

The Nigerian Power Sector

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Rural Electrification in Nigeria: Increasing access to Electricity

Executive Summary

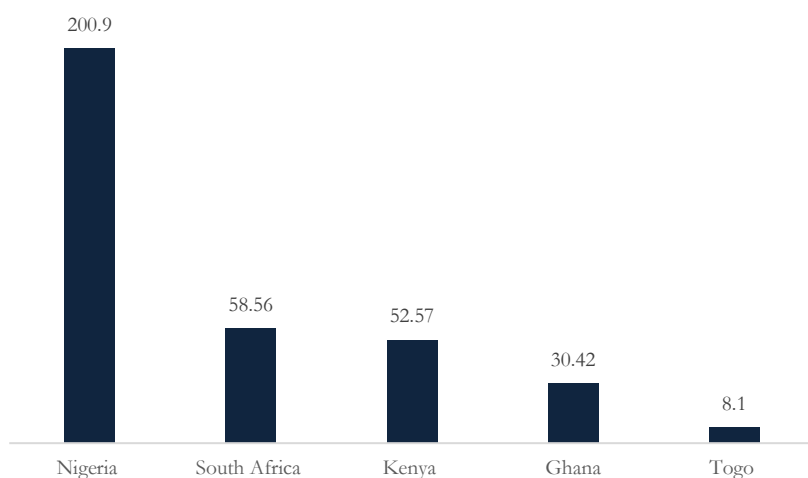
This report gives an overview of the Nigerian Power Sector and Rural Electrification as a solution to increasing access to electricity in the country, especially to the rural areas where the electrification rate is currently low. The lack of access to sufficient electricity puts major restrictions on socioeconomic activities and this undoubtedly reduces the quality of life, as well as on the implementation of new technologies in various sectors, such as agriculture, health, finance, education etc. Despite Nigeria's rating as the economic powerhouse in Africa with a GDP of \$448.12 billion in 2019, according to data from the World Bank, the country's power sector still lags behind its peers in respect to power generation versus rate of electrification. An estimated 43.5% of Nigeria's population (201 Million) have no access to grid connected electricity, while those connected to the grid suffer extensive power outages occasioned by a number of factors cut across the industry value chain. According to the World Bank, with 56.5% electrification rate, Nigeria falls behind South Africa, Ghana and Kenya who have an electrification rate of 91.2%, 82.4% and 75% respectively, while Togo stays behind Nigeria with 51.3% electrification rate as at 2018. Nigeria is blessed with abundant oil, gas, hydro and solar resources. The power sector in Nigeria is highly diversified. The industry has witnessed various phases from government control to privatization in 2013. Privatization has been implemented to allow the private sector to provide efficient services to meet the needs of electricity consumers. The Federal Government's Rural Electrification Policy outlines the Government's objectives, goals, and policies regarding rural electrification. The primary objective of the Nigerian Rural Electrification Policy and by extension this Rural Electrification Strategy and Implementation Plan (RESIP) is to expand access to electricity as rapidly as possible in a cost-effective manner.

1.0 Overview of the Nigerian Power Sector:

The lack of access to sufficient electricity puts major restrictions on socioeconomic activities and this undoubtedly reduces the quality of life, as well as on the implementation of new technologies in various sectors, such as agriculture, health, finance, education etc. Despite Nigeria's rating as the economic powerhouse in Africa with a GDP of \$448.12 billion in 2019, according to data from the World Bank, the country's power sector still lags behind its peers with respect to power generation versus rate of electrification. An estimated 43.5% of Nigeria's population (201 Million) have no access to grid connected electricity, while those connected to the grid suffer extensive power outages occasioned by several factors cut across the industry value chain. Electricity is very important for developing the economy, especially for the operation of factories, shops, growing of crops and delivery of goods to consumers. Access to electricity is especially important to human development as electricity is, in practice, essential for certain basic tasks, such as lighting, cooling and running of household appliances, and cannot easily be replaced by other types of energy. Access to electricity by individuals is one of the most direct and unbiased indicators of a country's energy poverty status.

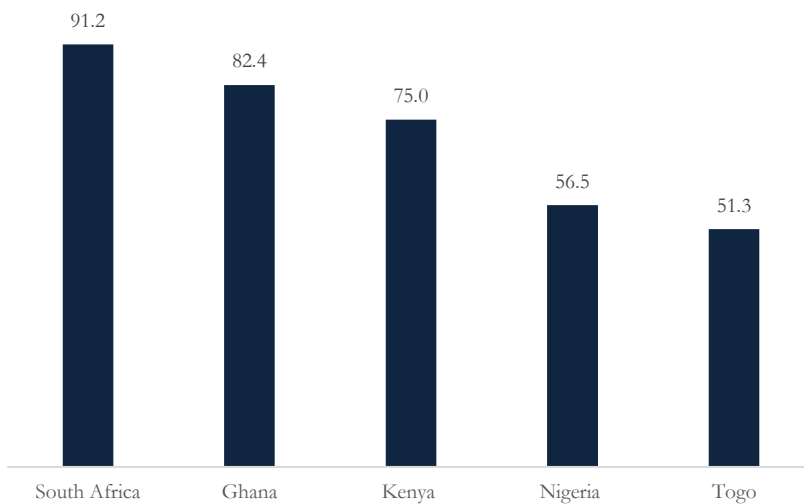
The lack of access to sufficient electricity puts major restrictions on socioeconomic activities and this undoubtedly reduces the quality of life...

Fig. 1: Population of selected Sub-Saharan African countries as at 2019 (million)



Source: Source: World Bank, PAC Research

As at 2019, Nigeria recorded a population of 201 million according to World Bank, while other selected countries in Sub-Saharan Africa such as South Africa, Kenya, Ghana and Togo recorded a total population of 58.6 million, 52.6 million, 30.4 million and 8.1 million, respectively. Despite being the most populous country in Africa, Nigeria has one of the widest energy gaps in the world. The rapid population growth makes it a matter of urgency to improve its power sector.

