not have adequate access to electricity [4], although the country is blessed with an abundance of natural resources (oil and gas, wind, solar, et cetera.). However, the rationalization of electricity is prominent in Nigeria due to an inadequate supply of electrical power from the national grid; which is unreliable and prone to system collapses due to it being weak, obsolete, and overloaded [5].

More than 4 million people die yearly from air pollution caused by the combustion of biomass and solid waste. Furthermore, the burning of biomass causes soil degradation, erosion, deforestation, and climate change [6]. While the introduction of specific policies and programs in line with SDG 7 would alleviate energy poverty, promote universal access, these programs and policies must include those developed to promote the general wellbeing of the people [6].
This paper seeks to study Nigeria's energy sector, energy access policies, draw lessons and give recommendations. The rest of the paper is arranged as Section II, provides a brief history of Nigeria's power sector, Section III, describes the energy situation in Nigeria, Section IV, explores energy access policies of selected countries and enumerate lessons. Finally, Section V concludes the paper.

2 History of the Nigerian Power Sector

Nigerian's first power utility company; Nigerian Electricity Supply Company (NESCO), was founded in 1929. However, electricity generation began in Nigeria by the close of the 19th century with a total capacity of about 59.9 KW. Electrical power, from this time till 1950, was developed through the department of public works, native authorities (NA), and municipal authorities on a regional basis. In a bid to unify electrical power development, the colonial government created the Electricity Corporation of Nigeria (ECN) in 1950 and placed the existing utility and units under its control. By 1964, hydropower was a significant contributor to the Nigerian energy mix with the construction of Kainji Dam through the creation of the Niger Dams Authority (NDA) in 1962. By 1966, all 36 state capitals, including the federal capital territory had been national grid.
Subsequently, ECN and NDA formed a unified body called the National Electric Power Authority (NEPA) in 1972 with the responsibility of power generation, transmission, distribution, among many others as specified in section 7 (2) of the NEPA Act of 1972. During the period of its existence, NEPA faced numerous challenges from lousy management to poor performance; made evident by its inability to meet its statutory obligations as specified in the act. In response to this, the government initiated a restructuring process by modifying the electricity and NEPA acts in the late 1990s. However, these reforms were not exhaustive; hence the National Electric Power Policy (NEPP) was enacted in 2001. The goal of the policy was to establish an efficient electricity market in the nation; with an overall objective of liberalizing the Nigerian electricity supply industry (NESI) through privatization. The policy provided a framework for restructuring NEPA which led to the creation of the Power Holding Company of Nigeria (PHCN); which assumed the assets, liabilities, and employees of NEPA in 2005; through the passing of the Electric Power Sector Reform (ESPR) Act, to serve as a legal framework for the achievement of the reform objectives of the NEPP. The ESPR act removed the government's monopoly of the power sector, increased private sector participation and inaugurated a regulatory body called the Nigerian Electricity Regulatory Commission (NERC), responsible for establishing grid standards, codes, regulation for electricity. The launch of the Roadmaps for Power Sector Reform in 2010 began the unbundling of the Nigerian power sector and was completed in 2013 and 2014 respectively.

3 Energy Situation in Nigeria

Even though Nigeria is considered an energy giant in Africa, she still has one of the lowest net electricity generation per capita in the world [7], with an electrification rate of almost 60 percent [8] which is still comparatively low and a Regulatory Indicators for Sustainable Energy (RISE) score of 30 which indicates the strength of support policy for energy access [9]. Table 1 shows the electrification rates of other African countries.

Table 1: Electrification Rate of Peer Countries. Source : [8]

Country	Electrification Rate (in %)
Algeria	99
Ghana	84
Gabon	91
South Africa	84

Kenya	73
Nigeria	60

Although her total primary energy supply (TPES) as at 2016 stands at almost 150 Kilo-ton of oil equivalent (Ktoe), according to statistics obtained from IEA, there is a high reliance on biomass and waste for cooking and heating purposes as depicted in figure 1.

