

Electricity Supply and Management Challenges in Nigeria: A Study of BEDC

¹Ogidigben, E. Allison, ²Ikenga, A. Francis And ³Otite, A. Atare

^{1, 2, 3}Department of Political Science, Faculty of Social Sciences, Delta State University, Abraka

*Corresponding Author: Email: faikenga@gmail.com

Abstract

Electricity supply situation in Nigeria can be best described as a total failure. It is highly insufficient and unavailable in some places regardless of the huge demand for its service. Successive administrations have voted huge amount of money to the power sector; yet, power outage is a commonplace in the country. It is on this background that this study examined the leading cause of the challenges in the Nigerian power sector over the years. To achieve this specific objective, the study finds it necessary to adopt historical research design and relied extensively on secondary sources of data through the survey of textbooks, journal publications, dailies and internet sources to gather relevant materials for the study. The study finds out that in spite of the policy reforms and funds allocated to the power sector by successive administrations in Nigeria, the sector is yet to be applauded for increase in power supply. In the face of the unending challenge of power outage in Nigeria, this study suggests among others that: the government should allocate sufficient funds to the sector and ensure that funds are utilised for the purposes of which they are allocated, experts in the area should be allowed to manage the sector, technical equipments should be adequately managed and replaced when necessary.

Keywords: Nigeria, Power Sector, Electricity Supply, Management, Challenges

Introduction

Electricity supply to the consumers is one of the major determinants of socio-economic development in any nation. Inadequate and limited access to electric supply is detrimental to the growth and development of industries. For economic development to thrive in any nation-state, regular power supply is one of the contributory factors. Nigeria in recent time faces triple challenge of unreliable and inadequate electric supply, reducing greenhouse gas emissions, and keeping energy affordable to consumers. This development has constrain on the economic growth and development of the country. Electricity supply to homes and businesses remain abysmally poor in spite of the effort of the last administration to ensure there was regular supply of power through privatisation of the power sector (Olowosejeje, 2020). The World Bank in 2022 as cited in Ojukwu (2022) stated that businesses in Nigeria suffer annual loss of over \$29 billion as a result of the dismal power supply in the country which prompted some Nigerians to be reluctant to pay electricity bills. Power supply has never been reliable, which made a number of businesses, companies and industries heavily reliant on self-generated power source, including solar energy source. In 2006, the administration of President Olusegun Obasanjo attempted to end the problem of poor outages through policy reform. The administration also funded some of the existing power generation projects in the country. The administration also changed the popular inscription, from 'National Electric Power Authority (NEPA)' to 'Power Holding Company of Nigeria (PHCN)'. In spite of the introduction of a Service Based Tariff in late 2020 on the promise that power supply would improve, consumers in some areas are yet to have constant supply of power (Jeremiah, 2022; InfoGuide Nigeria News, 2023).

As Edeh (2021) rightly stated, "even with the privatisation of NEPA, lack of power supply remained a serious problem in some places, people still complain of high electricity rates and lack of steady supply of power". Nigeria's national grid which is a network of generation, distribution and transmission companies in the country has collapsed for over 200 times in recent year causing regular blackouts. In some circumstance, the amount of electricity supply to the grid is lower than the electricity demand resulting to constant power outages (Emodi & Diemuodeke, 2022). In 2022 alone, the country's national grid collapsed over five times causing generation and transmission problems. The Federal Government has in several occasions said the reason for power outages is as a result of the occasional partial shutdown of the gas plants to allow repairs of some critical gas processing equipments. Lagos State, for example, only receive about 10 percent of its electricity needs, leaving over 20 million of its populace relying on self-generating power source such as generators and solar power source. Commercial and industrial sectors become heavily reliant on self-generating power supply, using diesel and petrol generators (Olowosejeje, 2020). In its path to savage the problem of power outage, the government has adopted several policy measures but the sector remains ailing. This makes electricity management and supply crisis in the country complex, and which stems from a number of issues, and has been happening for decades, irrespective of the reforms of the sector by the government in 2005. Power outages have in several instances prevented the populace from meeting routine businesses and household needs, resulting in enormous economic and social costs.

There is however no business and household that has not been affected by constant power outage in the country.

Statement of the Problem

The problem of poor power supply and management in Nigeria is one that has lived with the country since the time of its establishment by the colonial authorities and to the present. Most disturbing problems of the electricity sector is acute power supply that has evaded solutions despite governments' efforts in revolving this development. In 2006, President Olusegun Obasanjo led administration took proactive steps to end the problem of poor power supply through policy reforms and funding of some power generation projects across the country. There was also a change of inscription from National Electric Power Authority (NEPA) to Power Holding Company of Nigeria (PHCN) (InfoGuide Nigeria News, 2023), yet, the cancerous challenge of acute electric supply to electricity consumers remained sympathetic and irresolvable. Access to power supply which inarguably increases the number of businesses and job creation has been seriously affected by the obvious power outage in some places in the country. New market places, businesses and job openings that provide opportunities for the individual citizens to earn income to support their immediate family members have been under serious threat by this development. Worst still is that Nigerian business environment and manufacturing sector are negatively impacted by this development; as a result, firms and businesses lose revenues and are constantly faced with threats of collapse (Jonathan, 2018). Several factors such as corruption, crude oil and gas pipelines vandalism, non-functional plants, and lack of maintenance of equipments have been identified as the major problems that have bedevilled the power sector development in Nigeria outside poor management of training of staffs and unprofessional behaviour of employees in the power sector.

As Oseni (2011) puts it, vandalism of electricity installations and thefts, lack of proper maintenance of transformers, poor management and corruption are the reasons for low supply of electricity in Nigeria. Solutions to these challenges in the power sector and the unending problem of inadequate supply of electricity in some places in Nigeria have evaded policy options put in place by several government ministers of power. Efforts of government in recent time made very little impact in resolving the problem of power outage across the country. It is on this background that this study is posed to examine the current state of electricity generation and the leading causes of the challenges in the power sector, especially the problem of inadequate or total lack of supply of electricity in some places in the country.

Objectives of the Study

The general objective of the study is to examine the challenges of electricity supply in the power sector in Nigeria. While the specific objectives are to:

- i. Examine the current state of electricity generation and supply in Nigeria,
- ii. Examine leading factors responsible for the Challenges in the electric power supply and management in Nigeria, and
- iii. Suggest policy options that may resolve the problems of inadequate power supply in some places in the country.