Fig. 2: Access to electricity as at 2018 (%)

Source: Source: World Bank, PAC Research

According to the World Bank, with 56.5% electrification rate, Nigeria falls behind South Africa, Ghana and Kenya who have an electrification rate of 91.2%, 82.4% and 75% respectively, while Togo stays behind Nigeria with 51.3% electrification rate as at 2018. Nigeria is blessed with abundant oil, gas, hydro and solar resources. The Nigerian power sector is highly diversified. The industry has witnessed various phases from government control to privatization in 2013. Privatization has been implemented to allow the private sector to provide efficient services to meet the needs of electricity consumers. The power sector is currently working on the task of establishing a sustainable and competitive market.

According to the World Bank, with 56.5% electrification rate, Nigeria falls behind South Africa, Ghana and Kenya...

2.0 The Power Sector Value Chain

Generation, transmission, and distribution systems make up the main components of the value-chain required to deliver electricity to end consumers in residential buildings, commercial establishments and factories in a grid-based power system. In Nigeria, electricity is generated from the generating companies using two major sources of energy – thermal and hydro, electricity generated is transmitted to the national grid through TCN (Transmission Company of Nigeria), after which it is distributed to end-user via the 11 distribution companies (DisCos) in the country. NERC, as the market regulator, issues each of the market participants a license in accordance with its activities. Generation companies can sell electricity to the bulk trader, Nigeria Bulk Electricity Trading Company (NBET), distribution companies and eligible customers. For on-grid electric power and ancillary services, NBET enters a power purchase agreement for bulk procurement from the generation companies and resell to the distribution companies through a vesting contract. Transmission from the generation companies to the distribution companies is done by TCN who executes grid connection agreements with generation companies and transmission use of systems agreements with distribution companies.

Upon distribution, payment is made by consumers and distribution companies remit to the market operator for further distribution along the value chain to the market participants. While electricity flows from the generating companies to the consumers through TCN and the DisCos, money flows from the consumers to the GenCos through the DisCos, NBET and other key players.

2.1 Generation:

Prior to privatization of the sector, generation of electricity was controlled mainly by the government. In this regard, the government owned and managed three hydropower plants and seven thermal power generating stations. The need to ramp up generation capacity led to the government's quest for privatization of its assets, which were unbundled as successor generation companies. Under the National Integrated Power Project (NIPP) programme, the government also constructed 10 thermal power plants. The government commenced the privatization of the NIPP plants in 2013. Private investors are also encouraged to apply for generation licenses under the Act and set up independent power plants with guaranteed offtake by NBET for on-grid power subject to execution of a power purchase agreement.

2.2 Transmission:

The transmission network is under the control of the government-owned entity TCN. It is one of the successor companies that arose from the Electric Power Sector Reform Act, resulting in the unbundling of the state utility provider. TCN has licenses for the following activities: as a transmission service provider for the maintenance and operation of the transmission infrastructure, as a system operator for system operations and administration of the wholesale electricity market under its functions, and as a market operator.

2.3 Distribution:

The unbundling of the government-owned utility provider led to the formation of 11 distribution companies for its distribution assets and liabilities. Each distribution company may hold a dual license for distribution and trading; the distribution license entitles it to construct, operate and maintain a distribution network for connection of consumers, and the installation and maintenance of meters, among others; the trading license enables it to procure electric power from another trading licensee and, with the permission of NERC, from other sources.

2.4 Bulk trader:

The Electric Power Sector Reform Act provides for the licensing of a bulk trader (NBET) for the bulk procurement of electric power and ancillary services through a power purchase agreement from generation companies and the resale to distribution companies by vesting contracts. NBET was created primarily for payment guarantee assurance to generation companies for the bulk procurement of electric power and ancillary services. It also ensures through the vesting contracts that a minimum capacity from the available megawatts is provided to each of the distribution companies.

3.0 Generation, Transmission and Distribution Systems Operational Linkage:

The generation, transmission and distribution systems are interlinked by a common grid frequency which is largely determined by the speed of the rotating generator turbines on the grid. The energy produced by the generation system and consumed in the distribution network must be balanced in real time to maintain safe frequency; in which almost the same amount of energy flowing from the generation system must be consumed by the distribution system in real time. A large increase in difference between power in generation and distribution systems will lead to sharp frequency deviation which affect speeds of the generators' rotors. Generators are required to shut down for protective reasons when rotor speed reach a certain value. When this happens, the total grid will be down in a situation known as system collapse or total grid blackout. Restoring the system takes time and it is avoided by all means possible. The real time balancing and the associated techniques, rules, procedures and methodologies is called System Operations.

The generation, transmission and distribution systems are interlinked by a common grid frequency...

4.0 Regulators in the Nigerian Power Sector:

1. Nigerian Electricity Regulatory Commission (NERC):

NERC is an independent regulatory agency with authority to regulate the electric power sector. It is in charge of compliance across the entire value chain. As a sector regulator NERC undertakes technical and economic regulation of the power sector, such as:

- i. tariff regulation and fair pricing
- ii. promoting competition and private sector participation.
- iii. establishing or approving appropriate operating codes and standards regulation.
- iv. licensing and regulating entities engaged in generation, transmission, distribution and trading.
- v. approval of amendments to the Market Rules and monitoring the operation of the electricity market.

The Electric Power Sector Reform Act is the major instrument of regulatory control adopted by NERC in carrying out its regulatory functions.

2. Federal Ministry of Power:

The Federal Ministry of Power provides general direction to other agencies involved in the power sector. The key objective of the Ministry is to develop and facilitate the implementation of broad policies and programmes for the provision of adequate and reliable power supply from all sources of energy in the country.

