



Natural Gas Development Trend in Nigeria: The Investor's Road Map

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Authors' contributions

This work was carried out in collaboration between both authors. Author GOA wrote the introduction, plots the data points, carried out the analysis and developed the long term strategic frame work. Author SSI supervised the work, wrote and analyzed the investment indicators and conclusion. All authors read and approved the final manuscript.

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ABSTRACT

Natural gas as a cleaner energy is attracting investors across the globe, especially country like Nigeria with huge gas reserves. This paper present the development trend of natural gas in Nigeria from reserves through production, utilization, local demand, gas export, to regulation, Acts and Policies and possible investment indicators. With 200.41 Trillion cubic feet (Tcf) of gas reserves in 2018, Nigeria takes the first position in Africa as total proven gas reserves. However, in production, Nigeria falls to third position and consumption/utilization is minimal, indicating that some of the produced gas was flared. With a total reserve of 182.817 Tcf 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. 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. However, an independent Regulating Agency needs to setup policies to regulate natural gas flaring and prices in order to guaranty a workable partnership and protect consumers and investors.

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1. INTRODUCTION

The world relies on energy which is either derived from non-renewable sources (crude oil, Natural gas, Coal, Biomass, Tar sand, Shale) or Renewable Sources (wind, hydrodynamic, solar, geothermal wave) and Nigeria depends majorly on the non-renewable energy to drive the power, industries and the economic sectors. Crude oil products from crude oil refining is a major source of energy and revenue generation in the Nigeria economy. According to [1], about 83% of total export revenue, comes from the revenue generated from petroleum export.

Over time, the move from crude oil dependent economy to other sources of energy has been slow. This might be attributed to the readily available technology to extract and process the crude oil, available market for the crude oil and its products and increased influx of investors and producers in the crude oil business. In addition, Nigeria crude oil reserves is 36,996 billion barrels on the average over the past 15 years [1] and this might be another factor that has increased the confidence of investors in the crude oil business.

According to [2], maximum attention is needed for optimal development and utilization of clean energy. [3] stated the more natural gas is utilized as clean energy, the more the chances for greater economy for any country.

Nigeria crude oil reserves in 2018 was 36.972 billion barrels, making Nigeria the eight largest crude oil reserve and sixth largest producer of crude oil, estimated to be 1.602 million barrels [1] among OPEC countries. In Africa, Nigeria is the second largest crude oil reserve and contribute about 25% of crude oil produced, with Angola taking the second position of about 21% [4]. With the passage of time, the economy Nigeria and all tiers of government has depended on crude oil, making the Gross Domestic Product (GDP) per capital stand at \$2,056 and real GDP growth at 1.9% in 2017 [1]. The chances to expand the Nigeria's dependence on energy, increase the GDP per capital and GDP growth via development and utilization of other energy resources is high, with major focus on natural gas market. This is in agreement with [1], which stated that the activities of the oil and gas sector, account for about 10% of the GDP.

Development of facilities and utilization of natural gas resources, infrastructures, and market, of which Nigeria has abundant in reserves, may have been hampered by lack of workable regulations, acts, policies and political interference in the past.

In addition, [5], stated that, "there may be lack of willingness of oil producers to mobilize funds to monetize what is essentially seen as a low value by-product compared to oil", which have resulted to continually putting the nation's wealth in flames via flaring activities. This act has tampered with the natural state of the Nigeria's ecosystems.

However, this can be avoided by focusing on the indices that characterize the huge wealth that can be derived from investing in the "ever low value by-product (natural gas)" (as thought of by oil producers), by local and international investors. Therefore, this work seeks to present the developmental trend of natural gas over time and its investment opportunities in the Nigeria's economy, for local and international investors in natural gas business. This is achievable through analysis of proved reserves, trends in production, consumption, local demand and export of natural gas. In addition, flare outlooks, regulatory policies on flare were also presented.

