

Power Failure in Nigeria

Paul A. Adekunle¹, Matthew N. O. Sadiku², Janet O. Sadiku³

¹International Institute of Professional Security, Lagos, Nigeria

²Roy G. Perry College of Engineering, Prairie View A&M University, Prairie View, TX, USA

³Juliana King University, Houston, TX, USA

ABSTRACT

The general power or energy situation in Nigeria is so pathetic and appalling. Hardly does any month passes without reports of the collapse of the national grid by the Transmission Company of Nigeria (TCN). The recurrent disruptions to business and telecommunications, including mobile SMS, voice, and internet services are experienced regularly all over. During electricity outages, opportunistic criminal activities could increase, transport disruptions due to traffic signals malfunctioning, temporary unavailability of essential services such as ATMs and gas stations can occur. In addition, blackouts could adversely affect security protocols, including alarm systems and electronic fences.

The paper attempts to look at the causes, challenges to incessant power outages and proffer solutions in ensuring steady power supply nationwide.

KEYWORDS: Nigeria, national grid, power distribution, electricity, blackout, corruption

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INTRODUCTION

It is a well known fact that uninterrupted electrical power supply in any nation is the engine of life the world over. There is a strong link between the per capita consumption of electrical energy and the state of physical advancement/development of a nation [1]. This then follows that if the energy consumed per person in a nation is very high, more industries will be working, leading to a strong nation. As a right thinking person or citizen, this should be what we should expect or desire, but it is very sad to note that this is yet to be true in the country, Nigeria – called the “giant of Africa”. The country is known to also supply electricity to its neighboring states, despite the fact that the quantity we even generate is grossly inadequate to satisfy the home demand.

HISTORICAL BACKGROUND

The historical background of electricity development in Nigeria dates back to the end of the 19th century, when the first generating power plant was installed in Marina, Lagos, in 1898, fifteen years after its introduction in England. Its total capacity was 60kw. After the amalgamation of the Northern and Southern protectorates in 1914 to form modern Nigeria, other

towns in the country began to develop electric power supply on individual scale or basis [1]. The following major cities then had electricity supply in the following order: Port Harcourt 1928, Enugu 1929, Kaduna 1933, Maiduguri 1934, Yola 1937, Zaria 1938, Warri 1939, and Calabar 1939.

The government and Native Authorities (NA) owned systems remained separate operational entities for several years until 1946, the year the Public Works Department ceased to have control over the operation of the electricity generating plants and distribution system in the country. The Nigerian Government Electricity Undertaking (NGEU) was then established (as an arm of the Public Works Department) to take over the assets and liabilities of the electricity supply in Lagos. In 1950, the Electricity Corporation of Nigeria (ECN) was established to take over all the various electricity supply outlets within the country. Meanwhile, the Native Authorities (NAs) continued to manage their respective systems while the Niger Dams Authority (NDA) was also inaugurated for the benefit of generating electricity through hydro power systems. As a result of this, the Colonial Government

established the Electricity Corporation of Nigeria (ECN) under the ordinance no. 15 of 1950.

Therefore, the new body (ECN) officially took over all electricity supply activities in Nigeria in April 1951 by integrating all the government owned as well as native-owned generating plants and systems. This creditably led to improved electricity power supply in the country through grid connection of generation, transmission and distribution of electricity, as shown in Figure 1. Energy sale was done in a way such that the return on its investment had a common purse – which was later referred to as the Vertical Integrated Utility (VIU). The increase in the demand for electricity led to some projects being carried out in Ijora, Oji River, Kano and Ibadan power stations to improve the availability and quality of power delivery, as shown in Figure 2. Thus, the Ijora power station was commissioned in February 1956 and served satellite towns like Ikorodu, Shagamu, Ijebu-ode and other towns in the Ibadan-Ijebu provinces which provided the socio-economic transformation of these western states ahead of other parts of the country.