3. Nigerian Electricity Management Services Authority:

The Nigerian Electricity Management Services Authority (NEMSA) regulates and enforces technical standards in the power sector. It inspects, tests and certifies electrical materials, equipment, power systems and electrical installations of the Nigerian power industry. Installations are tested for their adherence to technical standards and regulations. Furthermore, NEMSA provides advanced training for technicians as well as licensing of technical personnel.

4. Energy Commission of Nigeria:

The Energy Commission of Nigeria (ECN) was established with the statutory mandate of the strategic planning and coordination of national policies in the field of energy. The Commission is empowered to carry out overall energy sector planning and policy implementation and promote the diversification of energy resources through the development and optimal utilization of all resources, including the introduction of new and alternative energy resources. The Commission's roles include:

- i. serving as a centre for gathering and dissemination of information relating to national policy in the field of energy.
- ii. inquiring into and advising the government of the federation or the state on adequate funding of the energy sector, including research and development, production and distribution.
- iii. monitoring the performance of the energy sector in the execution of government policies on energy.

5. Nigeria Bulk Electricity Trading Plc (NBET):

The Nigerian Bulk Electricity Trading (NBET) Plc. is the manager and administrator of the electricity pool in the Nigerian electricity supply industry (NESI). It was incorporated on the 29th day of July 2010 and is 100% owned by the Federal Government of Nigeria. It is in charge of electricity bulk purchase and resale. NBET purchases electricity from the Generating Companies through Power Purchase Agreements (PPAs) and sells to the Distribution Companies through Vesting Contracts. The Generating Companies include the privatized PHCN successor companies, the National Integrated Power Projects (NIPPs), the already existing Independent Power Producers (IPPs) and the new IPPs.

6. Rural Electrification Agency (REA) - Responsible for co-ordination of electrification in the rural region:

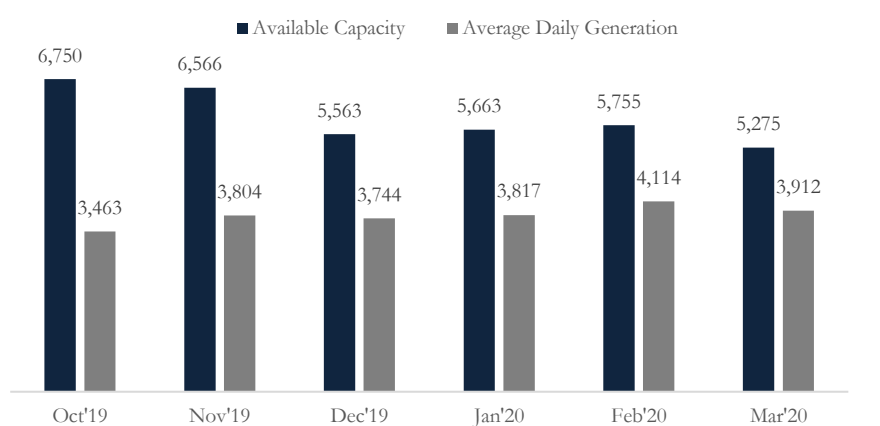
The Nigerian Rural Electrification Agency (REA) is the Implementing Agency of the Federal Government of Nigeria tasked with electrification of rural and unserved communities. It is responsible for the provision and access to reliable electric power supply in rural areas, in a way that would allow for reasonable return on investment through appropriate tariff that is economically responsive and supportive of the average rural customer.

4.0 Key Performance Overview:

According to a latest report from NERC, in Q1'20, the power sector recorded an average daily generation of 3,912MW in March 2020, which indicates 5% decline from 4,114MW in the previous month of February 2020. The available capacity fell by 8% to 5,275MW in March 2020 compared to the previous month which recorded an available capacity of 5,755MW in February 2020. This decrease in available generation capacity can be attributed to the increase in the number of generation units currently undergoing maintenance and repair, which made them unavailable for operation in the first quarter of the year. The average number of plants generation units that were available in Q1'20 was recorded at 66 plants, compared to 77 plants recorded in Q1'19.

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Fig. 3: Monthly Available Capacity and Average Daily Generation (MW)

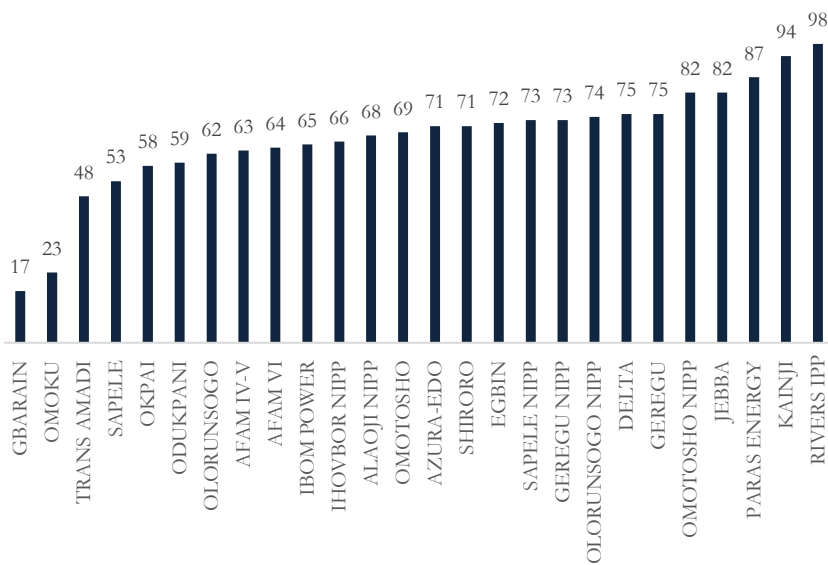


Source: NERC, PAC Research

The Available Capacity and Average Daily Generation data indicates that 71.02% of the available capacity was utilized in Q1'20, which represents a 12.17% increase from 58.85% of average generation utilized in Q4'19. The improved capacity utilization can be attributed to the reductions in technical and operational constraints relating to an inadequate gas supply, transmission constraints, limited distribution networks, and commercially induced low load off-take by DisCos, according to the NERC.

