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The Evolution of Gas Development and Utilization in Nigeria

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Abstract
Nigeria is endowed with abundant natural gas resources, which in energy terms, is in excess of the nations' proven crude oil reserve. Gas was discovered while searching for crude oil, as no deliberate effort was made to search for natural gas then. The reserved estimate of the Nigerian gas is over 120 trillion cubic feet, with about 50/50 distribution ratio between Associated Gas (AG) and Non Associated Gas (NAG). On an energy equivalent basis, Nigeria's natural gas reserve is three times her oil reserve. Nigeria's gas reserve estimated at 182 TCF (trillion cubic feet) with a projected growth rate of over 70% by 2023, has proven to possess the potential of being a key player in the emergent Global Natural Gas Market. A substantial portion of the gas produced is flared while a minute part is re-injected into the system and utilized. There is a subsisting Gas Master Plan to promote investment in pipeline infrastructure and new gas-fired 'power plants' to help reduce gas flaring and provide more gas. The gas master plan also seeks to eliminate the wasteful practice of gas flaring in the short term, but in any case make gas available at commercial and affordable prices to local markets as well as reflect its full economic value; allow for the widespread distribution of gas, LPGs, or even CNG to more remote areas, regionally and internationally; formulate a strategy that adds value for all parties and encourage beneficial gas usage both domestically and/or through capture and, where relevant, savings of foreign exchange. The PIA intends to harness the gas potential of the Country by encouraging investments in the gas space of the hydrocarbon sector. It is against this background that the paper evaluated the evolution of gas development and utilization in Nigeria with respect to the Nigerian Gas Master plan and the gas development and utilization measures. The authors therefore concluded that the proper exploitation and exploration of gas, barring any other odds, could be the game changer of the Nigerian economy.
Keywords: gas, hydrocarbon, global, market, industry

1. Introduction

Natural gas as a 'cleaner energy,' is attracting investors across the globe, especially for countries such as Nigeria, with a huge gas reserve. This resource is of growing benefit, as gas has become, and continues to be, the fuel of choice in developed as well as developing countries. Nigeria is a natural resource abundant country, blessed with a large hydrocarbon resource endowment, both in absolute terms and relative to other petroleum-producing countries. The oil and gas sector is the backbone and mainstay of Nigeria's economy,[1] accounting for over 95% of her foreign exchange earnings,[2] 40% of her Gross Domestic Product (GDP) and 85% of the Federal Government's collectible revenue. Over the past fifty years, the country's oil subsector has grown phenomenally.

Both production and exports have increased enormously since commercial production in 1958. Nigeria takes the first position in Africa with respect to total proven gas reserves. However, Nigerian production falls to third position. The consumption/utilization is minimal, indicating that some of the produced gas was flared. With a total reserve of 182.817 Trillion Cubic Feet[3] in 2010, 1.54% of the reserves was produced with 19.33% flared, and in 2017, with reserves of 199.09 TCF, 1.48% was produced and 11.74% was flared.[4]

Gas reserves found while looking for oil are conservatively estimated at more than 150 Trillion Cubic Feet. The reserves represent over 5% of the world's total, and the undiscovered potential is considered to be just as large. It has become clear that Nigeria, already well known as a major quality oil producer, is just as much or perhaps more of a gas than an oil province. Nigeria is only consuming a fraction of what she reasonably could, especially to meet its internal demand for energy and is therefore only on the first step compared to countries with similar or even smaller gas resources.[5]

Flowing from the above, it is obvious that a proper discourse on gas development and utilisation in Nigeria must reflect on global development and utilisation of gas.

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[1] Gbolahan Solomon Osho Texas Southern University, Matthew Nga Uwakonye, Grambling State University, Hyacinth Anucha, Sojourner - Douglass College Nume Ekeghe Oil and Gas Engineering: Replacing Oil as Mainstay of Nigerian Economy

[2] Matthew Nga Uwakonye et al, The impact of oil production on the Nigerian economy, The impact of Oil and Gas Production on the Nigerian Economy: A Rural Sector Econometric Model

[3] [Hereafter, The TCF]

[4] Energy Sector Management Assistance Program (ESMAP) (2004) Strategic Gas Plan for Nigeria

[5] G. O. Ani and S. S. Ikiensikimama, (2020) Natural Gas Development Trend in Nigeria. The Investor's Road Map, *J*ournal of Energy Research and Reviews, Page 39-48

2. The Development of Gas Industry

Gas is considered the cleanest of the fossil fuels in usage today as it emits 30% less carbon than crude oil and almost 2 times less than that of coal.[6] To better protect the earth from the adverse effects of hydrocarbons, the United Nations implemented the Sustainable Development Goals,[7] which focused on encouraging countries to move towards carbon neutrality to arrest the increasing levels of greenhouse gas emissions. In the same vein, the Paris Agreement of 2015 also seeks to reduce global warming to 2 degrees Celsius by 2050. Nigeria is a party to both the SDG and the Paris Agreement-hence it comes as no surprise that the Petroleum Industry Act[8] intends to harness the gas potential of the country by encouraging investments in the gas space of the hydrocarbon sector. Global natural gas demand had increased from 176 BCFD in 1990 to 255 BCFD in 2006.[9] Although actual year-to-year growth in natural gas demand has been much higher in Africa, South America, Middle East and Asia Pacific during this period. However, Europe, North America, Russia and the Caspian regions continued to be the primary demand markets, together accounting for over 46% of the world's natural gas demand.

