DELSU Journal of Management Sciences (DELJOMS)
Abbr. Title: Deljoms, FMS
ISSN: *(Online)* **: 2756-3731**
OPEN ACCESS
Research Article Volume 8, Number 1, June 2026

Electricity Infrastructure and Economic Growth in Nigeria: Evidence from ARDL Analysis.

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Publication Date: 2026/06/22

Abstract
This study examined the impact of Nigeria's electricity generation, transmission and distribution infrastructure on human development and economic growth from 2000 to 2025. Time series data on Real Gross Domestic Product (RGDP), Electricity Consumption Per Capita (ECPC), Total Primary Electricity Consumption (TPEC) and Gross Fixed Capital Formation (GFCF) were sourced from the World Bank, National Bureau of Statistics (NBS) and the Central Bank of Nigeria statistical bulletin. Four models were specified to capture the nexus among the variables. The Autoregressive Distributed Lag (ARDL) model to cointegration tested the long run relationship of the series. The findings revealed that ECPC, GFCF and HDI are positive but statistically not significant explaining variations in RGDP while TPEC was negative and statistically not significant explaining variations in RGDP. The study recommended effective electricity generation, transmission and distribution targeting policies that promote efficient modern technologies. Furthermore, massive maintenance and investment on electricity infrastructure should be prioritized in the budget with a view to strengthening public-private partnership in the power sector.

Keywords: *Distribution, economic growth, electricity generation, human development, transmission.*

Introduction

Electricity demand and use globally have been on the increase due to its importance in promoting human well-being and productivity (Davies et al., 2024). Developing countries are encouraging and sustaining their level of economic growth through the use of electricity sources such as solar, fossil fuels, biomass, nuclear, coal, hydro and geothermal. Studies have shown that the rising population rate and urbanization has become the major driver of the world's electricity consumption in recent years (Vo et al., 2024;) (Q. Li et al., 2023). An increase in electricity consumption enables the development of human capital and a determinant for economic growth of any country In recent years developing countries like Nigeria have sought a more efficient, reliable and affordable means of electricity as a panacea for human development and sustainable economic growth (Lekana & Ikiemi, 2021). For instance, electricity consumption improves human abilities in areas such as watching television, boiling of water, getting internet access for up-to-date information and quick environmental awareness (Dwivedi et al., 2022). Electricity consumption also improves the quality of education services with the use of viable and current technological innovations.
Furthermore, electricity consumption makes life-saving surgeries possible and high technological hospital equipment to function and cure advanced diseases and also life support machines amongst many others (Tesfaye Geta et al., 2023). Industries consume energy in the production of output, drastically cutting the cost of doing business. First, with the use of refrigerator, electricity enables the storage and preservation of drugs, food and vaccines for a longer period, hence improving industrial output and human health (Pambudi et al., 2022). Second, electrical lighting encourages humans to study for more hours thereby increasing the adult literacy rate, a major component of the Human Development Index (HDI) (Shishegar & Boubekri, 2022). Furthermore, computer, internet and television usages enhance economic agents' ability to obtain recent information and knowledge capable of promoting their financial transactions, businesses, human well-being and capital accumulation (Javaid et al., 2024). The steady supply of electricity makes the usage and adoption of modern households, businesses and industrial electronics and

electricity-powered appliances easy (Hannagan et al., 2022). It is usually more convenient for electricity-dependent individuals and industries into productive activities like cooking, heating, sanitation and entertainment which greatly enhance human quality of life (H. Li et al., 2024).

Furthermore, electricity usually comes in renewable form such as solar, wind, hydro and geothermal, which is capable of reducing pollution, $C0_2$ emission and enhances environmental quality. That is, it can be consumed without emitting carbon (Jaiswal et al., 2022). Due to its unmatched benefits, most developed countries have transited to more reliable sources that can efficiently promote cleaner environment and mitigate climate change especially in industrialized states (Ang et al., 2022). Finally, the efficient use of electricity releases humans and industries from manual operations and saves time for efficiency. It provides the good opportunities to be self-employed and encourages mass production abilities (Hafez et al., 2023). Therefore, the efficient consumption of electricity is an indicator of human welfare, major determinant of industrial output and sustainable economic progress.(Dube et al., 2024).

Globally, an average of 2.7 billion people still use conventional biomass, while 2.5 billion people worldwide lack access to reasonably priced and dependable electricity (Marie et al., 2021). The lack of electricity has turned into a barrier to social advancement. For example, the majority of rural populations in South Asia and Africa lack access to electricity. One measure of a nation's degree of socioeconomic progress is its electricity consumption (Bazán Navarro et al., 2023). In order to promote sustainable development, sufficient amounts of electric energy must be produced during the development process. As is commonly known, electric energy is a type of secondary energy that is created by converting primary energy sources like coal, nuclear, and hydropower into other useful forms of energy (Kaunda et al., 2012). From the development of resources to final use, the process of producing electricity requires a number of connections, including production, generation and transmission (Strielkowski et al., 2021). In addition, a service system and accompanying mechanical facilities are required to protect the electricity supply, particularly when designing and building a grid system. This will necessitate comparable financial resources and support strategies. Therefore, it is not possible to increase electricity usage overnight. While electricity is a clean energy source when used, its generation has certain environmental risks (Rahman et al., 2022). For example, massive amounts of greenhouse gases are released when coal is used to produce power. However, it is relevant to increase electricity usage in order to promote socioeconomic development (Dai et al., 2022).

The distribution, transmission and generation of electricity in Nigeria have been a major concern to growth and development for many years. Despite the massive natural endowment of clean electricity sources like solar, hydro, wind and geothermal, Nigeria still suffer from severe energy poverty (Nwozor et al., 2021). A great number of Nigerians do not have access to reliable and affordable power supply, as most of them rely on petrol and diesel powered generators. These generators emit carbon (IV) oxide which is detrimental to the environment and human health (Babamohammadi et al., 2025). However, majority of the people suffering from poor electricity supply reside close to the power grid. Hence, the fundamental question is why are these consumers not connected to the grid or how has electricity consumption influences changes in human development and GDP growth in Nigeria?

