The American Journal of Applied Sciences
ISSN 2689-0992 Volume 08 - 2026

Environmental Impact Assessment of Mid and Downstream Gas Distribution Debacle: Navigating Diverse Complex Geological Terrain for An Eco-Friendly, Clean and Lower Carbon Society, Nigeria

Ibrahim Olanrewaju Ibrahim
Planning and Design Department, Lower Niger River Basin Development Authority, Ilorin, Kwara state, Nigeria.

Ngozi-Chika Chiazor Stephen
Department of Geology, Dennis Osadebay University, Asaba, Delta state, Nigeria

Adamu Enemona Kogh
Senior Structural Engineer, Elcrest Oil and Gas Exploration and Production Nigeria Limited, Oil Mining Lease 40 AMT, Lagos, Nigeria.

Muhibbu-Din Eniola Ismail
Department of Chemical Engineering, University of Ilorin, Ilorin, Nigeria

Abubakar Idowu Mohammed
Kwara State Environmental Protection Agency, Ilorin, Kwara State, Nigeria

Atofarati Raheem
Kwara State Environmental Protection Agency, Ilorin, Kwara State, Nigeria

Abdulrahman Ameen Taiye
Kwara State Environmental Protection Agency, Ilorin, Kwara State, Nigeria

Received: 02 Jan 2026 | Received Revised Version: 24 Jan 2026 | Accepted: 22 Feb 2026 | Published: 12 Mar 2026

Volume 08 Issue 03 2026 | Crossref DOI: 10.37547/tajas/Volume08Issue03-03

ABSTRACT

Diverse, complex and rugged Geological terrains in Nigeria has been a major hindrance to gas distribution for economic growth. The study aimed to diagnose critical steps revolving around the Mid and Downstream to get gas and its infrastructures across the huge population of about 233 million inhabitants. With 210 TCF reserve deposit, Nigeria and Africa will need harness this potential for robust economic collaboration. A target to increase the current 7.18bcfd to 12.7bcfd gas production by 2030 is in the pipeline. A total 61.58% refinery utilization was recorded between Q1 and Q3 of 2025 with Aradel, (1,000bpd), Waltersmith (5,000bpd), Duport (2500bpd), Dangote (650,000bpd) at a total 1,195,000 barrels per day crude oil processing capacity. Ajaokuta-Kano-Kaduna (AKK) and Obiafu-Obrikom-Oben ie OB3 gas pipelines among several others are at advanced stages of completion for gas distribution. Existing gas pipelines across the Nigerian landscape revealed 32%, 26% and 13% across South-west, south-south and South-east respectively with virtually no sign of similar pipeline in the northern axis. CNG recorded just 0.5% utilization rate in 2025 (southern area) with an ambitious target of scaling up to 9.1% and 21% utilization rate by 2027 and 2030 respectively with an upcoming integrated 500 CNG retail outlets. LPG adoption and utilization increased on a year-on-year basis by 51.58%. About 300mmscf/d of gas goes into production of 65% of Nigeria's 111Kw/cap of electricity expected to triple soon. This energy study forecasts

that natural gas will be relevant beyond 2060 as a major source of energy, existing side by side with other forms of energy sources with solar energy serving as veritable energy mix to the tune of 25% compared to the current status of less than 12%. With upstream scalability, midstream connectivity and downstream certainty, gas production will not only surge in volume but advance a clean, eco-friendly society and ignite the new impetus that will enhance Nigeria's industrialization agenda.

Keywords: Trillion Cubic feet (TCF), Billion cubic feet per day (Bcfd), Compressed Natural Gas (CNG), Liquified Petroleum Gas (LPG) and Pipeline.

Cite This Article: Ibrahim, I. O., Stephen, N.-C. C., Kogh, A. E., Ismail, M.-D. E., Mohammed, A. I., Raheem, A., & Taiye, A. A. (2026). Environmental Impact Assessment of Mid and Downstream Gas Distribution Debacle: Navigating Diverse Complex Geological Terrain for An Eco-Friendly, Clean and Lower Carbon Society, Nigeria. The American Journal of Applied Sciences, 8(3), 19–40. https://doi.org/10.37547/tajas/Volume08Issue03-03

1.0 Background study

Significant changes in the operation and regulation of the Nigerian gas sector has been made by the passage of the Petroleum Industry Act (PIA) in August 2021 and the creation of new Ministry of Petroleum (Gas) for policy formulation. The legislative provisions on gas in the PIA makes it the first time that Nigeria's abundant natural gas resource attempt to reclaim the undisputed African gas province giant (Fig. 1) and has been treated to such a high level of legislative, judicial and executive attention. These provisions address the regulation of activities relating to gas in the upstream, midstream and downstream segments of the petroleum oil and gas value chain. Importantly, the legislation addresses the licensing of activities, a robust regulatory framework, a gas transportation network code and a clear fiscal framework for gas exploration, development and processing to CNG and other products in Nigeria (Ibrahim et al 2026). More importantly, NNPCL Gas Master Plan 2026 (NGMP 2026) was also recently launched at its twin towers as a bold, effective execution-anchored roadmap designed to unlock Nigeria's immense gas potential and elevate the country into a globally competitive gas hub (GCEO, NNPCL).

The regulatory function of the erstwhile Department of Petroleum Resources has been bifurcated between two newly established technical and commercial regulatory agencies of NMDPRA and NUPRC. One of the key innovations of the PIA with respect to the natural gas sector is the creation of the Midstream and Downstream Gas Infrastructure Fund by the newly created regulatory Authority. The fund is expected to assist in the development of gas infrastructure across various complex Geological terrains which has been a major challenge to economic growth. It is to be funded from various sources including 0.5 per cent of the wholesale price of petroleum products and natural gas sold in Nigeria as it is collected from wholesale customers. The phrase, sold in Nigeria has been interpreted to mean, sold free on board in Nigeria, loaded or offloaded for sale within a wholesale point in Nigeria or transaction which emanates, occurs or is concluded in Nigeria. The levies are only applicable to domestic sale of petroleum products or natural gas. The Nigerian Upstream Regulatory Commission (The Commission) regulates upstream petroleum operations including gas exploration and production and the Nigerian Midstream and Downstream Petroleum Regulatory Authority (The Authority) regulates midstream and downstream petroleum operations such as gas and oil supply, processing, storage, transportation and distribution.

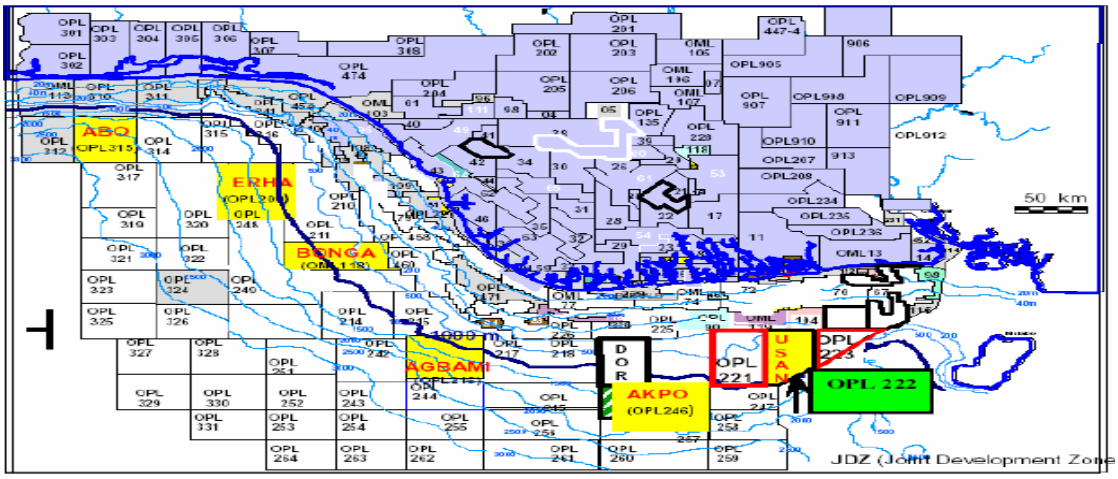

Fig. 1: Geological concession map of Niger Delta area showing awarded oil and gas block areas

The Midstream and Downstream Petroleum Fees Regulations (MIDPFR) were transparently published in the Federal Gazette on 4th November 2024 to facilitate a robust template for willing investors. All bureaucratic impediment to business and economic growth successfully removed. The MIDPFR consists of nine schedules, each specifying the activities, applicable fees (i.e application and processing fees), the currency of the fees, frequency of payment (where applicable) and annual administrative charges for different business activities and operations within the sector. Its objectives are to clearly outline the midstream and downstream operations and activities that require a license, permit, authorization or approval from the NMDPRA specifying payable fees for initial application, re-issuance or renewal of such licenses, permits, authorizations or approvals.

Notable regulations of the Authority thus includes: Gas distribution system regulations, Gas trading and settlement regulations, Midstream Downstream penalties and enforcement mechanism regulations, Midstream and Downstream alternative Dispute Resolution Regulation, Midstream Gas flare regulation, National strategic stock regulations, Assignment or Transfer of License Permit Regulations, Gas Pricing and Domestic demand regulations, Midstream and Downstream Petroleum operations regulations, Natural Gas pipeline tariff regulations, Petroleum (Transportation and shipment) regulations and Petroleum measurement regulations. However, in April 2021, NNPCL, a major oil and gas player signed a precedent-setting gas development agreement with one of its PSC with its contractors for the development of gas resources in one of the deep offshore oil mining lease, making it the first agreement of such in Nigeria for gas development. Natural gas has thus been projected to be the fastest growing fossil fuel over the next decades and Nigeria is currently favored as the biggest investment destination with good business return and new, excellent, stable, transparent, effective and efficient fiscal and regulatory framework that cannot be found anywhere in the world (Ibrahim et al 2026).

2.0 Methodology adopted for the study:

This study has adopted data from past and present studies, viable reports of government and non-government bodies like Nigerian Bureau of Statistics, Nigerian Inland Waterways, Nigerian Upstream Petroleum Regulatory Commission, Nigerian National Petroleum Company Limited, Central Bank of Nigeria, Nigerian Midstream Downstream Petroleum Regulatory Authority and existing published literatures. The study also relied on data obtained from International agencies like World Bank, Forbes Africa, United States Energy Information Administration, United Nations Environmental Protection Programme reports, Amnesty International reports, International Monetary Fund, PwC etc. Published books, Conference, Seminar Papers and Journals were also consulted to get robust data on the subject matter.

3.0 Diverse Complex Geologic terrains in Nigeria

Nigeria has a coordinate of Latitudes 4° and 14° North of the Equator and longitudes 3° and 15° East. It has a total landmass of about 924,000km^2 and a population density of about 233,650,000 people of very diverse origin with different ethnic, tradition, culture and religious affiliations basically of Northern and Southern extractions. The terrains of these 2 main Arid Northern

areas differs greatly with large deposit of Basement complex rocks and pockets of sedimentary rocks to the southern savannah one. The southern savannah area of Nigeria is composed of more of diverse sedimentary rocks and pockets of basement complex terrains with major intrusions, especially to the south-southern axis. Nigeria has two major rivers, the river Niger (Fig. 2), after which the country is named and the Benue river with several tributaries that cut through the diverse complex region of the country. Recent break-through of laying a gas pipeline from the southern axis to the northern area has shown how challenging the terrain could be, especially when the pipeline finally crossed River Niger (GCEO of NNPCL). AKK Pipeline from Ajaokuta to Kano and down to Kaduna is a 614 km long pipeline, conceptualized, designed and expected to deliver gas to the Northern axis for industrial development of the region with over 10,000 km of inland waterways that constitute tributaries of the river serving as serious Engineering challenges that the project must overcome to get up North.