Research Questions

- i. What is the current state of electricity generation and supply in Nigeria?
- ii. What are the leading factors responsible for the challenges in the power supply and management in Nigeria?
- iii. What are the policy options to the problems of inadequate power supply in some places in the country?

Literature Review

Foundation of Electricity Power Generations in Nigeria

Electricity generation and supply in Nigeria has a very long history which is traced to the crown colony of Lagos in the year 1896, fifteen years after it was first produced in England. In 1929, the Nigeria Electricity Supply Company (NESCO) was established to provide hydropower plant in Jos, Plateau State in Northern Nigeria. In 1951, the colonial legislative council established the Electricity Corporation of Nigeria (ECN) to manage power supply and development in Nigeria. In 1962, the Niger Dam Authority (NDA) was established through a parliamentary Act to construct and maintain dams for electricity generation, water supply, and agriculture and irrigation activities. In 1972, further expansion was made in the power sector to supply power in Nigeria resulting in the establishment of the Nigerian Electricity Power Authority (NEPA) through the merger of ECN and NDA (Anumaka, 2012; Oseni, 2012; Vincent & Yusuf, 2014; Kumar & Nagarajan, 2016). Between 1972 and 2005, NEPA enjoyed the monopoly of controlling and managing the power sector. Electricity transmission and distribution was its sole responsibility. With the implosive population growth experienced during the period, the demand for electricity supply was in the increase. This development made it very difficult for NEPA to manage the demand for electricity supply. There was also the problem of decaying and dilapidated infrastructure, and unqualified workforce in NEPA during the period (Anumaka, 2012; Monyei, Adewumia, Obolo & Sajou, 2017).

As Olaoye, Ajilore, Akinluwade, Omole and Adetunji (2016) and Obadote (2009) as cited in Onyekwana, Ishaku and Akanonu (2017:5) put it, the first ever source of electricity supply in Nigeria was during the colonial era in which it

was solely a government affair with the generating power plants of 0.06MW installed to serve government offices and quarters in Lagos in 1896, but over time, the government saw the need to spread its access to those who could afford it. In the light of this development, the colonial government in 1950 established the Nigeria Dams Authority (NDA) and the Electricity Corporation of Nigeria (ECN) as separate entities so as to generate and distribute power respectively. In 1972, the post-colonial Nigeria government merged the NDA and ECN to establish the National Electricity Power Authority (NEPA) in its effort to consolidate operations and efficiency in the power sector (Onyekwena et al., 2017). Between 1886 and 1945, power generation in Nigeria was very low with the major supply to Lagos and other commercial cities, including Jos Plateau and Enugu. Within the period, the colonial government also established electricity department within the Public Works Department which installed generating sets in some cities across the country purposely to serve colonial government reservation areas and commercial centres. In 1923, tin miners in Nigeria installed a 2MW Plant on the Kwali River located in the present day Kwali Local Government Area in the Federal Capital Territory, Abuja. Six years later, the Nigerian Electricity Supply Company (NESCO) which was a private company was established and located near Jos Plateau to manage hydro-electric plant at Kura to power the mining industry. There was also another private enterprise established in Sapele in the present day Delta State by United Africa Company (UAC) to power the African Timber and Plywood Company located in the region (Simpson, 1969; Adedeji, 2016).

In 1950, the Legislative Council of Nigeria enacted a law to establish the Electricity Corporation of Nigeria (ECN) which had the sole responsibility of developing and supplying electricity. In 1951, ECN was able to manage over 46 MW of electricity. Between 1952 and 1960, the firm established Coal-powered turbines at Oji and Ijora areas of Lagos. In 1961, ECN completed a 132KV transmission line that linked Lagos and Ibadan metropolis through Shagamu. In 1965, this project was extended to Oshogbo, the capital city of the present day Osun State, and Benin City in the present day Edo State, and Ughelli in the present day Delta State to form the Western system. In 1962, a statutory organisation known as the Niger Dams Authority (NDA) was created to maintain dams along River Niger and Kaduna River. In 1969, a 320MW Hydropower plant located in Kainji was commissioned with the power generated sold to the ECN. In 2010, the Nigerian Bulk Electricity Trading (NBET) Plc, was established as a credible electric power generation company. In 2014, the power sector was privatised with three major firms entrusted with the responsibility of providing power. By November 2013, the privatisation of all the Power Generating Companies (GenCos) and the eleven (11) Distribution Companies (DisCos) was fully completed with the federal government retaining ownership of the transmission company (Oyewo, Aghahosseini, Bogdanov & Breyer, 2018:12).

Between 1980 and 1996, there was a drastic decline in electricity generation in Nigeria. There was also a greater loss of electricity transmission, and theft from unauthorised connections in Nigerian cities and towns. Since the return of democracy in 1999, the ratio of losses reduced tremendously from 46 percent in 1996 to 9.4 percent in 2008. Vandalisation of electricity installations and theft, lack of proper maintenance of transformers, poor management and corruption are a few of the reasons Nigeria state has produced lower electricity (Oseni, 2011). The return to democratic rule in 1999 has provided more space for Nigerians and the civil societies, and the private investors to push for power sector reform which subsequently necessitated the amendment of Nigeria's Electricity Act in a bid to eliminate the monopoly of NEPA over the sector, and to promote private sector partnership in the sector (Onagaruwa, 2011). The amendment Act was instrumental to the privatisation process in the power sector which also attracted investors at all times. The National Assembly passage of the Electricity Power Sector Reform Act (EPSRA) in March 2005 has its imperatives: transfer of control and operation of the power sector from public to private sector for efficient investment, improvement in infrastructure development and power supply in Nigeria (Onyekwena et al., 2017:6). Nigeria's electricity system as it stands currently has three sub-sectors which include: generation, transmission and distribution sectors. These sectors have twenty-three (grid-connected energy generation plants (hydro and thermal) controlled by the government and private sectors. The power sector has a transmission company with a large network of connections across the country, and managed by the government alone. The distribution sector, the Electricity Distribution Company (DisCo) on the other hand has eleven (11) companies that manage the distribution of power to the consumers. This sector is owned and managed by private companies such as the BEDC in Edo and Delta States. The DisCos each have their allocations with distribution capacity around 5000MW to 6000MW (Chanchangi, Adu, Ghosh, Sundaram & Mallick, 2022).