In 1962, an Act of Parliament established the Niger Dam Authority (NDA) which was responsible for dam construction after discovering the immense benefits that would accrue from the dam. This led to the construction of Kainji Dam in 1962 and was completed in 1968. The vast nature of the country grid power transmission system started operation in 1966 with the collaborative effort of the defunct ECN and NDA, which linked Lagos with Kainji. Kainji-Kaduna link was extended to Zaria and Kano. In the southern part, Oshogbo-Benin-Ughelli and Benin-Onitsha-Afam (Alaoji) links were constructed. Despite the great size of the country, the national grid now links the thirty-six state capitals and the Federal Capital Territory Abuja, as shown in Figure 3.

On the 1st of April 1972, ECN and NDA were merged to form a unified body known as National Electric Power Authority (NEPA), while the actual merging took place on 6th January 1973 when the first manager was appointed. NEPA's network grew between 1978 and 1983, with the Federal Government sponsoring two panels of inquiry to fashion out models for the restructuring of NEPA into an independent unit or toward privatizing it out of monolithic nature. This led to the establishment of the electrification boards to ensure the supply of power to the rural areas and new cities.

In 1999-2005, which was the advent of democratic government, an act was enacted establishing Power Holding Company of Nigeria (PHCN), an Initial Holding Company (IHC), as a result of government

effort to revitalize the power sector. This was meant to privatize the power sector as well as to transfer assets and liabilities of NEPA to PHCN. The company was officially commissioned on the 5th of May 2005 and was to carry out the business of NEPA. Consequently, in 2004 the National Integrated Power Projects (NIPP) was inaugurated to catalyze and fast track the upgrading of adding more capacity to the current available electricity capacity in the country. This was basically a private initiative which is currently being supervised by the Niger Delta Power Holding Company (NDPHC).

The PHCN, as a company was unbundled into 18 companies as follows:

- Six (6) generating companies
- One (1) transmission company i. e. the Transmission Company of Nigeria (TCN), and
- Eleven (11) distribution companies.

The generating companies are: Egbin Electricity Generating Company (EEGC), Sapele, Ughelli, Afam, Shiroro, and Kainji. There were also some new Independent Power Producers under the auspices of the Niger Delta Power Holding Company (NDHC), as shown in Figure 4.

The 11 distribution companies are:

- Abuja Electricity Distribution Company (AEDC)
- Benin Electricity Distribution Company (BEDC)
- Eko Electricity Distribution Company (EkEDC)
- Enugu Electricity Distribution Company (EnEDC)
- Ibadan Electricity Distribution Company (IbEDC)
- Ikeja Electricity Distribution Company (IkEDC)
- Jos Electricity Distribution Company (JEDC)
- Kaduna Electricity Distribution Company (KdEDC)
- Kano Electricity Distribution Company (KnEDC)
- Port Harcourt Electricity Distribution Company (PHEDC)
- Yola Electricity Distribution Company (YEDC)

POWER GRID COLLAPSE

The recent power grid collapse in the country is the eighth time this year 2024. Between 2017 and 2023 it was reported that the power grid collapsed 24 times. It is a great shame that the country is still struggling to have a stable power supply with humongous energy sources including 200 trillion cubic feet of gas, a vast network of rivers for hydropower, coupled with abundant sunshine for solar arrays. That Nigeria can hardly muster 5000MW for its 220 million

citizens 128 years after electricity was first generated underlines the folly of the visionless, inept, corrupt, and self-serving leadership that has afflicted the country for years. The Nigerian Electricity Regulatory Commission blamed Saturday's grid collapse on a transformer explosion at Jebba. Failure to invest, replace and upgrade aging or obsolete components of the national power grid – substations, transformers, and lines – would always guarantee the regularity of such embarrassing incidents. According to the Minister of Power, Adebayo Adedun, the total or partial collapse of the power grid is almost inevitable and will continue to remain like this until we overhaul the entire infrastructure, so for now we are to continue to manage it. Despite the 10 loans worth \$4.36 billion secured by Nigeria from the World Bank over the past decade, the key challenges in the power sector remain unsolved [2].