2. NATURAL GAS DEVELOPMENT TREND: FROM RESERVES TO DEMAND

Nigeria is regarded as a natural gas province, due to its abundant natural gas resources, and this is evident in Fig. 1, where from 2001, Nigeria was first in natural gas reserves in Africa, with Algeria coming second. In 2018, Nigeria natural gas reserves (Associated and Non-Associated gases) hits 200.41 Tcf from 192.065 Tcf in 2015 [1,6], indicating that more natural gas reserves has been discover within this period. Nigeria's gas reserves trend in Fig. 1, shows the likelihood of increasing gas reserves with the passage of time, and this is a pointer for rapid development of natural gas infrastructure to harness the ever increasing reserves.

Hydrocarbon reserves (in this case gas) is an asset for any country that has it in abundance. However, producing and processing this hydrocarbon is highly dependent on available market for the hydrocarbon, its products and

demand. Producers will be willing to produce natural gas when there is high demand for the product, both locally and international market. This demand is both local and international market. The local demand market include domestic, power sectors, industries (which utilize natural gas as feedstock), etc. The international market is open to countries that rely on natural gas to solve their energy problem. Therefore, the production and processing of natural gas is highly dependent on local and international demand.

Despite the huge reserves of natural gas in Nigeria, which places her as first in Africa, production of natural gas is low, and this places Nigeria in the third position behind Algeria (first position) and Egypt (second position) (Fig. 2). In

addition, natural gas production in Nigeria showed significant increase from year 2000 till date.

The local demand for natural gas in Nigeria is an indication of its availability for utilization, which depends on the emphasis placed on its production and processing via deliberate investment in gas infrastructure. The local consumption of natural gas in West Africa countries (including Nigeria) is low. This is evident in Fig. 3, where West Africa countries take the third position in local consumption of natural gas and the combine highest amount consumed till date is below 900 Billion cubic feet (Bcf), indicating that more needs to be done to take advantage of the huge gas resources in Nigeria.

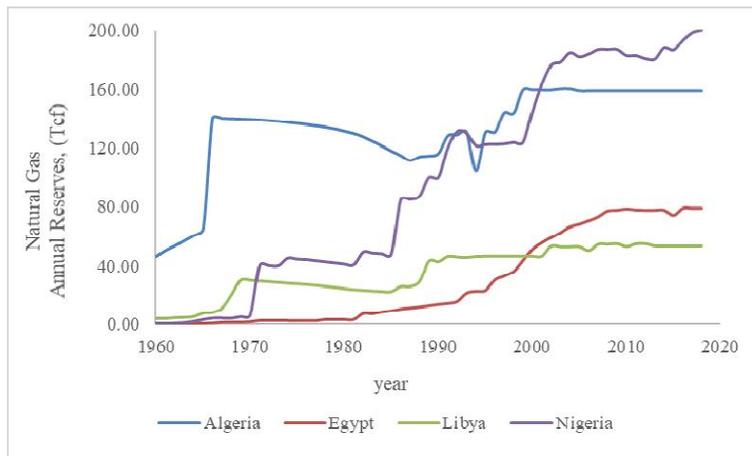


Fig. 1. Natural gas reserves in Africa [1]

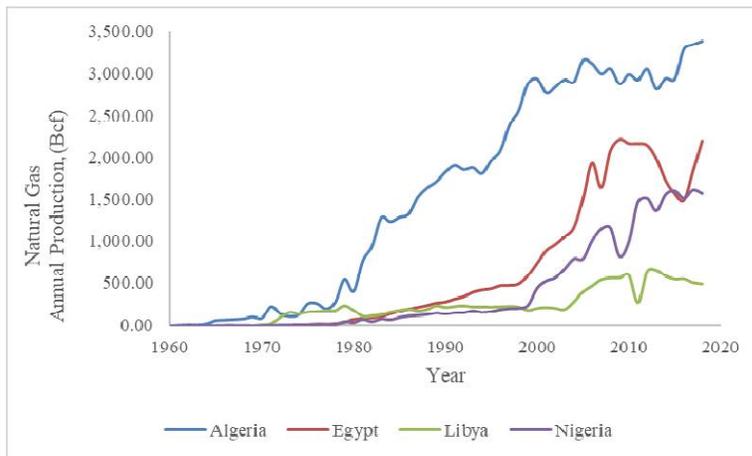


Fig. 2. Natural gas production in Africa [1]