In 2023 Nigeria generated about 40 terawatt hours of electricity which indicates a 5 terawatt hour increase from 2022. However, the demand for electricity surpasses the generated amount with about 40.6 terawatt hours (Obada et al., 2024). Nigeria's continuous electricity challenges have further increased unemployment, weakened industrialization, and led to the massive withdrawal of foreign investors and Nigeria's ability to favourably compete globally has been abated. There is need for improved investment in the power sector to cover the demand-supply gap. Electricity demand is forecasted to further increase with expected rise in Nigeria's population (Owebor et al., 2021). Have electricity consumption significantly influenced human development in Nigeria?

Most studies have established the relationship between electricity consumption and economic growth in Nigeria. However, none or a few have examined a disaggregated impact of the generation, transmission and the distribution of electricity on human development and economic growth in Nigeria. The government, corporate bodies and researchers would be guided in making relevant policies in combating the challenges of specific electricity challenges in Nigeria, in terms of generation, transmission and distribution. This study has contributed to existing literature as it provides electricity generation, transmission and distribution core determinants to electricity consumption, human development and economic progress in Nigeria.

Objectives of the Study

The broad objective of this study is to investigate electricity infrastructure, consumption, human development and economic growth nexus in Nigeria from 2000 to 2025. The specific objectives are to:

i. examine the relationship between electricity consumption and human development in Nigeria

ii. investigate the relationship between human development and economic growth in Nigeria.
iii. establish the relationship between electricity consumption and economic growth in Nigeria

Research Hypotheses
The relationship between electricity consumption, human development and economic growth can be tested using the following hypotheses:
H_{o1}: There is no significant relationship between electricity consumption and human development in Nigeria.
H_{o2}: There is no significant relationship between human development and economic growth in Nigeria.
H_{o3}: There is no significant relationship between electricity consumption and economic growth in Nigeria.

Review of Related Literature

Conceptual Review

Evolution and Present Situation of the Nigerian Power System

Generation, Transmission and Distribution

Generation

This sector consists of stations under the National Integrated Power Project (NIPP), Generation Companies (GenCos), and Independent Power Producers (IPPs). There are currently 23 grid-connected generating plants operating with an average installed capacity of 12,520MW (Owebor et al., 2021). The IPPs are privately owned operated plants such as the Agip-operated Okpai (480MW), the Shell-operated Afam VI (642MW), Ibom Power, NESCO, and AES Barges (270MW). An essential component of the government's strategy to address the nation's power outages is the NIPP. It was a government-funded project that was started in 2004 with the goal of significantly expanding Nigeria's power supply industry's generation, transmission, and distribution capacity as well as building the infrastructure needed to supply natural gas to gas-fired plants across the nation. The total capacity of the ten National Integrated Power Projects (NIPPs) is 5,455 MW (Akuru et al., 2017). With a transaction cost of over \$3.0 billion, the privatization strategy of the Nigerian Power industry is one of the most audacious privatization efforts of the world's power industry in the past ten years (Idowu et al., 2020) .

For the generation and distribution sectors, the Nigerian government has successfully finished the privatization process. Electricity production in Nigeria began in 1896, according to the Nigerian Electricity Regulation Commission (NERC), while the countries' first electricity utility, the Nigerian Electricity Regulation Commission (NERC) was founded in 1929. In 1902, an additional unit was added, and as at 1909, the average capacity installed had increased to 120KW with average electricity consumption of 65KW (Edomah et al., 2016). Nigeria constructed her first electrical power plant in the year 1896 which consisted of a 1000v, 30kw, 80cycle, single-phase electricity supply (Ayamolowo et al., 2019). The power station in Marina, Lagos had an average installed capacity of 420 kW in 1920. In 1924, the average capacity installed was 3.6 MW with a 3-phase , 4-wire, 50-cycle system (Edomah et al., 2016) while the first coal-fired power plant was constructed and commissioned on June 1, 1923. However, the Marina power station faced challenges like low gas supply, liquidity problems and transmission lines related issues and was unable to operate optimally. There was an increase in the capacity installed of the new power plant to 13.75 MW. Despite these increase, Nigeria experienced decline in the use of coal generated electricity between 1944 and 1948 due to fewer mining operations and the discoveries of small-scale crude oil that led to the large-scale discovery in 1956 (Edomah et al., 2016). The Niger Dams Authority (NDA) built three hydroelectric plants in Kainji, Jebba and Shiroro in 1968, 1985 and 1990 respectively to meet the electricity needs of the rising population (Babatunde et al., 2023). However, there was no corresponding rise in the amount of power available in Nigeria as the country's population demand for electricity outgrew its supply. The available power was then raised from 4,105 MW in 2023 to 5,530 MW by the end of 2024 (Adeshina et al., 2024).

Nigeria's power needs were not being met by the country's electrical infrastructure in the 1990s, which prompted the National Electric Power Policy of 2001 along with a number of other reforms (Somoye, 2023). The National Electric Power Authority (NEPA), a state-owned monopoly, controlled the production, transmission, and distribution of electricity in Nigeria by the year 2000. With two hydro and four thermal power facilities, it generated roughly 6,200 MW of electricity overall and functioned as a vertically integrated utility corporation. As a result, the nation's electric power supply became unstable and unreliable, exposing consumers to long periods of power outages and frequent power cuts (Mak Wai Kin et al., 2015). The industry was also characterized by outdated power plants, low revenues, high losses, power theft, and non-cost reflective tariffs, as well as a lack of maintenance of power infrastructure. To address the issue of power scarcity, the National Integrated Power Projects (NIPP) and Independent Power Producers (IPPs) were created by 2001. Nigeria's installed power producing capacity was projected to be 6,861 MW in 2005 (Ayamolowo et al., 2019).

The vertical transformation of the Nigerian power sector produced 6 IPPs and power generating companies which were known as GenCos with defining features of the country's energy reform. The founding of the NDA in 1962 and the Electricity Cooperation of Nigeria (ECN) in 1951 marked the beginning of the transition. NEPA was thereafter known as the Power Holding Company of Nigeria (PHCN), and was created by the merger of the NDA and ECN under Decree 24 of 1972. The National Electric Power Policy, which was established in 2001 with the intention of creating an effective energy market in Nigeria, marked the beginning of the electricity sector's reform in Nigeria (Adeshina et al., 2024). Its main goal was to give the private sector control and ownership of the assets and infrastructure of the energy sector, which would lead to the establishment of the structures needed to establish and maintain a market for electricity in Nigeria (Arowolo & Perez, 2020).