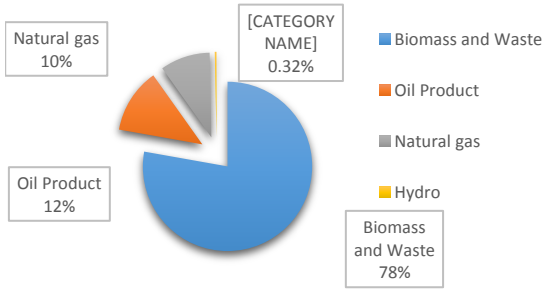

Figure 1: Primary Energy Supply by Source

Efforts made by the Federal government to cut this dependency through the promotion and provision of cleaner and safer sustainable alternatives have been inefficient. The Nigerian Alliance for clean cookstove (NACC), inaugurated in May 2011; introduced an ethanol gel cookstove called the kike cookstove, however, its adoption is quite low due to its comparatively high cost and inefficient marketing and advertising strategies [10].

Africa's per capita electricity consumption is insufficient in comparison with the global average, based on electricity consumption per capita Nigeria ranks 31st in Africa; as electricity only represented about 2% of final energy consumption in 2016 as shown in figure 2, which is a sharp contrast to observed trends in other developing countries as shown in table 2.

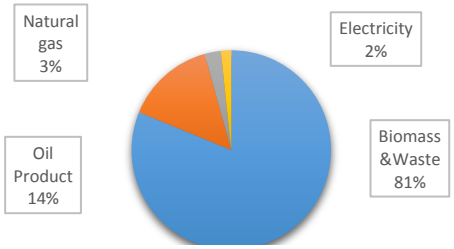

Figure 2: Final Energy Consumption in Ktoe

Table 2: Percentage of Electricity in Peer Countries

Country	Share of Electricity in Final Consumption (in %)
Algeria	12
Ghana	13
Gabon	3.5
South Africa	23.7
Kenya	4.3

In 2016, approximately 82 percent of generated electricity in Nigeria was delivered to end-users; with the residential sector being the most significant consumer [11], as shown in figure 3. However, there is still a substantial need for private electricity generation; owing to the unreliable power supply- caused by the unavailability of power plants; due to gas, water management, transmission and other constraints [12].

3.1 Generation

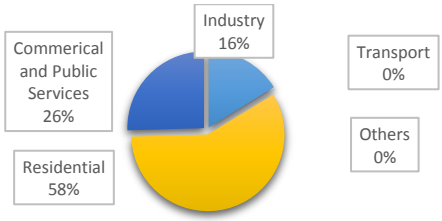

Figure 3: Electricity Consumption by Sector for 2016 in GWh

At the end of 2017, Nigeria had an installed capacity of about 13GW, with the available capacity of 7.5GW and operational capacity of about 4GW [13]; this implies that Nigeria's supply deficit is remarkably high.

In 2004, the federal government sought to increase generating capacity while minimizing gas flaring, introduced the Nigerian National Integrated Power Project (NIPP), managed by the Niger Delta Power Holding Company (NDPHC). The project aims to add new generation, transmission, and distribution capacity to the NESI. NDPHC would add about 4774 MW of power to the national grid after completion of its ten generation project.

The challenges faced by the generation subsector of the Nigerian electricity supply industry are:

1. Poor infrastructure maintenance.
2. An over-reliance on thermal power plants has it takes 84 percent of the nation's energy mix.
3. Unavailability of power plants because of fuel supply shortage due to maintenance and or sabotage/vandalism of gas pipelines.
4. Water and Line constraints.
5. Continued use of old and obsolete power plants; which represent at least 20 percent of the installed capacity.
6. Vandalism of energy infrastructure. The amount of electricity lost to gas, water and line constraints for September 2018, is given as in [14].