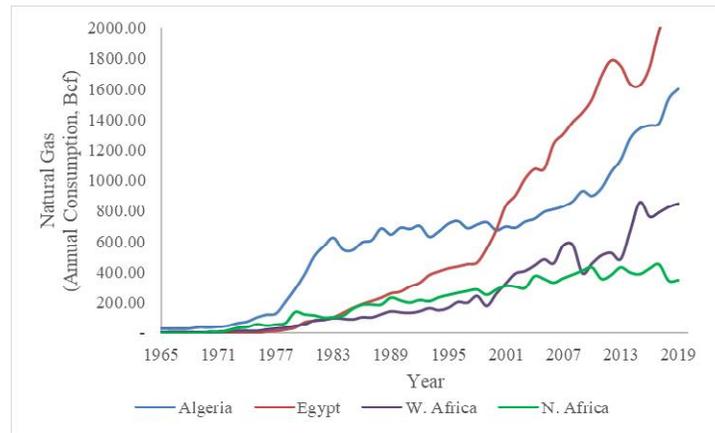


Fig. 3. Natural gas consumption in Africa [4]

The market for natural gas is expanding, as new entrants (investors and consumers) are taking advantage of the availability and numerous area of utilization. Thus, natural gas consumption, for country like Nigeria is not limited to local market, but also to international market via export. Fig. 4, indicate the state of Nigeria export (international market) of natural gas to other countries. Before, year 2000, Nigeria's export of natural gas was minimal, but showed a significant increase from 2000 till date. However, the highest quantity exported till date is below 1,200 Bcf.

Despite the expanding market for natural gas, producers of natural gas will be willing to process natural gas when the demand is high. Over the years, the demand for natural gas has shown significant increase, but in 2010, there was downward steep in demand (international demand (gas export) and local demand) and consumption (Figs. 3, 4, and 5). This drop in demand was affected by the drop in production (Fig. 2).

Local demand (domestic, industries and power sector) contribute to the increase in gas demand since number of homes using Liquefied Petroleum Gas (LPG) is increasing [7]. According to [2] report, the extent of natural gas demand and its utilization, are largely indicative of the level of national economic development and growth.

Although, there is increase in natural gas production over the years, the percentage of the reserves produced, is an indication of the effect of government regulations, policies and extent of investment on natural gas infrastructure development. Fig. 6, shows that less than 2% of the reserves is produced each year. In 2010, with reserves of 182.817 Tcf, only 1.54% could be produce and in 2017, the percentage produced drop to 1.48% with a reserve of 199.09 Tcf. This is a poor performance in the natural gas business in Nigeria and it is an open call for aggressive development in the country's abundant resources via investment.

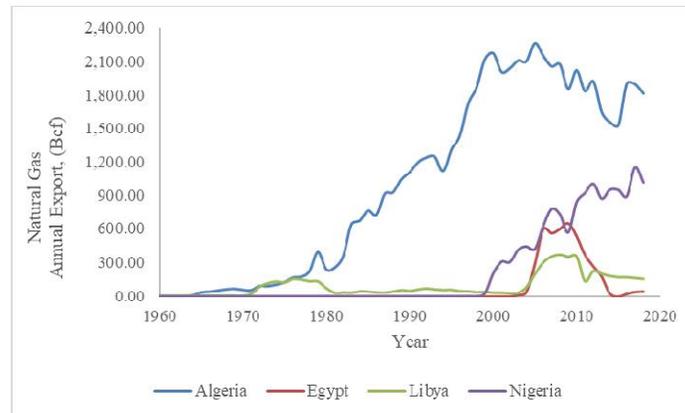


Fig. 4. Natural gas export in Africa [1]



Fig. 5. Natural gas annual demand [1]