Table 1: Nigeria's Power Demand, Generated and Available Power

Year	Estimated Demand (MW)	Power Generated (MW)	Power Available (MW)
2010	21,624	6,904	3,358
2014	25,434	8,876	3,795
2016	28,360	10,396	4,959
2018	30,458	12,297	5,254
2020	25,322	8,625	4,826
2022	32,207	10,261	6,421
2024	35,332	12,872	7,126
2025	37,216	15,211	8,271

Source: Nigeria Electricity Regulatory Commission, 2025

Because of this, a sizable portion of Nigerians are forced to rely on alternate power sources, primarily fossil fuels (both small diesel generators and centralized large-scale generators), which greatly increase carbon footprints (Heinemann et al., 2022). Prospective investors were recently sent Expressions of Interest (EOI) notices by the Bureau of Public Enterprises (BPE) regarding the acquisition of a 100% stake in any of the five power generation businesses listed for sale under the NIPP. Calabar Generation Ltd. has 634 MW, Omotosho Generation Ltd. has 513 MW, Olorunsogo Generation Company Ltd. has 754 MW, Benin Generation Company (BGC) ltd. has 507 MW, and Geregu Generation Company ltd. has 506 MW of installed capacity (Okoye, 2024).

Transmission and Distribution

Nigeria's transmission network is controlled by the Transmission Company of Nigeria (TCN). Transmission of power, system operation, GenCos, and wheeling it to the DisCos are among the licensed activities of TCN, which is currently entirely owned and run by the government at the early part of the 1960s, power stations at Afam, Jebba, Kainji, Shiroro, Egbin (Lagos), Delta (Ughelli) and Sapele (Ogorode) were connected, marking the beginning of electricity transmission in Nigeria. The 330 kV transmission network expanded to include thirty-two transmission lines and twenty-eight buses during this time (Okakwu & Ogujor, 2017). The number of buses increased from 28 to 52 between 1998 and 2023, with a corresponding increase in the transmission lines number from 32 to 64 (Gielen et al., 2019). The grid has 4 control centers (1 national control center at Oshogbo and 3 supplementary control centers at Benin, Shiroro, and Egbin) and connects these stations with 42 buses and 64 transmission lines. The merging of PHCN's transmission and system operations divisions gives birth to one of the 18 businesses that were separated from the now-defunct PHCN in April 2004. On July 1, 2006, it received a transmission license after being incorporated in November 2005 (Adoghe et al., 2023). Currently, Nigeria has over 197 substations; 19,000 km of 153132Kv and 43330 kV substations lines that make up the power distribution network. There are currently 11 electrical distribution companies operating in the nation (Esan et al., 2025). By 2013, 10 distribution businesses had been fully privatized, although the Federal Government still owned the transmission company (Esan et al., 2025). In November 2014, the eleventh distribution firm was fully privatized. Nigeria presently has 11 Electricity Distribution Companies (DisCos) who are responsible for receiving generated energy from GenCos and further distribute to billing customers and consumers in Nigeria (Adoghe et al., 2023).

Activities and Components of the Nigerian Power System

Electricity Access

The 2024 reports from the World Energy Outlook database and International Energy Agency's (IEA), revealed that Nigerians with access to affordable electricity was 61.6% as of 2023, which is 87.5 million people out of the 227.9 million lack access to electricity supply (Olaniyan et al., 2024). An average of 49% of Nigeria's population resides in rural areas of which the electricity poverty is more severe and about 51% in urban areas. Access to electricity was recorded at 91.4% for the urban population and 30.4% for the rural population, a roughly 6% decline from 36% in 2018 (Alabi et al., 2022). Nevertheless, the

Covid-19 epidemic has undone earlier gains. Nigeria is not the only country affected by this. The percentage of people in Nigeria without access to electricity rose in 2020, undermining the gains made since 2013 and putting many nations further away from reaching the 2030 universal access target (Kruk et al., 2018). The IEA, World Bank , UN, and WHO released the Tracking SDG7: The Energy Progress Report of 2024 ranked Nigeria as the nation with the worst access to electricity in the world, with approximately 88 million people living without power (Arora & Mishra, 2022). This figure represents almost 40% of the entire population. Customers who live in areas where the grid is accessible, which includes 55% of the population, frequently lose electricity for four to 15 hours per day (Nyarko et al., 2023). Nigerians use alternative, frequently less hygienic, and more costly stopgap techniques to address this enormous gap. According to the REA it cost Nigerians about $14 billion (₦21.8 trillion) a year on inefficient and inadequate power generation that is expensive, polluting and noisy. The IEA estimates that 41GW of standby generating capacity in sub-Saharan Africa produced 40TWh of power in 2018, or 8% of total energy generation. Nearly half came from Nigeria, which produced 18TWh of electricity using roughly 9GW of backup generation. Given the existing situation, the three significant and relative ambitious goals have been set by the Nigerian government for the country's electrical sector by 2030. These three goals have to do with lowering emissions, developing renewable energy, and facilitating access to electricity. 90 percent of Nigeria’s population, including those urban and rural regions, should have access to power supply by the end of the year (Adeshina et al., 2024).

Electricity Generation Mix and Installed Generation Capacity

Nigeria has been Africa’s largest economy for many decades but her power sector has faced some limitations that hinder its ability to grow economically (Copinschi, 2022). With her abundant untapped renewable and non-renewable resources the country is capable of generating an average of 12,522MW of electricity, from its current facilities alone, excluding off-grid generation, if these resources are optimally harnessed (USAID). However, the country’s capacity utilization rate is about 32% as at 2024. (Diemuodeke et al., 2021).

Main Sources of Power

The installed electricity generation capacity of Nigeria is 5,528MW in 2023 (Owebor et al., 2024). Gas-fired thermal and Hydro power plants are the primary sources of electricity generation in Nigeria; the hydro facilities generate 2,062MW, while the gas-fired plants generate 11,972MW (Table 1). The remaining 2,350MW come from wind, solar, diesel and Heavy Fuel Oil (HFO) (Nchege & Okpalaoka, 2023). Nigeria still has challenges in dispatching at full capacity, even with the aforementioned data. The nation achieved its greatest dispatch power ever on February 28, 2021, at 5,615.40MW, 22MW more than the earlier of 5,592.30MW, which was recorded just three days earlier (Remy & Chattopadhyay, 2021).