Gas-fired power generation was the primary driver of worldwide incremental gas demand, growing from 53 BCFD in 1990 to 94 BCFD in 2006, a CAGR of 3.7%. This growth was driven by two key factors;

(a) Increasing electricity demand fuelled by economic growth and,

(b) Replacement of an aging coal-fleet in Europe and North America.

Gas has been the fuel of choice in power for a number of reasons including costs, development time (much shorter than coal or nuclear), as well as increasing environmental concerns and pressure to reduce emissions.[10]

In response to this growth in demand, global trade had also been steadily increasing from 1994 to 2006. Europe, Asia Pacific and North America were increasingly forced to depend upon gas imports[11] from other regions of the world in order to fill the developing gap between domestic gas supply and demand. Europe had access to pipeline gas from Russia and

[6] Petroleum Industry Act – A New Era for the Nigerian Oil and Gas Upstream Industry
[7] [Hereafter, The SDG]
[8] [Hereafter, The PIA]
[9] Nigerian Gas Master Plan (2013) page 29
[10] Organization for Economic Co-operation and Development (OECD) Green Growth Studies Energy (2011)
[11] (LNG through pipeline)

the Caspian region in addition to LNG imports. However, North America and Asia Pacific has been mostly reliant on LNG imports to fill their domestic gas demand requirements.[12]

2.1 Gas Development in Nigeria

Gas utilization in Nigeria commenced in 1963 with accompanied gas sales by the Shell Petroleum Development Company of Nigeria[13] to industrial users in Aba. In its bid to create value for Associated Gas (AG) which was routinely being flared by operators, the Government initiated several projects to increase gas utilization in the country from the mid-1960s to the late 1990s. These projects included gas supply to Thermal Power Plants-Delta State; Port Harcourt Refinery-Rivers State; Power Holding Company of Nigeria[14] Sapele-Delta State; Delta Steel Aladja; National Fertilizer Company of Nigeria[15]); Ajaokuta Steel Complex; Egbin Thermal Power Station and Aluminium Smelting Company of Nigeria,[16] Ikot Abasi).[17]

A noticeable increase in gas production in Nigeria commenced in the early 1970s, ultimately rising above 2.7 BSCF/D by 1979. By this time, a domestic market had been created for the consumption of produced gas in the eastern part of the country, close to the gas source. Since 1990 gas production has steadily increased with daily production rising above 8.2 BSCF/D in 2015. The steady increase in production is strongly linked to the discovery of more non-associated gas (NAG) reserves in deeper reservoirs, the development of deep offshore oil fields with huge associated gas (AG) reserves, participation in the gas export business through the Nigerian Liquefied Natural Gas Company, and increasing demand for local gas supply for power generation. In 2015 there were 39 companies directly involved in oil and gas. It should be noted that the pressure to reduce flaring, desire for economic growth and general enhancement of the quality of life of the citizens, and desire for industrial development are the principal drivers for the development of natural gas.[18] Generally, the

[12] Ibid.
[13] [Hereafter, The SPDC]
[14] [Hereafter, The PHCN]
[15] [Hereafter NAFCON]
[16] [Hereafter, ALSCON]
[17] Dr. David O. Ige (2009) The Nigerian Gas Master-Plan Status Update Group General Manager/Senior Technical Assistant to GMD Nigeria National Petroleum Corporation Abuja, Nigeria The focus of the Gas Master Plan was to create a stable and suitably attractive commercial environment to ensure that the full potential of the gas sector could be realized.
[18] Emeka Nnanna Ojijiagwo (2017) Development of A Sustainable Framework to Manage Flare Gas in an Oil and Gas Environment: A Case Study Of Nigeria

development of the Nigerian LNG project has been pivotal to increased gas utilization in Nigeria and in the creation of a position in the international market.

Notwithstanding, the increase in the utilisation of gas in Nigeria, there are also associated myriads of challenges, such as the structure of investment, inclusive of large investments in pipelines and distribution systems; inappropriate domestic pricing policy, inclusive of government policy, for instance, through social or sector policies, such as producing natural gas from 189 fields with daily AG production of 4.74 BSCF/D and NAG production of nearly 3.46 BSCF/D.