4.1 Load Factor and Average Generation of Power Plants:

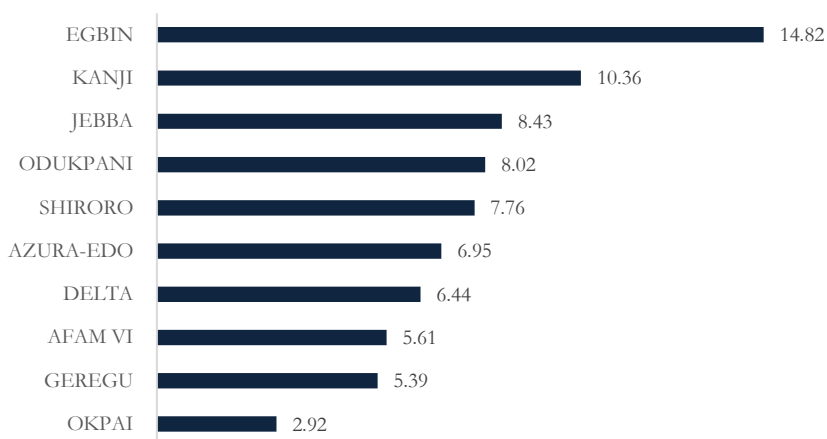
The average load factor of the generation plants is referred to the amount of energy that a power plant can generate over a certain period relative to its available capacity for the said period. The average load factor of the 28 power plants in Nigeria stood at 68.94% during the first quarter of 2020, which represents a 15.22% increase from the previous quarter which was recorded at an average of 53.72%.

Fig. 4: Plants Load Factor in Q1'20 (%):

Sources: NERC, PAC Research

12 of the 26 operational power plants accounted for 82.16% of the total electric energy generated in Q1'20. Rivers IPP accounted for the highest load factor recorded at 98%, followed by Kanji, which is the second highest plant with a load factor of 94%.

The contribution of selected power plant to the total energy output during the first quarter of 2020 is represented below:

Fig. 5: Share of top 10 Generation Output Plants in Q1'20 (%)

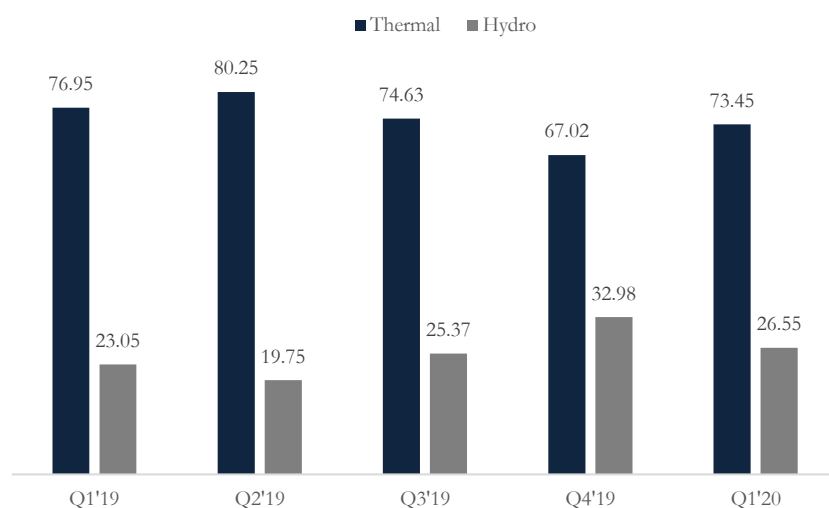
Sources: NERC, PAC Research

The data from NERC represents the contribution of the top 10 operational power plants in Nigeria as at Q1'20. These plants accounted for 76.7% of the total electric energy generated during the period under review. Due to its highest available capacity, Egbin power plant accounted for 14.82%, which is the highest share of the total energy output, followed by Kanji hydropower plant, Jebba and Odukpiani power plants, which accounted

for 10.36%, 8.43%, and 8.02% respectively. During the same period, Sapele NIPP power plant accounted for the least share of output with 0.11%. This shows that energy generation in Nigeria highly dependent on 9 power plants as these plants accounted for 73.76% of the total electric energy output during the first quarter of 2020.

4.2 Generation Mix:

Fig. 6: Quarterly Share of Electricity Generated by Fuel Sources (%)