This problem stems from long time neglect and low investment that the electricity sector has been subjected to by successive governments despite the rising population and aggregate demand over the years – these must be urgently addressed by the government. The President of the African Development Bank, Akinwunmi Adesina noted that Nigeria has the highest population of people, about 86 million, living without electricity globally, and while a recent IMF report estimated that Nigeria loses about \$29 billion annually or 5.6% of its GDP due to lack of reliable power supply.

It is said that generators provide 48.6% of the electricity consumed by both household and businesses across the country with \$16 billion spent annually on fuel per National Bureau of Statistics. Furthermore, about 59% of industries in Nigeria are off the national electricity grid because they see the grid as not a reliable source of power supply and for which reason they remain globally uncompetitive amid high energy costs. The country's power sector woes are so complex and myriad which include inadequate power generation capacity, transmission and distribution bottlenecks, sub-optimal pricing and subsidies, operational inefficiencies of the distribution companies, and regulatory uncertainties/policy inconsistencies [3].

Privatization as at now is yet to yield results due to failure to match generation capacity with transmission and distribution.

VANDALIZATION

Some few weeks ago, it was reported that there was vandalization and willful destruction of power infrastructure and other public assets that resulted in 17 northern states and caused millions of people to contend with a prolonged blackout. This was due to

the damage to the Shiroro-Kaduna transmission lines, the major conduit supplying electricity to the north, which has paralyzed social and economic activities. This caused the President to direct the Minister of Power and relevant agencies to speed up the pace of work to restore electricity to all the affected states in the north [4].

COMMON CAUSES OF POWER OUTAGES

It is important to know the causes of power outages, some of these are as follows [5]:

1. Severe weather and storms: Weather is known as the biggest cause of power outages and of which 83% is due to this. Severe weather can take several forms such as:
 - Wind, such as derechos, hurricanes and tornadoes, can blow down power lines.
 - Lightning can knock down trees that fall on transmission wires.
 - Heavy rains can cause flooding and mudslides that bring down wires and short circuit power systems in homes or neighborhoods
 - Winter storms bring ice and snow that can overburden trees and sometimes elements of the grid itself, potentially damaging wires and transformers
 - Heat waves may strain components and systems. Coinciding wildfires can destroy wide swaths of land and the electricity infrastructure with it.

Some other causes of power outages include natural disasters like earthquakes, tidal waves, volcanic eruptions and solar storms that could knock down transmission lines, damage transformers, destroy substations and overburden components.

2. Trees: Trees are known to take in carbon dioxide and release oxygen, adding beauty and life to the landscape, they can also cause power outages. Falling trees and branches can damage power lines along the roads that leads to houses, and as well by high winds and the load from heavy snow or ice. An individual or professional seeking to trim branches or cut down a tree could inadvertently hit a powerline and cause a power blackout.
3. Animals and wildlife: Power outages are also caused by local wildlife and are the second most frequent cause for power outages. While foraging for food and nesting materials, defecating or taking shelter in the warm hum of an electric grid component, they can cause damage that stops the flow of power. Other animals indicted for this are also squirrels, other rodents like rats and mice,

can chew through the wires. So also are birds, raccoons, snakes, insects, monkeys and jellyfish can wreak havoc by causing power outages.

4. Motor vehicle accidents: This is due to motor vehicle accidents, such as a car or truck that skips out of control and hits a utility pole bringing down power lines and equipment. Moreover, driver impairment, a momentary lapse of attention or a slippery pavement can result to hitting an utility pole.
5. Power equipment failure: The components that bring power to customers can be faulty or may break or wear out with age and exposure to the elements. Transformers can fail, insulators corrode, insulation on cables cracks and wires snap.
6. High energy demand: Power blackout can be as a result of an uncommon cause of too many people drawing too much power in a given area at one time. On a hot summer day, for example, when everyone's air conditioner is working overtime, excessive demand can overload the system and lead to an outage.
7. Power line damage from construction work: This is the use of construction equipment to knock down utility poles, and where excavators and landscapers can accidentally cut underground lines or cables.
8. Damage from the public: Not only errors by professionals cause power outages, but also caused by people i. e. the public when doing yard work. Other causes are vandalism and deliberate acts of destruction. Thieves risk serious harm (including electrocution) when they steal wire and other components for the copper inside, selling it for scrap – resulting to random power outage.
9. Destruction of power from cyberattacks: Less common reason of why power outages occur is a deliberate attempt by a foreign power or terrorist group to disrupt operations. Power suppliers have extensive security measures in place to safeguard power stations, therefore, these types of attacks are rarely successful.
10. Planned power outages: This could be a deliberate or planned outage, as the utility company may have reasons for power outages e. g in order to conduct routine maintenance, repairs or upgrades. However, how often this type of power outages occur can vary with respect to the age and configuration of the system. In advanced countries, before the outage of power, the utility company will notify the public in advance, but this is not so in developing countries.