Currently, Nigeria has an installed electricity generation capacity supply to the national grid of 12,522MW with available capacity of only 4,500MW to meet the daily supply of the population of over 170 million people and a GDP growth rate of 7 percent. In 2015, much of Nigeria's installed capacity was relatively unavailable from the estimated available capacity from the national grid of approximately 4,500MW. In 2013 alone, the power generation potential from domestic gas reserves was greater than 10,000MW which is relatively higher than the potential from domestic gas reserves in other African countries. Outside the natural gas, Nigerian power sector has achieved significant milestone in Coal-fired power with Zuma Energy Nigeria Limited which has executed its first power purchase agreement (PPA) with the Nigerian Bulk Electricity Trading Company (NBET) for the construction of a 300MW Coal Power Plant in Kogi State in North-Central region of the country. There have also been lot of interests in solar power projects in Nigeria in recent time. As at 10 November 2015, NBET had negotiated a total of eight PPAs with solar power developers. This sector has attracted huge interests from developers with some recurring generation licenses from the Nigerian Electricity Regulatory Commission (NERC) (NERC Quarterly Reports, 2021). The Generation Companies (GenCos), the independent power providers and the Niger Delta Holding Company are saddled with the responsibility of managing the power plants in the country. Currently, electricity power generated by GenCos is used to power the grid through the Transmission Company of Nigeria (TCN). The DisCos have the responsibilities of receiving energy from GenCos through the TCN and distribute energy to the end consumers, and metering, billing of energy, revenue collection, and

revenue remittance to Nigeria Bulk Electricity Trading (NBET) Plc for energy received. The GenCos also have the responsibility of remitting revenue to TNC for service provided, receiving complaints from customers, and compliance to NERC's service level agreements (SLAs), customers' enlightenment through local mass media in the 36 states and Federal Capital Territory (FCT), Abuja and load demand forecast (NERC Quarterly Reports, 2021).

In 2008, the Nigeria Electricity Regulatory Commission (NERC) introduced a new tariff order often known as "the Multi-Year Tariff Order (MYTO)". In 2012, the MYTO was amended, specifically, to provide for a 15 year tariff path for the electricity industry. The amended MYTO which was later referred to as MYTO II undergone minor reviews in certain parameters, including inflation, exchange rate and gas prices. It provides for the conduct of a major review for five (5) years which was intended to consider inputs from all stakeholders, including investors in the power sector. On 18 December 2015, NERC published a new set of tariffs which has a life time of Nine (9) years (i.e. 2015-2024) for the distribution companies. The new tariff however becomes effective on 1 February 2016 and then many changes have not been recorded. The new tariff also requires end-users in different locations and categories to pay different amounts of money for KWh (Kilowatt per hour) which symbolises a unit of energy equivalent to One Kilowatt (1 KW) of power expended for one hour (1h) of time. The major duty of MYTO is to set wholesale and retail prices in the Nigerian electricity sector market (Latham & Watkins Africa Practice, 2016). As at today, there are the National Integrated Power Projects (NIPPs) located in different states in the country, including Egbema Generation Company located in Owerri in Imo State with design capacity of 381MW; Geregu Generation Company Limited located near Yenagwa, Bayelsa State design capacity with 254MW; Geregu Generation Company Limited located in Ajaokuta, Kogi State design capacity with 506MW; Benin Generation Company Limited located at Ihovbor, Benin City, Edo State with design capacity of 508MW; Omoku Generation Company Limited located near Port Harcourt, Rivers State designed with 265MW; Omotosho Generation Company Limited located at Okitipupa, Ondo State with designed capacity of 513MW; Ogorode Generation Company Limited located at Sapele, Delta State with designed capacity of 508MW; Calabar Generation Company Limited located in Calabar, Cross River State with designed capacity of 634MW; Olorunsogo Generation Company Limited located at Olorunsogo in Ogun State with designed capacity of 754MW; and Alaoji Generation Company Nigeria Limited located near Aba, Abia State with designed capacity of 1131MW (Latham & Watkins Africa Practice, 2016).

These NIPPs, though, are functional and strived to improve on power generation in the country but epileptic power supply remains a major challenge in the power sector causing Nigerian citizens, and industries and domestic private owners to resort to self-power generation through the use of generating set. Some have also resorted to the use of private solar power installations which is capital intensive, and in most cases, not reliable because of the change in weather condition in the country, as well as the use of inferior materials for the installations. Unavailable or scarcity of premium motor spirit (PMS) also known as "petrol or fuel", and Automotive Gas Oil (AGO Diesel) have made it very difficult for some of these private businesses and industries to thrive in the country.

Method

Method of this study is historical design. The utilitarian value of historical research design or analytical research method is that it enables researchers to interpret past and current trends or events in order to gain a clearer perspective of the present. Historical or analytical research can accommodate comprehensive understanding of current events. It is used to state the conceptual structure within which a research or research works would be conducted. It relied extensively on secondary sources of data collection via textbooks, dailies, periodicals, journal articles, internet sources, among others.

Results and Discussion

Current State of Electricity Generation and Supply in Nigeria

In Nigeria, electricity is generated through different power stations located in the six geopolitical zones of the country. Nigeria's grid has an installed capacity of about 12,522 megawatts but because of poor infrastructure this has been underutilised. While the Kainji, Jebba and Shiroro power stations use hydro-power system (water), Egbin and Sapele use steam; and Sapele, Afam and Delta power stations use gas turbines for generation of power (Ijewere, 2016; Okedu, Kenu, Idowu & Uhumwangho, 2018; Dipo, 2020). The Nigeria's Power Holding Company is currently made up of three subsidiary companies, namely: the Generation Company (GenCo), Transmission and System Operations Companies (TRANSYCO), and the Distribution Company (DisCos). Power transmission is currently around 5,523.8KV of 330KV, and 6,801.49KV transmission lines respectively. The 32 Nos.330/132KV Sub-stations have a total of 7,688MVA (6,534.5MW) installed transformation capacity; 105Nos.132/33/11KV Sub-stations of 9,130MVA (7,760.5MV) with total transformation capacity (Ijewere, 2016; Okedu et al., 2018). Because of the constant power outage in some areas in the country, members of the National Assembly voted in large numbers in support of constitutional amendment to provide for State governments to generate and transmit their own electricity in a bid to support increase in electricity generation, transmission and distribution in the country. In the light of this, 298 out of 360 and 92 out of 109 members of the House of Representatives and the Senate respectively voted in support of a Bill for an Act to alter the provision of the Constitution of the Federal Republic of Nigeria (FGN) 1999 to allow States to generate, transmit and distribute electricity in areas that are not covered by the national grid, and for related matters (Dipo, 2020). In the first quarter of year 2020, the total electric energy generated in Nigeria was 8,734,927MWh, that is, 1.4 % more than the energy generated during the preceding quarter". Within the same quarter, the sector recorded a zenith daily power generation of 5,316MW while the average plant generation units also increased to 73 from the daily average of 66 units recorded in the preceding

quarter. In the face of the increase of 1.4% in total electric energy generated in the first and second quarter of 2020, utilisation rate fell by 8.16%. This diminution was attributed to constraints which are related to shortages of gas supply, and transmission and distribution networks challenges and which consequently resulted to technical operational capacity problems during the period (Babalwa, 2021).