Sources: NERC, PAC Research

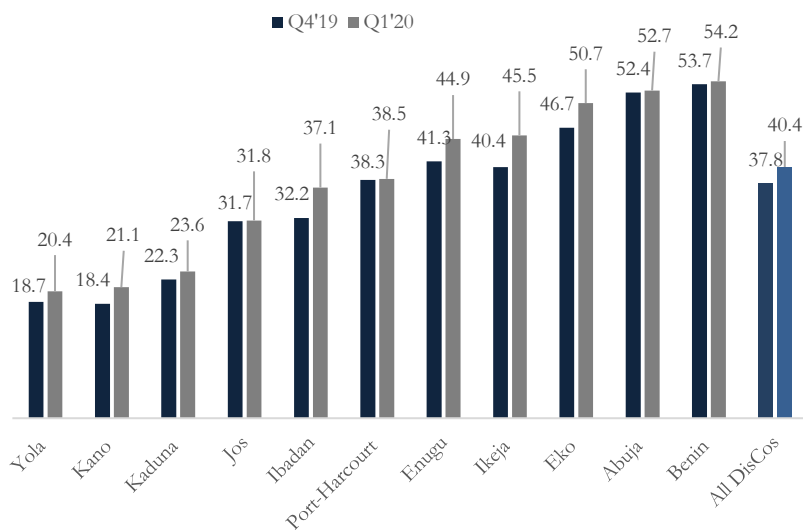
Gas continues to dominate the electricity generation mix in Nigeria. According to NERC, 73.45% of the electricity generated in Nigeria came from gas as at Q1'20. This implies that about 7.35kWh of every 10kWh of electric energy is generated from gas. This represents a 9% increase from 67.02% in Q4'19 (about 6.70kWh of every 10kWh). Although thermal share has been on the decline since Q3'19, where it recorded a decline from 80.25% to 74.63% in Q2'19 and Q3'19 respectively, it still dominates the electricity generation mix in Nigeria according to the latest data from NERC. The share of the electricity generated from hydro is inversely related to the share generated from gas. The latest data on hydro was recorded at 26.55% as at Q1'20, representing decrease from 32.98% in Q4'19, which was the period hydro recorded its highest supply and gas recorded its lowest supply within Q1'19 to Q1'20. The report states that the NERC recognises that the low security of supply associated with having only two energy mixes substantially controlled by gas fuel, as acts of vandalism of gas pipelines could lead to severe grid instability as experienced in 2016. NERC plans to strategically work with other important stakeholders in NESI to develop regulatory interventions and implement policy actions necessary for the actualization of improved energy mix through on-grid/off-grid renewables. At the off-grid level, the Commission's constant engagement with the Rural Electrification Agency ("REA") indicates that potential investors have continued to take advantages of the opportunities created by the Mini-Grid Regulations.

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4.3 Metering of End-use Customers:

Although there was a slight improvement in Q1'20, the huge metering gap for end-use customers remains a key challenge in the industry. Latest data from NERC indicates that, of the 10,477,856 registered electricity customers as at the end of the first quarter of 2020, only 4,231,940 (40.39%) have been metered. Therefore, 59.61% of the registered electricity customers are still on estimated billing which has contributed to customer apathy towards payment of electricity bills. In comparison to the fourth quarter of 2019, the number of registered and metered customers increased by 1.00% and 8.00% respectively. The increase in registered customer population was due to the on-going customer enumeration exercise by DisCos through which unregistered consumers of electricity were brought unto the DisCos' billing platform. Similarly, the increase in metered customers was attributed to the rollout of meters under the MAP scheme.

Fig. 7: Metering Status of DisCos as at Q1'20 (%)



Sources: NERC, PAC Research

Data from NERC shows that all the DisCos recorded progress in the metering of their electricity customers as at Q1'20, compared to Q4'19. Benin, Abuja and Eko DisCos had metered more than 50% of their registered electricity customers, recorded at 54.2%, 52.7% and 50.7% respectively, as at Q1'20. To ensure speedy metering of electricity customers in line with the target of closing the metering gap in NESI by 31 December 2021, NERC continued its monitoring of DisCos' implementation of and compliance with the provisions of the MAP Regulations to fast-track meter roll-out. The NERC approved more preferred MAPs for DisCos that had finalized their MAPs procurement process, increasing the total number of approved MAPs to 29 as at Q1'20.

Data from NERC shows that all the DisCos recorded progress in the metering...

5.0 SWOT Analysis of the Power Sector in Nigeria:

A SWOT analysis of the power sector provides a breakdown of the strengths, weaknesses, opportunities and threats facing the industry in Nigeria:

5.1 STRENGTHS

- Government's Responsiveness and Support
- Increased adoption of better and energy-efficient technology
- Privatisation
- Regulation in the industry

5.2 WEAKNESSES

- Rising costs of electricity generation.
- Poor and obsolete infrastructure.
- Capacities mismatch across the various sections of the power value chain - although GenCos do not utilize their full capacity generating electricity, there is a capacity limitation from the National grid in fully transmitting electricity generated from the grid to the DisCos. While the DisCos also have a capacity limitation in distributing electricity to the end users. This ultimately leads to increased losses across the value chain.

5.3 OPPORTUNITIES

- Growing demand for energy due to rapid growth in population and industrialization.
- Localisation of services: With the localisation of services in the power sector, local manufacturers of meters have an opportunity to showcase their capability to produce bulk meters. This will lead to the creation of jobs and business opportunities for service providers in the metering space such as energy sales merchants.
- Increase in revenue protection needs by the DisCos: As metering density of customers increase across the country, DisCos will require technology and various measures to protect their revenue as there will be an increased risks of meter bypass from customers. Hence, there is an opportunity in providing revenue protection services to DisCos.
- Increase in the use of off grid solutions such as mini solar farms as the power from the grid is unreliable.
- Increasing investment in the improvement of the power sector.

5.4 THREATS

- Compliance and regulatory risks - The act which established NERC does not provide for the absence of a regulator and even though this has been violated in the past, it is important to urgently appoint new NERC commissioners to oversee the affairs of NESI.
- Uncertainty in policy and fuel pricing.
- Foreign exchange volatility.
- Close monitoring and increased accountability to the regulators and government: Holding DisCos Accountable - In allowing DisCos to pass their costs to consumers,

the government through NERC has asked for certain service level agreements (SLAs) from the DisCos. It is very important that the regulator is able to demand accountability from them going forward. NERC needs to set KPIs to be monitored and enforced. This, in the very least will include the distribution code which they have signed to as part of their licence conditions. NERC can use incentives and penalties to drive the development of NESI and make the privatisation process a success providing the desired model for other soon to be privatised public utilities. Hence, DisCos are under constant pressure to improve their efficiency and attain greater cost competitiveness.