To tackle these challenges, the Federal Government of Nigeria (FGN), in its Roadmap to Power Sector Reform (2013) [15]; set to embark on a rapid expansion of generating assets by 2020; by increasing installed hydro to almost 5.7 GW, thermal to over 20 GW and renewables to 1 GW capacities by 2020- to be achieved through the recovery of existing power plants and construction of new plants. As an interim solution, several distribution companies via Independent Power Producers (IPPs) and states invested in distributed generation [16] to close the gap between local demand and supply of electricity. To further close the gap, the Federal Government intend to carry out several rural electrification projects through solar mini-grid and stand-alone systems.

The reform (2010) proffers solution to the gas supply shortage through the implementation of preventive measures in the short run and resilience building in the long run; to guard against vandalism and maintain supply during repair work [17]. The ongoing generation expansion projects are shared across three technologies, namely hydro, wind, and solar cutting across several locations [18–21].

3.2 Transmission

TCN comprises of three departments consisting of Transmission Service Provider (TSP), System Operator (SO), and Market Operator (MO) with their various responsibilities specified in the EPSR Act. The Nigerian transmission network has a wheeling capacity of about 5500 MW [22] and high transmission losses due to its radial nature. However, through the transmission expansion rehabilitation program, TCN successfully increased the wheeling capacity to 8100 MW [23]. As it

stands, transmission capacity is approximately two times the average operational generation capacity of about 4 GW, although still far below the total installed capacity.

Against this backdrop, if operational generation capacity increases to the same capacity as transmission; then the transmission subsector will become a significant bottleneck to electricity delivery reported in [12]. Furthermore, transmission losses across the Nigerian power sector are significantly high compared to global standards which reveal the substantial infrastructural and operational challenges faced by the network [12].

The challenges faced by the transmission subsector of the Nigerian electricity supply industry are:

1. The radial nature of the transmission system makes it unreliable; thus contributing to the high frequency of system collapses.
2. Vandalism of transmission facilities causing overloading of the network.
3. Other issues include low budgetary allocations for grid expansion exercises [24], security issues [25], procurement, and labour deficits.

To tackle the problems in the transmission sector, TCN unveiled a 20-year transmission rehabilitation and expansion master plan, developed by Fitchner GmbH and funded by development banks [19]. This master plan further strengthens the Transmission Rehabilitation and Expansion Program (TREP) found in [26].

3.3 Distribution

The Nigerian distribution network consists of 11 regional grids, vastly varying in network size, customer size, and coverage. The challenges faced by the transmission subsector of the Nigerian electricity supply industry are:

1. The distribution sector's biggest challenge is distribution losses; which is compounded by the non-payment of electricity debt owed by Federal Government Ministries, Departments and Agencies (MDAs) [13]. These losses accounted for almost 46 percent of energy lost through technical, commercial, and collection losses in 2014, 54 percent in 2016, 53 percent in 2017, and 48 percent in 2018 [12,13,27].
2. Vandalism of distribution infrastructure.
3. Poor tariff structure and the continued use of estimated billing [13].

To tackle these challenges, three hundred and eleven (311) nationwide distribution projects were awarded under NIPP; with a total of 288 completed [28]. While the Federal Government has earmarked one billion Naira for distribution network expansion [29] and has started the process of settling their debts [30]. However, to tackle losses (commercial and collection) and restore the financial viability of the sector, NERC would begin mass metering on 1st of May 2019, several challenges have frustrated this plan [31,32]. NERC is also looking to reduce DisCos' monopoly while improving service delivery; by developing a regulatory framework for electricity distribution franchising [33].