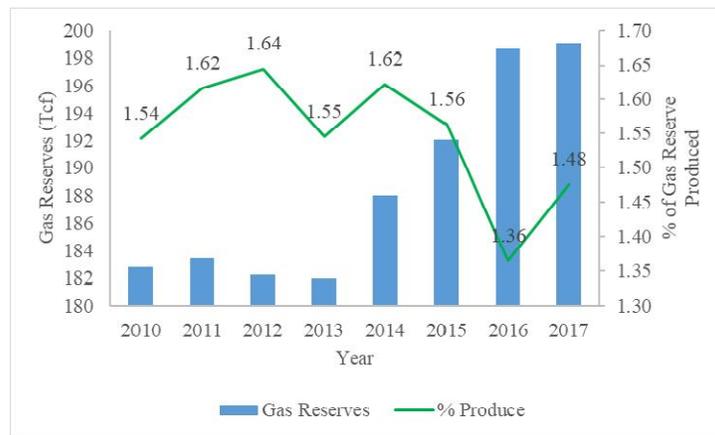


Fig. 6. Gas reserves and percentage produced ([1] and [6])

3. NATURAL GAS FLARING IN NIGERIA: THE BIG ISSUE

Over time, there are two major options for handling natural gas in the oil and gas industry: re-injecting the gas and monetizing the gas. This is evident in some developed (oil and gas producing) countries with stable economy. A third option exist, which is practiced in underdeveloped (oil and gas producing) countries of which Africa countries are more in number. This option is flaring the gas and as such [8] report that global levels of flaring and venting natural gas exceeds 150 billion cubic meters (5.297 Trillion cubic feet) a year.

Producers have supported gas flaring on safety reasons: abnormal gas pressure build up in vessels and others: its viability for commercialization. In Nigeria, from 1969, the government has been putting measures in place

to either reduce or stop gas flaring and to utilize the gas by compelling operators to find sustainable use for the produced gas, through Regulations and Acts. The Petroleum (Drilling and Production) Regulation (1969) and Petroleum Amendment Act (1973) are such acts, which aimed at oil and gas producers to plan and implement the utilization of associated gas. Other acts are: Associated Gas Re-injection Act (1979), Associated Gas Fiscal Agreement Implementation (1997), National Domestic Gas Supply, Pricing Regulation and Policy (2008) and The Nigeria Gas Master Plan (2008) which created a framework for the expansion of the gas infrastructure, commercial exploitation, utilization and management of the natural gas sector.

To further give strength to the acts, a penalty for flaring the gas was prescribed in the Associated Gas Re-injection Act (1979). A penalty of 2 kobo/Mscf gas flared in 1985 which was later

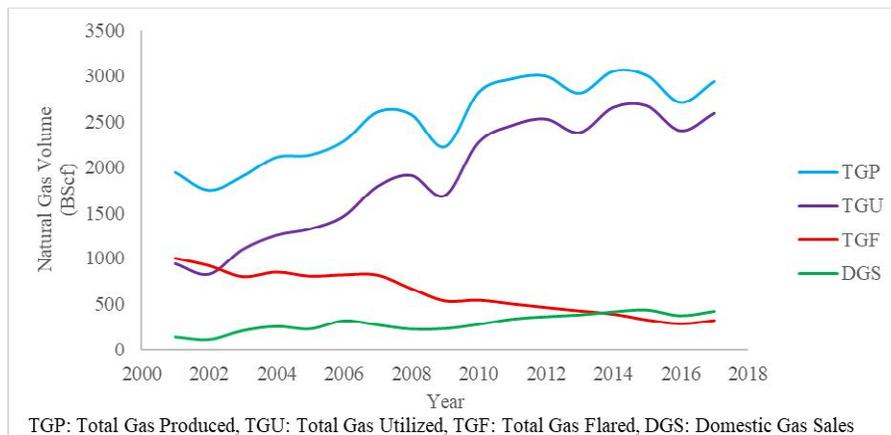


Fig. 7. Nigeria gas status since 2001 [6]

increase to 50 kobo/Mscf gas flared in 1990. Compliance was insignificant and the penalty was increase to N10/Mscf gas flared in the 1998 Budget.