Chinwuko, Mgbemena, Aguh & Ebhota (2014) posit “that the primary distribution system in Nigeria’s power sector consists of high voltage (11 and 33KV) networks often connected from primary and sub-primary substations. In most cases, industries in Nigeria including cement factories, refineries, breweries, flour mills, and steel rolling mills take source of supply at the primary distribution system with associated transformers, switchgears and breakers”. The secondary distribution system in the country consists of low voltage feeder networks from secondary transformers that are installed along major streets in towns and villages. Service connections to individual consumers in Nigeria are connected from the network feeder lines with cables. Essentially, the various systems of alternating current distribution for domestic consumers in the country include: the single-phase 2-wire system, single-phase 3-wire system, Three-phase 3-wire system, and Three-phase 4-wire system. Of all these systems, the single phase 2-wire and the three phase 4-wire system are the most widely used. Technically, the direct distribution has its specific area of application. Alternating current is usually converted into direct current by rotary converters (Chinwuko et al., 2014:7934). However, the current structure of Nigerian Electricity Sector (NEC) which is made up of Eleven (11) Distribution Companies (DisCos) and Six (6) Generation Companies (GenCos) and operated by private investors in partnership with the Federal Government of Nigeria (FGN). The DisCos include: Eko Distribution Company Plc; Ikeja Distribution Company Plc; Ibadan Distribution Company Plc; Benin Distribution Company Plc; Abuja Distribution Company Plc; Port Harcourt Distribution Company Plc; Enugu Distribution Company Plc; Kaduna Distribution Company Plc; Kano Distribution Company Plc; Jos Distribution Company Plc; and Yola Distribution Company Plc. The Generation Companies (GenCos) include: Kainji Power Plc, Shiroro Power Plc, Ughelli Power Plc, Sapele Power Plc, Afam Power Plc, and Geregu Power Plc (Okedu, Kenu, Idowu & Uhumwangho (2018).

The table below shows the current state of the existing power generation capabilities in the country:

S/N	Generating Stations	Raw Material	MW
1.	Egbun Thermal Power Plant	Gas, Coal	1080MW
2.	Kainji Hydro Power Plant	Hydro(Water)	480MW
3.	Jebba Hydro Power Plant	Hydro(Water)	360MW
4.	Shiroro Thermal Power Plant	Hydro(Water)	450MW
5.	Sapele Thermal Power Plant	Gas Turbine	170MW
6.	Afam Thermal Power Plant	Gas Turbine	72MW
7.	Delta Thermal Power Plant	Gas	329MW
8.	Geregu Gas Power Plant	Gas	414MW
9.	Omotosho Gas Power Plant	Gas	300MW
10.	Papalantso Gas Power Plant	Gas	300MW
11.	Alaoji Gas Power Plant	Gas	346MW
	Total MW		4301MW

Sources: Oshin, Adanikin, Fakorede & Ojotu (2019:1557).

Besides these provisions, issues of power outages in some areas in the country persist. As USA Department of Commerce (2021) rightly stated, sympathetically, Nigeria which is a member state of the Economic Community of West African States (ECOWAS), and West African Power Pool (WAPP), a specialised agency under ECOWAS with 14 member states out of the 15 countries in the regional economic community, is faced with same issues over and over again in spite of the collaborative efforts of the federal government of Nigeria and WAPP to improve on the state of the Nigerian power sector that has been bedevilled by handfuls of problems such as corruption, lack of proper maintenance of transformers and poor management, and vandalism of electricity installations. Meter Assets Provider regulation programme was aimed at bringing new money into the Nigerian market to finance meter deployment, and closing metering gaps, removing estimated billing and other related issues faced by the DisCos played remarkable role in improving metering in the power sector. Under the federal government distribution policies, the government introduced what is today known as “willing seller and willing buyer” electricity distribution policies aimed at allowing electricity to be transferred from the generating companies to willing consumers, including the public and industries (USA Department of Commerce, 2021). The current state of the power sector in Nigeria is increasingly pathetic on daily basis resulting in mass unemployment rate, increasing crime rate, and slow economic and poor national development with no visible solution to these challenges in the nearest future. Individual homes, and offices and business places rely heavily on self-generations of power supply which in often times very expensive to sustain considering the cost and scarcity of petroleum products, such as Automotive Gas Oil, AGO (diesel), premium motor spirit, PMS (petrol) and engine oil in the country.

1. What are the Leading Factors Challenging Electric Power Supply and Management in Nigeria?

Projects implementation failure in the power sector has become a reoccurring dilemma in Nigeria. Over the years, the regimes have been confronted with the problems of acute electricity supply project which is traced to policy implemental failure, and other sundry issues emanating from the power sector. It was because of this development that the 2005 Electric Power Sector Reform was undertaken. With the Reform Act of 2005, the electric power sector in Nigeria is yet to be accomplished by the successive administration. As Eze and Onuoha (2016) and Taiwo (2021) put it, poor

electric power generation, distribution and supply of electricity to the public remain the critical problem in the sector. Consequently, this has impacted negatively on the social and economic development of the Nigerian state. One thing that is certain about the challenges in the Nigeria electric power sector is that scholars, experts and political analysts who have talked about the historical development, progresses and challenges in the sector, agreed that the perennial problems associated with the sector remained the same with corruption as the major challenge in the sector.