- **Absence of a customer-friendly regulatory regime** - The whole purpose of an electric power system is to provide electricity to consumers. A power system is only effective if the consumers are happy and satisfied with the level of service received. Hence, a key measure of success of the privatisation process is the level of customer satisfaction over time. NERC should develop an interim and long term customer engagement and charging mechanisms such as the long run incremental cost model accounting for network utilisation factors, contingency analysis, peak demand and so on. NERC to further monitor investment in loss reduction strategies to ensure consumers are not short-changed for longer than necessary.
- **Security of Lives and Infrastructure** - There is no gain saying that there can be no significant development of NESI if attention is not giving to security of lives, power equipment, gas pipelines and power network infrastructure.
- **Transmission Network** - As generation increases, the weakness of the Nigerian power transmission network will be revealed. Hence, it is better to accelerate the revamping of the ailing transmission and distribution networks at a rate that is commensurate with the growth in aggregate installed generation capacity.
- **Diversified Energy portfolio** - The world is a global village and with key players in the energy sector looking for alternative forms of energy, the reform process will suffer major setbacks without the diversification of the portfolio of energy sources for power generation. There is much to be gained from the international community by way of finance and foreign direct investment if the government increases the portfolio of energy sources to be tapped for electricity generation. For example, government could include, as part of the voluntary emissions reduction targets to address “climate change”, the reduction from the losses within the Nigerian power and gas network. Using the baseline values recorded in NESI, it is easy to attract funding from promises made by developed economies to assist developing nations to adapt to the effect of climate change. Government can do more in the home front to encourage the increased deployment of diverse energy resources for generation of electricity especially for micro grid applications – off grid solar, hydro, coal etc. 55% of Nigerians who are yet to be connected to the grid can therefore have it without recourse to the national grid.

6.0 Challenges in the Nigerian Power Sector:

1. Tariff paid by electricity consumers do not cover the cost of generation, transmission and distribution of electricity supply.
2. Lack of trust between stakeholders and the public.
3. Chronic vandalism that has crippled gas pipelines, creating gas shortages at power plants.
4. Underinvestment in infrastructure and poor maintenance that has affected transmission.
5. Obsolete infrastructure and inadequate investment in power distribution.
6. High collection and commercial losses that have impacted on the financial viability of the privatized distribution companies.
7. Inadequate gas supply.
8. Non-cost reflective electricity tariff and liquidity constraints
9. Low operational capacity compared to its installed capacity.
10. Limited transmission capacity
11. Operational inefficiencies.

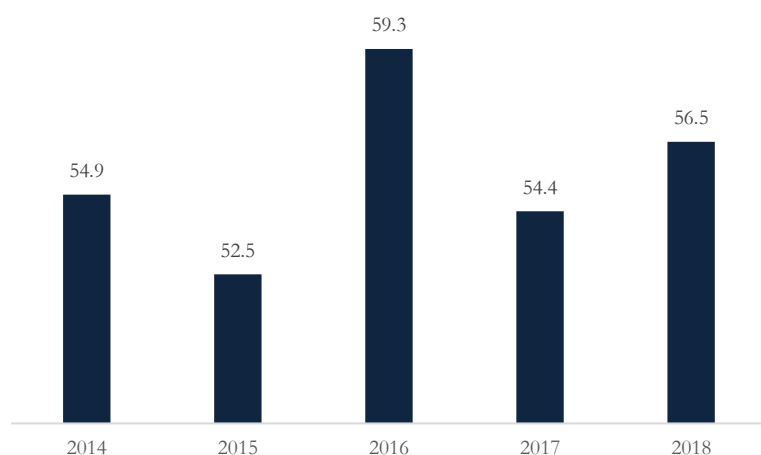
However, Nigerian government has taken steps to address the challenges faced across the power generation value chain. They include:

- i. The introduction of a power regulatory body, the Nigerian Electricity Regulatory Commission (NERC) in 2005.
- ii. The unbundling of power assets and the implementation of the National Integrated Power Project (NIPP) formed to address issues of insufficient electricity generation.
- iii. The introduction of Meter Assets Provider (MAP) in 2018 to encourage the development of independent and competitive meter services and eliminate estimated billing practices.
- iv. The Electricity Theft and Prohibition Bill to tackle energy losses due to theft and sabotage.

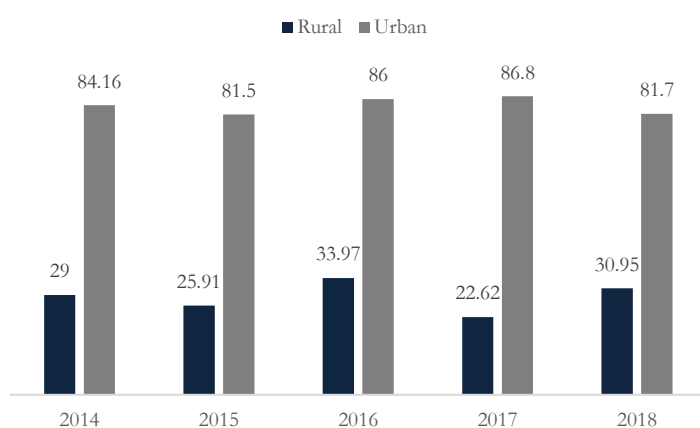
7.0 Rural Electrification in Nigeria

It is undisputable that rural electrification greatly improves the quality of life. Lighting alone brings benefits such as increased productivity in personal activities, improved study environment for school children, extended hours and productivity for small businesses, greater security and operations in the healthcare sector. The people who live in rural areas greatly deserve these benefits as much as those in the urban regions. However, the access to these benefits such as public goods, as well as their distribution, has been in short supply in Nigeria.

It is undisputable that rural electrification greatly improves the quality of life.

