



ABSTRACT

The gas and electric power sectors can be described as inseparable duo as long as the latter continue to generate from gas-fired (thermal) generation plants. Out of the six generation companies – Afam, Egbin, Kainji, Shiroro, Ughelli, Sapele, Shiroro and Kainji are hydro powered while the rest four are thermal which are gas-fired. By implication, natural gas is a major factor in power generation in Nigeria. Therefore, the supply of gas to these power stations goes a long way to determining the quality in standard of electric power supply in the country. Therefore, for the development of a gas-based industrial economy, the

THE NATIONAL GAS POLICY (2017) AND THE ESTABLISHMENT OF STRONG LINKAGES WITH ELECTRIC POWER SECTOR, AND THE DEVELOPMENT OF THE GAS SECTOR IN NIGERIA.

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Introduction

Background to the Study

The National Gas Policy, NGP (2017) herein referred to as The Policy, articulates the vision of the Federal Government of Nigeria, sets goals, strategies and an implementation plan for the introduction of an appropriate institutional, legal, regulatory and commercial framework for the gas sector. It is intended to remove the barriers affecting investment and development of the sector. The policy will be reviewed and updated periodically to ensure consistency in Government policy objectives at all times (NGP, 2017). This gas policy is based on a fundamental review of the policy positions of the Government over the last ten years in respect of Nigeria's gas resources. The previous policy positions emanated from the Gas Master Plan (GMP), which was designed to ensure the development of a full-blown domestic market by 2015. However, the Plan has not delivered on all its set targets. For example, Nigeria still lacks critical gas infrastructure and continues to fall short of Domestic Gas Supply Obligations. Nigeria is experiencing a full-blown energy crisis in spite of its abundant gas resources. A new gas policy that is more effective and adjusted for the much harsher international business environment for gas is required to drive the reforms necessary to attract investment into the sector.

The Vision of The Policy is "To be an attractive gas-based industrial nation, giving primary attention to meeting local gas demand requirements, and developing a significant presence in international



establishment of a linkage of the gas and electric power sectors is indispensable. The article examines the NGP (2017) provision for this linkage, critically assesses the extent of implementation, and interrogates how this standpoint may serve as catalyst for the realisation of a gas-based industrial economy in Nigeria. Both primary and secondary sources of data collection were utilised. Questionnaires were administered, in-depth interviews conducted and personal observations also used. Secondary sources were books, published journal articles, internet sources, among others. The data was analysed using descriptive and content analyses. This study was anchored on the Systems Theory to indicate that both the gas and electricity sectors are systems having sub-systems represented with their value chain arrangement in such a manner that each of them and even the gas and electricity sectors are dependent variables on each other. The study findings revealed that, the four major generation companies and several other NIPP plants scattered all over the country owe their operation at full capacity to adequate supply of gas. The paper concluded that an attempt at solving the electric power generation, transmission and distribution problem should by necessity begin with what is happening to the supply of natural gas to the thermal plants.

Keywords: Natural gas, Electric power sector, thermal plants, Generation, Hydro plants, NEP (2003), NGP (2017), NGMP (2008)

markets”, while the Mission is: “To move Nigeria from a crude oil export-based economy to an attractive oil and gas-based industrial economy”. The gas policy intends to move Nigeria from an oil-based to an oil and gas-based industrial economy.

This gas-based industrialisation will be driven by some core principles, namely, to:

- separate the respective roles and responsibilities of government and the private sector;
- establish a single independent petroleum regulatory authority;
- implement full legal separation of the upstream from the midstream;
- implement full legal separation of gas infrastructure ownership and operations from gas trading;
- realise more of the LNG international downstream value;
- pursue a project-based, rather than a centrally-planned domestic gas development approach;
- make a strong maintenance and safety culture a priority;
- implement international best practice for environmental protection;
- establish strong linkages with electric power, agriculture, transport and industrial sectors;
- establish payment discipline throughout the energy chain;
- honour stability of contract terms;
- ensure security of assets; and
- ensure compliance with the Nigerian Content Act.

The article centred on one of the core principles which is the establishment of strong linkages with electric power sector especially in a bid to develop the Nigerian gas sector.