Ezeani (2008), Ezirim, Eze and Onuoha (2016), and Taiwo (2021) traced the problem of epileptic power system in the country to gas constraint which has hampered the production capacities of the generating companies. Also identified as contributing factor are infrastructure decay, poor project implementation plan, and ineptitude and corruption on the part of government official in the power sector. Arowolo and Yannick (2017) argued that the acute shortage of electric power supply in Nigeria stems from interconnected web of factor created by complex challenges that need to be addressed by the government in its path to promote economic growth. Odion (2021) stated that in attempt to solve the issue of shortage of electric power supply in Nigeria, the successive regimes introduced several electric power sector reforms, among which is the 2005 Electricity Power Sector Reform Act (EPSRA) passed by the National Assembly and signed into law by President Olusegun Obasanjo administration. Until the 2005 Power Sector Reform Act, the power sector was in the exclusive list of the 1999 Constitution and solely managed by the Central Government through its agency. With the unbundling of NEPA/PHCN into seven Generation Companies (GenCos), eleven Distribution Companies (DisCos) and one transmission company, it is expected that the problems in power sector will have been resolved at least to a reasonable extent (Strategic Development & Policy Implementation Committee, SDPIC Report, 2017:381).

Further attempt by Abuja (Federal Government of Nigeria, FGN) to ameliorate the electric power sector problem, it invested heavily on the sector through large, medium and small hydrostatic power plant projects with the total capacity of 6,024MW. In 2020, the World Bank approved additional \$750 U.S. dollars under the Power Sector Recovery Operation (PSRO) loan for Nigeria to achieve financial sustainability accountability, and ensure there is a total supply of 4,500MW/h of electricity to the national grid in 2022. The PSRO was initiated in 2017 by the government of Nigeria in collaboration with the World Bank. It was an operational and financial intervention to address the Nigeria power sector issues, including the power sector finance deficit. In 2019, the Bank approved \$550 million loan for Nigeria to develop mini grid and solar system, yet, the country's power sector challenges remain unresolved (USA Department of Commerce, 2021). Drawing on the perennial power sector challenges in Nigeria, Oshin, Adanikin, Fakorade and Ojotu (2019) argued "that the Nigeria's power sector development is unimaginably problematic in spite of the huge resources that the governments at all levels have invested in the sector". They maintained that due to poor management of the resources and facilities by the staffs of PHCN, and by extension, the power distribution companies (DisCos), the country generates only 3,500MW within the period. The generation, transmission and distribution systems have all recorded high rates of failures of equipments, energy losses, poor protection system and poor project implementation due to governance failure and corruption, and a handful of other challenges, including financial misappropriation, inadequacy of equipments and non-commitment on the part of the staffs of PHCN in the country. The current state of the power sector in the country is increasingly pathetic on daily basis (Oshin et al., 2019).

Oduro (2018) noted that the main goal of any state is the development of its socio-economic sector often designed by the government of the state. He thus argued that the purpose of this development is to promote competitive, fast growing and productive economy that would fast track socio-economic development and generate sufficient employment for the citizens of the state. What is fundamental to the fulfilment of the objective of the state therefore is provision of reliable and affordable energy source to all the productive sectors of the state's economy. This will not only promote economic growth but stimulate and sustain a long-term economic growth, and reliable and affordable energy to the citizens of the state at all times. Essentially, Nigeria is not an exception to this concept of development, and adequate, reliable and affordable energy sources for economic development and the general welfare of the citizens. Since there are abundant and cheaper energy sources, including natural gas, hydro, solar, tidal wind and biomass that can be converted into electricity, socio-economic development is achievable in Nigeria. Regrettably, access to electricity consumption and cost present a sharp contract (Oduro, 2018:1).

According to the World Bank (2019) as cited in Obuebite, Nwosi-Anele and Okwonna (2021:1), "over eight hundred million people live without having access to sufficient power supply and over 2.2 billion lacks portable drinking water service because of the associate project implementation failure and poor regulatory policy frameworks". This has resulted in the decline in human capital development across the country, businesses and households mostly affected. Obuebite et al. (2021) assert the creation of Power Holding Company of Nigeria (PHCN) and its successor companies, and the transfer of access to the PHCN successor companies, and establishment of the Nigerian Electricity Regulatory Commission (NERC) and the National Council on Privatisation (NCP) in 2007 commenced the process of privatisation of the successor companies which was concluded in November 1, 2013. Regrettably, several factors including corruption in the power sector, poor project implementation, among others, impede power management and supply to the Nigerian public.

Aloke (2017) stated that the decision to reform Nigerian power sector by the federal government in 2001 was driven by the report of the National Council for Privatisation (NCP) steering committees created to investigate and proffer recommendation alternative management sources of power in the power sector. Odulani and Okokwa (2009) argued that, "Nigeria is one of the developing countries in Africa with highly endowed natural resources; yet, accessing energy has proved to be a continuous issue because of poor policy and failure of project implementation in the power sector".

Adeleke, Nwosa and Amassoma (2018) in their study assert that “the low performance of the Nigerian power sector created unavoidable need for the collaboration under the West African Power Pool Project (WAPPP)”. Notably, the reality in the Nigerian power sector after the enactment of the Electric Power Sector Reform Act 2005 shows that the private sectors still perceived the new power sector reform as significantly risky to invest their resources. Inactive private sector involvement in the new electricity regime, regularity and operational overlaps, funding constraints, over centralisation of electricity sector, among others are factors that have consistently mitigating against the new power sector reform in Nigeria (Adeleke et al., 2018:23). Dahunsi, Olakunle and Melodi (2021) opined that “the evolution of metering technology in Nigeria which came up with the unbundling of NEPA, at the moment is yet to record applauding progress and success despite the implementations of the various reforms in the power sector”. They conclude that the problem with Nigerian government is not formulation of public policies but implementation which is caused by conflicting interests and self-serving interests and manipulation of the instrument of policy-making to the advantage of the policy-makers (Okolie & Edo, 2023). This form of behaviour has created a missing-link in the structure of public policy formulation and implementation in Nigeria (Dahunsi et al. (2021).