However, compliance by producers was still insignificant such that, before 2002, Total Gas Flared (TGF) was more than the Total Gas Utilized (TGU) (Fig. 7). This non-compliance of the Acts, not only put the nation's wealth in flames but also damaged the environment. Little was achieved, as compliance become significant beyond 2002, where TGF reduce and TGU increase gradually. In addition, in 2010, 1.54% of the 182.817 Tcf reserves produced (Fig. 6), 19.33 % was flared and in 2011, the percentage of gas flared was still above 19%, so to put pressure on producers to reduce flaring the penalty was increased to \$3.50/MScf gas flared, by the Ministry of Petroleum Resources. However, in 2017, 1.48% of the 199.09 Tcf reserves produced (Fig. 6), 11.74% was flared [1]. This little achievement has not impacted much on the local market, and domestic gas sales (DGS) was very low compared to TGF (Fig. 7). Nevertheless, there was little boost in recent years, indicating that there are lot of potentials in the local market, but has not been fully utilized.

Recently, [9] tied the penalty for gas flaring to the barrel of oil produce per day. Section 3 of the Regulation stated that, for any Oil Mining Lease area or Marginal Field producing 10,000bbl/d or more will pay \$2.00 per 28.317 Standard cubic meter (Scm) of gas flared and \$0.05 per 28.317 Scm of gas flared for any Oil Mining Lease area or Marginal Field producing less than 10,000bbl/d.

4. STRATEGIC FRAMEWORK: WORKABLE PARTNERSHIP

In any oil and gas producing country, there exist two major parties: the Government and the contractors. The Government is the host and the owner of the resources (in this case oil and gas). The Government develops, establishes and implements regulations, acts and policies that guide the exploration and exploitation of the resources. The contractors (local or foreign), is a private investor, who invest resources to explore and exploit the oil and gas in the host country, based on an established regulations and policies. A workable partnership between the host and the contractor, requires deliberate effort from both parties to keep to the terms that bond the partnership. Failure by any of the parties (especially the contractor) should attract a penalty which is determine by legislature. In addition, the operating license should be revocable on the ground of noncompliance, and this should be part of the contract terms ab initio. The regulations and policies should be long term (subject to periodic review), comprehensive and completely clear in meaning, portraying the intension of the host with respect to exploration and exploitation of both associated and non-associated natural gas, while creating an environment that guarantee thriving investment in gas infrastructure and development.

Fig. 8 shows a proposed long-term strategic framework to sustain development in gas infrastructure. Three frameworks can be identified: Contractual Framework, Fiscal Framework and Regulatory Framework.