Statement of Research Problem

The gas and electric power are critical sectors of the nation's economy. If development is to be witnessed in the nation's economy, the linkages between them should be strengthened. In particular, part of the issues in the power sector is the short supply of gas to the generation thermal plants. Since the three subsectors operate as system, the entire power value chain, generation, transmission and distribution are equally affected. two sectors

Study Objectives

The study objectives are to:

- (a) identify reasons of the necessity for the gas/electric power sector relationship
- (b) assess the quality of relationship between the two sectors
- (c) investigate factors that may help to strengthen the gas/power sector relationship

Significance of the Study

The synergy between the gas and the electricity industry stem from the fact that natural gas is a veritable feedstock for electricity generation, among others. Meanwhile, out of the six electricity generation stations, namely: Afam, Egbin, Sapele, Shiroro, Kainji, and Ughelli, only two (Kainji and Shiroro) are hydro, meaning that they are generated with water through the damming system while the remaining four (Afam, Egbin, Sapele and Ughelli) are thermal, and as such, gas-fired. This is apart from several other Independent Power Providers' (IPP) plants which are also gas-fired. Therefore, as long as most of the country's electricity generating plants depended on gas supplies for its operations, the strengthening of the gas/power sector linkage is inevitable.

With the ever-deplorable power supply situation in the country, the study serves to emphasis the need for strong synergy between the two sectors. The study stresses the need for all liquidity challenges between the gas suppliers and the power value chain are resolved amicably between the sectors in order for the energy sector to be developed in line with international best practices.

Literature Review

Conceptual Analysis

Natural Gas

Natural gas is described as a combustible, gaseous mixture of simple hydro-carbon compounds, usually found in deep underground reservoirs formed by porous /permeable sedimentary rocks. Natural gas is a fossil fuel composed almost entirely of methane, but thus contain small amount of other gases, including ethane, propane, butane and pentane. Methane is composed of a molecule of one carbon atom and four hydrogen atoms. (CH₄). Natural gas is used extensively in residential, commercial and industrial applications.

A mixture of gaseous hydrocarbons occurring in reservoirs of porous rock (commonly sand or sandstone) capped by impervious strata. It is often associated with petroleum, with which it has a common origin in the decomposition of organic matter in sedimentary deposits. Natural gas consists largely of methane (CH₄) and ethane (C₂H₆), with also propane (C₃H₈) and butane (C₄H₁₀) (separated for bottled gas), some higher alkanes (C₅H₁₂ and above) (used for gasoline), nitrogen (N₂), oxygen (O₂), carbon dioxide (CO₂), hydrogen sulfide (H₂S), and sometimes valuable



helium (He). It is used as an industrial and domestic fuel, and also to make carbon-black and chemical synthesis. Natural gas is transported by large pipelines or (as a liquid) in refrigerated tankers. Natural gas is combustible mixture of hydrocarbon gases, and when burned it gives off a great deal of energy. We require energy constantly, to heat our homes, cook our food, and generate our electricity. Unlike other fossil fuels, however, natural gas is clean burning and emits lower levels of potentially harmful byproducts into the air. It is this need for energy that has elevated natural gas to such a level of importance in our society, and in our lives.

In 2013, production fell by 10% to 1.35tcf because of supply disruptions and a temporary blockade on Nigeria's LNG Shipment, which, according to the EIA Report, also led to a corresponding fall in export and to a lesser extent, domestic consumption. Nigeria consumed 490bcf of dried natural gas in 2013, which is about 36% of its production.