Fig. 8: Access to Electricity in Nigeria as at 2018 (%)

Source: World Bank, PAC Research

Fig. 9: Rural and Urban Population Access to Electricity in Nigeria as at 2018 (%)

Source: World Bank, PAC Research

It is estimated that about 30.95% Nigerians do not have access to modern electricity, with millions more suffering from extreme undersupply resulting from frequent load shedding and power outages. The lack of access to energy is directly affecting livelihoods, lowering quality of life and hindering socioeconomic development. The Rural Electrification Strategy and Implementation Plan (RESIP) was developed in line with the federal government's plan for rural electrification and provides the implementation framework and measures for driving rural electrification across the country by means of on- and off-grid energy solutions. The Federal Government of Nigeria has outlined its commitment and approach to rural electrification in a number of official documents, including the National Electric Power Policy (NEPP) 2001, National Energy Policy 2003, the Electric Power Sector Reform Act (EPSRA) 2005, and the Rural Electrification Policy 2009. The Federal Government's Rural Electrification Policy outlines the Government's objectives, goals, and policies regarding rural electrification. The policy, in addition to other key documents on regulation, funding and institutional development, details the institutional framework and procedures to be pursued in order to achieve the objectives of Government's rural electrification program. The primary objective of the Nigerian Rural Electrification Policy and by extension this Rural Electrification Strategy and Implementation Plan (RESIP) is to expand access to electricity as rapidly as possible in a cost-effective manner.

This implies full use of both on-grid and off-grid approaches, with subsidies being primarily focused on expanding access rather than consumption. The EPSRA requires the Minister of Power to submit to the President - a Rural Electrification Strategy and Plan for Nigeria. RESIP sets forth the Government's strategy to accomplish the goals established in the EPSRA 2005 and Rural Electrification Policy and was prepared through input from past work carried out by various rural electrification stakeholders in Nigeria. The Rural Electrification Strategy, together with the Rural Electrification Policy, form the framework through which the expansion of electricity services to rural areas will be achieved. RESIP supports public and private stakeholders in the power sector primarily the REA in attaining its target for 100% rural electrification. It supports on-grid and off-grid players including the Transmission Company of Nigeria (TCN), distribution companies, electricity project developers - implementing rural electrification projects such as mini-grid developers and stand-alone solar technology enterprises, RESIP also supports the electricity market regulator, the Nigerian Electricity Regulatory Commission (NERC), private sector investors including donor/development partners, community based organizations, non-governmental organizations, and ultimately the rural electricity consumer. RESIP was developed as set out in Section 88 of the Electric Power Sector Reform Act (2005) which mandates the establishment of the Rural Electrification Agency (REA), and a Rural Electrification Strategy and Plan. It is currently the strategy document used by the REA in its ongoing rural implementation initiatives across the country.

The goal of the Federal Government of Nigeria is to increase access to electricity to 75% and 90% by 2020 and 2030 respectively with renewable energy contributing at least 10% to the energy mix by 2025 as contained in the National Electric Power Policy (NEPP) of 2001 and the Rural Electrification Policy of 2005 respectively. The national target of 75% can be achieved only if urban electrification reaches 95% and rural electrification reaches 60% by 2020. This will only happen by connecting more than 10,000,000 additional rural households (assuming 7 persons per household). The objectives of the Rural Electrification in Nigeria is to promote economic and social activities in various sectors in order to improve the standard of living of the rural population and also promote the use of affordable clean energy appliances to reduce hard monotonous routine work, especially domestic labour. The implementation plan involves the use of multi-stakeholder approach by involving the government and private stakeholders, which shall be done through Public-Private Partnership and co-investment and financing. The lack of large-scale productive uses for rural electricity remains a constraint on the financial viability of Rural Electrification because of low load factors resulting from consumption being heavily concentrated in the evening peak hours. Rural Electrification does not drive industrial development, but it can provide an impetus to home businesses, even though few households use electricity for productive purposes. Decentralized energy solutions through renewable energy technologies have proven to be the most viable option in reducing energy access deficit for unserved and underserved locations in Nigeria.

The goal of the Federal Government of Nigeria is to increase access to electricity to 75%...

The Nigerian Government has prioritized the exploitation of renewable energy sources to complement the limited power generation and supply and to provide clean and cost-effective electricity especially to unserved and underserved rural areas, economic clusters and federal universities. The Rural Electrification Strategy and Implementation Plan (RESIP) was developed in line with the federal government's plan for rural electrification and provides the implementation framework and measures for driving rural electrification across the country by means of – on and off-grid energy solutions. The REA is currently implementing multiple off-grid electrification programs with the support of the World Bank, African Development Bank and the private sector, mostly through the deployment of solar power to electrify homes, communities and businesses. The following programs are currently being implemented:

- **Energizing Economies Initiative Decentralized Energy Programme (DEP):**

The EEI program has been developed to support the rapid deployment of clean and sustainable off-grid electricity solutions to economic clusters in Nigeria. The aim of the EEI is to increase energy access and economic growth by assisting private sector developers provide clean, reliable and affordable power to economic clusters across Nigeria. The aim of the initiative is to provide sustainable and affordably power to 500,000 SMEs. The EEI project is divided into Phases. Phase 0, which is the pilot phase has powered and commissioned 3 markets in Sura Market in Lagos, Ariaria market in Aba, and Sabon Gari market in Kano. Under this phase, about 8000 shops are currently receiving uninterrupted power supply. Phase 1 of the EEI have identified 13 more markets.