Nwabisi (2018) noted that the regimes in Nigeria, from the military to civilian administration, embarked on several power sector restructuring programmes as a means of addressing power problems in the country, but to date very little improvement has been achieved despite huge capital expenditure that have been provided in the national annual budgets over the years. It indicates that the power sector in the country has shown very little capacity. Transmission and distribution are currently insufficient, thus the power sector has been characterised by numerous problems, especially in the area of low power generation, transmission and distribution. Corruption and insecurity also pose substantial threat to project implementation in the power sector (Nwabisi, 2018:8). He suggests among others, that there should be strict regulation in the power sector to ensure adequate implementation of projects in line with policy plans, and to ensure there is adequate gas supply to supply power to the households, and manufacturing companies and industries to increase production outputs. Aremu (2019) while examining the leading challenges of the epileptic electric power supply in Nigeria since independence observed that majority of Nigerian citizens pay excessively for what he refers to as “darkness” as they in most times experience power outage for an average of 20 hours daily, while their estimated billing continued unabated, which has impacted negatively on the socio-economic development of the country and currently inciting conflict between the electricity distribution companies (DisCos) and aggrieved consumers in the country. Furthermore, he identified certain factors such as the expanding vast territory and geographical spread, expanding industrial output and the adoption of multi-state structure as the factors that have confronted the Nigerian electric power distribution and supply.

There is also the problem of inadequate planning and absence of an integrated national fuel policy in the country, although, the regimes initiated various development plans that would have impacted positively on the overall advancement and development of the electric power sector, surprisingly, such was not the case because of lack of sufficient development plan, as well as absence of political will and failure of policy and project implementation by the successive regimes (Okereka, 2015). Also identified as constraint to regular supply of electricity in Nigeria is over reliance on hydro-electric power source, although, water energy was at a time considered an alternative source because it was considered to be cheap, readily available and accessible by electricity planners in the country, but this source of energy was confronted with serious constraints due to the low-head at some months of the year, thereby reducing the output of the generating installations. As consequence, there was a diversion of attention to other alternative sources, particularly thermal sources such as coal, crude oil, natural gas, nuclear fusion and solar energy to support outputs of hydro-powers (Aremu, 2019:76-77). Other leading factors that challenge electric power supply in Nigeria, include poor plant maintenance, pipeline Vandalism, inadequate funding, wrong location of power, unskilled manpower, lack of energy mix, inadequate staff training, aged and absolute equipment, Low staff morale, Seasonal drought, lack of policy continuity, poor electricity pricing, Poor asset management, inadequate gas supply, high cost of operation, poor plant maintenance, pipeline vandalism, customer indebtedness to power providers, inadequate gas pipeline maintenance, unwholesome practice by the staffs of the power companies, climate change, and corruption (Adenikinji, 2005; Sada, 2007; Obadote, 2009; Sule, 2010; *Amadi, 2014*; Oladipo & Temitayo, 2014; Emovon, Olusegun, Mgbemena & Adeyeri, 2018). Amadi (2014) argued that “the problems that encouraged the power sector reform in Nigeria include poor sector capacity, government’s inability to run a world class sector, endless capital injection without corresponding output, nation power dilemma knotted in politics, ever expanding workforce of the vertically integrated monopoly of the PHCN; and sundry liabilities for outstripping and aging asset base, government funding often eclipsed by sector colossal financial appetite, and a national culture of non-payment for public goods (Amadi, 2014). Therefore the main reason for the power Sector Reform Act of 2005 is to ameliorate the challenges that played out in the power sector, but, to date the power sector is bedevilled by these numerous challenges, and it seems there is no solution yet, even in the nearest future.

Conclusions

There is a long history in poor power supply in Nigeria in spite of government efforts to ensure there is limited cases of regular power outages in the country. From the era of the National Electricity Power Authority (NEPA) and the Power Holding Company of Nigeria (PHCN) down to the birth of the private Electricity Distribution Companies the problem of regular power outage remain the same. This development has in several instances linked with corruption in the sector, vandalisation of gas lines and power installations, and theft, and lack of proper maintenance of transformers, and poor management of electricity installations. Without doubt, these are the major problems associated with the electric power sector in the country overtime which seem to defy solutions. From findings, there is a general consensus

that there is a significant relationship between poor/bad governance and the failures in the power sector. It is however appropriate to conclude that the root causes of the problem of poor power supply in Nigeria are numerous, such failure in projects implementation, corruption and vandalism of power installations are the leading challenges in the power sector development. The following recommendations when implemented may ameliorate the challenges of lack of power supply in Nigeria:

1. The government should allocate sufficient funds to the sector and ensure that funds are utilised for the purposes of which they are allocated.
2. Experts in the area should be allowed to manage the sector, and technical equipments should be adequately managed and replaced when necessary.
3. Workshops and seminars should be organised on regular basis for Workers in the sector especially now that new equipments are introduced into the sector. This no doubt will enable them to be abreast and up to date with modern technologies.
4. There should be public-private collaboration in the power sector. This will go a long way to improve supply of power, and check irregular billings which has always be exorbitant and often skyrocketed on monthly basis even in the absence of supply of electricity to the consumers/general public.
5. The government should expand its source of power generation from hydro and gas plants to modern means of power generation which include renewable energy sources such as solar power, wind turbines and hydropower. Renewable sources of power generation may be the solution to electricity supply problem in the country.