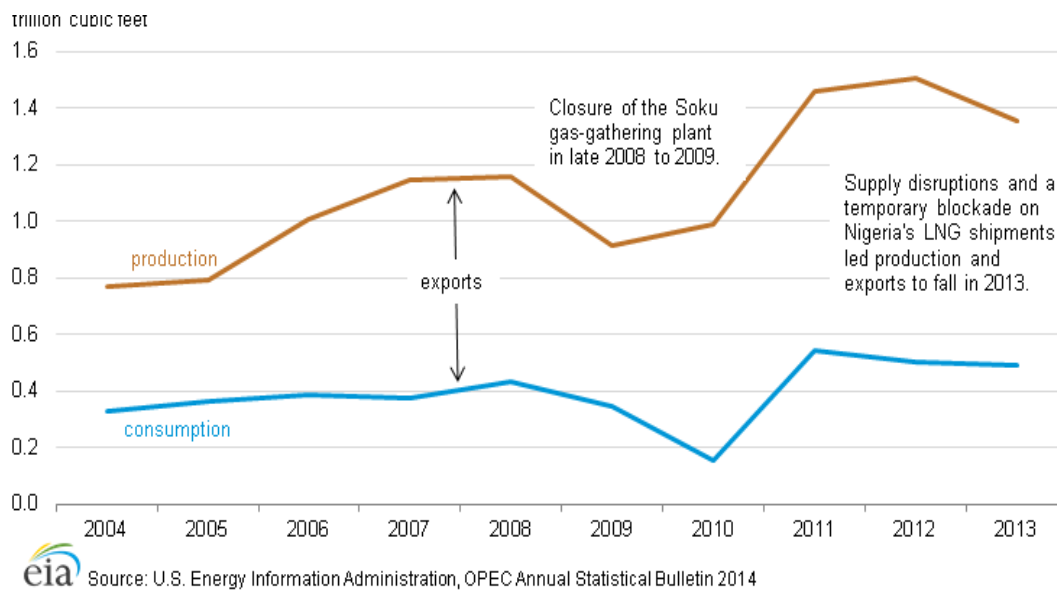


Fig 1: Nigeria's Dry Natural Gas Production and Consumption.

The use of natural gas is increasingly being applied in electric power generation, cooling and for transportation. Research has it that, it is the cleanest and most environmentally friendly fuel than oil. In Nigeria, natural gas is mainly produced along with oil (Associated Gas).

Natural Gas is a vital component of the world's supply of energy. It is one of the cleanest, safest, and most useful of all energy sources. Despite its importance, however, there are many misconceptions about natural gas. For instance, the word 'gas' itself has a variety of different uses, and meanings. When we fuel our car, we put 'gas' in it. However, the gasoline that goes into your vehicle, while a fossil fuel itself, is very different from natural gas. The 'gas' in the common barbecue is actually propane, which, while closely associated and commonly found in natural gas, is not really natural gas itself. While commonly. grouped in with other fossil fuels and sources of energy, there are many characteristics of natural gas that make it unique. Below is a bit of background information about natural gas, what exactly it is, how it is formed, and how it is found in nature



Report has it that, Nigeria has the world's 7th largest proven reserves of gas with 187 TCF already discovered (Okorie 2010). However, Cynthia Egboboh of Business Day Newspaper reported on May that this figure slightly increased to 208.62tcf in January 2022. The gas is rich in natural gas liquids and has little or no Sulphur. Over the years, there has been a steady growth in reserves with recent discoveries coming from the deep-water basin. To date, all gas discoveries in Nigeria have been incidental; resulting from the search for oil gas. There is a significant potential for reserves growth with focused gas exploration. The reserve potential has been put at up to 600tcf which will make Nigeria the 4th largest gas reserve owner after Russia, Iran and Qatar. However, the country losses between 35-39% (Gigabit Watts) of this deposit to flaring. Put another way, the gas flared in Nigeria is sufficient to generate 15GW of electricity; this in a country with 6GW of installed and only 3GW of available power generation. Nigeria's Gas Sector is predominantly government-controlled (Okorie 2010). He reports further that, government is the dominant gas resource owner but has limited operatorship.

Most of the production is by Major Oil Companies (MOCs) which, though are about 60 % owned by NNPC and commercially driven, the export market, according to him, is growing. For instance:

- With train 6 now operational, LNG's capacity has reached 22MTPA
- Other LNG plants (Olokola and Brass) are under evaluation
- The West African Gas Pipeline Project is continuing a pace and there is evidence of increasing demand.

The domestic demand is also growing. According to Okorie (2010), the power sector reform and the attendant government funded Gas Power Plant developments of over 10GW was driving domestic demand. He states that, oil prices were driving up the cost of alternative fuels and industries were turning to gas where available. The government-led investment in domestic gas infrastructure is no longer adequate, he stressed.

The Escravos-to-Lagos Pipeline System (ELPS), completed in the nineties is the main transmission pipeline system dedicated to domestic consumption in the country. This pipeline system is the only source of supply to the industrial and utility sectors of the domestic market. ELPS also serves as the source of gas supply for the West African Gas Pipeline System (WAGPLS). As with many other oil and gas facilities, repeated sabotage of this and feeder systems has led to frequent supply disruptions of recent. The other major downstream pipeline systems are dedicated to single projects leading to sub-optimal pipeline configurations. These pipelines are mainly to export oriented projects and cover areas already served by other single project pipelines. The private sector will feel the brunt of any long-term gas unavailability (Okorie, 2010).