3. Gas Utilization in Nigeria

The first era of the Nigerian gas sector reflected the start of gas production in 1975 until the commencement of operations at NLNG in the late 1990's. This 'demand constrained era' was marked by intense gas flaring as well as the introduction of a number of incentives to promote investment in gas utilization with a focus on developing NLNG, which was considered the most promising route for gas monetization.[19] The first era, resulted in the birth of an export-oriented gas sector. The successful implementation of NLNG in 1999 heralded the start of the second era in the evolution of Nigeria's gas sector. This was characterized by a rapid growth in gas monetization via exports of high value LNG, the beginning of steady decline in flaring, and initiation of new export oriented conversion projects (GTL). This era also witnessed a small increase in the utilization of gas in both the domestic power and industrial sectors.

Furthermore, there are other major sources of gas demand today which include the West African Gas Pipeline Company,[20] the Escravos Gas to Liquid Plant, the SPDC Afam VI Power Plant and numerous gas plants operated by producing companies to process gas and recover natural gas liquids for export to international markets. Oil and gas producers were also encouraged to utilize the produced AG for gas-lift, fuel for production operations and re-injection into the reservoir for conservation and reservoir pressure maintenance. Accordingly, of the 4.74 BSCF/D of AG produced in 2015 about 4.26 BSCF/D representing nearly 90% was utilized either by consumption or re-injection back into the reservoir.

[19] Charles Odumugbo (2016) Journal of Natural Gas Science and Engineering, Volume 33, pp. 769-776 Natural Gas Utilization in Nigeria, Challenges and Opportunities
[20] [Hereafter WAGPCO]

Nigeria has recorded typical gas utilization projects capable of supporting her economic growth. Such options available to Nigeria include:

a. Power Generation
b. Gas to Liquids (GTL) manufacture.

The second priority covers the following:
a. LPG processing
b. Cement manufacture
c. Steel (DRI) manufacture
d. Fertilizer (Ammonia/Urea).

The third category options include:
a. Further Liquefied Natural Gas (LNG)
b. Methanol
c. Aluminium smelting

Furthermore, the domestic availability of gas supply to the Nigeria market cannot be over-emphasised. There was a concentration of market power in a few dominant Joint Ventures including core IOC operators, who had typically focused their gas activities on the export of LNG rather than on supply of the domestic market.[21] This had been driven largely by the commercial returns associated with exports (compared to the domestic market), including high returns in the LNG plant, as well as the security of income associated with international LNG purchasers. With limited confidence in the domestic market and significant fiscal incentives for the development of gas for exports, it is not surprising that the focus on gas monetization had historically been on LNG. The full potential of the indigenous market could only be realized if the economic balance between the domestic market and exports could be redressed. With current reserves, it was estimated that unconstrained gas production could reach a maximum level of 12-13 (BCFD). This maximum production estimate was a theoretical number reflecting a notional environment where there are no financial, technical or geological constraints.[22]

[21] Tade Oyewunme and Akin Iwayemi (2016) Article, Gas-to-Power Market in Nigeria: A Regulatory and Economic Assessment. Most of the projected capacity and efficiency gains of the power sector reforms initiated from 2001-2013 has been hinged on the secured, affordable and reliable gas supply to about 75% of power generation plants in Nigeria.

[22] Nigerian Gas Master Plan: The Need for Government Intervention Multiple Challenges Requiring a Coordinated Approach: In the planning of facilities, it is important to recognize the close relationship between design and construction. These processes can best be viewed as an integrated system.

The domestic market is controlled by the Nigeria National Petroleum Company Plc. through its subsidiary the Nigerian Gas Company, which supplies gas for power generation, either as source of fuel or as feedstock to cement and fertilizer plants, glass, food and beverages, manufacturing industries and so on. More local industries are now aware of the advantages and benefits of using gas. The Nigerian gas market is a profit oriented market awaiting potential investors. There are identifiable categories of the market regime in Nigeria.

Export- Oriented Gas Projects

For the international market, NNPC and its Joint Venture partners are currently embarking on several gas utilization projects, which include the following:

I. Escravos Gas Project

   This project was executed by NNPC/Chevron JV. The plant is located in the South-western part of the country and it produces mainly LPG for export from its first phase. Detailed engineering for the second phase has reached advanced stage, while the third phase is being proposed.

II. OSO NGL Project

The NNPC/Mobil JV commissioned an NGL plant located at its OSO field in the South Eastern part of Nigeria. It started production for export in the third quarter of 1998.