In anticipation of the completion of AKK pipeline (A major gas infrastructure) in 2026, the Minister of Petroleum (Gas) just made it abundantly clear at the launch of NNPCL 2026 gas masterplan (NGMP 2026) that Nigeria will produce 10 bcfd in 2027 and 12 bcfd in 2030 through aggressive exploration and production and this will effectively position Nigeria as not only the biggest reserve holder in Africa, but the biggest gas producer.

According to statistical data from Nigerian Inland Waterways (NIWA), 28 of the 36 states of the Federation can be linked by water for more easier transportation of goods and services, but the changing climate with unpredictable flooding pattern in recent time has hindered the Government from harnessing that potential to facilitate local trade (Ibrahim et al 2025). Moreso, the volume of water cannot really facilitate movement of goods from one state to another on a large scale. The River Niger (Fig. 2) is the main river of West Africa extending about 4,180 kilometers (2,600 miles). Its drainage basin is 2,117,700 km^2 (817,600 sq mi) in area and it constitute a significant source of international trade and Hydrocarbon potential (oil and gas) in the Southern corridor especially in Lagos, Ondo and Niger Delta region where it intersects the Atlantic ocean. It transports large remains of Cretaceous rocks, flora and fauna from the hinterland axis to the southern area which are preserved (fossils) in anoxic condition to form oil and gas. The Nigerian basement complex is one of the three major litho-petrological components that make up the Geology of Nigeria (Fig. 2) with a highly undulating plane across several states and landscapes of the country and this is an uncommon one in Africa. Nigeria is the final downstream country through which the Niger River flows with its sediments and contain 28.3% (424,500 square kilometers) of the Basin area and the country benefits most from the river course among other countries.

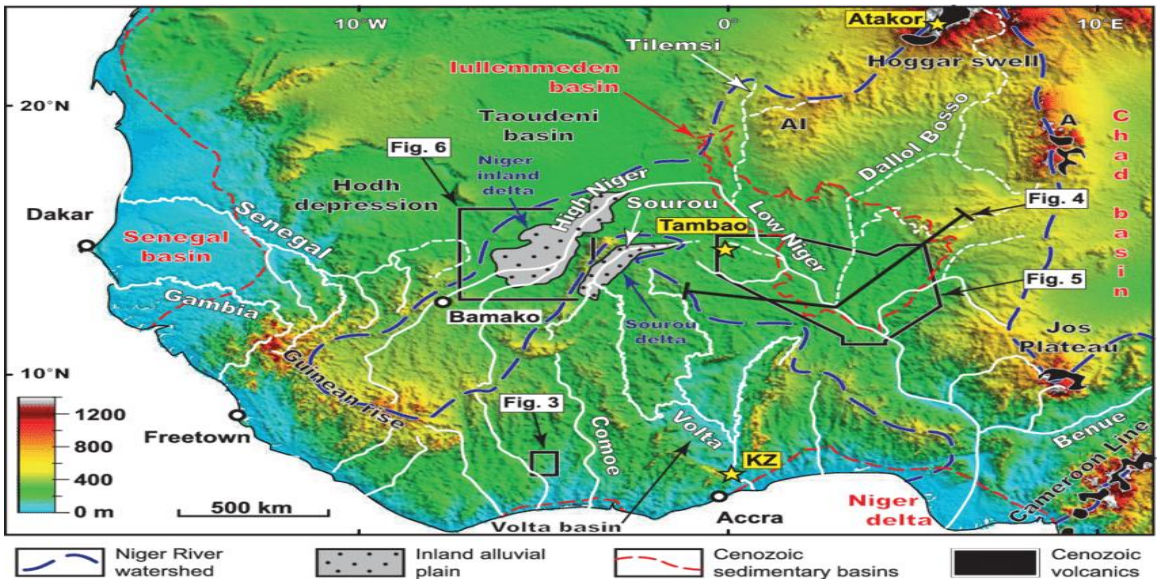

Fig. 2: River Niger and its numerous tributaries across Nigeria and other notable West African states

4.0 Energy Dynamics

The world is currently shifting to gas and renewable as main energy source of powering the global economic growth. The federal government of Nigeria has recently launched the Decade of Gas and Energy Transition Plan (ETP) strategies designed to address energy poverty and the climate change crisis affecting the consumers majorly domiciled in the downstream terrain. More importantly, the ETP plans to decarbonize Nigeria's power sector and all hydrocarbon streams through the expansion of generation capacity via gas, renewable sources, primarily solar, wind and biomass. Moreso, Nigerian carbon credit market is developing to clean up the environmental space of carbon. The ETP also recognizes natural gas as a key transition fuel on the path to net zero society, given Nigeria's abundant gas reserves with low and almost negligible carbon content. The strategy is for an initial ramp-up of gas generation prior to 2030 to facilitate the integration of renewable sources as its energy mix. Key to the ETP is the decarburization of cooking sources by encouraging the move from traditional charcoal, firewood and kerosene to adoption of cleaner fuel sources such as liquefied petroleum gas prior to 2030, through national and intentional education and awareness campaigns. Given the importance of natural gas in Nigeria's energy transition, the ETP acknowledges the commercialization of gas as a priority for the Nigerian government and has identified tax benefits and support schemes as crucial tools in encouraging investment in gas infrastructure.

With regard to the foregoing, Nigeria LNG Limited has committed large volume of its liquefied petroleum gas production to the Nigerian domestic market, signed sale and purchase agreements with several local power companies for the annual delivery of 1.1 million tonnes of liquefied natural gas. A recent study has thus shown that the utilization of gas as a transition fuel is inevitable for domestic and national development and a forecast has revealed an increasing trend against a decreasing one (Fig. 3). The NNPCL the major operator in Nigerian oil and gas sector just launched its highly ambitious gas masterplan tagged NGMP 2026 and has given a target to produce 10 bcfd in the immediate future of 2027 and 12 bcfd by 2030. This is highly ambitious!

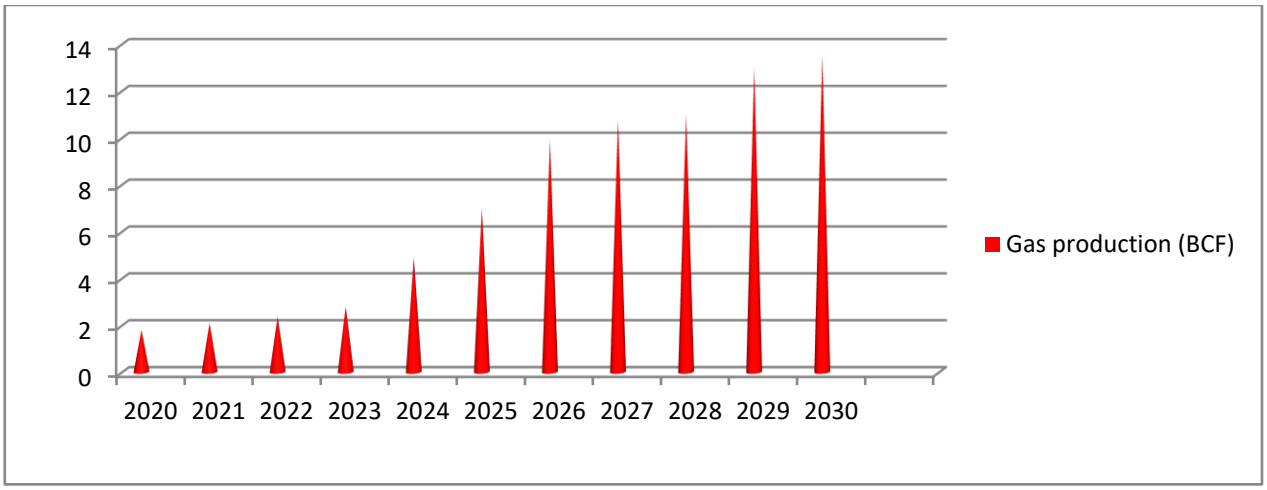

Fig. 3: Gas production and consumption trajectory in Nigeria (Billion cubic feet). (Source: Forbes Africa 2025)

A study (Ige 2014) projected an increasing trend of gas utilization till 2020 in Nigeria especially for power generating plants to produce electricity as vital components in the Nigerian Gas Master Plan Investors Road Show held 2008. The current modern reality is that gas will be the major transition fuel that will fuel the world economy growth beyond 2050 especially in the Transportation, Electricity, Agriculture, Commerce and Industry, Aviation and Water resources (Ibrahim et al 2026). For the power sector, over 70% of the power generating plants across Nigeria currently use gas as feedstock to function and generate electricity which is so vital for national development. Nigeria targets to make reliable electricity available to 75% of the population by 2026 and 100% of its population by 2030 and gas will be playing a major role expected to surge to 12.7bcfd (Fig. 3) from current 7.1bcfd (Forbes Africa 2025). The demand for gas to produce this electricity will therefore ultimately increase over the years beyond 2050 with its 210TCF of current reserve deposit and tremendous global demand for it as a major energy to catalyze the world economic growth which has been traced to its

better environmental quality than oil and less carbon emission footprint potential.

5.0 Mid and Downstream Oil and Gas operations

By virtue of the Petroleum Industry Act (PIA), which was enacted in August 2021, the Minister of Petroleum Resources is responsible for formulating policies relating to the petroleum sector in Nigeria (Fig. 4). The Minister is also responsible for the supervision of activities in the sector. The PIA established two new regulators for the upstream, midstream and downstream petroleum sectors, namely, the Nigerian Upstream Petroleum Regulatory Commission (the Commission) and the Nigerian Midstream and Downstream Petroleum Regulatory Authority (the Authority). The PIA does not explicitly provide for the independence of the regulators from the Minister; however, the remit or scope of the function of each regulatory agency and the Minister are clearly

defined. Also, there are important checks and balances in the legislation that limit the scope of the Minister's powers in relation to the regulators. Each regulatory agency is given technical and commercial regulatory powers with wide-ranging authority of enforcement, such as powers to issue lease and desist orders, powers of seizure and powers to close oil, gas and allied products premises.