Citing Okorie further, the dearth of investment in major domestic pipeline infrastructure has led to a short fall in the pipeline capacities required to sustain the growing economy. In addition, he stressed that, there was no pipeline connection between the gas supply fields of the East and the growing markets of the West and North. This according to him, had led to a shortage of gas availability for the newly commissioned power plants in the Western parts of the country. Significant and urgent pipeline infrastructure has now become imperative if the country is to benefit from the gas resource (Okorie 2010).



Electric Power Sector

The electric power industry covers the generation, transmission, distribution and sales of electric power to the general public and industries. The commercial distribution of electric power started universally in 1882 when electricity was produced for electric lighting. In the 1880s and 1890s, growing economic and safety concerns led to the regulation of the industry. What was once an expensive novelty limited to the most densely populated areas, reliable and economical electric power has become an essential aspect for normal operation of all elements of developed economies. By the mid-20th Century, electricity was seen as a natural monopoly, only efficient if a restricted number of organisations participated in the market. In some areas, vertically integrated companies provide all stages from generation to retail, and only governmental supervision regulated the rate and cost structures. (*en.m.wikipedia.org*).

The new drive of the Nigerian government is to "restructure the industry," disaggregate the industry into functional autonomous components of generation, transmission and distribution", develop the market, "come up with a cost reflective tariff, ensure the "presence of a strong regulator," privatisation, encourage "active participation of the private sector in the business of the industry, and ensure "outright transfer of assets to the private sector where applicable. The new framework and renewed priorities include the restructuring of the power sector". The Electric Power Sector Reform Act enacted in 2005 was to drive reform process. "Sector regulator (NERC) was established October 2005, " Power Holding Company of Nigeria was unbundled into Transmission Company of Nigeria (TCN), 6 GenCos and 11 DisCos, " Private sector participation was introduced with NERC licences PHCN and IPPs New Framework and Renewed Priorities II " New Power Sector Roadmap was officially launched by Mr. President on 26th August, 2010 " the roadmap outlined government's plan to accelerate the pace of reforms and improve on short term service deliver. " Presidential Action Committee on Power (PACP) was created to remove "red-tape, achieve policy consistency and cut-through bureaucracy in decision-making by key stakeholders in power ". The Presidential Task Force on Power (PTFP) was actually created to see to the day-to-day planning, developing and driving forward of the Reform Plan for the Nigerian Power sector.

New Framework and Renewed Priorities " The Reform of the Nigerian Electricity Supply Industry involves the divestment of government's core interest, namely:

- Power Generation; the privatisation of all government owned thermal power plants
- Power Transmission; Government retains core ownership but private sector management
- Power Distribution; the transfer of ownership of the distribution companies to the private sector

All these are in accordance with the Electricity Power Sector Reform Act 2005

The Nigerian Gas Sector Value Chain

The parts of the gas value chain, for the purposes of the Gas Policy, are defined as follows: **Upstream**: These are activities related to exploration for, development and production of gas; drilling and operation of gas producing wells; construction and operation of gas gathering pipelines; gas separation and treatment facilities and operations; transportation of personnel and equipment to and from upstream gas locations and facilities.

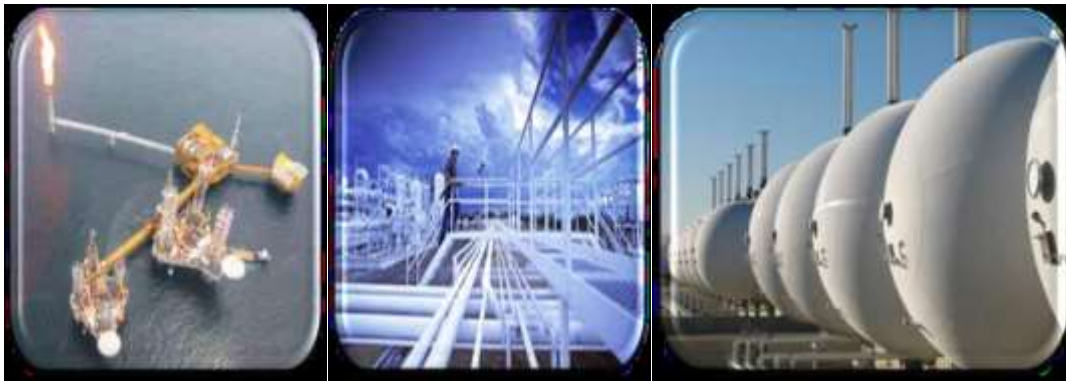


Midstream: refer to activities related to: construction and operation of gas transportation pipelines, in general after the flow station; gas processing facilities; natural gas liquefaction plants; gas bulk storage facilities; shipping of gas and related products; Other bulk transport methods, such as rail, barge and trucks for transporting gas and related products on a wholesale basis.