III. LNG Projects

Nigeria, through NLNG (Nigeria Liquefied Natural Gas) Ltd., embarked on the construction of its first LNG plant in collaboration with three partners, namely, ELF, AGIP, and SHELL. The LNG plant site is located at Finima in the Eastern region of Nigeria and, these three companies in joint venture with NNPC, also supplied up to 1 billion standard cubic feet of natural gas for feed stock/fuel to the plant from their Obite, Obiafu and Soku fields respectively. It was expected that flaring would reduce coupled with the expected huge revenue.[23]

[23] Emeka Ojijiagwo et al , (2016) Article, Economics of gas to wire technology applied in gas flare management, The global availability of natural gas is valued and expected to increase with time.

IV. Ekpe Gas Compression Projects

The NNPC/MOBIL JV executed this project in order to gather the gas that was being flared in this field for enhancement of oil production by gas lifting and gas re-injection.

V. OSO 2Y2 Project

This project was also executed by the NNPC/MOBIL JV. The objective was to provide additional gas make-up for the OSO NGL as well as maintain condensate production at the expected plateau.[24]

VI. Belema Gas Injection Project

The NNPC/SHELL Joint Venture is executing this project with an objective to reduce gas flares in five flow stations by re-injecting some of the gas, some for gas lifting, and some for use as fuel by local industries and the excess for backing out NAG that is currently used to meet various existing contractual obligations. The contracts for the execution of the EPC and gathering pipelines have reached advanced stages of execution. About 80mmscf/d of gas is expected to be utilized.[25]

VII. Odigbo Node Gas Project

The objective of this project was to gather about 113mmscf/d of AG from about Six flow stations in the NNPC/Shell Eastern Nigeria Fields, for supply (about 92mmscf/d) to ALSCON (Aluminium Smelting Company of Nigeria) as feed gas and for gas lifting.

[24] Samuel Chika Dike, (2020) Article, Evaluating the Gas Flaring Commercialization Program in Nigeria an agenda for mitigating Gas Flaring. The National Petroleum Investment Services (NAPIMS) is a Corporate Services unit in the Upstream Directorate of NNPC, An integral arm of the Corporation which manages the Federal Government Investments in the Joint Ventures, Production Sharing Contracts and other contract agreements in the Upstream Sector. NAPIMS is a partner in the Joint Venture (JV) assets and the Concessionaire in the Production Sharing Contract (PSC) arrangements. NAPIMS is neither an operator nor a regulatory body of the industry, contrary to the not ion held by some sector of the public; rather, NAPIMS manages the Federal Government of Nigeria (FGN) interests in the oil and gas industry.

[25] Engr. Oyelere Oyeyemi (2018) Belema Oil Producing Limited has commenced its Gas Utilization Project to Unlock and Harness the Natural Gas Potential in OML. OML is a large block in the south-eastern Niger Delta. It extends kilometers from east to west and most of the infrastructure lies in shallow water or tidal swamp. Belema oil acquired the block in February 2015, but previously it was part of the NNPC/Chevron JV. The block contains five fields, the largest of which is Robertkiri. Two fields - Robertkiri and Inda - are located in water depths of more than five meters and are platform developments. The Jokka and Idama fields are smaller.

VIII. Odidi AGG Project

This project was executed by the NNPC/Shell JV in the South Western part of Nigeria. The objective of the project was to gather gas and inject into the ELP (Escravos to Lagos Pipeline), which eventually formed part of the West African Gas Pipeline that supplied gas to some West African Countries.

IX. Cawthorne Channel Gas Injection Project

The objective of this project was to gather the gas that was being flared in this field for re-injection and for supply to a third party for LPG extraction.

X. The West African Gas Pipeline Project

The objective of this project was to supply gas to some ECOWAS countries in pursuant of Nigeria's commitment to Article 48 of the ECOWAS Treaty, which encourages member nations to co-operate, consult and co-ordinate their policies regarding energy and mineral resources. Following deliberations by member-states on improving co-operation on energy, the governments of Nigeria, Ghana, Benin and Togo, through their ministries and departments responsible for energy matters, signed Heads of Agreements (HOA) in 1995, to provide a framework for the construction of a Ministerial Steering Committee (MSC), and Project Implementation Committee to monitor the development of the project.[26]

A commercial group also was set up comprising Nigerian Gas Company (NGC), Ghana National Petroleum Corporation (GNPC), SOBEGAZ (Benin) and SOTOGAZ (Togo); and two gas producers Chevron Nigeria Ltd. (CNL) and Shell Petroleum Development Company of Nigeria (SPDC). In 1998, the commercial group retained a German company to conduct a feasibility study and the final report was submitted in March 1999. The report showed that the WAGP was commercially viable and technically feasible. Negotiations were on-going with a number of prospective buyers in the sub region which later included companies in Senegal.