Fig. 4: Mid and Downstream oil and gas operations

There is no difference between the statutory and regulatory structure for the operation of gas transportation pipelines and that for the operation of a gas distribution network. In either case, a permit to survey a gas pipeline route, followed by a license issued by the Nigerian Midstream and Downstream Petroleum Regulatory Authority (the Authority) pursuant to the PIA, (in this case, a gas distribution license) must be obtained from the Authority for the construction and operation of natural gas pipelines for purposes of gas distribution (Fig. 4). Also, compensation must be paid to the owner of the land on which the gas pipelines and ancillary facilities are installed. Gas distribution utilities are thus subject to public service obligations to the extent that the Authority issues regulations imposing such obligations on licensees for matters such as the security of gas supply, maintenance of strategic stock, economic development, environmental protection, health and safety. The supply and trading of natural gas is undertaken either directly by gas producers or by gas marketing companies affiliated with gas producers. Most of the gas producers are unincorporated joint ventures between the Nigerian National Petroleum Corporation Limited (NNPCL), international oil companies and some local investors. Other producers are independent local companies operating on a sole-risk basis.

Natural gas is also traded by a growing segment of players in virtual gas pipeline companies that are transporting and trading gas through compressed natural gas and mini-liquefied natural gas systems to underserved markets in Nigeria. Prior to the enactment of the PIA, holders of upstream oil mining leases with proven gas reserves were obligated to supply a portion of their gas to the domestic market through a process managed by the Gas Aggregation Company of Nigeria Limited, the domestic gas aggregator (the Domestic Gas Supply Obligation ie DGSO). The PIA and the Domestic Gas Delivery Obligation Regulations 2022 has tightened the supply obligation by requiring that such gas must be delivered by the producer to a location indicated in a gas purchase order issued by the domestic gas aggregator

(the domestic gas delivery obligation ie DGDO), subject to limited exceptional circumstances stated in the PIA. The PIA empowers the Commission to allocate DGDOs to gas producers annually before 1st March based on the annual domestic gas demand requirement determined by the Authority. The Authority is also responsible for regulating the price at which gas subject to the DGDO will be supplied. Gas volumes outside a producer's DGDO can be sold at market-based willing-seller-willing-buyer price.

The FCCPC is a newly established competitive regulatory agency. As such, it is yet to make a determination in respect of the gas sector. However, it has a mandate to determine whether to conduct anticompetitive or manipulative by assessing whether there is participation in agreements to restrict or distort competition such as price-fixing, dividing markets, limiting or controlling the production or distribution of goods or services, collusive tendering or making the conclusion of an agreement subject to some other obligation that has no bearing on the agreement. Others are a supplier unlawfully withholding products from a dealer, the abuse of dominant position and the existence of a monopoly that is adverse to the public interest. The FCCPC is empowered to issue an order or directive requiring that any person it finds to be engaged in anticompetitive practices will face the consequences to pay a fine as high as 10 per cent of its turnover in the preceding year.

The PIA empowers the Minister of Petroleum Resources, following a recommendation from the Commission, to take action such as the revocation of upstream licenses where a licensee is engaged in practices contrary to the terms and conditions for the issuing of the license or in the exercise of the supervisory power over the oil and gas sector. Where the Authority determines that a particular licensed activity is a monopoly service or there is insufficient competition in the market or a particular licensee is a dominant provider, it is empowered to regulate the prices charged in a manner consistent with the pricing principles in the PIA after having undertaken a consultation process with licensees, industry participants and other stakeholders. The Authority is also mandated to undertake periodic pricing methodology reviews. In addition to the foregoing, where in the opinion of the Authority, there is or maybe an abuse of market power, it is empowered to issue a cease and desist order, require and compel a licensee's disclosure of relevant information, undertake inquiries and investigations and levy fines prescribed in regulations that do not exceed 5 per cent of the company's turnover for the preceding year.

The FCCPC has the authority to approve or disapprove mergers in the natural gas sector. Unless a merger falls below the merger notification threshold prescribed by the FCCPC, the FCCPA requires that the FCCPC's approval is obtained for a merger resulting in a change of control of the target undertaking. Application to the FCCPC for review of a proposed merger and approval will require the preparation of an information memorandum describing the merger, transaction parties, nature of the acquiring and target companies' businesses, the controlling interest being acquired, the economic rationale for the merger in relation to the Nigerian market and the target company's turnover in the preceding financial year. The FCCPC can thus take up to 60 business days, if no notice of extension is given to determine if a proposed merger is approved or otherwise. A midstream or downstream petroleum operations licensee is prohibited from merging with another license holder or affiliate of a license holder without the prior written consent of the Authority. The PIA also requires upstream producers that wish to participate in midstream or downstream petroleum operations to only do so through separate corporate vehicles. The Authority may also require a midstream or downstream operations licensee to only participate in another activity using a separate corporate channel.

6.0 Refinery operation and Role of NNPCL

The NNPCL (The major oil and gas player) has shown great and highly uncommon dexterity in growing the Nigerian oil and gas production, refining and marketing through partnership and collaboration with foreign and local investors, especially in the mid and upstreams through vast network of pipelines approximately 5,120 km. But events in recent time has shown that NNPCL will need expand its funding models beyond such partnership to accelerate the growth and development of Nigerian mid and downstream oil and gas sector as the main player. NNPCL has been so magnanimous in catering for Nigerians by providing the energy security and revenue that propel the country to greatness. Its four state-owned refineries (Table 1) that collectively have a capacity of 445,000 b/d, which is nearly enough to meet all domestic demand have not been producing close to installed capacity. Moreover, the refineries have remained offline for long-term maintenance or rehabilitation since 2020.

Getting foreign capital and real technical expertise to bring back Nigerian refineries will need be reviewed. Partnering with investors on equity basis to refurbish and maintain these refineries, especially offshore refiners that have the capacity to rehabilitate and once again make them functional and maintain them is inevitable. Latest information has shown that NNPCL is working to bring them back functionally in collaboration with technical offshore partners in 2026 (GCEO of NNPCL). The funding model adopted by LNG seems to be one of the practicable solutions to bring back the glory of the plants. It is now crystal clear that government property managed by government body hardly thrives just as it has always been in any country of the world. Staffs working in these refineries might have to be migrated to other oil and gas organizations to safe-guard their jobs and means of livelihood for total and comprehensive overhaul of the plants

Table 1: Refinery operation and functional status in Nigeria

No	Refinery	F. Status	Location	Crude source and ramp-up	Crude capacity (barrels/day)
1	Kaduna refinery	Shut-in	Kaduna	Escravos @ forcados	110,000
2	Port-Harcourt 1 @ 2	Shut-in	P-harcourt	Escravos	210,000
3	Warri	Shut-in	Delta	Bonny	123,000
4	Dangote	Functional	Lagos	Ongoing ramp-up to 1.4 million/day capacity	650,000
5	Aradel	Functional	Edo	Not available	1,000
6	Waltersmith	Functional	Imo	Not available	5,000
9	Duport	Functional	Edo	Not available	2,500
	TOTAL				**1,195,000**

NMDPRA fact-sheet recently released revealed a record of 61.58% refinery utilization between Q1 and Q3 of 2025 (CEO of NMDPRA). This was linked to technical constraints, crude supply limitation across refineries and repeated downtime at government refineries. Aradel, (1,000bpd), Waltersmith (5,000bpd), Duport (2500bpd), Dangote (650,000bpd) are the only current functional refineries with a total 1,195,000 barrels per day crude oil processing capacity (Table 1). It was made known that the Dangote refinery is still running bellow installed capacity, despite the management plans to expand to 1.4 million processing capacity per day (Table 1). It is worthy of note that 47 licenses to **establish** refinery have been issued till date with a cumulative refining capacity of 1.75 million bpd, while 31 licenses were issued by NMDPRA to **construct** refineries with a total refining capacity of 1.228 million bpd of planned capacity. Despite all approvals, only 3 refineries are under active construction phase with total expected capacity of 47,000bpd including Waltersmith train 2 expansion. Assurance on supply of crude oil has actually prevented most of the proposed refineries to proceed to the Final Investment Decision due to Domestic Crude obligation assurance upon investment, as such, the urgent need for PIA to be amended to fasttrack investment in the refinery operation for Nigeria to fully overcome the local refinery challenges.

7.0 Mid and Downstream Licenses and Permits categories

There are no affiliate restrictions except for transfer pricing rules which are enforced by the Nigerian Revenue Service. The Nigerian Midstream and Downstream Petroleum Regulatory Authority may serve a cease and desist order on a licensee where activities between such licensee and an affiliate are not undertaken on an arm's length basis or do not reflect the pricing principles in the PIA. Where the licensee fails to comply with the cease and desist order, the authority may levy a fine not exceeding 5 per cent of the annual turnover of the licensee for the preceding year or revoke the license granted to the licensee. Existing Licenses and permits in the Authority thus include: Automated Gas systems for autogas, addon and industrial storage with gas depot, reticulation and trucking, Barging and Trucking, CNG Industrial storage, CNG Compression station, Coastal vessel License, Expert permit (crude oil0, Gas terminal export, LPG Gas depot License, LPG Refilling plant, LPG Retailer, LPG Storage, Lube oil blending plant, Lube oil and sales License., Mid and Downstream oil and

gas industry service plant, Refining plant renewal, Retail outlet management system, Petroleum import permit, Gas import permit, Gas network code electronic system and Petroleum pipeline License.

8.0 Gas utilization and pipeline transportation across Geologic terrains

Transportation of gas via pipeline in Nigeria for domestic purpose has been a very difficult one for government and potential investors due to highly complex Geologic terrains the pipelines will navigate to cover the country, most especially to the northern axis. Recent events has shown it is about to surmount that problem with the ongoing fabrication, construction and installation of AKK pipeline. Moreso, Nigeria is a major exporter of liquefied natural gas (LNG) and the Nigeria LNG Limited is producing up to 22 million metric tonnes of LNG per annum from its sixth train. A seventh train has been approved for construction by its shareholders. Beyond LNG, natural gas is exported to markets in West Africa through the West African Gas Pipeline, while several million metric tonnes of natural gas liquids are exported from Nigeria to global markets annually. The Nigerian government's ambition to provide gas to local consumers, improve the industrial sector in addition to being a key exporter and these have resulted in numerous new pipeline ventures.

The gas sector in Nigeria is presently experiencing a major development, expanding from under 7.5bcf/d in 2025/2026 to an anticipated capacity of 12.5 bcf.d by the year 2030 (Forbes Africa 2025). This expansion has compelled a major overhaul of the current system and development of gas substructure. Gas Aggregation Company of Nigeria has suggested that the national pipeline gas design should be certified simply by the gas producers. An array of gas pipeline infrastructure exists, with more currently under fabrication, construction and installation to carry gas to most parts of the country and even beyond its shores. Typical among these pipelines include:

8.1 Western Gas Pipeline Network:

The is primarily the Escravos-Lagos Pipeline System (ELPS) connected with the Oben–Ajaokuta Pipeline System which provides gas to the manufacturing districts of Lagos and the western areas was built in 1989 and owned by NGPTC (Fig. 5).