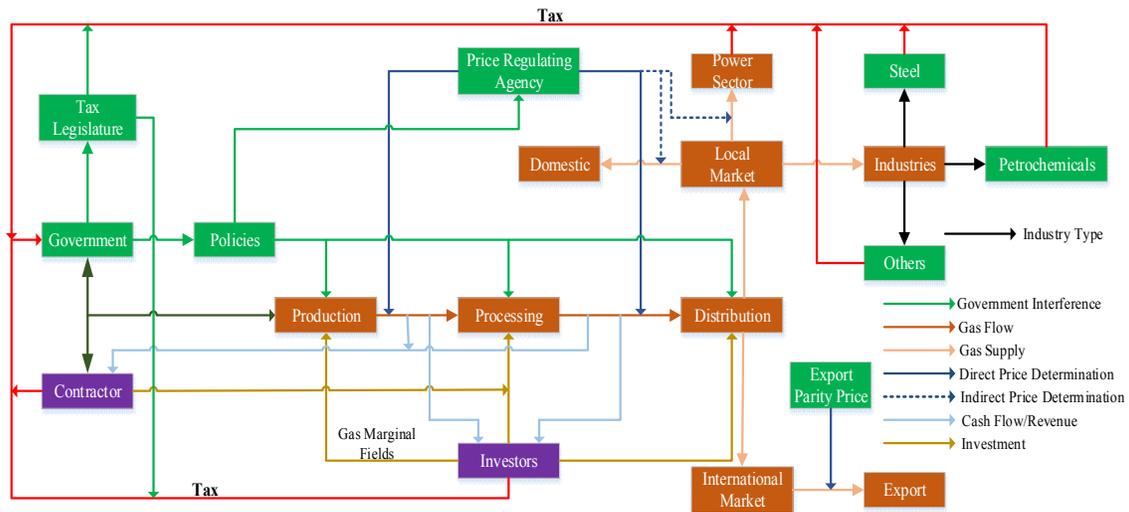


Fig. 8. Long term strategic framework for natural gas infrastructure and development

4.1 Contractual Framework

A clear and unambiguous agreement in the utilization of natural gas, is a starting point for a workable partnership between the host and contractor. Fig. 8 shows that, the host government and/or contractor can invest in the production, processing, and distribution of natural gas. The contractor or the investor has a choice of investing in the three or two or one of production, processing and distribution. Both parties can reach four types of agreement [10].

4.1.1 Concession agreement

In this contractual agreement, the host government through the Ministry of Petroleum Resources grants the contractors the right to develop and operate gas infrastructure, for an exchange of streams of payment in the form of tax and royalty. A major advantage of this type of agreement is that the host does not share in the risk associated with the project, but has a share in the revenue generated. The disadvantage is that the contractors bears all the risk and loss that may arise in the course of development and operations. The host will require legislative expertise to properly develop the taxation structure.

4.1.2 Joint Venture agreement

The host government through the National Oil Company (NOC) and the contractors (foreign or local) can form an alliance via joint venture agreement to develop natural gas infrastructure,

which requires that both parties contribute a percentage of the total investment and profit accrued is shared according to the percentage invested. A major advantage is that geological, technical and financial risk associated with the investment is shared and the host exert greater control on the project. High level negotiation is required between the host and the contractors, before this agreement can be developed. However, the host must employ financial, legal, environment and technical expertise, which must be provided by the National Oil Company or Ministry of Petroleum Resources.

4.1.3 Pure service agreement

The contractual framework for this agreement is simple; the host provides the capital for the development of the natural gas infrastructure. Consequently, a major disadvantage for the host is that it bears all the risk in this type of agreement, since the contractors is/are contracted to develop the infrastructure, paid an agreed flat fee and does nothing thereafter, leaving the host solely responsible for production, down to marketing. This type of contractual agreement is good for Nigeria since it has high natural gas reserves that years for utilization (Fig. 1), because of the minimal risk of exploring for natural gas.

4.1.4 Risk service agreement

Like the pure service agreement, the contractors are contracted to develop the infrastructure, but the risk is shared between the host and the

contractors. Unlike the Pure Service Agreement, in the risk service agreement, the contractors are paid from the share of the revenue generated for a stipulated period till all contracted cost is completely paid off.

In all the above agreements, the host controls the fiscal terms.

4.2 Fiscal Framework

The fiscal framework consist of the financial and contractual arrangement and it include all forms of taxation (corporate income tax, royalty) related to the exploration and exploitation of gas resources. The host government through the legislature arm, develops a tax structure by which contractors pay share of the revenue to the government. As stated in [11], where expenses are identified as exclusively for gas project, 30% of Income Tax is paid to the host government. When gas is transferred from a Natural Gas Liquid facility to a Gas-To-Liquid facility, a tax of zero percent and royalty of zero percent shall be paid. The contractor, investor and every sector downstream of the distribution pay tax to the host as will be stipulated in the Fiscal framework via the legislature (Fig. 8). This is a good way, for host to generate funds for national and economic development.

Tax incentives for natural gas utilization are also provided in [11]. For example, prior to start of production, a tax-free period of three years is allowed, but it is renewable for additional two years, if performance of the gas business is satisfactory.