In order to achieve the flare-out target date of 2010, NNPC and some of its partners, had drawn up activities and strategic programs for the utilization of all gas being flared as well as

[26] West African Gas Pipeline Company Limited (WAPCO) is a limited liability company that owns and Operated by the West African Gas Pipeline (WAGP). The company's headquarters is located in Accra, Ghana with a branch office in Ikeja, Nigeria and field offices in Badagry – Nigeria, Cotonou – Benin, Lomé – Togo, Tema and Takoradi in Ghana.

future gas production resulting from growth in oil production. These programs include: NNPC/Elf JV set its flare-out target year at 2006, and some of their planned projects include Amenam/Kpono, Ofon (Phase-2) and 4-bar integrated oil and gas projects.

NNPC/Shell JV's flare-out target year was 2008. Some of their planned projects include Akri/Oguta, S. Forcados, EA, Bonga, Ubie, Bomu etc., and gas gathering and utilization projects. NNPC/Chevron JV's flare-out target year is 2006 and their planned projects were EGP phases 2 and 3.

4. Nigerian Gas Master Plan

The Nigerian Gas Master Plan was devised as a major interventionist concept to move the gas sector from its essentially dormant status in 2006 to a market-based system with willing sellers and willing buyers, realizing the full potential of the sector for the benefit of all Nigerians.[27] The Nigerian Government introduced the Gas Master Plan in 2008. The GMP is a guide for the commercial exploitation and management of Nigeria's gas sector and also seeks to grow the Nigerian economy with gas. The aspiration of the Master Plan is to reposition Nigeria in the shortest possible time, as a regional gas supply hub with concurrent presence in the domestic, regional and export market. This is in tandem with Nigeria's resolve to become a major player in the international gas market as well as lay a solid framework for gas infrastructure development and expansion within the domestic market. Nigeria aspires to leverage its abundant natural gas reserves to catalyse unprecedented domestic economic growth. Unlike oil, natural gas will be deployed to foster visible GDP growth by enabling geographically dispersed industrialization with consequent impact on job creation.

4.1 Strategic Aspiration

To accomplish this, there is a strategic aspiration which is anchored on 3 clearly articulated focus areas:

I. Gas to Power

Natural gas will be deployed as Nigeria's dominant fuel for power generation with an immediate objective of attaining at least a five-fold increase in generation capacity from about 3GW to 15GW by 2018.[28]

[27] Nigerian Gas Master Plan (2013) 1st ed., In line with the country's resolve to become a major player in the international gas market as well as lay a solid framework gas infrastructure expansion within the domestic market, the Nigerian Gas Master Plan was conceived.

[28] Emeka Iheme, supra (2020) Natural Gas as a Catalyst for Africa's Industrialization

II. Gas Based Industrialization

Nigeria will be positioned as the African regional hub for gas based industries, that is to say, industries that use natural gas as feedstock, such as Fertilizer, Petrochemicals, Methanol, CNG, etc. These primary industries, if properly delivered, will stimulate a wide range of small and medium scale secondary industries that will be geographically dispersed and drive GDP growth. Fertilizer production will boost agricultural yield, causing the growth of agro-processing and related industries. The petrochemicals industry will produce polyethylene and polypropylene which are the basic ingredients for a wide range of secondary industries such as packaging, plastics, carpets, etc. CNG for transportation, in addition to the environmental benefit, will displace PMS as the preferred fuel for transportation, reducing the nations spend on petroleum subsidy whilst improving the net disposable income of transport owners. The combined impact of the gas industrialization is widespread job creation and in-country value addition.[29]

III. High Value Export

Nigeria will selectively invest in high value export through LNG and regional gas pipelines. Specifically in LNG, Nigeria will aim to protect about 10% of global market share of traded LNG. It will also leverage its natural gas for regional economic influence by selective investment in cross-country pipelines within the sub-region, stimulating the economic growth of those nations and creating investment and sales outlet opportunities for Nigerian entrepreneurs and for Nigerian gas.[30]

4.2 The Objectives of the GMP

A. One of the prior objectives of the GMP has been to maximize the multiplier effect of gas in the Domestic Economy through the following means:

i. The facilitation of gas to power, fertilizer, et cetera.

ii. The increase in supply and availability of domestic LPG

iii. Stimulation of broad gas based industrialization-methanol, fertilizer, et cetera.

[29] Stephen Onyekwelu, (2022) Top Bio-fuels Market Trends in 2022 and Beyond. The Gulf of Guinea: The Nigerian Gas Master Plan and Opportunities for The Development of Gas Infrastructure, at p. 12

[30] Chikwendu Ubani, (2016) Article, Strategic Themes of Gas Master Plan. Pedro Omontuemhen Partner, Energy, Utilities & Resources, Evaluating Nigeria's Gas Value Chain The second of a three part gas series

B. The optimization of Nigeria's share and competitiveness in high value export markets through the following:

i. Selective participation in high value markets.

ii. Strategic positioning for growth.

iii. Assure long term energy (gas) security for Nigeria.