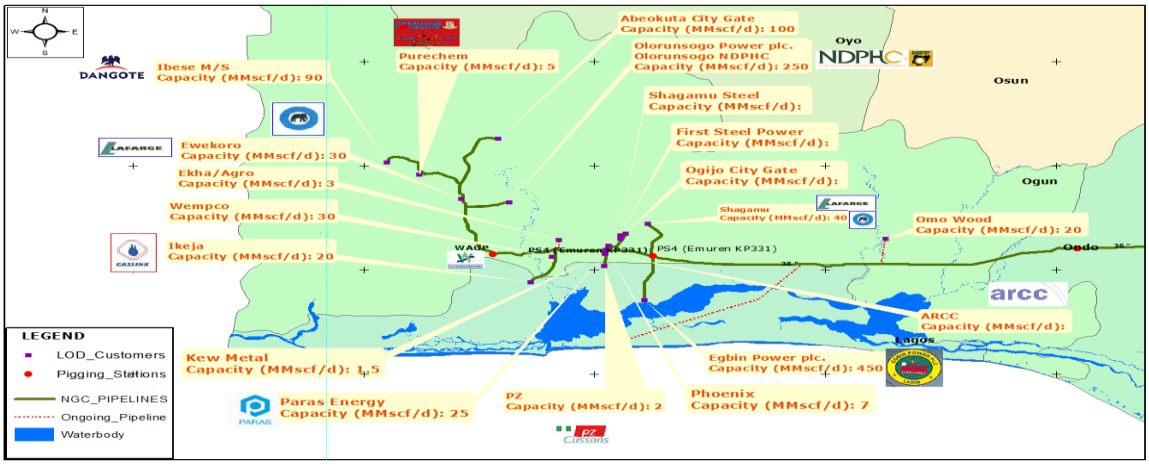

Fig. 5: Gas pipelines across notable private businesses in South-western corridor

The WGPN additionally supplies gas to the West African Gas Pipeline for distribution to bordering Gulf of Guinea nations. Numerous gas-fired power facilities are presently profiting from this continual provision of gas with additional extension under consideration.

8.2 Eastern Gas Pipeline Network:

The National Petroleum Investment Management Services (2022) expanded the pipeline network in the eastern region involving about 812 Km with additional expansion intended as shown by the schematic of this pipeline network (Fig. 6). The sections of the eastern gas pipeline delivery, which consist of the Qua Ibo/Calabar Ajaokuta Pipeline (CAP) system, are identified (Fig. 6). This pipeline covers the Alakiri-ObigboIkot Abasi pipeline.

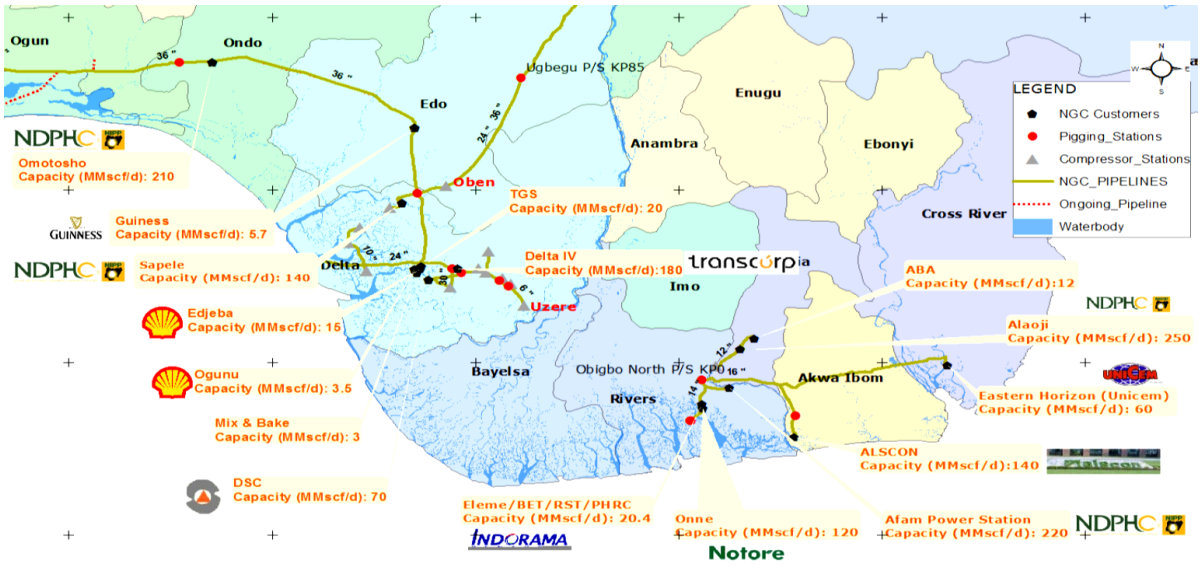

Fig. 6: Gas pipeline network in South-eastern corridor and south-southern areas

8.3 Eastern-Nigeria Gas Pipeline Network (E-NGPN)

This project is a vital element for expanding the gas network to the Northern axis of Nigeria and potentially extending it into the Sahara to expedite gas delivery to Europe through Morocco. So as to secure this venture, a clear, secure pricing and monetary system for gas and power will be needed. The planned northern gas pipeline system would possibly provide gas to power cement and additional manufacturing sectors along its path and thereby accelerating employment and the local wealth in the northern region of Nigeria. The gas pipeline network as envisaged and solely financed by NNPCL (Fig. 7) is composed of the Ajaokuta-Kaduna Kano (AKK) Pipeline stretching across:

a. total length of 614 Km
b. 40” X 187 Km pipeline between Ajaokuta and Abuja
c. 40” X 193 Km pipeline between Abuja and Kaduna
d. 40” X 65 Km pipeline between Kaduna and Zaria
e. 40” X 238 Km pipeline between Zaria and Kano

Fig. 7: 614 Km constructed AKK Gas pipeline.

8.4 West African Gas Pipeline.

Nigeria commenced selling natural gas overseas via the WAGP in 2011 which is managed by the West African Gas Pipeline Company limited (WAPCO), and is mutually held by Chevron West African Gas Pipeline Limited (36.7%), Nigerian National Petroleum Corporation (25%), Shell Overseas Holdings Limited (18%), Takoradi Power Company Limited (16.3%), Societe Togolaise de Gaz (2%), and Societe BenGaz S.A. (2%) (U.S Energy Information Administration, 2021). The 678-kilometre WAGP (Figure 13) is connected to the current Escravos-Lagos line at the Nigeria Gas Company's Itoki Natural Gas Export Terminal in Nigeria and progresses to a strategic position in Lagos from where it goes along an offshore channel at a mean water deepness of 35 meters ((WAGCo, 2022). From there it stretches to Takoradi, around Ghana, with gas supply laterals from the key line spreading to Cotonou, Lome and Tema (Ghana). The original capacity of 170 million standard cubic feet per day (MMscf/d) has been upheld and strategies are under way to expand volume to about 460 MMscf/d with the view of expanding the pipeline towards Ivory Coast at the west (US Energy Information Administration, 2012). As stated by WAGPCO, 85% of the exported gas through this pipeline is utilized for power generation and the residual for industrial uses. In recent years, WAGP has been unable to produce the projected volume of gas to its consumers owing to a number of factors such as: politics, policy, security, infrastructure, funding, unfavorable prices presented to gas suppliers etc. (Addeh, 2022).

8.5 Nigeria-Morocco gas pipeline:

The aim of this venture is to provide gas to certain ECOWAS nations notably, Benin, Togo, Ghana, Ivory Coast, Liberia, Sierra Leone, Guinea, Guinea-Bissau, Ivory coast, Liberia, Gambia, Senegal, Mauritania, pursuant to Nigeria's pledge to Article 48 of the ECOWAS Treaty, which urges member countries to co-operate, confer and coordinate their polities concerning energy and mineral reserves. The project is designed to supply gas to three landlocked countries of Niger, Burkina Faso and Mali. The existing West African Gas pipeline that currently supply gas to Benin, Togo and Ghana will serve as the precursor pipeline to Morocco. A business group has also been established including Nigerian Gas Company (NGC), Ghana National Petroleum Corporation (GNPC), SOBEGAZ (Benin), SOTOGAZ (Togo), Chevron Nigeria Ltd. (CNL) and Shell Petroleum Development Company of Nigeria. (SPDC). The feasibility and viability study was conducted and the report indicated that the WAGP was commercially and technically feasible for such extention. The main natural gas pipeline transportation infrastructure in Nigeria ie the Alakiri–Obigbo–Ikot Abasi Pipeline (the eastern network), the Escravos–Lagos Pipeline System (the western network) and the proposed Ajaokuta–Kaduna–Kano gas pipeline connecting the north to the south are all owned by the Nigerian Gas Processing and Transportation Company (NGPTC), a subsidiary of the Nigerian National Petroleum Corporation Limited. Some upstream natural gas pipelines, gas processing facilities and other related infrastructure have also been developed by gas producers for their operations. The NGPTC has granted franchises to private parties such as Shell Nigeria Gas, Gaslink Nigeria Limited and Falcon Corporation Limited for the development of gas distribution infrastructure in specified markets on a build, own, operate and transfer basis.

8.6 Trans-Sahara and AKK Gas Pipeline

The capacity of Trans-sahara pipeline would be up to 30 billion cubic meters of natural gas per year and will be 4,128 km long. More importantly, it will similarly be an offshoot of ongoing AKK pipeline (614km) which is currently under construction. It would have a diameter of 48 to 56 inches (1,220 to 1,420 mm). The pipeline was designed originally to be operational by 2025. The original investment for the pipeline was expected to be around US$10 billion and $3 billion for gas gathering centers. As of 2019, the project was still in the prospect phase. The idea of the trans-Saharan pipeline was first proposed in the 1970s. On 14 January 2002, NNPCL and Algerian national oil and gas company Sonatrach signed the Memorandum of Understanding for preparations of the project. In June 2005, NNPCL and Sonatrach signed a contract with Penspen Limited for a feasibility study of the project. The feasibility study found the pipeline to be technically, economically and environmentally feasible, viable and reliable. The pipeline is thus to be built and operated by the partnership between the NNPCL and Sonatrach. The company would include also the Republic of Niger. Initially NNPCL and Sonatrach would hold a total 90% of shares, while Niger would hold 10%. Russian gas company Gazprom has negotiated with Nigeria about its possible participation in the project. Also, Indian company Gail, France's Total S.A, Italy's Eni and Royal Dutch Shell have all expressed interest in participating in the project. The current situation of its

fabrication, construction and installation is still unclear as at the time of drafting this article.

The AKK pipeline is thus also part of (phase 1) of the larger Trans-Nigeria Gas Pipeline (TNGP) project and this ongoing AKK pipeline will be an extention of Trans-sahara gas pipeline, which also includes a proposed pipeline that aim to connect the Qua Iboe Terminal on the coast of southern Nigeria to Ajaokuta. The TNGP project itself is also part of a proposed larger, regional natural gas pipeline project called the Trans-Sahara Gas Pipeline (TSGP) project. The TSGP aim to transport natural gas from Nigeria to Algeria via Niger, which would provide an additional extra route for Nigeria to transport natural gas to Europe via Algeria's own international existing pipeline network.