In the fiscal framework, penalty should be established to checkmate the flare rate of natural gas. The penalty should be structured through legislature to capture enforcement of the law. In addition, the penalty (as those stated in the Associated Gas Re-injection Act), should be severe to discourage flaring and encourage development of gas infrastructures.

4.3 Regulatory Framework

In the natural gas infrastructure development, two key aspects are important to regulate: flaring/venting and pricing of the natural gas. The federal government through the legislature, empowers institute to develop acts and policies to regulate the flaring and pricing of natural gas. Many of these Acts and Policies (Petroleum Regulation, 1969; Petroleum Amendment Acts,

1973; Associated Gas Re-Injection Act, 1979; National Domestic Gas Supply, Pricing Regulation and Policy, 2008) has been in existence. The most recent is the Gas Flaring Regulations, 2018. The letters in each of these Acts, expressly forbid the flaring of natural gas and encourage utilization, but their impact is still minimal. Though, natural gas utilization has received some boost in the country (Figs. 5 and 7), but more needs to be done.

Fig. 8, shows the position of a Pricing Regulating Agency which will determine natural gas prices, both at the upstream and downstream, directly and/or indirectly. The agency will directly be involved in determining and regulating the price of natural gas at any time for all investors. In addition, taking advantage of the huge revenue from gas export, the export gas price parity should be directly determine by the agency, taking into consideration all parameters/factors that contribute to price parity. However, the pricing policy should be at par with international standard.

The Agency through a third party may influence/determine the price of gas for local market. The position of the third party is important to create a pricing framework that will capture the cost of transportation. However, gas price ceiling (maximum price) above price floor (minimum price) should be determine through legislature to protect consumers and investors.

A stand-alone regulating body that is vested with powers through acts, regulations and policies should be established. It should be responsible for monitoring, accountability, transparency and participation in the natural gas business without any political interference.

5. INVESTMENT INDICATORS: THE BIG PICTURE

The Nigeria Gas Master Plan allows private sectors (International and local) to develop the gas resources in the country via investment in gas business, which will have direct impact on the growth of Gross Domestic Profit of the country [12]. [13] stated that “the broad trend toward privatization and deregulation provides and impetus for domestic and foreign investment in energy, with natural gas taking the lead in several countries.

Therefore, the Nigeria natural gas infrastructure requires aggressive investment and investors are keen to indices that spur their interest to invest.

5.1 Liquefied Petroleum Gas (LPG)

According to [5], LPG consumption, which cut across domestic and industry, is increasing due to its attractive price and as clean energy. Report by [14], stated that consumption of LPG has increased from 50,000 tons in 2001 to 140,000 tons in 2013. This increase has spurred the interest of Total to invest in LPG plants in five States of the country, with state-of-the-arts facilities, having storage capacity of 2,150 m³ and filling capacity of 700 LPG cylinders. In addition, [15] report, stated that it supplied 50% of domestic LPG across the country and plans to deliver 350,000 mtpa of LPG into the LPG market, so as to meet up with the increasing demand, but in 2016, could only deliver 74.86% of it. A major part of the problem was availability of jetty. Thus, bridging the gap between supply and demand of domestic LPG and citing jetties at strategic locations across the country are investment indicators.

5.2 Compressed Natural Gas (CNG)

Compressed Natural Gas (CNG) is a vehicular fuel and according to [16] report, the number of vehicle utilizing CNG has increased from 5,000 in 2015 to 6,000 in 2016. To meet up with the increasing demand, dedicated CNG stations needs to be established so as to provide uninterrupted supply of the fuel. However, eight (8) stations has been established in two States (Edo and Ogun States).