Renewable Energy

Solar

In 2024, the largest economy in Africa has an average of 6.25 hours of sunshine each day, according to the Nigerian Meteorological Agency (NIMET). According to Oyedokun et al.(2022) Nigeria gets around 4.850 × 1010 kWh power of electricity direct from the sun every day. Nigeria's yearly average solar energy is 1.804 × 1015 kWh, which is on the basis of the country’s landmass. Accordingly, Nigeria offers countless chances to harness solar energy (Bisu et al., 2024). Data from IRENA revealed that Nigeria claimed a total installed capacity of about 28 MW in 2019. According to the Solar Report of Nigeria (2021), this is in consonance with the country's solar installed capacity rising from 15.2 MW in 2012 to 19.3 MW in 2018. 500MW of solar PV installed capacity is the aim of the 2025 Renewable Energy Master Plan (Obada et al., 2024). About 427,000MW of concentrated solar power and photovoltaic generating are thought to be possible. Nigeria had approximately 2.8MW of installed mini-grid capacity in 2019, with 59 projects catering to rural customers (Obada et al., 2024). The scenario has changed since an increased number of solar mini-grids have been installed in 2020. The increasing number of firms using the technology to power their operations has brought an expansion in industrial and domestic solar sector in Nigeria.

Hydro

Large rivers, natural waterfalls, and an estimated 1,800 m3 of renewable water resources per person year are all abundant in Nigeria. The Niger River, Benue River, and Lake Chad basin are the primary water resources with abundant hydropower potential (Adeniran et al., 2021). There are currently 2,062MW of hydropower installed overall. Additionally, hydropower's entire exploitable potential is estimated by study to be over 14,120 MW (Nchege & Okpalaoka, 2023), or more than 50,800 GWh of electricity per year. Therefore, over 85% of the potential hydropower remains untapped and unexploited. In 2020, Nigeria was rank among the world's 20 greatest economies by expansion at a rate of 11 to 13 % (Raghupathi & Raghupathi, 2020). Target for hydropower development of 12,801MW and 6,156MW were established for 2030 and 2020, respectively, in accordance with this objective. Additionally, a partnership was formed between the Ministry of Water Resources and the Ministry of Power with the goal of repairing a number of existing hydroelectric plants. As a boost to the

40MW Kashimbila and 700MW Zungeru hydropower projects that are in construction, the plants include the, Challawa (8MW), , Oyan (10MW), Gurara 1 (30MW), 6MW Ikere plant and Tiga (10MW). There are 6 hydroelectric plants in Nigeria, albeit not all of them are completely functional. There are three large plants operating: Shiroro (600MW), Jebba (578MW), and Kainji (760MW). Additionally, the Mambilla Power Plant is anticipated to be finished with an installed capacity of 3,050 MW.

Wind

The Katsina Wind Farm is Nigeria’s first wind generated electricity project with an installed capacity of 10 megawatts (Akporhonor et al., 2024). The facility was completed and commissioned in 2021 and is situated in Lamber Rimi region of the state. The farm was designed to boost rural electrification in the rural areas in the north and ensure that over 27000 rural households have access to reliable and affordable access to electricity (Ibrahim et al., 2023). The Katsina wind farm marks a significant advancement for Nigeria's wind energy industry.

Nigeria's wind energy capacity remained steady at 3 megawatts as of 2020, the same level recorded since 2014 (Okafor et al., 2022). In 2020, South Africa has Africa's largest wind energy capacity. Nigeria is endowed with resources for wind energy, especially in its northern states. There is currently a 10 MW wind farm in Katsina, but it has several obstacles that prevent it from operating to its full potential, including security issues and budgetary limitations (Obada et al., 2024). Nigeria may lessen its dependency on fossil fuels and diversify its energy mix by making direct investments in renewable energy projects like wind and solar farms. On the other hand, foreign investment can provide much-needed funds and experience to build these projects effectively and sustainably.

Nigeria’s Energy Future

Nigeria's energy future depends on effectively balancing the country's plentiful resources with the expanding population's energy demands (Adeshina et al., 2024). Every industry is supported by a robust energy system, including high technology, infrastructure, communications, agriculture, enterprises, healthcare, and education (Emezirinwune et al., 2024). The Nigerian government recognized these issues and in 2022 unveiled its ambitious Energy Transition Plan, which calls for a substantial investment of $1.9 trillion across a number of sectors, including power, transportation, and cooking, in order to achieve carbon neutrality by 2060. The Energy Transition Plan, along with a move toward renewable energy sources like solar and hydropower, provides a roadmap for a more equitable and sustainable energy future (Hassan et al., 2024).

Compared to the fossil fuel industry, switching to renewable energy could result in a lot more job possibilities as a way to reduce carbon emissions (Hanna et al., 2024). According Garrett-Peltier (2017), the renewable energy sector has the potential to generate up to three times as many employment as the fossil fuel sector. Even while it makes sense to expect a brief spike in employment to promote the renewable energy industry, it is obvious that this growth in employment would continue after the initial stage. In comparison, coal and other fossil fuel-based power sources naturally need less labour. Moreover, the establishment of a national renewable electricity standard would promote job growth in industries like financial services and transportation in addition to directly generating jobs in the renewable energy sector. Additionally, workers in the renewable energy business would have more money to spend on restaurants and movie theaters, among other goods and services, which would benefit industries unrelated to energy. By 2030, consumers would also save an estimated $95.5 billion on their electricity expenses, which would boost the economy even further (Murinde et al., 2022). With continuous research and development activities aimed at improving efficiency, cutting prices, and further raising the proportion of renewable energy in the world's energy mix, the future of electricity generation is bright. We have the chance to build a more sustainable and just future for future generations as long as we keep utilizing the potential of electricity generation. It is quite worrisome as the gap between power generation in Nigeria and world advancement in clean energy continue to grow.

Empirical Literature

Electricity consumption and human development have been found to be less correlated in the past than electricity consumption and economic growth. For the 120 countries that were examined, Lekana & Ikiemi (2021) discovered a significant relationship between electricity consumption and both the Human Development Index (HDI) and GDP. The countries with the highest levels of per capita electricity consumption also achieved the highest rankings in both economic activities. The study of Lawal (2023) found that electricity consumption is a core determinant of human welfare in Africa. The study of Sarkodie & Adams (2020) show that electricity consumption can improve quality education, health, livelihoods, access to resources which lead to healthier and better society.