8.7 Nigeria-Equatorial Guinea gas pipeline

With the newly announced Nigeria-Equatorial Guinea gas pipeline agreement signed in 2024, Nigeria is gradually turning itself into an African gas hub, positioning gas as a transition energy not only for itself but for its African neighbors, helping them to grow and gradually converting from traditional energy sources to cleaner energy and to achieve sustainable and inclusive economic development agenda. This will also help improve countries' local economies, create jobs in various countries, curb deforestation, reduce energy cost and enhance industrialization of the participating countries notably the mining and extractive, steel, automobile plants, petrochemicals and refining hubs. Gas is thus a complementary source of energy set to play a strategic and critical role in supporting the transition towards a modern diversified energy mix. An integration with renewable energies will enhance reliable, sufficient energy security and in tune with global commitments under international frameworks, such as the Paris Agreement of 2015. Furthermore, in 2025, Nigeria achieved a record available power generation of 6,003 megawatts (MW) for domestic consumption, the highest in recent time. This was followed by another landmark within the period, when the country recorded a peak generation evacuation of 5,801.84 MW and a daily maximum energy output of 128,370.75 megawatt-hours (MWh).

8.8 East-West Gas pipeline (OB3):

This is one of the largest gas pipeline in Nigeria currently undergoing fabrication, construction and installation by Oilserv company. It can also be refered to as Obiafu-Obrikom-Oben pipeline. It is called the East-West Gas pipeline (OB3) which is 136km length and 48 inch diameter. The gas treatment plant is massive with a capacity of 2 billion standard cubic feet of gas per day (2bscf/d). OB3 gas pipeline is the interconnector which links the Eastern gas pipeline to the Escravos in Lagos, South-west Nigeria and to the upcoming AKK pipeline in the North.

8.9 Ibadan-Ilorin-Jebba gas pipeline:

This pipeline was conceived to enable an inclusive development along the axis. Axxela Ltd company has shown great interest in the conceived Ibadan-Ilorin-Jebba gas pipeline with a feasibility study to build and install the 510km gas pipeline network across western and central Nigerian states of Ibadan, Oyo state to Jebba, Kwara state conducted. This is expected to revive several industries along the axis. The pipeline was proposed as part of the Nigeria Gas Master Plan of 2013. The pipeline route would start in Ibadan, Oyo state and run through the towns of Osogbo, Ogbomoso, Ado-Ekiti, Ilorin and terminate at Jebba in Kwara state. The 510 Km ELPS-Ibadan-Ilorin-Jebba (EIIJ) pipeline network across the Western and Central states of Nigeria will enhance industrialization and power generation along the entire corridor of the area. More importantly, it will create direct and indirect jobs for the teaming youths along the section as well. The proposed pipeline project which was conceived as part of the Nigeria Gas Master Plan (then GED Gas and Power, now CEO NMDPRA) is aimed to improve power generation and distribution to major cities within Nigeria's South-Western region. Axxela is one of the pioneer developer of Nigeria's foremost natural gas distribution network, delivering at peak, 70 million standard cubic feet of natural gas per day (mmscf/d) to over 175 industrial and commercial customers via a vast network of gas infrastructure, thus has shown vast expertise to handle the fabrication and construction of the pipeline. The Final Investment Decision is expected between 2026/2027 for the procurement, fabrication, construction and installation of Ibadan-Ilorin-Jebba gas pipeline project.

9.0 Pipeline infrastructure challenges

Pursuant to the PIA, upon the grant of a gas transportation pipeline license by the Authority to a company, the company, as proponent of the natural gas pipeline, is entitled to an overriding right to access and construct the pipeline and ancillary facilities along the route proposed and approved for the pipeline. The Oil

Pipelines Act 1956 (which is applicable to the extent not inconsistent with the PIA), empowers a license holder to enter upon, take possession of or use a strip of land of a width not exceeding 200 feet or of such other width or widths as is specified in the license to construct, maintain and operate a pipeline and ancillary installations, subject to the payment of compensation for such use of land to the owner or occupier of the land. The Oil Pipelines Act 1956 further provides that where additional land outside the scope granted under a pipeline license is required by a grantee, such land will need to be acquired from the land titleholder.

There are three major gas pipeline networks in Nigeria: the south-eastern network, the eastern network and the western network. An inter-connector of the networks in the eastern part of the country and the western network, the Obiafu–Obrikom pipeline (OB3) is nearing completion. The relevant legislation providing for the construction, operation, maintenance of gas pipelines and the bulk storage of gas. The PIA, however, requires holders of upstream licenses to carry out midstream and downstream petroleum operations, such as gas transportation and storage through separate corporate vehicles.

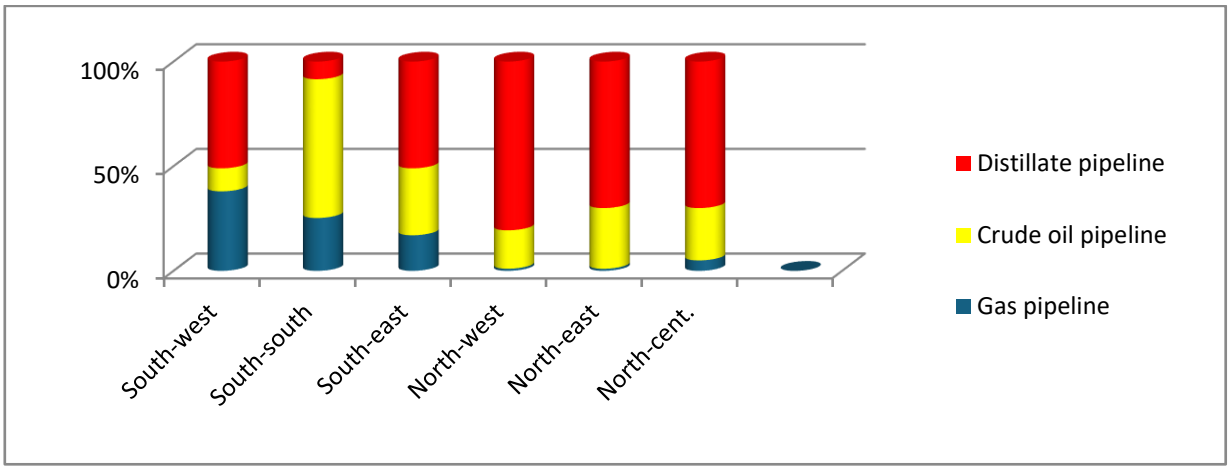

Fig. 7: Current existing Gas, crude oil and Distillate pipelines ratio across the Geo-political zones of Nigeria

To carry out gas transportation activities, a gas transportation pipeline license or a gas transportation network operator license or both must be obtained from the Nigerian Midstream and Downstream Petroleum Regulatory Authority (the Authority) and similarly, with respect to the storage of natural gas, a bulk gas storage license must be obtained from the Authority. The main natural gas pipeline transportation infrastructure in Nigeria–the Alakiri–Obigbo–Ikot Abasi Pipeline (the eastern network), the Escravos–Lagos Pipeline System (the western network) and the ongoing Ajaokuta–Kaduna– Kano gas pipelines connecting the north – are all owned by the Nigerian Gas Processing and Transportation Company (NGPTC), a subsidiary of the Nigerian National Petroleum Corporation Limited. Some upstream natural gas pipelines, gas processing facilities and other related infrastructures have also been developed by gas producers for their operations. The NGPTC has granted franchises to private parties such as Shell Nigeria Gas, Gaslink Nigeria Limited and Falcon Corporation Limited for the development of gas distribution infrastructure in specified markets on a build, own, operate and transfer basis. Natural gas producers using the natural gas transportation pipelines owned by the NGPTC, which are subject to the Network Code are thus required to accede to a network framework agreement by which the terms and conditions of the Network Code become applicable to the shipper. Such producers may also have entered into gas transportation agreements with the NGPTC for use of the pipelines prior to the entry into force of the Network Code. These legacy agreements are recognized by the Network Code and the NGPTC may with the assent of the Authority, continue to provide such transportation services on the terms of the legacy agreement.

All such arrangements outside of the Network code are however, required to be migrated to the Network Code. Gas transportation agreements are typically entered into for the use of pipelines not subject to the Network Code. For instance, any person that proposes to use pipelines belonging to affiliates of upstream producers and holders of gas distribution franchises will enter into a gas transportation agreement with the pipeline owner or gas transportation pipeline license holder. The PIA also

mandates gas transportation pipeline license holders to provide third-party access to their pipelines on a non-discriminatory basis, which will require entry into gas transportation agreements with such third-party users.

10.0 Ambitious targets for Gas Distribution

Nigerian government approved the National Gas Policy, expanding the policy strategies of the 7 Big Wins. The Policy aim to reduce Nigeria's reliance on crude oil by increasing gas exploration, production, installations, infrastructure investment and its utilization. Nigeria could potentially improve its creaking power grid with its gas reserve by prioritizing domestic gas demand requirement and by strengthening gas to power projects.

It is worthy of note that the domestic gas obligation hinges on access to infrastructure, a clearly articulated pricing path and institutional capacity strengthening. An efficient and ambitious transparent point-to-point gas transportation agreement with flexibility for third-party access meaning that third parties are welcome, policy must be set up to this effect and completion of the network code shall be the driver of the policy. The vertically integrated operation system of natural gas transmission has led to lagging pipeline network construction, low transmission network utilization rates and high consumer prices. From 2010 to 2024 alone, fossil gas constitutes a robust volume to the electricity generation in Nigeria (Fig. 8)

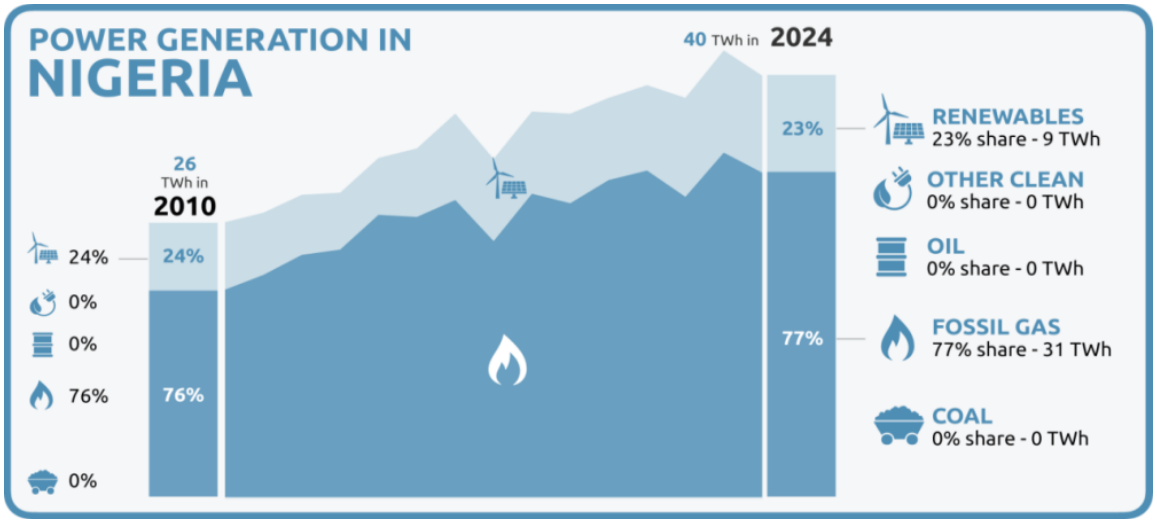

Fig. 8: Chart showing power generation across Nigeria

More importantly, LPG and CNG are 2 main processed gas that is needed domestically for the day to day activities of Nigerians to curb climate change pandemic from acute deforestation. While CNG is used as alternative transport fuel over PMS ie Premium Motor spirit and AGO ie Automotive Gas oil, LPG is mainly for safe home cooking. A detailed assessment of the current progress on the adoption, utilization and future projection of CNG is ongoing and under review for publication with the title: Compressed Natural Gas: The Geo-scientific and Technological Innovation shaping the Energy Landscape for a Cleaner and Eco-friendly Society in Nigeria (Ibrahim et al 2026 In-press). 27 mother stations (compression hubs), 63 daughter stations (refueling outlets) and 242 certified vehicle CNG conversion centers has been achieved in 2025. The adoption trend in Nigeria is thus at infancy with only about 0.5% utilization rate recorded, the bulk of which are commercial vehicles of about 12,000,000 total registered ones. Projection of scaling up to 9.1% and 21% utilization rate by 2027 and 2030 respectively is currently in the pipeline with several interventions of government, local and multinational companies with free conversion kits, ambitious 500 upcoming CNG retail outlets, mobile refueling outlets, highly reduced and subsidized retrofitting cost among others. More recently, MDGIF of NMDPRA has announced with keen interest to construct these 500 CNG outlets across the country before 2030. That is quite an ambitious target, but its strongly recommended that the CNG outlet should be a modern integrated type that will cater for LPG consumers alike with regular CNG supply across the country to accelerate the switch to cleaner energy (Ibrahim et al 2026). The design should therefore be such that they can market CNG and LPG with customer

incentives to accelerate its utilization and adoption among Nigerians especially across low- and medium-income households.