TYPES OF POWER OUTAGES

The different types of outages are [5]:

1. Permanent fault: this is a type of fault caused by abnormal or unbalanced voltage or current, or a disruption in flow that must be fixed or reset.
2. Brownout: this occurs when power is temporarily reduced but not totally cut, to keep the grid from being overloaded and resulting in total/full blackout. Rolling brownouts are when power is reduced section by section across the power grid.
3. Blackout: this occurs when the whole system fails and is the most severe power outage. Recovering power can be difficult, especially when power stations are tripped and knocked off the grid. It could last for hours, days or even weeks.
4. Rolling blackouts: A systematic and temporary interruption of electrical service done by design is a way that utility companies can relieve the stress on a power grid that is experiencing exceptional high demand, interruptions in supply or infrastructure issues. Rather than let the grid fail in an unpredictable and potentially highly damaging ways, planned temporary blackouts help balance supply and demand until stability can be restored.

EFFECT OF POWER OUTAGES

The negative effects of power outages can be very severe and hard to fully calculate. These could tantamount to [5]:

- No lights or air conditioning
- The possible interruption of water and natural gas service
- The dangerous interruption in the running of life-sustaining medical devices
- No cell phone service because cell towers are out
- The damage to appliances or electronics due to power surges
- Spoiled food in the refrigerator
- Inoperative traffic signals and limited travel
- Lost revenue for businesses

The United States boasts one of the most robust electrical systems in the world, where widespread or regular power outages are rare. The US uses many different energy sources and technologies to generate electricity. The three major categories of energy for electricity generation are: fossil fuels (coal, natural gas, and petroleum), nuclear energy, and renewable energy. Most electricity is generated with steam turbines that use fossil fuels, nuclear, biomass, geothermal, or solar thermal energy, as shown in

Figure 5. Other major electricity generation technologies include gas turbines, hydro (water) turbines, wind turbines, and solar photovoltaics [6].

SOLUTION TO ENERGY PROBLEM IN NIGERIA

The solution to the energy and environmental problem in Nigeria must be seriously and urgently looked into. The Federal government must start to invest massively in alternative and environmentally friendly options such as solar power, wind, nuclear energy, and renewable energy, as shown in Figures 6 and 7. The country located in the tropics has a large amount of insolation coming from the sun and has involved solar companies such as Hansa Energy [7] and Arnergy [8] in Nigeria [9] to help in the mass production of solar plants and the distribution of solar systems for households and businesses. Since Nigeria has easy access to uranium needed for energy plants, nuclear energy could be a viable solution to energy problem due to its lack of emissions and reliability [10].

The development of hydroelectricity seems not practicable because of the dependence on the seasons for the amount of water supply and the amount of greenhouse gases it emits, as shown in Figure 8. Wind energy has a great potential but is unreliable for constant energy supply [11, 9]. The best suggestion is the use of a sustainable development option on renewable energy sources, with a gradual or slow change from fossil fuels [12, 9].

The country is also fret with the widespread capture and misallocation of public resources i. e whether through wasteful spending or outright theft, including within the electricity sector itself. In furtherance to this, corruption has been recognized as one of the primary factors hindering Nigeria's ambition to achieve the 2030 Agenda for Sustainable Development, which includes: political corruption, petty corruption, and private-to-private corruption [13, 14].