References

- Adedeji, A. A. (2016). Spatial exploration and analysis of electricity power poverty: a case study of Ibadan, South-West, Nigeria. March 11, 2016. Retrieved from: <https://ira.le.ac.uk/handle/238461>. Accessed 17/06/2022.
- Adeleke, O., Nwosa, P. I., & Amassoma, D. (2018). Determinant of Household Accessibility to Alternative Sources of Electricity Supply in Nigeria: A Case Study of Ekiti State. *Singaporean Journal of Business Economics, and Management Studies (SJBEM)*, 6(5), 22-39. DOI:10.12816/0046862.
- Ademola, T., Adekunbi, I., & Eytayo, A. (2019). Legal and Regulatory Mechanism of Electricity Generation and distribution in Nigeria: A Review of Ibadan Distribution Outlets. *European Journal of Social Sciences*, 58(4), 267-276.
- Adenikinju, A. F. (2005). *Analysis of the cost of infrastructure failure in a Developing Economy*. African Economic Research Consortium Lecture Series, AERS Research Paper 148(2005), pp.1-44.
- Aloke, A. (2017). Is the Power Sector Recovery Plan the Panacea for Resolving the Challenges of Power Sector? *Privatization Digest Journal of the Bureau of Public Enterprise*, December 2017.
- Amadi, S. (2014). *Successes and Challenges of the Power Sector Reform So Far: Next Step*. Keynote Presentation at the Nigeria Bar Association 2nd Annual Energy and Environmental Law Roundtable, Yenagos, Bayelsa State, Nigeria, February 20th- 21st 2014.
- Anumaka, M. C. (2012). Scenario of Electricity in Nigeria. *International Journal of Engineering and Innovation Technology (IJEIT)*, 1(6), 2277-3754.
- Aremu, J. O. (2019). Epileptic Electric Power Generation and Supply in Nigeria: Causes, Impact and Solution. *Journal of Contemporary Research in Social Sciences*, 1(3), 73-81. DOI: 10.33094/26410249.2019.13.73.81.
- Arowolo, W. & Yannick, P. (2017). Market Reform in Nigeria Power Sector: A Review of Issues and Potential Solutions. Work Paper, April 2017. *ResearchGate*. Retrieved from: <https://www.researchgate.net/publication/31583865>. Accessed 29/09/2022
- Babalwa, B. (2021). *Nigeria: How the electricity supply industry performed in Q2 2020*. Nigerian Electricity Regulatory Commission (NERC) Report, 2020. Retrieved from: <https://www.esi-africa.com/industry-sectors/finance-and-policy/nigeria>. Accessed 30/06/2022.
- Chanchangi, Y. N., Adu, F., Ghosh, A., Sundaram, S., & Mallick, T. K. (2022). *Nigeria's energy review: Focusing on solar energy potential and penetration*. Environment and Sustainability Institute (ESI), University of Exeter, Penryn Campus, Penryn. Retrieved from: <https://doi.org/10.1007/s10668-022-02308-4>. Accessed 30/06/2022.
- Chinwuko, E. C., Mgbemena, C. O., Aguh, P., & Ebhota, W. (2014). Electricity Generation and Distribution in Nigeria: Technical Issues and Solutions. *International Journal of Engineering Science and Technology (IJEST)*, 3(11), 1934-7941.
- Dahida, D. P. & Maidoki, B. P. (2013). Public Policy Making and Implementation in Nigeria: Connecting the Nexus. *Public Policy and Administration Research*, 3(6), 56-64.
- Dahunsi, F. M. & Melodi, A. O. (2021). Evolution of Electricity Metering Technologies in Nigeria. *Nigerian Journal of Technological Development*, 18(2), 152-165.
- Dipo, O. (2022 March, 2). Devolution of 'power': States get right to generate own power. *BUSINESS DAY NEWS*. Retrieved from: <https://businessday.ng/news/article/devolution-of-power-state-to-benefit>. Accessed 30/06/2022.
- Edeh, S. C. (2021). Poor Electricity Supply in Nigeria: Causes, Effects and Solutions. Retrieved from: <https://bscholarly.com/poor-electricity-power-supply-in-nigeria/>. Accessed 16/03/2023.
- Emodi, N. V. & Diemuodeke, O. E. (2022). Why Nigeria's electricity grid collapses and how to shore it up. *THE CONVERSATION*. Retrieved from: <https://theconversation.com/why-nigerias-electricity-grip-collapses-and-how-to-shore-it-up>. 11/04/2023.
- Emovon, K., Olusegun, D. S., Mgbemena, C. O., & Adeyeri, M. K. (2018). Electric Power Generation Crisis in Nigeria: A Review of Causes and Solutions. *International Journal of integrated Engineering*, 10(1), 47-56. DOI:

<https://doi.org/10.30880/ijie.xx.xx.xxxx.xx.xxxx>.