Furthermore, LPG has not been abundantly available to consumers readily and this has been driving prize upward majorly due to low gas infrastructures within the country to drive its distribution. Average retail price for refilling a 5kg Cylinder of Liquefied Petroleum Gas (Cooking Gas) increased by 3.23% on a month-on-month basis from N6,699.63 recorded in September 2024 to N6,915.69 in October 2024 (NBS 2025). On a year-on-year basis, this increased by 51.58% from N4,562.51 in October 2023. On state profile analysis, Borno recorded the highest average price for refilling a 5kg Cylinder of Liquefied Petroleum Gas (Cooking Gas) with N7,939.29, followed by Yobe with N7,580.00, and Benue with N7,578.00. On the other hand, Katsina recorded the lowest price with N6,270.00, followed by Zamfara and Delta with N6,410.71 and N6,427.78 respectively. In addition, analysis by zone showed that the North-East recorded the highest average retail price for refilling a 5kg Cylinder of Liquefied Petroleum Gas (Cooking Gas) with N7,319.03, followed by the South-West with N6,961.58 while the North-West recorded the lowest with N6,703.95 (NBS 2025).

Also, the average retail price for refilling a 12.5kg Cylinder of Liquefied Petroleum Gas (Cooking Gas) increased by 2.58% on a month-on-month basis from N16,313.43 in September 2024 to N16,734.55 in October 2024. On a year-on-year basis, this rose by 58.68% from N10,545.87 in October 2023. On state profile analysis, Rivers recorded the highest average retail price for the refilling of a 12.5kg Cylinder of Liquefied Petroleum Gas (Cooking Gas) with N17,895.00 followed by Osun with N17,739.06 and Benue with N17,731.25. Conversely, the lowest average price was recorded in Katsina with N14,725.00, followed by Nassarawa and Adamawa with N15,390.55 and N15,474.21 respectively. Analysis by zone showed that the South-South recorded the highest average retail price for refilling a 12.5kg Cylinder of Liquefied Petroleum Gas (Cooking Gas) with N17,114.67, followed by the South-East with N16,906.01 while the North-Central recorded the lowest price with N16,411.19 (NBS 2025).

11.0 Gas to Power Potential in Nigeria

Nigeria has reiterated its dedicated efforts and commitment to double current power generation from gas stations in the next ten years. Nigeria will need an investment to the tune of $10 billion every year for the next decade to close its crippling power deficit (CEO of Renaissance Africa Energy). This position was reflected in government policy explanation as it joined several other African countries in boosting planned use of fossil gas as a "transition fuel" in its updated climate plan, reflecting the continent's struggles to quickly ramp up renewable energy output. The country aims to have 17 gigawatts (GW) of gas-fired power capacity in 2035 which is nearly double the current level and more than the target for solar and hydro power combined, according to its new nationally determined contribution (NDC) plan. Currently, the Nigerian gas-to-electricity project has over 2,335km of pipelines. For an electricity output based mainly on gas, Nigeria will need about 10,000km of such gas pipeline infrastructure, especially around the hinterland currently underserved.

The questions arising from the gas to power proposal include the following: Who will be investing all the needed finances? Is the domestic gas price attractive to encourage investors to invest in gas pipeline expansion? Will the extant enabling policies ensure returns on investment? How sustainable is the available gas reserves to meet the needs of future generations? If realizable, will the expansion of the gas pipelines infrastructure guarantee sustainable and accessible power to all Nigerians especially those in the off-grid communities? The answers to these questions are with us in our various communities. Nigeria earn more from exporting its gas than domestic sales, a portion of such will need be re-invested (subsidy) in expanding gas infrastructure. Production data has shown a life index of 94 years, in essence, for every cubic feet of gas distributed within the country, then subsidy equivalent is paid to encourage more local distribution for low- and medium-income earners the benefits of clean energy.

The national gas reserves stood at 200.76 TCF as at January 01, 2019 with an Associated Gas (AG) and Non-Associated Gas (NAG) reserves split of 101.98 TCF and 98.81TCF respectively based on aggregated Reserves report from Exploration and Production companies. With a 2018 gas annual production of 2.18 TCF, the gas Reserves Life Index (RLI) is 92 years. There was a 3.88 TCF gross addition and a 1.7TCF net addition to the gas reserves of 199.09 TCF as at 01.01.2018. This translates to an increase of 0.85% and a Reserves Replacement Ratio (RRR) of 8/2. 210 TCF is the current deposit estimate of both associated and non-associated reserve. Today 2026, 210 TCF has been the proved gas reserve

with a life index of 93 years and more gas deposits are currently been explored to ramp up reserve. Recent information has also shown that NUPRC just advertised (December 1, 2025) another lucrative existing and new oil and gas blocks for investors to shore up reserve base. Gas to electricity generation is fairly good

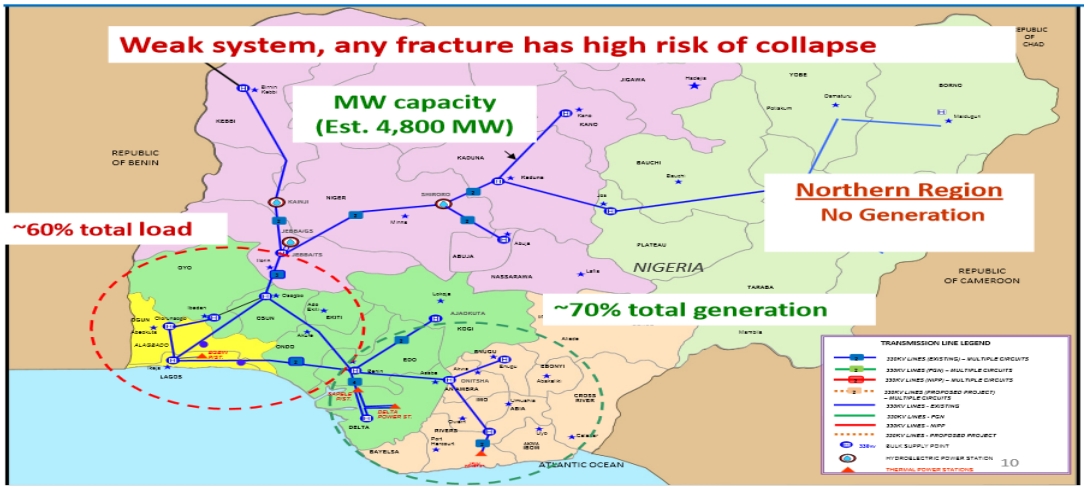

Fig. 9: Gas to power electricity generation across Nigeria

Across the southern Nigeria ie South-western, southern and eastern axis (Fig. 9) with no single generation along the northern corridor, a condition the upcoming AKK pipeline and associated fittings is about to change. The Nigeria power sector is characterized by huge gap between supply and demand; current power demand is estimated at 17,520MW including latent and suppressed demand, against 5,300MW peak generation. The country targets 10.2MW by 2019 and 18,879MW by 2030 including all energy mix for electricity generation. In order to achieve this, massive investments are expected in the power value chain. In order to attract investment into the sector, the Federal Government in 2005 enacted the Electricity Power Sector Reform (EPSR) Act which liberalized, commercialized and privatized the electricity sector (Fig. 10). About 300mmscf/d of gas goes into production of 65% of Nigeria's 111Kw/cap of electricity. However, The AKK natural gas pipeline is envisaged to enhance Nigeria's power generation capacity by increasing 3,600MW of power to the national grid and deliver electricity to the northern region currently with no gas generation potential (Fig. 9). The project will open-up opportunities for construction of gas-powered plants along the corridor and generally improve the power situation of the country.

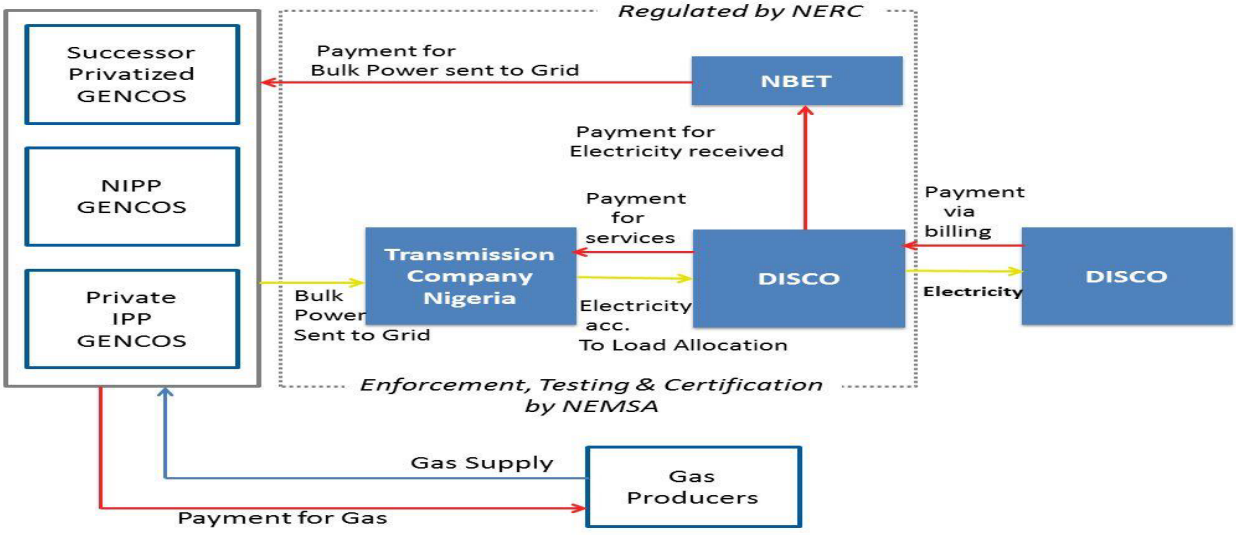

Fig. 10: Structural flowchart of gas to power for Electricity generation in Nigeria

Nigeria is well endowed with resources in both renewable and non-renewable energies which could sufficiently address existing power shortages and promote the Federal Government's drive to attain sufficiency in power supply by the year 2030 and beyond (Fig. 10). A study by GIZ/FMoP identified a total of 47,489 population clusters spread across the country. It was also established that out of the population of 233.4 million people, 174 million live within the clusters. Also, about 10% of population is assumed to live in very small settlements or have no permanent settlement locations. Of the identified clusters, a total of 45,456 clusters are considered to be non-electrified (95%). Although this represents the vast majority of clusters, only 89 million people out of 193.4 million people (46 %) live in the electrified area (Table 2).