In their research Nchege & Okpalaoka (2023) established that the utilization and discovery of electricity have positively influenced the growth of the Nigerian economy and sustained improvement of human development. This is in agreement with the findings of Onabote et al. (2023) and Keji (2021) which discovered a correlation between human development and the growth of the Nigerian economy. They used secondary data and adopted the Augmented

Solow model, and discovered that electricity consumption and human development are strongly correlated On the contrary the study of Sarkodie & Adams (2020) revealed that electricity consumption is positively correlated with human development, human development is negatively correlated with growth in Nigeria. The studies recommend the proper and efficient allocation of electricity to rural and urban dwellers in order to boost Nigeria's economy. Casati et al. (2023) investigated the impacts of the various ways of measuring human development as influenced by electricity consumption in sub-Saharan Africa, noting that health and education are salient factors of human development. Using secondary data sourced from the World Bank, the findings from the study revealed poor attention has been paid to electricity transmission and distribution compared to education and health but both are vital to sub-Saharan Africa's economic growth and development.

Adejumo et al. (2021) examined the relationship between the role of schooling and the growth of Nigeria's economy. The study showed that schooling (proxy by primary, secondary and tertiary school enrolments), health and physical capital stock exhibits a positive relationship while secondary and tertiary enrolments were found to be inversely related with economic growth in Nigeria. Arjun et al. (2020) investigated the importance of electricity consumption and human development to the Nigeria's economy using the endogenous growth theory coined by Paul Romer. The study adopted the cointegration approach and the Error Correction Mechanism (ECM), and the results revealed that a response device exists between electricity consumption and human development in Nigeria. The study carried out by Daly et al. (2024) investigated the relationship between investment in electricity transmission, human development and the growth of the Nigerian economy, using the Error Correction Model (ECM) and Granger causality econometric techniques. The findings revealed the existence of no causality between investment in electricity transmission, human development and economic growth in Nigeria. The study recommends budgetary increase to the power and health sectors and increased investment on related infrastructure like steady power supply, good roads, affordable housing and supplies to further boost human capital development. Labour mis-match is another bane militating against human development in Nigeria. The authors concluded that, in the long run, when the consumption of energy, especially electricity increases, there will also be an improvement in the level of human development and economic growth in Nigeria.

Ali et al. (2020) employed a trivariate causality method, to investigate how the consumption of electricity will translate to the growth of the Nigerian economy and found out that there exist a two-way causality between electricity usage and the growth process in Nigeria. Also, Iyke (2015) investigated the relationship between electricity usage and GDP growth in Nigeria and the results show that a long-run relationship exist between electricity usage and economic growth in Nigeria.

Tambari et al. (2024) carried out an empirical research to analyse the roles of electricity consumption in Croatian economic growth, using the Error Correction Model (ECM) to analyse the long run nexus among industrial and household electricity consumption, primary energy production, net electricity imports and oil consumption. The findings revealed causality that runs from economic growth to other variables. The study of Karanfil & Li (2015) established that human development and electricity consumption per-capita are found to be correlated with economic growth and other welfare indicators. It was inferred that the more energy is consumed in form of electricity, the higher the quality of life. Nguyen et al. (2023) employed the Lorentz Curve, Theil Index and Gini Coefficient to explain the inequality of electricity consumption in low, medium and high income countries. For instance, in Brazil, rural electrification has become a core determinant in alleviating poverty through the enhancement of power generation in rural areas.

Gaps in Previous Studies

Previous literatures have examined the inter-relationships between electricity consumption, human development and economic growth in Nigeria. However, a very few or none had investigated the electricity generation, transmission and distribution process as it influences human development and economic growth in Nigeria. Unlike previous studies, this study examined the three stages of the electricity system with the aim of investigating the particular stage of the system that requires policy attention. Unlike other studies, this study investigated three-way inter-relationships between human development and electricity consumption; economic growth and human development; and economic growth and electricity consumption in Nigeria, using an Autoregressive Distributed Lag Models (ARDL) to cointegration.

Theoretical Framework

This study re-specified the New Growth Theory as:

$Y = b_o + b_1L + b_2C + b_3E + b_4H + b_5INFR + b_6TPEC + b_7ECPA + b_8\,HDI + u_t$ (17)

Where C= Capital; L=Labour; E=Education Investment; H=Healthcare Investment; INFR= Infrastructure Investment; u= stochastic term.

The modification of the New Growth theory established TPEC, ECPA and HDI as explanatory variables RGDP. As lacunae the theory did not incorporate the function of electricity consumption to human development and GDP, of which this study established. It is expected that the quality and quantity of electricity generation, transmission and distribution influence human development and economic growth.

Research Methodology

Nature and Sources of Data

Annual data on Real Gross Domestic Product (RGDP), Human Development Index (HDI), Electricity Consumption Per Capita (ECPA), Total Primary Electricity Consumption (TPEC) and Gross Fixed Capital Formation (GFCF) were sourced from the World Bank Development Indicator (WDI) and the Central Bank of Nigeria (CBN) Statistical Bulletin (various issues) from 2000 to 2025, presenting a sample size of 25 time series data.

Definition and Measurement of Variables

Table 2 shows the definition and measurement of variables used in this study.

Table 2: Definition and Measurement of Variables

S/N	Variables (Sources)	Definition of Variables	Measurement of Variables
1	Real Gross Domestic Product (CBN Statistical Bulletin)	The Real GDP is a measure of Nigeria's economic output that has been adjusted for inflation for the period under study	The use of constant prices from base year (2000)
2	Human Development Index (WDI)	The Human Development Index measures living standard, life expectancy and adult literacy level (education).	The GNI per capita is used to measure the standard of living. The HDI is the geometric mean of education, life expectancy, and the living standard.
3	Gross Fixed Capital Formation (GFCF) (CBN Statistical Bulletin)	GFCF comprises the purchase of new assets for private use and production minus disposals.	GFCF measures the total assets acquired for the purpose of production minus value realized after the disposal of fixed assets plus extra values from non-productive assets.
4	Total Primary Electricity Consumption (WDI)	It measures the aggregate demand of electricity (renewable sources) of a country. It consists of the consumption from the power sector and the process of transformation.	Kilowatt-hours (*kWh*)
5	Electricity Consumption per capita (WDI)	ECPC measures the value of electricity consumed per man in Nigeria.	Kilowatt (kWh) per man in a year.