CONCLUSION

The importance of uninterrupted and constant power supply cannot be overemphasized most especially to the economic and social development of a nation. Nigeria loses a lot of money due to power outages and lags behind in terms of infrastructure development. The fixing of energy supply will definitely solve many problems such as the overpricing of electricity, poverty, job creation, reduction of carbon emissions, etc. The President of the African Development Bank, Akinwunmi Adesina noted that Nigeria has the highest population of people, about 86 million, living without electricity globally, and while a recent IMF report estimated that

Nigeria loses about \$29 billion annually or 5.6% of its GDP due to lack of reliable power supply. The President of the African Development Bank, Akinwunmi Adesina noted that Nigeria has the highest population of people, about 86 million, living without electricity globally, and while a recent IMF report estimated that Nigeria loses about \$29 billion annually or 5.6% of its GDP due to lack of reliable power supply. The issue of corruption must be decisively dealt with in order to boost the country's economy, etc.

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Figure 1, National Grid (Malaysia)

Source:https://www.google.com/search?sca_esv=4ea9ed7b68a81626&sxsrf=ADLYWIIIn4166FqieiaXL PzttvAHWAWdDVg:1733710239708&q=images+on+electricity+by+wikipedia&udm=2&fbs=AEQN m0Aa4sjWe7Rqy32pFwRj0UkWd8nbOJfsBGGB5 IQQO6L3JyJJclJuzBP112qJyPx7ESJehObpS5jg6J8 8CCMRK72qUv4GOvBp3LxAsC35pUAVd1mVJI z_kJEl7OpW0Y42rOM96fEVibRmxJCzmEqh53sB nJMLdHFyYMnh1J8SLKdTBIS0c&sa=X&ved=2a hUKEwi2xOz3zZmKAxWaWkEAHW00LDYQtK gLegQIFxAB&biw=1036&bih=539&dpr=1#vhid=ib_vGWEkeS8-M&vssid=mosaic



Figure 2. Power station

Source:https://www.google.com/search?sca_esv=4ea9ed7b68a81626&sxsrf=ADLYWIIIn4166FqieiaXL PzttvAHWAWdDVg:1733710239708&q=images+on+electricity+by+wikipedia&udm=2&fbs=AEQN m0Aa4sjWe7Rqy32pFwRj0UkWd8nbOJfsBGGB5 IQQO6L3JyJJclJuzBP112qJyPx7ESJehObpS5jg6J8 8CCMRK72qUv4GOvBp3LxAsC35pUAVd1mVJI z_kJEl7OpW0Y42rOM96fEVibRmxJCzmEqh53sB nJMLdHFyYMnh1J8SLKdTBIS0c&sa=X&ved=2a hUKEwi2xOz3zZmKAxWaWkEAHW00LDYQtK gLegQIFxAB&biw=1036&bih=539&dpr=1#vhid=MGMHxcRoSHC6vM&vssid=mosaic



Figure 3. Electric power

Source:https://www.google.com/search?sca_esv=4ea9ed7b68a81626&sxsrf=ADLYWIIIn4166FqieiaXL

PzttvAHWAWdDVg:1733710239708&q=images+on+electricity+by+wikipedia&udm=2&fbs=AEQNm0Aa4sjWe7Rqy32pFwRj0UkWd8nbOJfsBGGB5IQQO6L3JyJJclJuzBP112qJyPx7ESJehObpS5jg6J88CCMRK72qUv4GOvBp3LxAsC35pUAVd1mVJIz_kJEl7OpW0Y42rOM96fEVibRmxJCzmEqh53sBnJMLdHFyYMnh1J8SLKdTBIS0c&sa=X&ved=2ahUKEwi2xOz3zZmKAXWaWkEAHW00LDYQtKgLegQIFxAB&biw=1036&bih=539&dpr=1#vhid=p9rq5xdMEvFJgM&vssid=mosaic