C. Balancing the trans-generational needs-managed exploitation.

The stated objectives are being pursued through the instrumentality of the Gas Infrastructure Blue Print, Gas Pricing Policy and Domestic Gas Supply Obligation which are enumerated below:

A. The Gas Infrastructure Blue Print.

This is a robust gas infrastructure blueprint developed to foster the implementation of the master plan. The blueprint aims to reduce the overall infrastructure cost as well as ensure a more flexible supply grid nationwide. The gas grid will provide connectivity amongst major gas reserve sources and the demand centres, thus providing a roadmap that would guide future investment in the gas sub-sector and effective utilization of gas resources in the key sectors of the economy as well as the regional market.[31]

B. Gas Pricing Policy

The policy seeks to create a structured and transparent framework for the pricing of gas driven by market forces. The policy categorizes the Nigerian domestic market into 3 categories:

i. The Strategic Domestic Sector

This being the sector with the greatest multiplier effect on the economy namely power (to residential and light commercial users).

ii. The Strategic Industrial Sector.

This is the sector that takes gas as feedstock in the creation of new products, for instance, fertilizers, methanol, petrochemical plants and LNG.

[31] Nigeria approves gas infrastructure blueprint. The Gas Infrastructure Blueprint identifies the critical infrastructure required to develop the domestic market.

iii. The commercial sector is the sector that uses gas as industrial fuel, for example, the manufacturing industries. This categorization of the domestic market will form the basis for the pricing framework which will determine the floor price for the different sectors. The pricing policy also stipulates the establishment of a Strategic Gas Aggregator (SGA) Company, which manages the demand and supply of gas in the domestic market and align the reserves obligation accordingly. This SGA Company is already operational in Nigeria.

C. Domestic Gas Supply Obligation.[32]

Given the level of foreign direct investment interests being shown by gas based industries such as fertilizer manufacturers, power producers and methanol producers, the FGN has introduced the Domestic Gas Supply Obligation Regulations[33] to ensure the availability of gas for domestic gas utilization projects. This is Nigeria's first major attempt to refocus the gas resource for domestic use. The regulation will penalize any defaulter (who fails to pay compensation to any purchaser for any losses suffered as a result of default) to supply gas in compliance with the order of the Gas Aggregator. The policy sets a penalty of $3.5/MCF of obligation that is under supplied and otherwise flared, and an environmental surcharge of 0.5C/MCF.[34]

4.3 The Regulation

The regulation as a matter of fact encompasses the following:

a. Mandates all oil and gas operators in the country to set aside a pre-determined amount of gas reserves and production for the domestic market.

b. Empowers the Nigerian Minister of Petroleum Resources to stipulate the requisite amount of gas to be set aside periodically by the International Oil Companies (IOC's) for a period of between 5 and 7 years.

c. Mandates oil and gas producers to comply with their obligations or face penalty for gas under supplied and or restrict export of gas produced by erring producers or both.

d. Establishes a 'Department of Gas' within the Ministry of Petroleum Resources that will oversee the execution of this regulation in concert with the Department of Petroleum Resources (DPR).

[32] [Hereafter, The DGSO]
[33] Federal Republic of Nigeria Official Gazette Lagos - 23rd November, 2022, No. 206, Vol. 109 Petroleum Industry Act, No. 6, 2021, Domestic Gas Delivery Obligation Regulations, 2022
[34] T. Lanardonne (2015) Domestic Gas Supply Obligation Regulations, Nigeria

5. Gas Industrialization

The global restructuring trends of gas-based industries away from the existing demand centres represent a timely opportunity for Nigeria to attract international investors and to develop new industries within Nigeria which will provide considerable benefits throughout the domestic economy. To reinvigorate and accelerate this agenda, the Gas Revolution Master Plan was launched in 2011.

The objective of the plan is to add value to its natural gas resource by engaging in gas based industries like Fertilizer, Methanol and Petrochemical. This will be achieved by redirecting gas that might otherwise have been flared towards the development of these gas based industries.[35] A key objective of the Gas Industrialization policy is to stimulate GDP growth through employment creation in associated secondary industries which are dispersed throughout the nation. The benefits to the nation will be maximized via the multiplier effects of the primary gas based industries rather than via a maximization of direct tax revenue.[36]

The following elements are included in the overall industrialization policy in order to achieve the desired impact on the overall economic productivity of the country:

a. Leverage natural gas for use in primary industries/anchor facilities that will stimulate economic growth, but that can also be geographically dispersed and have a higher impact throughout the country;
b. Leverage the synergies which can be gained by co-locating plants in purpose-built gas based industrial clusters with world scale production of fertilizer, petrochemicals, methanol and related products;
c. Drive gas based industrialization through using the supply of wet gas predicated primarily on the DS and the CPFs (Infrastructure Blueprint) to supply dry gas and natural gas liquids for gas based industrialization (see figure below);

[35] Nichole Liebov (2019) New Gas-to-methanol Technology (OxE) could end Oil Well "flaring." The conversion of natural gas to a liquid product like methanol offers economic advantages, as it would enable more facile and economical transportation using either existing or inexpensive infrastructure, unlike liquefied natural gas which requires specialized equipment, and it can avoid the controversial building of natural gas pipelines to isolated sites. The development of new environmentally friendly and scalable technologies is crucial to avoid unproductive greenhouse gas contributions from natural gas flaring.