Source: Author's Compilation from IEA, 2024

Explanation of Key Terms

Watt (W) measures the rate by which electricity is produced and consumed in Nigeria.
Kilowatt (*kW*) refers to one thousand watts
Megawatt (*MW*) refers to one million watt or one thousand kilowatt
Gigawatt (*GW*) refers to one billion watts or one thousand megawatts
Kilowatt-hour (*kWh*) refers to the amount electricity used up by a device with a output power of one kilowatt per hour.
Megawatt-hour (*MWh*) is used to measure the output of an electrical plant.
Gigawatt-hour (*GWh*) is used for the measurement of the capacity of large electrical power plants

Description of Expected Relationship

Table 3 presents a description of the dependent and explanatory variables and their expected relationships.

Table 3 Variables and Expected Relationship

Models	Dependent Variables	Explanatory Variables	Expected Relationship
Model 1 RGDP $=f(GFCF_{it}, ,TPEC_{it})$	RGDP	GFCF and TPEC	GFCF (+ relationship) TPEC (+ relationship)
Model 2 RGDP $= f(GFCF_{it},, ECPC_t)$	RGDP	GFCF and ECPC	Labour (+ relationship) Capital(+ relationship) ECPA (+ relationship)
Model 3 HDI $= f(GFCF_{it},, TPEC_t)$	HDI	GFCF and TPEC	GFCF (+ relationship) TPEC (+ relationship)
Model 4 HDI $= f(GFCF_{it},, ECPA_t)$	HDI	GFCF and ECPC	GFCF (+ relationship) ECPA (+ relationship)
Model 5 RGDP $= f(GFCF_{it},,HDI_t)$	GDP	GFCF and HDI	GFCF (+ relationship) HDI (+ relationship)

Source: Author's compilation

Methods of Data Estimation

As first step, descriptive statistics for the series were carried out to ascertain the distribution status. Further, the test for unit root was done using the Augmented Dickey Fuller and Phillips Perron unit root test in order to ascertain the time series behaviour of the individual variables and the order of integration. To determine the long-run relationship of the series, the Auto-regressive Distribution Lag (ARDL) bounds test approach to cointegration was employed. The ARDL is most appropriate when the regressors are stationary at level *1(0)*, and/or first difference *1(1)*. The ARDL bounds test further gives room for different optimal lags of the variables (Kripfganz & Schneider, 2023).

Results and Discussion

Descriptive Statistics

Descriptive statistics allowed us to gain an insight of the data used in this study and also a more precise idea of the distribution of the variables. Descriptive statistics examined the mean, median, maximum values, minimum values, standard deviation, skewness, kurtosis and jarque-Bera statistics. Table 4 shows the values of the descriptive statistics.

Table 4: Summary of Descriptive Statistics

	RGDP	ECPC	GFCF	HDI	TPEC
Mean	751499.8	2.002	17.493	0.477	339.240
Median	674889.0	2.047	15.490	0.480	283.000
Maximum	2513243	2.708	33.834	0.560	592.000
Minimum	210890.1	1.221	14.020	0.220	196.000
Standard Deviation	541434.0	0.472	4.443	0.065	132.476
Skewness	1.483	-0.185	2,066	-1.611	0.592
Kurtosis	4.899	1.710	6.982	7.650	1.812
Jarque-Bera	18.098	2.624	48.044	46.689	4.103
Probability	0.000	0.269	0.000	0.000	0.128
Sum	26.302	70.073	612.258	16.720	11873.40
Sum Sq.Dev.	9.977	7.582	671.301	0.147	596703.5
Observations	26	26	26	26	26

Source: Author's Computation

The mean of the variables measures the average value of the series. The figures provide a single point summarizing the central tendency of the series, effectively indicating where majority of the series lie within the distribution. The mean of the RGDP is the highest (751499.8) while HDI reflects one of the lowest in the world of 0.477. This indicates the increasing level of adult illiteracy, deteriorating educational institutions, rising infant mortality rates due to inadequate and moribund health facilities, rising brain drain in the health sector, declining standard of living due to weak reward for labour and rising rate of unemployment in the country.

The median of the series show a more robust measure of the central tendency that are less influenced by skewed distribution or outliers, providing a true representation of the series when there are extreme values as compared to the mean. This shows that the series are normally distributed.

The maximum and minimum values of the series show the range or spread of data and indicate the lowest and highest possible values of the series. It also provides crucial understanding of the total distribution and identifies possible outliers. The figures show the absence of outliers and data –entry errors. This implies that the series are normally distributed. The values of the standard deviation provide relevant insights that the series are normally spread around their means, with valuable insight of the variability within the series. This allows for a more comprehensive and understanding beyond their average values alone. The lower standard deviation values for the explanatory variables (ECPC, GFCF, HDI and TPEC) indicate the data are tightly clustered around their means. This means that the series are normally distributed.

The positive skewness values show a right tail from the normal distribution while the negative skewness value show a left tail This shows the lack of asymmetry in the series and hence, normally distributed. The kurtosis measures the flatness or tallness (peakedness) of the series' distribution. As a rule, the normal distribution is 3, but if it is higher than this value, the distribution is peaked (Leptokurtic) in relation to the normal, but if it is below 3, the distribution is flat (platykurtic) in relation to the normal. From table 4 the values are close to 3 which mean that the series are normally distributed.

Unit Root Test

The unit root test results are presented in tables 5a, 5b, 5c and 5d at level and at first difference.

Table 5a: Augmented Dickey Fuller (ADF) Summary of Unit Root Test Results

Variables	ADF Test Statistics (At level)	Mackinnon Critical Values			Prob. (values)	Remark
		1%	**5%**	**10%**		
RGDP	1.511	-3.670	-2.963	-2.621	0.998	Not Stationary
ECPC	-4.318	-4.284	-3.562	-0.215	0.009	Stationary
GFCF	-2.953	-4.252	-3.548	-3.207	0.159	Not Stationary
HDI	-9.191	-4.262	-3.562	-3.209	0.000	Stationary
TPEC	-2.426	-4.252	-3.548	-3.207	0.360	Not Stationary

Source: Author's Computation

The unit root test, as identified in the Augmented Dickey Fuller Test result in table 5a, at levels shows that Real Gross Domestic Product (RGDP), Gross Fixed Capital Formation (GFCF) and Total Primary Electricity Consumption (TPEC) are not stationary at level with a probability values of 0.9989, 0.1596 and 0.3602 respectively. This is because their respective probability values are greater than 0.05 and their respective absolute values of ADF test statistics are lower than the critical values at 5%. These imply that there are random walks in the aforementioned variables. However, Electricity Consumption Per Capita (ECPC) and Human Development Index (HDI) are stationary at levels because their respective probability values are less than 0.05. Due to the non-stationarity of RGDP, GFCF and TPEC at their level forms, the first difference is conducted as reported in table 5b