5.3 Gas Export

According to [17], in Africa, Nigeria is a net exporter of LPG, producing more than 2 mtpa of which 15% of the volume is consumed while about 85% is exported. In the case of natural gas, only in late 1999 that Nigeria gas export started showing significant increase, whereas, local demand had increased beyond 200 Bcf in the same year (Figs. 4 and 5). However, In Africa, Nigeria contributes about 30.02% of natural gas export, which places Nigeria in second position, with Algeria coming first with about 54% of natural gas export. In 2017, 2.938 Tcf of natural gas was produced and 39.07% of it was exported, with the rest of 60.93% for domestic consumption. This is a significant increase in export gas when compared with 2010, where 2.82 Tcf was produced and 29.62% was exported (OPEC ASB, 2019), an indication of increasing demand of natural gas in the international market and an opportunity for

government and private investors to increase the production and processing of natural gas via investment in natural gas infrastructure.

6. CONCLUSION

Insight into the timeline of the development of natural gas infrastructure leaves investors with wise investment decision. In addition, critical and important realistic indices are necessary to enhance investment decision.

However, in the case of Nigeria natural gas infrastructure system, the development timelines show the level of involvement of resource owner and the investors (local and foreign). With the huge reserves of natural gas of 200.41 Tcf in 2018, the percentage produced annually is minimal and it is below 2% (Fig. 6). In addition, consumption/utilization, is also below expectation, when compared to the amount of reserves and indicators that shows strong investment opportunity.

Furthermore, sustained development of natural gas infrastructure requires a contract term (including revoking of operating license when investors fails to comply with gas flaring policy) that guaranty a workable partnership of both the resource owner and the investors. There is the need to set up independent agency via legislature, with the sole aim of regulating natural gas flaring activities and set up pricing framework to provide investment thriving environment (with clear tax laws), for a long term infrastructural development.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Organization of Petroleum Exporting Countries, Annual Statistic Bulletin (OPEC ASB); 2019.
2. Energy Commission of Nigeria, National Energy Policy. Federal Republic of Nigeria; 2003.
3. Odularu GO, Okonkwo C. Does energy consumption contribute to economic performance? Empirical Evidence from Nigeria. J. Economics and International Finance. 2009;1(2):44-58.
4. BP Statistic Review of World Energy; 2020.

5. Antoine J. Outlook for flare reduction in Nigeria, Technical Report No. 34, Agence Française de Développement, France; 2017.
6. Department of Petroleum Resources (DPR), Nigeria, Oil and Gas Annual Report; 2018.
7. Ani GO, Ikiensikimama SS. Economic model and risk analysis for natural gas plant in a dynamic gas pricing system in Nigeria. Petroleum and Coal Journal. 2019;61(2):377-389.
8. Global Gas Flaring and Reduction Partnership (GGFRP), Guidance on Upstream Flaring and Venting; Policy and Regulation; 2019.
9. Flare Gas (Prevention of Waste and Pollution) Regulations, Nigeria; 2018.
10. Mian MA, project economics and decision analysis: Deterministic Models, Second Edition. Penn Well Corporation, Tulsa, Oklahoma, USA. 2011;1.
11. Company's Income Tax Acts (CITA) Cap 60 L.F.N., Section 28G (3), Nigeria; 2004. (Reviewed 2007)
12. Ubani CE, Ani GO. Natural gas utilization and its effect on Nigeria's Economy. International Journal of Scientific Engineering and Technology. 2006;5(12): 532-536.
13. Deshazo P, Ladislav S, Primiani T. Natural gas, energy policy and regional development. Brazil and the Southern Cone. Policy Papers on the Americas. 2007;XVIII:Study I.
14. Promoting Cleaner Energy in Nigeria through Liquefied Petroleum Gas (LPG), Total E&P Report; 2018.
15. Nigeria's Domestic Liquefied Petroleum Gas (LPG) Market, Nigeria Liquefied Natural Gas (NLNG) Magazine. 2018; 4(1).
16. Compressed Natural Gas (CNG), National Fleet on the Rise in Nigeria, Nigeria Independent Petroleum Company (NIPCO) Report; 2016.
17. Abdul-Kadir KH, Domestic LPG. Market Growth: Infrastructural Challenges & Opportunities, Nigeria Liquefied Natural Gas (NLNG) Paper Presentation; 2016.

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