[36] Ed Ubong, Managing Director of Shell Nigeria Gas Limited (SNG) and President of the Nigeria Gas Association. Partnership with businesses like SNG will play a key role. Industrialization hinges on gas development, investment: **SHELL PLC (**2022) Nigeria will only achieve industrialization if it develops its natural gas resources further and builds the infrastructure to convert this into electricity to power businesses and homes,

d. Capture the full NGL value;[37]
e. Progress fertilizer projects in order to boost domestic fertilizer utilization in the domestic agriculture sector thereby increasing productivity and enhancing its contribution to GDP. This will be achieved both through improving crop yields and through stimulating the growth of agro processing industries which will be geographically dispersed around the agricultural belts of the country;
f. Strategically support development of petrochemical industries in the primary production of Polypropylene and Polyethylene and other primary products which can then be sent to various part of the country to stimulate geographically dispersed secondary industries, for example Manufacturing;
g. Incentivize anchor investors in these sectors thus attracting a critical mass of such investments to jumpstart the industrialization agenda;
h. Use the gas based industrialization policy to target domestic consumption as well as also encouraging export of these industrial products;
i. Use the gas based industrial program to support creation of over 5 million jobs in the medium term across the value chain and across the country. The operating model reflects the targeted use of wet gas predicated primarily on the DSO and the CPFs (Infrastructure Blueprint) to supply dry gas and natural gas liquids for use in gas based industries.[38]

Notwithstanding the abundant gas resources, the production of gas remains challenged. With the focus on Gas as the transition source of energy and the Federal Government's 2020 Decade of Gas Agenda, the Petroleum Industry Act arrives at a pivotal time to provide the much required governance, regulatory and fiscal framework for the transition.[39] Consequent

[37] Abiodun Ibikunle 2006, Reducing Greenhouse Gas Emission Nigerian Approach: Nigeria, Algeria, Egypt and Libya have more than 90% of the continents The natural gas reserves and also produce more than 95% of the continents total production.

[38] Femi Adekoya (2020) Addressing issues in Nigeria's gas value chain: Nigeria's gas value chain cuts across the three core segments of the gas sector (upstream, midstream and downstream). Various players operating along the value chain range from oil companies that extract gas during oil production, to natural gas producers, petrochemical firms, power generation companies, regulatory agencies, as well as industrial and household consumers. With completion of the Ajaokuta-Kaduna-Kano (AKK) Natural Gas Pipeline scheduled for 2023, Nigeria's 614 km-long gas pipeline will boost electricity supply to the country,

[39] Kasirim Nwuke (2021) Managing Partner-Mirisak & Associates Former Chief, Green Economy, Technologies and Innovation -United Nations Economic Commission for Africa. The PIA represents an effort by Africa's leading oil-producing country to respond to this changing environment. In 2019, the oil and gas sector accounted for about 5.8 per-cent of Nigeria's real GDP and was responsible for 95 per-cent of Nigeria's foreign exchange earnings and 80 per-cent of its budget revenues.

on the PIA Act, numerous but primary and prominent changes have been effected in oil and gas industry. Such changes include the following:

A. Governance and Institutions.

i. The Nigerian Upstream Regulatory Commission regulates the upstream operations (Commission) while the Nigerian Midstream and Downstream Petroleum Regulatory Authority (Authority) regulates the midstream and downstream operations.

ii. Establishment of the NNPC Limited to assume the assets, liabilities and responsibilities of the defunct NNPC in relation to gas assets.

iii. Establishment of a progressive cost-reflective pricing framework with a structure for market intervention through Domestic Gas Supply Obligations and a wholesale natural gas market.

B. Promotion of Investment in the Sector.

This could be achieved through the following methods:

i. The establishment of the Mid-stream and Down-stream Gas Infrastructure Fund,[40] (MDGIF) to promote equity investments in midstream and downstream gas infrastructure.

ii. Grandfathering provisions to ensure that investor's returns on existing Oil Mining Licenses are protected and a framework for voluntary conversion.

iii. The introduction of the Incorporated Joint Venture for existing Joint Venture Agreements to promote efficiency in the management of gas assets.

iv. Alignment of the Act with the existing network transport code for gas, existing domestic gas supply obligations and long-term export gas supply arrangements.[41]

C. Fiscal Environment.

i. Profits from upstream gas operations will be subject to income tax in line with the provisions of the Companies Income Tax Act (CITA). Hydrocarbon tax will not apply to such profit.

ii. A royalty rate of 5% will apply for natural gas and natural gas liquids production. This is reduced to 2.5% where the natural gas is produced and utilized in Nigeria.