Table 5b: Augmented Dickey Fuller (ADF) Summary of Unit Root Test Results

Variables	ADF Test Statistics (At 1st Diff.)	Mackinnon Critical Values			Prob. (values)	Remark
		1%	**5%**	**10%**		
RGDP	-3.739	-4.296	-3.568	-3.218	0.004	Stationary
ECPC	-3.690	-4.323	-3.586	-3.225	0.039	Stationary
GFCF	-6.803	-4.262	-3.552	-3.289	0.000	Stationary
HDI	-19.754	-4.262	-3.552	-3.209	0.000	Stationary
TPEC	-7.215	-4.262	-3.552	-3.209	0.000	Stationary

Source: Author's Computation

From table 5b, all the variables, RGDP, ECPC, GFCF, HDI and TPEC are stationary at first difference. This is because their respective probability values are less than 0.05 and their respective absolute ADF test statistics are greater than the critical values at 5%. This imply that the series are all integrated at order one, *I(1)*. It was established that the series are not integrated of order 2, *I(2)*. Based on the tests, the variables are stationary at level *I(0)* and first difference, *I(1)*. The p-values are shown at 1%, 5% and 10%, which show that all the variables are statistically significant and stationary. These satisfy Pesaran et al. (2001) that the endogenous variable (RGDP) must be *I (1)* and the exogenous variables (ECPC, GFCF, HDI and TPEC) *I (0)* or *I(1)*. Table 5c presents the Phillips Perron unit root test results at levels.

Table 5c Phillips Perron (PP) Summary of Unit Root Test Results

Variables	Phillips Perron Test Statistics (At Level)	Mackinnon Critical Values			Prob. (values)	Remark
		1%	**5%**	**10%**		
RGDP	1.006	-4.252	-3.548	-3.207	1.000	Not Stationary
ECPC	-3.049	-4.252	-3.548	-3.207	0.134	Not Stationary
GFCF	-2.953	-4.252	-3.548	-3.207	0.159	Not Stationary
HDI	-1.997	-4.252	-3.548	-3.207	0.000	Stationary
TPEC	-2.311	-4.252	-3.548	-3.207	0.416	Not Stationary

Source: Author's Computation

The unit root test results, as identified in the Phillips Perron unit root test, at level, are presented in table 5c. The results show that HDI is stationary at level i.e. *I(0)*, because the probability value of 0.0000 is less than 0.05 and the absolute value of the t-statistics of -7.997 is greater than the critical values at 5% level of significance (-3.548). However, RGDP, ECPC, GFCF and TPEC, are not stationary at level. This is because their respective probability values are greater than 0.05. In addition, their respective absolute values of Phillip Perron test statistics are lower than the critical values at 5% level of significance. These imply that there are random walks in the aforementioned variables as shown in table 5c. Due to the non stationarity of RGDP, ECPC, GFCF and TPEC at their level forms, the first difference is conducted as depicted in table 5d

Table 5d Phillips Perron (PP) Summary of Unit Root Test Results

Variables	Phillips Perron Test Statistics (At 1st Diff)	Mackinnon Critical Values			Prob. (values)	Remark
		1%	**5%**	**10%**		
RGDP	-6.675	-4.262	-3.552	-3.209	0.000	Stationary
ECPC	-6.827	-4.262	-3.552	-3.209	0.000	Stationary
GFCF	-10.088	-4.262	-3.552	-3.209	0.000	Stationary
HDI	-16.752	-4.262	-3.552	-3.209	0.000	Stationary
TPEC	-7.524	-4.262	-3.552	-3.209	0.000	Stationary

Source: Author's Computation

From table 5d, RGDP, ECPC, GFCF, HDI and TPEC are stationary at first difference. This is because their respective probability values are less than 0.05 and their respective absolute Phillips Perron test statistics are greater than their critical values at 5% level of significance. These imply that they are integrated at order one, *I(1)*.
The Schwarz Information Criterion (SIC) and Akaike Information Criterion (AIC) are used to select the lags orders and are most appropriate for ARDL estimation (Badshah & Bulut, 2020).

Diagnostic Checks
Table 6 presents the test for heteroskadasticity test to identify if the variance of errors in the specified models are consistent across the different levels of the independent variables, hence ensuring the statistical reliability of inference that are drawn from the models.

Table 6: Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-Statistics	2.771	Prob. F(4;30)	0.045
Obs R-squared	9.444	Prob.Chi-Square(4)	0.050
Scaled explained SS	17.633	Prob.Chi-Square(4)	0.001

Source: Author's Computation

Table 6 established that the models do not have heteroskedasticity, which imply the models are favorable and consistent in ascertaining the nexus between electricity consumption, human development and economic growth in Nigeria. Table 7 presents the test results for serial correlation. This test enable us identify whether there is statistical significant relationship between the series in the study.

Table 7 Breusch-Godfrey Serial Correlation LM Test

F-Statistics	0.853	Prob. F(2;17)	0.443
Obs R-squared	2.827	Prob.Chi-Square(4)	0.243

Source: Author's Computation

Table 7 presents the statistical values of Breusch - Godfrey of 0.853 with probability value of 0.443. This implies that the null hypothesis is accepted or it can be stated that there is the absence of autocorrelation among the errors. Thus, the series are free from autocorrelation

Cointegration Test
The ARDL Bounds test to cointegration for the specified models is presented below:
Table 8a: ARDL Bound Test to Cointegration

Asymptotic critical values				
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	12.289	10%	2.45	3.52
K	2	5%	2.86	4.01
		2.5%	3.25	4.49
		1%	3.74	5.66

Source: Author's Computation

Data from table 8a show that the series are cointegrated, since the calculated F-statistic of 12.289 is greater than the lower bound *I(0)* of 2.86 and upper bound *I(1)* of 4.01, at 5% level of significance. This implies that the null hypothesis is rejected and there is a long run equilibrium relationship between the dependent variable (RGDP) and the explanatory variables (ECPC, GFCF, HDI and TPEC). Table 8b presents the Error Correction Model (ECM) results from the bounds test**.**