Table 2: Electricity policies and targets in Nigeria

S/N	Policies	Regulations	Institutions	Target 2030
1	Unsolicited projects	Bulk Procurement Regulation	NBET	10,000(FF+RE)
2	Competitive Procurement	Bulk Procurement Regulation	NBET	10,000(FF+RE)
3	REFIT	REFIT Regulation	NBET/DisCo	3,000 (RE)
4	Mini-grid (Off-grid)	Mini-grid Regulation (draft)	REA/SREA	10,000(FF+RE)

Significant increase in available generation capacity were recorded in Afam_1 (+182.05%) towards the last quarter of 2024. Omotosho_1 (+92.36%) and Olorunsogo_1 (+84.01%) power plants in 2024/Q3 compared to 2024/Q2. The cumulative available generation capacity of the NDPHC power plants (Odukpani_1, Olorunsogo_2, Omotosho_2, Ihovbor_1, Geregu_1, Sapele_2 & Alaoji_1) also increased by +24.21% from 499.16MW in 2024/Q2 to 619.98MW in 2024/Q3 using gas. The large proportion of the energy mix growth would come through other generation arising from already signed number of Power Purchase Agreements (PPAs) with Bulk Trader as well as those coming through new competitive procurement bid by electricity producers to meet expected target (Fig. 10 and Table 3). Investment in Nigeria power sector is very attractive due to the growth opportunities in the Nigerian electricity market where demand far outstrips current supply. The potential for strong economic growth is high with population advantage of over 238.4 million.

12.0 Gas Fired-Power Electricity Plants;

Nigeria is a signatory to the Paris Agreement, having submitted its Intended Nationally Determined Contributions on the 28th of November, 2015, signed the agreement on the 22nd of September, 2016 and ratified the agreement on the 16th of May, 2017. The NDC Sectoral Action Plan was developed and then validated in July 2018 prioritizing five major sectors - agriculture, industry, power, transport, and oil and gas; with the Department of Climate Change, Federal Ministry of Environment being the agency to drive national implementation. Gas Gathering opportunity for Domestic and export use currently estimates is about 210Tscft of associated and non- associated gas reserve exist in the country, making Nigeria the $9^{th}/10^{th}$ largest gas reserve holder in the world and undisputed largest reserve in Africa with Associated gas making up about 88.8Tscft or 49.2%, while Non – Associated gas makes up of 91,7Tscft or 50.8% of the gas reserve. Nigeria gas production is about 7.5bscft/day. (41%) of this is exported, 2.3bscft/day (28%) is used domestically for power and industries, 1.2bscft/day (15%) is used upstream for gas re-injection, while the balance 0.8bscft (10%) is flared. Presently there is acute inadequate gas pipeline infrastructure, most especially to the newly developed power plants and upcoming Independent Power Plants as well as industries. Several thousands of kilometers of pipelines would be needed to meet present gas use and need in Nigeria. This includes over 7,000km of new gas pipelines to be laid and about 8,000km of existing lines to be replaced or refurbished to meet the growing demand.

Table 3; Gas to Electricity stations and ownership status

S/N	OWNERSHIP STATUS	STATIONS	INSTALLED CAPACITY (MW)	NO. OF UNITS	GAS REQUIREMENT (MMSCF)
1	PRIVATISED PHCN COMPANIES	EGBIN	1,320	6	352
2		SAPELE	720	10	192
3		DELTA	765	18	204
4		AFAM IV-V	300	8	80
5		GEREGU GAS	435	3	116
6		OMOTOSHO GAS	337	8	90
7		OLORUNSOGO GAS	336	8	90
8	NIPP	GEREGU NIPP	435	3	116
9		SAPELE NIPP	500	4	133
10		ALAOJI NIPP	504	5	134
11		OLORUNSOGO NIPP	750	6	200
12		OMOTOSHO NIPP	500	4	133
13		ODUKPANI NIPP	625	5	167
14		IHOVBOR NIPP	450	4	120
15	Independent Power Projects	OKPAI	480	3	128
16		AFAM VI	695	4	185
17		IBOM	198	3	53
18		A.E.S	224	9	60
19		ASCO	110	2	29
20		OMOKU	150	6	40
21		TRANS AMADI	136	4	36
22		RIVERS IPP	150	6	40
		TOTAL	**10,120**	**129**	**2,698**

The Nigerian gas and power sector(s) have undergone various reforms in the past months, from the introduction of the Electricity Act 2023, the updated 2023 Mini-grid regulations to the most recent developments ie the increase in the domestic base price for natural gas for power generation companies (GenCos) for 2024 from $2.18 per million British thermal units (MMBTU) to $2.42 per MMBTU. This represents about 11% increase in the price of gas for power generation as announced by the Nigerian Midstream and Downstream Petroleum Regulatory Authority (NMDPRA), alongside a change in electricity tariff via a tariff hike for Band A customers.

This is based on a revision to the Multi-Year Tariff Order (MYTO) for distribution companies (DisCos), as issued by the Nigerian Electricity Regulatory Commission (NERC), in the supplementary MYTO for DisCos. These changes present a cascade of implications for the Nigerian economic landscape (Table 4).

Table 4: Nigeria's 2023 Energy overview. Source: U.S Energy Information Administration,

Energy overview	Coal	Natural gas	Petroleum	Solar	Wind	Hydro	Nuclear
Primary energy consumption (quads)	0.0	0.7	1.0	1	0	1	0
Primary energy consumption (%)	2	40	57	1	0	1	0
Primary energy production (%)	1	30	68	1	0	0	0
Electricity generation (Terrawatt/Hr)	0	32.8	0.0	0	0	9.6	0
Electricity generation (%)	0	77	0	0	0	23	0

According to the International Hydropower Association, Nigeria has natural resources that provide significant hydropower potential, particularly in its central and northern regions, but hydropower in the country is underdeveloped. The Nigerian government is seeking to build hydropower plants and increase the country's hydropower capacity to address domestic electricity needs. In June 2023, the 700-megawatt (MW) Zungeru hydropower plant, Nigeria's second-largest plant, began operations. The largest hydropower plant, the 760-MW Kainji plant is currently undergoing rehabilitation and expansion scheduled to be completed by 2027, which will increase capacity to 980 MW, but this is still far from demand of about 234 million Nigerian people. More importantly, electricity supply from such facilities are usually epileptic due to maintenance and rainfall variability volume, as such, its highly time bound in electricity supply.

The government similarly raised the price of commercial gas from $2.50 to $2.92 per cubic foot. This is after a month since Presidential executive orders were gazetted; giving tax credit incentives for Non-Associated Gas (NAG) greenfield initiatives in onshore and shallow water sites with initial gas production on or before January 1, 2029. The shortage of gas despite over 200 tcf reserve is one of the factors mentioned as to why gas-fired plant generation is low, hence hindering the fulfillment of domestic gas supply obligations to the power sector. This is owing to the lack of cost reflective tariffs in the power sector, infrastructures which in effect affects the profitability of gas production for domestic supply. The resultant effect has been a buildup of debts owed to gas producers, informing the reduced supply to electricity generation companies. The vast network of gas pipeline criss-crossing the Nigerian landscape will is expected to improve electricity generation and distribution across the country.

Although solar power comprises a small share of Nigeria's total generation capacity, it has grown substantially in the last decade, increasing from about 16 MW to 132 MW from 2014 to 2025 (Fig. 11). This increase is partially due to government support that aims to increase access to electricity for off-grid populations in remote and rural areas as well as to replace expensive diesel generators. Nigeria currently forecasts and targets 2060 as the time for zero carbon emission with renewable sources playing a dominant role in achieving this target. This study forecasts that gas (66%) will still be relevant till 2060 as a major source of energy, though renewable energy (solar energy) will be more adopted as an energy mix to the tune of 25% compared to the current status of less than 12% (Fig. 11). Fossil fuel in the form of crude oil (PMS and AGO) is currently been replaced with CNG and LPG as a cleaner fuel, thus will continue to increase in demand as Nigerians are currently adopting the cleaner energy by retrofitting their vehicles to CNG. There is currently low investment in wind energy (Fig. 11).

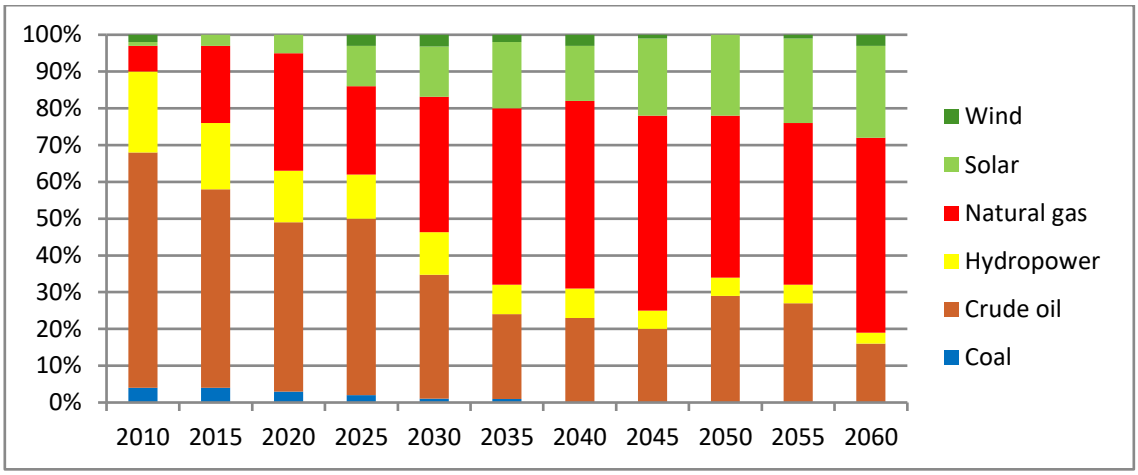

Fig. 11: Trajectory of energy utilization sources in Nigeria. (Source: Ibrahim et al 2026).