4 Energy Access Policies Review and Lessons

The African continent has vast potential to harness electricity from renewable energy sources; however, the slow pace of adoption is accredited to several limitations as identified by the author in [34]; of which policy and legal barriers were the top limitations. The African continent is sub-divided into five regions: North, West, Central, East, and Southern African. The selection of countries from each sub-region is based on electrification rates, as presented in table 1. However, countries in northern and central Africa were excluded from the lack of English translated policy documents.

a. Ghana

High access rate in Ghana is a result of the reform set in motion in 1989; with the establishment of the National Electrification Scheme (NES) via programs like Self Help Electrification scheme (SHEP) and Ghana Energy Development & Access Project (GEDAP) [35] to extend electricity to all parts of Ghana. The authors in [36] identified several challenges with NES, amongst which is the curse of power rationing due to unreliable power supply, which indicates that electricity access goes beyond merely been connected to the grid but having a reliable electricity supply [37]. Ghana introduced a

renewable energy strategy in 2006, which thwarted the successful implementation of renewable energy technology due to the absence of legislation to govern its development and use of these technologies [38].
Lessons from Ghana are as follows: i.) Provision of reliable and affordable electricity would ensure that electrification efforts are not in vain. ii.) For successful implementation of policy action points, robust legislation and enforcement of these policies are required.

b. Kenya
In Kenya, electrification rates rise rapidly through programs like the last mile connectivity project [35,39], which seeks universal access by 2020, energy access scale-up program which involves the expansion of the national distribution grid to connect a million new customer in five years. Inflated and misrepresented new connection numbers and cost overruns were the banes of the last mile connectivity project [40,41]; this further compounded by the fact that newly connected customers could not afford to remain connected primarily low-income customers [41].
Lessons from Kenya are as follows: i.) Provision of reliable and affordable electricity ii.) There is a need for an independent body for proper oversight and reporting; to foster transparency.

c. South Africa
Eskom initiated a mass electrification program in South Africa through its reconstruction and development program; access rate targets were propelled by programs such as the integrated national electrification program [42] and the free basic electricity [43] which were introduced in 2002 and 2004 respectively. The authors in [44] highlighted several problems with the integrated national electrification program.
Lessons from South Africa- the introduction of free basic electricity and lifeline tariffs in South Africa- ensured electricity consumption by both the urban and rural poor.

5 Recommendations to the Federal Government of Nigeria
Nigeria's energy policies are weak as indicated by her low RISE score; therefore, it is high time these policies are reviewed and amended to keep abreast of the ever-changing demands of the modern world. The following are the authors' recommendations:

1. Significant investments are needed in all aspects of the power value chain- from gas production and transmission to electricity generation, transmission, and distribution; to ensure reliable and affordable electricity supply to all her citizen by 2020 and beyond.
2. Energy conservation and efficiency promotion through:
    a) Awareness and behaviour change campaigns,
    b) Distribution and replacement of all incandescent lamps with compact fluorescent lamps (CFLs) by the government as was done in Ghana and Kenya,
    c) Creation of testing centres to ensure appliances meet standards - especially the testing of CFLs in the Nigerian market should be done [45],
    d) Banning all inefficient appliances and setting standards and codes to support their ban as was done in Ghana [46],

Although Nigeria has an energy efficiency policy [47], it is comparatively weak, as highlighted by [9].

3. Creation of an independent body to oversee, monitor, and report the overall progress of energy access project across the country.
4. Tariff structure should be reviewed, making it cost-reflective and subsidized for low-income and female-headed households.
5. Public-Private partnership to provide financing for the clean cookstove sector.
6. The subsidization of Liquefied Petroleum Gas (LPG) should be to encourage local consumption through the development and implementation of an LPG promotion program similar to the one implemented in Ghana.

7. Provision of low emission stoves as a transitional solution in impoverished rural areas, while awareness and behaviour change campaigns should be embarked on to discourage the use of traditional fuels further.
8. Mandatory energy audits of all Government and commercial building by adopting the methodology used in [48].

6 Conclusion

The paper describes the energy situation in Nigeria concisely, it reviews policies, draws lessons, and makes recommendations which could strengthen policies in Nigeria and other countries on the African continent. From the review, it is evident that Nigeria's energy policies need major overhaul and reviews to strengthen them further as key objectives are yet to be achieved. Finally, Nigeria needs to develop policies and programs well informed by gender consideration with cross-sectoral coordination.

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