[40] [Hereafter, The MDGIF]

[41] Miracle Eme, S. P. A. Ajibade & Co., (2022) Article. Nigeria's Petroleum Industry Act: Addressing Old Problems Creating New Ones, The Nigerian Guide on Relevant Changes to the Fiscal Framework in the Petroleum Industry Act, 2021

iii. For royalty purposes, condensates will be treated as crude oil and natural gas liquids as natural gas.

iv. A 0.5 per cent of the wholesale price of petroleum products sold in Nigeria to fund the Regulatory Authority.

v. A 0.5% of the wholesale price of petroleum products and natural gas sold in Nigeria to fund the Midstream and Downstream Gas Infrastructure Fund.

vi. The above stated levies will be remitted by the licensed operator within 21 days of the sale of the relevant products subject to additional regulations to be issued by the Authority.

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vii. Gas flaring penalty will be determined by Regulation. Such penalty will not be tax deductible or cost recoverable. Monies received from gas flaring penalties shall be transferred to the Midstream and Downstream Gas Infrastructure Fund for investment in infrastructure within the host community.

viii. Tax incentives for midstream petroleum operations, downstream gas and large-scale industries including ten (10) years tax holiday for investment in the gas pipeline.

ix. Contributions of 3% of annual operating expenditure to a Host Community Trust Fund, approval of an environmental management plan and maintaining an abandonment fund.

x. Framework for the public service levy to be introduced by way of regulations which may be imposed on customers where it is deemed to be in the wider public interest.[42]

The Act codifies the regulatory, administration and fiscal framework for the sector. It is estimated that harnessing Nigeria's proven gas reserves can stimulate an estimated Gross Value Added (GVA) of over $18 billion annually to the domestic economy. The Act sends a strong message to domestic investors, foreign operators, financiers and the international community of Nigeria's commitment to gas transformation whilst making strides to achieve its carbon emission commitments. The potential impediments, especially price control and lack of infrastructure should be promptly addressed to unlock the potential of the gas sector for domestic energy use, foreign exchange earnings and power generation among others.[43]

[42] For instance, the Company Income tax; Income tax; Hydrocarbon tax; Actual Year Basis, Income Tax for Upstream Petroleum Operations, Tax, Fiscal, and General Provisions of Petroleum Industry Act 2021, Hydrocarbon Tax apply to Natural Gas Liquids from Associated Gas and produced in the field Upstream of the measurement points.

[43] The PIA overhauled the regulation and governance of the oil and gas industry. In doing this, the PIA superseded and abrogated all other subsisting regulations that were associated with oil and gas industry in Nigeria. The Act provided for two regulatory agencies; the Nigerian Upstream Petroleum Regulatory Commission (NUPRC) and; the Nigerian Midstream and Downstream Petroleum Regulatory Authority,

6. Conclusion

The present state of the power sector, Liquefied Petroleum Gas (LPG) (production and consumption) and Compressed Natural Gas (CNG) for vehicles are indicators for investors to aggressively develop the natural gas infrastructure.

The significance of the provisions of the PIA on the oil and gas industry cannot be overemphasized. It is an audacious attempt to overhaul the petroleum sector in Nigeria and upon proper implementation; it will drastically redefine the Nigerian oil and gas landscape through its wide-ranging impact on various fundamental aspects of the economy including energy, banking, and insurance, among others.

The practice of gas flaring has continued for a long time despite the deleterious effects on the environment, human and plant life and the loss of revenue to both the government and the oil producing companies. Although the government has made efforts through legislation to control gas flaring, the laws in place have not been effective in controlling gas flaring in Nigeria. The reason is attributable to the gaps in the existing gas legislation, one of such being the permission given to oil companies to continue flaring gas in so far as they pay such penalties as would be determined by the Minister.

Consequent on the above, it is recommended that the following be addressed in order to give teeth to the gas master plan as well as boost the Nigerian economy:

That the price control and lack of infrastructure should be promptly addressed to unlock the potential of the gas sector for domestic energy use, foreign exchange earnings and power generation among others. Furthermore, that the adequate institutional provisions and regulations should be put in place to shape national interests and the government must position itself to be able to generate the needed revenue for infrastructural development emanating from the new regime. It is also recommended that all stakeholders should carefully monitor events as they unfold as this will create desired checks and balances to ensure that the implementation of the provisions of the Act will have the desired effects.

(NMDPRA)-vested with the responsibility of regulating technical and commercial regimes of petroleum operations in their respective sectors, and furthermore granted the power s to acquire, hold, and dispose of property, as well as sue and be sued in their own name.