In a nutshell, Renewable energy especially solar energy will continue to grow, just as gas as a form of energy will also grow in multiple folds due to its high adoption and several ongoing gas infrastructure projects across the world. The Nigerian government's Rural Electrification Agency is a major stakeholder championing solar electricity across the Nigerian ecosystem. World Bank and African Development Bank recently launched the Solar Power Naija initiative with the aim to connect 5 million new households to solar power and expand energy access to 25 million individuals in underserved communities through the provision of solar home systems and the development of solar mini-grids by next decade.

This initiative and others will boost the adoption of solar energy as a dependable renewable energy source. Nigeria hold about 246 million metric tons of coal reserves in 2023 with consumption sharply declining (Fig. 12). Between 2014 and 2023, the country averaged about 2.7 million tons of coal production all of which was bituminous coal. Nigeria uses it all to satisfy its domestic needs but due to its fundamental uncleanness and lack of environmental suitability and sustainability with large carbon footprints from its utilization, the world including Nigeria is gradually phasing-out the use of such coal as an energy source.

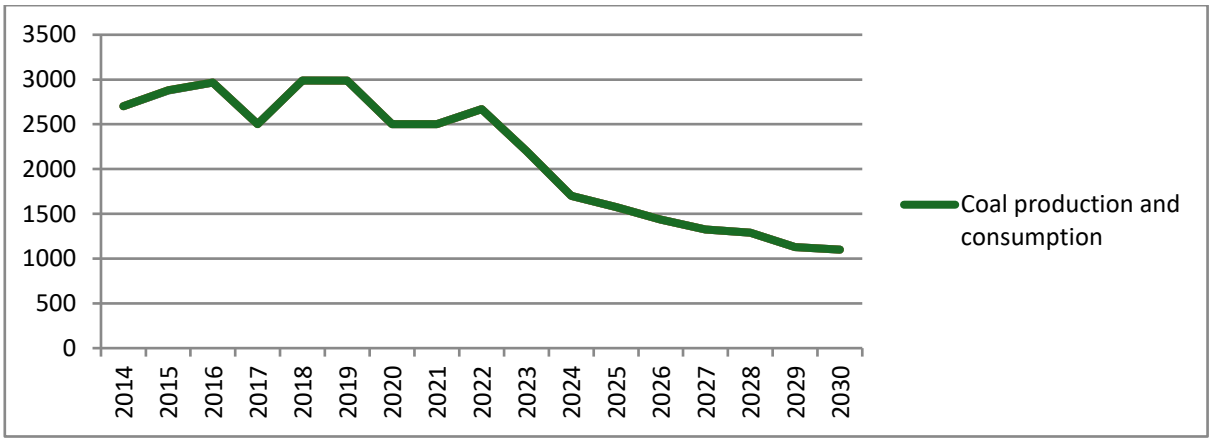

Fig. 12: Steep decline of coal production and consumption as energy source in Nigeria

13.0 Conclusion

The impacts of the Nigerian Mid and Downstream oil and gas is extremely high on the day to day activities across several sectors of the Nigerian ecosystem. Man's activities has always revolved around the oil for almost 10 decades, so it has been a big task switching to other forms of renewable energy currently revolutionalizing the global energy industry. It will have to be a gradual process, gradual planning and gradual adoption trend with significant, sustainable investment towards the clean and eco-friendly alternative energy to power global

economic growth. The diverse complex Geological terrains for this energy in Nigeria is gradually been navigated with several pipeline projects notably AKK, OB3 using latest sophisticated technology. About 300mmscf/d of gas goes into production of 65% of Nigeria's 111Kw/cap of electricity expected to triple soon. This study forecasts that gas (66%) will still be relevant beyond 2060 as a major source of energy existing side by side with other forms of energy. Renewable energy (solar energy) will continue to be adopted as an energy mix to the tune of 25% compared to the current status of less than 12%. Fossil fuel in the form of crude oil products (PMS, DPK and AGO) is also currently been gradually replaced with CNG, LPG as a cleaner transport and cooking fuel respectively, but this study has shown that they will also continue to exist side by side with gas and renewable energy as a total displacement is currently not envisaged even by 2060.

In a nutshell, the Nigerian Mid and Downstream offers tremendous opportunities for national and international investors partnership in gas distribution across various sectors of the Nigerian ecosystem. Moreso, the world is now catalyzing its economic growth using natural gas resource that will usher in clean, eco-friendly and more robust economic future.

Recommendation:

Amendment of the Petroleum Industry Act 2021 will be highly needed to promote private sector investment in Gas pipeline fabrication, construction, installation and other critical gas infrastructures. This is expected to hasten the delivery of affordable gas molecules to Nigerians and aid Nigerias industrialization agenda, moreso that pipeline is safer in the delivery of gas and other hydrocarbon to local and international markets. More importantly, amendment of the PIA will need include strengthening MDGIF activity to adequately participate in funding such Gas infrastructures.

Brief Biography of Lead Researcher (Author)

Dr. Ibrahim Olanrewaju Ibrahim is a versatile researcher, especially oil and gas expert with over 40 published articles in different national and international journals. He is an Environmental, Hydro, Engineering and Petroleum Geoscientist with published articles covering all the aforementioned skills. He is a book and several manuscripts reviewer with several Award of Excellence on reviewed manuscripts from numerous international journals to his credit. He has delivered several public lectures, seminars and attended several seminars and conferences locally and international arena. He has mentored several Students of Industrial Work Experience (SIWES) from different institutions of learning at Lower Niger River Basin Development Authority, Ilorin, Kwara state, Nigeria on Hydrogeology, Exploration Geophysics, Engineering Geoscience and Sedimentology, equipping them with different knowledgeable practical skills to create jobs. He earned a first degree in Applied Geology from Abubakar Tafawa Balewa University, Bauchi, Nigeria. He also attended University of Ilorin where he was awarded a Master and Doctorate degree in Geological Science. His area of current research is on Climate change, Carbon credit market, Natural Gas development and their impact on economic growth in Nigeria and Africa.

Acknowledgements

We sincerely thank God for helping us complete this manuscript. We profoundly appreciate listed authors for their individual contribution to bring out the best of this paper. More importantly, Authors appreciate our publishers and reviewers for the kind attention they have given the manuscript to bring out the best of its content. All national and international sources of data are hereby duly acknowledged, appreciated and adequately referenced.

Conflict of interest

No conflict of interest has been declared in this paper as contents have been put together to contribute to learning, knowledge acquisition and investment drive on the Natural Gas potential in Nigeria currently grossly untapped for world economic growth.

References

1. **Aba, M. M., Amado, N. B., Rodrigues, A. L., Sauer, I. L. and Richardson, A. M. (2023).** Energy transition pathways for the Nigerian road transport: Implications for energy carrier, power train technology and CO_2 emissions, Sustainable Production and Consumption, Vol 38, Pp 55–68.
2. **Agboola, O.M., Nwulu, N.I., Egelioglu, F., and Agboola, O.P. (2011).** Gas Flaring in Nigeria: Opportunity for Household Cooking Utilization. International Journal of Thermal and Environmental Engineering. 2 (2), pp 23-36

3. **Africa Forbes (2025).** Driving growth through Gas: Nigeria unleashed series. Special Report Produced by Pentresa. www.pentresa.com and www.rollingenergyltd.com

4. **Akintunde, M. O. (2016).** Review of Gas Resource Utilization Using Applicable Technologies: A Case Study of Nigeria. IJERST, 71-78.

5. **Anifowose, B., Lawler, D., Van der Horst, D., and Chapman, C. (2014).** Evaluating Interdiction of Oil Pipelines at River Crossings Using Environmental Impact Assessments. 46(1), pp. 341-349

6. **Carim, A. A., and Onyekonwu, M. (2016).** Review of gas resource utilization using applicable technologies: A case study of Nigeria. International Journal of Engineering Science, 5(3), 71–78.

7. **Emejulu, O (2009),** "Development of Gas Aggregation and Allocation Models in the Domestic Sector of the Economy" A paper presented at Gas Stakeholders Forum in Abuja.

8. **Giwa, S. O., Nwaokocha, C. N., and Odufuwa, B. O. (2017).** Mitigating gas flare and emission footprints via implementing natural gas vehicles in Nigeria. Energy Policy, 111, 193–203. https://doi.org/10.1016/j.enpol.2017.09.027

9. **Ibrahim Olanrewaju Ibrahim, Seun Bewaji, Abubakar Idowu Mohammed, Abdulsalam Yinka Saheed, Abdullah-Abdulsalami Fatima Hajiya, and Mamunu Maryam Umar (2025).** Geosciences and Public Health Medicine: The Nexus of an Evolving Society in a Highly Dynamic Environment. Nigerian Journal of Engineering Science Research (NIJESR). 8(1), 70-86. https://doi.org/10.5281/zenodo.15829278

10. **Ibrahim, O.I Ngozi-Chika C.S Okanigboan, P.N Abdulraheem, K.K and Bilqees, D (2023).** Mothballing, Manifold, Pipeline installation and Impact Assessment in existing Saghara Gas solution Flowstation Facility, Warri, Niger Delta, Nigeria. Nigerian Journal of Engineering Science Research (NIJESR). 6(02), pp.9-23. ISSN: 2636-7114

11. **Idigbe, K. I., and Onwuachi-Iheagwara, P. N. (2018).** Optimizing natural gas assets from marginal fields in Nigeria. Journal of Scientific and Multidisciplinary Research, 10(3), 49–64.

12. **Idigbe, K. I. (2020).** Driving sustainable growth through natural gas assets in Nigeria. Journal of Emerging Trends in Engineering and Applied Sciences, 5(2), 140–147.

13. **Imoudu P. B. and Igbatayo, S. A. (2006),** Developing Nigeria's Gas Industry for Regional Economic Integration: The West African Gas Pipeline Project SPE 105967, presented at 30th Nigerian Annual International Conference and Exhibition held in Abuja, Nigeria.

14. **Iyoke, J. U. (2013).** A Review on Natural Gas Utilization and Cutting Carbon. Journal of Energy Technologies and Policy., 37-46.

15. **Kazeem L. A., Amam, S. and Yang, J. (2006),** "Between Gas Flare-out and Sustainable Oil and Gas TS2" Gas Utilization. "SPE 105963, presented at 30th Nigerian Annual International Conference and Exhibition held in Abuja, Nigeria.

16. **Malcolm, B. (2004).** The vital role of gas in a sustainable energy future, paper presented at CERA conference, Houston, USA.

17. **Morgan L. and Chinwo, C. N. (2006),** Sustainable Gas Utilization and the Clean Development Mechanism: The Nigerian Perspective SPE 105968, presented at 30th Nigerian Annual International Conference and Exhibition held in Abuja, Nigeria.

18. **Nduka K., Anyadiegwu C. I., Duru, U. I., Obibuike, U. J., Ekwueme, S. T (2020).** Development of Domestic Gas Supply Obligation Model for Efficient Gas Utilisation in Nigeria, International Journal of Oil, Gas and Coal Engineering.

19. **NUPRC, 2024 Report.** Nigerian Upstream Petroleum Regulatory Commission report submitted to the Ministry of Petroleum, Nigeria.

20. **OyewunmiTade, Iwayemi Akin (2016).** Gas Supply to Power Markets in Nigeria: A Regulatory and Economic Assessment. The 9th NAEE/IAEE International Conference, Abuja Nigeri