- **Energizing Education Programme (EEP):**

The EEP is expected to provide adequate power supply (89.6MW in total) to thirty-seven (37) Federal Universities and seven (7) University Teaching Hospitals across Nigeria. It also aims to provide streetlights to promote and facilitate safe, secure and productive learning environments as well as to develop and operate training centres to build capacities of university students in renewable energy technology innovations. The REA has been mandated to implement the EEP. The EEP has been divided into phases to ensure effective implementation. Phase I of the EEP is fully funded by the Federal Government of Nigeria, while Phase 2 and 3 will be funded through the World Bank and the African Development Bank, respectively. Phase I involves the powering of 9 Federal Universities across the 6 geo-political zones, which are listed below:

1. University of Petroleum Resources (Delta State)
2. University of Lagos (Lagos State)
3. Obafemi Awolowo University (Osun State)
4. Nnamdi Azikiwe University (Anambra State)
5. Ndufu Alike University (Ebonyi State)
6. University (Kano State)
7. Abubakar Tafawa Balewa University (Bauchi State)
8. Usmanu Danfodiyo University (Sokoto State)
9. University of Agriculture (Benue State)

- **Nigeria Electrification Project (NEP):**

The Nigeria Electrification Project (NEP) is an innovative programme to catalyze off-grid development in Nigeria, through the provision of grant funding, detailed market data and technical assistance. To support this effort, the Federal Government secured funding of \$350 million and \$200 million from both the World Bank and the AfDB, respectively. The NEP is broken into the following four components:

- i. Solar Hybrid Mini-grid - Develop solar hybrid mini grids to serve over 2 million people and over 100,000 SMEs.
- ii. Rural Standalone Solar Home Systems (SHS) - Deploy Solar Home Systems to 1.5 million households which includes solar panels, batteries, fans, TV, lights etc
- iii. Energizing Education Phase 2 - Develop solar hybrid independent power plants at 7 universities.
- iv. Technical Assistance.

The applications for the bids to build and operate mini grids have been launched. The REA is receiving applications from eligible companies to build and operate mini grids in their choice locations through the performance-based grants funding.

12.0 Nigeria Off-grid Funding:

The Nigerian off-grid market has been able to attract massive support within the last three years in the form of grants, low interest loans and equity investments. According to REA, the sector now attracts the biggest foreign direct investments into Nigeria. In the last three years, organisations like the USAID Power Africa, United States Africa Development Foundation, African Development Bank, GIZ, DfID, Heinrich Boell Foundation (a German Foundation), and Shell-funded All On have ramped up funding and advocacy about the prospect of off grid to deliver energy access to Nigerians without power. These organisations have provided both material and technical support to off -grid energy companies in Nigeria. Another \$80 million in debt capital coming through the EU/AFD's SUNREF program through Access Bank and United Bank for Africa, according to REA. Bank of Industry (BOI), a Nigerian development finance Institution and All On, signed a financing agreement which offers N1 billion to off -grid project developers in the nine states of the Niger Delta. In 2016, BOI signed a \$2 million agreement with the United Nations Development Programme, (UNDP) to provide solar-powered electricity to six communities in six states of the federation. All On has provided funding for nationwide Challenges for the incubation of early stage of grid energy companies through the Co-Creation Hub and the Nigerian Climate Innovation Centre as at 2019, according to REA. There are various barriers to the Decentralised Rural Electrification plan, such as:

- a. **Central Planning and Coordination:** While projects will be established in response to demand, rather than top down government planning. Coordination of the activities within the sector must take place at the federal, state and local government levels.
- b. **Demand:** Rural electricity demand and willingness to pay due to rural perception of electricity as government's responsibility that should be highly subsidized.

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- c. **Supply:** The supply of rural electrification schemes under a decentralized, demand-driven system will depend on the interest of project promoters. Their participation will be forthcoming only if it is financially attractive for them to participate.
- d. **Economics:** Rural Electrification schemes usually have high costs relative to the consumers' willingness and ability to pay for service. Many rural electrification programs have proven unsustainable overtime, as operation and maintenance costs were not fully accounted for in project cost estimates.
- e. **Financing:** In addition to high initial costs, rural electrification schemes are also characterized by long pay-back periods. More commonly, they do not offer a payback at all. Financial institutions and investors will offer funds only where it is commercially viable to do so.
- f. **Technical Capacity:** While there are many engineers and other technical professionals in Nigeria, there is a scarcity of qualified personnel for renewable and off-grid renewable energy applications. There is a lack of commercial and financing skill experienced in putting together investment worthy projects.

13.0 Incentives in the Rural Electrification Scheme:

- **Capital Cost Subsidies** - Subsidies towards the initial capital costs associated with establishing rural electrification schemes will be granted in order to lower the economic barriers to entry. These will be offered by the REF as capital grants based on an allocation method that is transparent, competitive, and sustainable. Subsidies for rural electrification, in this case, will also be used as tools for social justice. The Federal Government has identified alleviating poverty and addressing the needs of rural populations as a matter of equity.
- **Promoting efforts to reduce equipment cost** - The REA will advocate for tax incentives, investment capital allowances, and low-interest loans for local producers of rural electrification equipment and materials. In the meantime, the import taxes levied on renewable electricity generation equipment and low-cost supplies must be reduced. While the Nigerian industry prepares to compete in this area, rural electrification schemes must have access to imported materials, components and equipment for rural electrification systems – all without paying exorbitant import taxes.

14.0 Finance and Investment in Rural Electrification Scheme:

Public-private partnership is encouraged between the private sector and community-based organisations that are responsible for majority of the service delivery. This will be done with minimum necessary financial support from the public sector. In accordance with the Rural Electrification Policy and international best practice, tariffs for rural electricity service will be cost-reflective. They shall account for the average annual cost of fuel, operation, maintenance, safety, generation, distribution, revenue collection, spares, equipment and operator fees, expected sales of electricity, generator capacity, number of connections, volume of consumptions, and level of service. The NERC allows the mini-grid developers to adopt cost-reflective tariffs which could either be fixed or variable in line with the Mini-Grid Regulations.

The Commission monitors the output and revenue from the mini grid based on the report submitted quarterly by the permit holder to determine if the tariffs are favourable based on the return on investment. Having established the framework and committed funds for rural electrification, the Federal Government needs state and local governments, the private sector, NGOs, community-based organizations, donors, and other relevant parties to participate in the rural electrification agenda with the goal of achieving universal service coverage by 2040.

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