Table 8b: Short Run ARDL Estimates

Dependent Variable: RGDP
Method: ARDL
Selection Model: ARDL (4, 0, 3, 0, 0)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
(RGDP(-1)	-0.628	0.242	-2.556	0.019
(RGDP(-2)	-0.066	0.340	-0.195	0.047
(RGDP(-3)	0.391	0.318	1.230	0.233
(RGDP(-4)	1.091	0.316	3.443	0.002
ECPC	77481.99	96563.70	0.802	0.486
GFCF	16324.64	8267.733	1.974	0.063
GFCF(-1)	27356.21	12646.38	2.169	0.043
GFCF(-2)	23403.50	13258.71	1.765	0.093
GFCF(-3)	31369.77	11153.04	2.812	0.011
HDI	204359	1423399	1.435	0.167
TPEC	-569.628	536.491	-1.081	0.292
C	-2260354	730021.1	-3.096	0.005

R-squared **0.986**
Adjusted R-squared **0.978**
Prob.(F-statistics) **0.000**
F-Statistics **122.792**
Durbin-Watson Stat.: **2.25**

Source: Author's Computation

Table 8b shows the short run analysis of the ARDL estimates of the series. Although, statistically not significant, Electricity consumption per Capita (ECPC) has a positive coefficient implying that a unit change in ECPC will bring about a 77481 increase in RGDP. Though, the power sector experiences structural inefficiencies and short run shocks this relationship supports the electricity-led growth hypothesis. These findings are in consonance with the studies of Rafindadi et al., (2022) and Odhiambo, (2023) A one lag period of Gross Fixed Capital Formation GFCF(-1) is statistically significant with a probability value of 0.0435 and a positive coefficient of 27356.21. This implies that a unit change in GFCF in the previous period will bring about a 27356 increase in RGDP within the study period. Furthermore, the Human Development Index (HDI) is not statistically significant in explaining changes in RGDP with a probability value of 0.167. Despite the rising population in Nigeria the economic impact on real output (RGDP) has been abysmally low. The human resources in Nigeria are characterized by inadequate and moribund health and education infrastructure. With high infant mortality rate and low adult literacy rate, Nigeria is ranked among the poorest countries in the world. These findings are in consonance with the studies of Nwanze et al., (2023) and Umar et al., (2025). Total Primary Electricity Consumption (TPEC) is statistically not significant in explaining changes in RGDP with a probability value of 0.292 and, a negative coefficient of -569.628 implies that a unit change in TPEC will trigger a 569 decrease in RGDP within the period of study. This result explains the story of Nigeria endowed with massive renewable resources like solar, wind, hydro, etc but relies heavily on fossil fuels, hence the energy poverty, CO_2 emission, Green House Gases (GHGs) and other elements impairing climate change. These findings are in consonance with the studies of Dinneya-Onuoha (2025) and Sikwela & Aderemi (2024). Table 8c provides the long-run estimates of the models.

Table 8c: Long Run ECM Estimates

Dependent Variable: D(RGDP)
Method: ARDL
Selection Model: ARDL (4, 0, 3, 0, 0)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2260354	265287.3	-8.533	0.000
D(RGDP(-1)	-1.416	0.187	-7.570	0.000
D(RGDP(-2)	-1.482	0.296	-4.994	0.000
D(RGDP(-3)	-1.0907	0.275	-3.965	0.000
D(GFCF)	16324.64	6618.994	2.466	0.023
D(GFCF(-1)	-54773.33	11150.12	-4.912	0.000
D(GFCF(-2)	-31369.77	5329.930	-5.885	0.000
CoinEq(-1)	-0.204	0.0237	-8.624	0.000

R-squared **0.853**
Adjusted R-squared **0.809**
Prob.(F-statistics) **0.000**
F-Statistics **19.172**
Durbin-Watson Stat.: **2.25**

Source: Author's Computation

According to the long run estimates in table 8c, the ECM value is negative, less than 1 and statistically significant with a probability value of 0.000. This implies that there is a high speed of adjustment of 20%, from the short run to the long run, when there is any disequilibrium in the model. The R-squared value of 0.853 implies that the dependent variable (RGDP) explained 85.3% of the variations from the explanatory variables (ECPC, GFCF, HDI and TPEC). This shows that the model has a good fit. Gross fixed capital formation (GFCF) at one and two period lags are statistically significant in explaining changes in real gross domestic product (RGDP) at one, two and three period lags during the period of study. However GFCF at the current period is positive but not statistically significant in explaining changes in RGDP.

Conclusion and Recommendations

Conclusion

Electricity infrastructure is paramount to sustainable human development and economic growth in Nigeria. Output was positively influenced by non-renewable electricity consumption and gross fixed capital formation. These outcomes summarize the high utilization and consumption rates of fossil fuels in the country. Although, the cost of petroleum products is high causing untold hardship on the economy most Nigerian, especially the low income group prefers the petroleum products to expensive solar home systems. It is important to understand the nexus between electricity infrastructure, consumption, human development and economic growth in Nigeria, so that economic policy makers can predict the impact of implementing electricity policies so as to improve electricity infrastructure, human development and economic growth. In relation to the relationship among the variables, there were feedback effects between human development and electricity consumption; human development and economic growth in Nigeria.

However, despite the vast natural resources endowment and huge government spending on power generation, transmission and distribution in Nigeria, the power situation has been abysmally poor, as most Nigerians have resorted to providing their own source of electricity through the use of expensive solar panels, petrol and diesel generators. Others, especially in the rural areas, who could not afford the bills and are not connected to the grid, rely on traditional biomass like charcoal and wood. The country's dependence on fossil fuels rather than clean energy puts its energy future in doubt. Efforts made by the government and private sector to provide affordable and reliable electricity in Nigeria have been painfully slow and not effective. These have adversely affect human development and hence growth in Nigeria.

Recommendations

The study puts forward the following recommendations:

i. Electricity generation issues in Nigeria can be addressed when the government strategized on the implementation of a decentralized mini-grid and off-grid systems, powering transmission networks and securing adequate gas supplies.

ii. Electricity transmission systems require upgrading dilapidated grids, protecting critical energy assets and decentralizing power supply for a more efficient coverage.

iii. To achieve affordable and reliable electricity supply in Nigeria, the government must strike more partnership deals with the private sector, NGOs and other stakeholders in the industry. Low income households should have access to installment-based payment plans and reduced connection fees.

iv. Revenue realized from the exportation of electricity to Benin Republic, Niger and Togo should be reinvested solely for the provision of power infrastructure in Nigeria. This will cut the gap between energy demand and supply in the country.

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