Figure 4. Electricity generation

Source:https://www.google.com/search?sca_esv=4ea9ed7b68a81626&sxsrf=ADLYWIIIn4166FqieiaXL PzttvAHWAWdDVg:1733710239708&q=images+on+electricity+by+wikipedia&udm=2&fbs=AEQNm0Aa4sjWe7Rqy32pFwRj0UkWd8nbOJfsBGGB5IQQO6L3JyJJclJuzBP112qJyPx7ESJehObpS5jg6J88CCMRK72qUv4GOvBp3LxAsC35pUAVd1mVJIz_kJEl7OpW0Y42rOM96fEVibRmxJCzmEqh53sBnJMLdHFyYMnh1J8SLKdTBIS0c&sa=X&ved=2ahUKEwi2xOz3zZmKAXWaWkEAHW00LDYQtKgLegQIFxAB&biw=1036&bih=539&dpr=1#vhid=JVk0kQ3BkbyMtM&vssid=mosaic



Figure 5. Energy in the United States

Source:https://www.google.com/search?q=images+on+electricity+in+the+us+by+wikipedia&sca_esv=4ea9ed7b68a81626&udm=2&biw=1036&bih=539&sxsrf=ADLYWILuNnRD9yKdd601NCFH_Y3y8vdbeQ%3A1733710245804&ei=pVFWZ5zhMK-ehbIPg4SGsAw&ved=0ahUKEwjcxD6zZmKAXUv

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Figure 6. Electricity (wind)

Source:https://www.google.com/search?sca_esv=4ea9ed7b68a81626&sxsrf=ADLYWIIIn4166FqieiaXL PzttvAHWAWdDVg:1733710239708&q=images+on+electricity+by+wikipedia&udm=2&fbs=AEQNm0Aa4sjWe7Rqy32pFwRj0UkWd8nbOJfsBGGB5IQQO6L3JyJJclJuzBP112qJyPx7ESJehObpS5jg6J88CCMRK72qUv4GOvBp3LxAsC35pUAVd1mVJIz_kJEl7OpW0Y42rOM96fEVibRmxJCzmEqh53sBnJMLdHFyYMnh1J8SLKdTBIS0c&sa=X&ved=2ahUKEwi2xOz3zZmKAXWaWkEAHW00LDYQtKgLegQIFxAB&biw=1036&bih=539&dpr=1#vhid=6fgPUzlG7C4ywM&vssid=mosaic



Figure 7. Solar panel

Source:https://www.google.com/search?sca_esv=4ea9ed7b68a81626&sxsrf=ADLYWIIIn4166FqieiaXL PzttvAHWAWdDVg:1733710239708&q=images+on+electricity+by+wikipedia&udm=2&fbs=AEQNm0Aa4sjWe7Rqy32pFwRj0UkWd8nbOJfsBGGB5IQQO6L3JyJJclJuzBP112qJyPx7ESJehObpS5jg6J88CCMRK72qUv4GOvBp3LxAsC35pUAVd1mVJIz_kJEl7OpW0Y42rOM96fEVibRmxJCzmEqh53sBnJMLdHFyYMnh1J8SLKdTBIS0c&sa=X&ved=2ahUKEwi2xOz3zZmKAXWaWkEAHW00LDYQtKgLegQIFxAB&biw=1036&bih=539&dpr=1#vhid=ICWeVwV28w9JCM&vssid=mosaic



Figure 8. Electricity sector in Ghana (Hydro)

Source:https://www.google.com/search?sca_esv=4ea9ed7b68a81626&sxsrf=ADLYWIIIn4166FqieiaXLPzttvAHWAWdDVg:1733710239708&q=images+on+electricity+by+wikipedia&udm=2&fbs=AEQNm0Aa4sjWe7Rqy32pFwRj0UkWd8nbOJfsBGGB5IQQO6L3JyJJclJuzBP112qJyPx7ESJehObpS5jg6J88CCMRK72qUv4GOvBp3LxAsC35pUAVd1mVJIZ_kJEl7OpW0Y42rOM96fEVibRmxJCzmEqh53sBnJMLdHFyYMnh1J8SLKdTBIS0c&sa=X&ved=2ahUKEwi2xOz3zZmKAxWaWkEAHW00LDYQtKgLegQIFxAB&biw=1036&bih=539&dpr=1#vhid=x31R8YxInPiHPM&vssid=mosaic