- Ezeani, C. O. (2008). The state and crisis in the power sector in Nigeria. *University of Nigeria Journal of Political Economy*, 2(1&2), 1-21.
- Ezirim, G., Eke, O. & Onuoha, F. (2016). The Political Economy of Nigeria's Power Sector Reforms: Challenges and Prospects, 2005-2015. *Mediterranean Journal of Social Science*, 7(4), 443-453. Doi:10.5901/mjss.2016.v7n4p.
- Ijewere, A. A. (2012). Management of Electricity Power Supply in Delta and Delta States of Nigeria: Problems and Prospects. *International Journal of Research in Computer Application & Management*, 2(40), 26-32.
- InfoGuide Nigeria News. (2023 March, 16). 10 Ways to Improve Power Supply and Utilization in Nigeria. Retrieved from: <https://infoguidenigeria.com/10-ways-improve-power-suuply-nigeria/>. Accessed 16/03/2023.
- Jeremiah, K. (2022). Why Nigeria's power generation challenges may persist in 2022. *The Guardian Business News*. Retrieved from: <https://guardian.ng/energy/why-nigerians-power-generation-challenges-may-persis-in-2022>. Accessed 16/3/2023.
- Jonathan, E. (2018 September, 5). How poor power supply is hindering growth of Nigerian SMEs. *TheCable News, Nigeria*. Retrieved from: <https://www.thecable.ng/power-supply-hindering-growth-nigeria-smes>. Accessed 16/03/2023.
- Kumar, S. S. & Nagarajan, C. (2016). Performance-economic and energy loss analysis of 80KWp grid connected roof top transformer less photovoltaic power plant. *Circuits and System*, 2016 (17), 662-679. <https://doi.org/10.4236/cs.2016.76056>.
- Latham & Watkins Africa Practice. (2016). *Nigeria Power Sector: Opportunities and Challenges for Investment in 2016*. White Paper Number 1930, USA. February 23, 2016.
- Monyei, C. G., Adewumia, A. O., Obolo, M. O., & Sajou, B. (2017). Nigeria's energy poverty: Insights and Implications for smart policies and framework towards a smart Nigeria electricity network. *Renewable and Sustainable Energy Reviews*, 81(2018), 1582-1601.
- National Electricity Regulatory Commission (NERC) Quarterly Reports. (2021). *Electricity Sector in Nigeria*. Retrieved from: <http://www.nerc.gov.ng/index.php/library/documens/NERC-Reports/NERC-Quarterly-Reports/>. Accessed 30/06/2022
- Nwabisi, P. N. (2018). *Energy Sector and Business Development in Nigeria: A Study of South Eastern Nigeria: 1990-2016*. A Dissertation Submitted to the Department of Business Administration, Faculty of Management Sciences, Nnamdi Azikiwe University, Awka, In Fulfilment of the Requirements for the Award of Doctor of Philosophy (PhD) Degree in Business Administration, August 2018.
- Obadote, D. J. (2009). *Energy Crisis in Nigeria: Technical Issues and Solutions*. Abuja, Power Sector Prayer Conference, pp.1-9
- Obuebite, A. A., Nwosi-Anele, A., & Okwonna, O. (2021). Public Private Partnership (Ppp) and the Provision of Infrastructure in Nigeria: A Case for Energy Mix Sector in the Niger-Delta. *International Journal of Petroleum and Petrochemical Engineering (IJPPE)*, 7(1), 11-20.
- Odion, O. (2021 October, 27). EPSRA Bill 2021: Amending an Act to make it worse (1). *Premium Times*. Retrieved from: <https://www.premiumtimesng.com/opinion/492001-epsra-bill-2021-amending-an-act-to-make-worse-1-by-odion-omonfoman.html>. Accessed 30/06/2022.
- Odulani, G. O. & Okokwa, C. (2009). Does Energy Consumption Contribute to Economic Performance? Empirical Evidence from Nigeria. *East-West Journal of Economics and Business*, 12(2), 37-79.
- Oduro, R. A. (2018). *Theory, Application and Policy of Efficiency Regulation: The Case of the West African Electricity Distribution Sector*. A PhD Thesis Submitted in Fulfilment of the Degree of Doctor of Philosophy, University of Surrey, October 2018.
- Ojukwu, E. (2022). *Poor Electricity Supply in Nigeria: Impact on Businesses*. Tekedia Institute, April 22. Retrieved from: <https://www.tekedia.com/poor-electricity-supply-in-nigeria-impact-on-business>. Accessed 16/03/2023.
- Okedu, K. E., Kenu, S., Idowu, K., & Uhunmwangho, R. (2018). Impact of the Independent Power Producers and National Integrated Power Projects on the Deregulation of the Nigerian Electricity Sector. *Journal of Sustainable Development in Africa*, 20(1), 147-170.
- Okereka, O. P. (2015). Vital civic registration system as a tool for development planning in Nigeria: An examination of the major challenges. *Journal of Culture, Society and Development*, 11(6), 36 - 42.
- Okolie, U. C., & Edo, Z. O. (2023). Issues and failure of infrastructure project implementation in Nigeria. *Social Sciences, Humanities and Education Journal*, 4(3), 580 - 596.
- Oladipo, F. & Temitayo, O. (2014). The Nigerian Power System till Date: A Review, *International Journal of Advance Foundation and Research in Science and Engineering*, 1(5), 20-33.
- Olaoye, T., Ajilore, T., Akinluwade, K., Omole, F., & Adetunji, A. (2016). Energy Crisis in Nigeria: Need for Renewable Energy Mix. *American Journal of Electrical and Electronic Engineering*, 4(1), 1-8.
- Olowosejeje, S. A. (2020 September, 22). What Nigeria's poor power supply really costs and how a hybrid system could work for business. *THE CONVERSATION*. Retrieved from: <https://theconversation.com/what-nigerias-poor-power-supply-really-cost-and-how-a-hybrid-system-could-work-for-business>. Accessed 16/04/2023.
- Onagoruwa, B. (2011). *Nigerian Power Sector Reforms and Privatisation*. Abuja: Bureau of Public Enterprises.
- Onyekwena, C., Ishaku, J., & Akanonu, P. C. (2017). *Electricity in Nigeria: Challenges and Way Forward*. Second Draft, Centre for the Study of the Economies of Africa (CSEA), Abuja, Nigeria.
- Oseni, M. O. (2011). An Analysis of the Power Sector Performance in Nigeria. *Renewable and Sustainable Energy Reviews*, 15 (9), 4765-4774.

- Oseni, M. O. (2012). Households' access to electricity and energy consumption pattern in Nigeria. *Renewable and Sustainable Energy Reviews*, 16: 1990-1995.
- Oshin, O. A., Adenikin, A., Fakorede, E., & Ojitu, J. (2019). Incessant Power Supply in Nigeria and the Need for the Design and Production of 100,00MW Power Plant. *International Journal of Scientific & Engineering Research (IJSER)*, 10(2), 1554-1574.
- Oyewo, A., Aghahosseini, A., Bogdanov, D., & Breyer, C. (2018). Pathways to a fully Sustainable Electricity Supply for Nigeria in the Mid-term Future. *Energy Conversion and Management*, 178: 44-64. doi:10.1016/j.enconman.2018.10.036.
- Sada, I. (2007). *Analysis on Generation Transmission and Distribution of Nigeria Power for National Development. Proceedings of the 2nd National Conference of Colleges of Agriculture, Environmental, Engineering and Science and Technology, Hassan Usman Polytechnic, Katsina, Katsina State, Nigeria.*
- Simpson, E. S. (1969). Electricity Production in Nigeria. *Economic Geography*, 45(3), 239-257. doi:10.2307/143093.
- Sule, A. H. (2010). Major Factors Affecting Electricity Generation, Transmission and Distribution in Nigeria. *International Journal of Engineering and Mathematics Intelligence*, 1, 159-164.
- Taiwo, A. (2021 March, 22). Analysis: Why Nigeria's power sector suffers low gas supply despite having African largest reserve. *The Premium Times Nigeria*. Retrieved from: <https://www.premiumtimesng.com/news/top-news/450482-analysis-why-nigerias-power-sector-suffers-low-gas-supply-despite-having-africas-largest-reserve.html>. Accessed 30/06/2022.
- Udegbonam, O. (2022 June, 4). A gas plant fails at a time other power plants are undergoing planned maintenance and capacity testing. *Premium Times Nigeria*. Retrieved from: <https://www.premiumtimesng.com/news/headlines/534754-why-electric-supply-fails-at-a-time-other-power-plants-are-undergoing-planned-maintenance-and-capacity-testing>. Accessed 16/3/2023.
- United State of America (USA) Department of Commerce. (2021). *Nigeria-Country Commercial Guide: Electricity and Power System*. 2021-10-13 Publication. Retrieved from: <https://www.trade.gov/country-commercial-guides/nigeria-electricity-and-power-system>. Accessed 17/06/2018
- Vincent, E. N. & Yusuf, S. D. (2014). Integrating renewable energy and smart grid technology into the Nigerian electricity grid system. *Smart Grid and Renewable Energy*, 5(2014), 220-238.
- World Bank. (2019). *Public-Private Partnership Units: Lessons for their Design and Use in Infrastructure*. Work Bank/PPIAF, Washington, D. C.