Downstream: are activities related to: construction and operation of facilities for distributing gas to customers; retail stations for CNG; city gate reception terminals for gas; distribution of gas; wholesale marketing of gas and gas products; marketing, retailing and sale of gas.

According to The Policy, the reasons for the clear separation of the segments of the gas value chain are for fiscal reasons (dealt with in the complementary Petroleum Fiscal Policy); to enable market entry and access for new entrants and investors. Furthermore, a clear separation and distinction between the upstream and the midstream will provide a level playing field between incumbents and new entrants, ensure clarity in midstream regulation, and provide basis for ending the practice of consolidation of midstream costs against upstream tax liabilities.

Oyewumi in his work, *The Nigerian Gas Industry: Policy, Law and Regulatory Developments*, provides detailed account of the gas operations and sub-sectors. These are the Upstream, the Midstream and Downstream Sub-sector Operations respectively. This is shown below:



Upstream-Exploration & Production

- NNPC/NPDC
- IOCs
- E & P Contracts/Joint Venture Operations.

Midstream

- Refining Transmission & Processing
- Liquefied Natural Gas
- NLNG, Brass, OKLNG etc
- Central Processing
- Facilities. OANDO, Chevron etc.
- Gas-to-liquid facilities- Escravos GTL, Mobil Oso etc.
- West African Gas Pipeline
- Trans Sahara Gas Pipeline.

Downstream-Storage & Distribution

- Nigerian gas company Ltd
- Shell Gas Nigeria
- Local Gas Distributors
- LPG & CNG Distributors.

Fig 2: Gas Operations and Sub-sectors (adopted from Oyewumi's *The Nigerian Gas Industry....*).



According to *Philip E. Agbonifo* Nigeria is increasingly a hub centre for natural gas with sustainable economic growth and development in addition to the prospect of sustained environmental benefits. The environmentally friendly, cost effective and cleanliness aspect of natural gas makes it the first choice for energy users. Thus, this paper identified environmental, social and economic, wealth creation, employment generation and sustainable development as some fundamental benefits of natural gas development. While there are some invaluable opportunities from natural gas, however, there appear some obstacles. The paper revealed that obstacles are deeply rooted in dearth of gas gathering and distribution infrastructure, fiscal and regulatory policy, funding, and more importantly, the prevailing security situation in the main gas supply source, the Niger Delta region. It concludes that the absence of enabling environment for private participation on gas development, lack of energy intensive plants across Nigeria to utilise vast proportion of natural gas and the imposition of price control mechanism are serious threat to gas development

Natural Gas Policies

Like other government programmes and activities, natural gas is operated, driven and regulated with a body of laws, policies and statutes. Of these policies are the:

a) National Energy Policy (2003)

Among the body of policy and regulatory frameworks in the gas sector is the Natural Gas Policy that is contained within the National Energy Policy (2003). This particular policy provides that:

- the nation's gas resources shall be harnessed and optimally integrated into the national economy, energy mix and industrial process,
- the nation shall engage intensively in gas exploration and development with a view to increasing the reserve base to the highest level possible,
- the nation shall put in place necessary infrastructure and incentives to encourage indigenous and foreign companies to invest in the industry, and that
- the nation shall put in place necessary infrastructure and incentives to ensure adequate geographical coverage of the gas transmission and distribution network.

This four planks'-policy is closely followed by a set of objectives towards facilitating the policy. These objectives are to:

- eliminate the flaring of associated gas by 2008,
- expand the utilisation of natural gas as industrial and domestic fuel, as well as for power generation.
- increase the use of natural gas as industrial feedstock for petrochemical, pharmaceutical and fertilizer plants, etc
- use gas to diversify the foreign exchange earning base of the nation,
- accelerate the process of technology acquisition and diffusion in the gas industry,
- encourage indigenous entrepreneurial capability in the gas industry, including the development of end-user devices; and
- determine the level of gas reserves available to the nation.

To achieve both the policy and its objectives, the following strategies are put in place by the policy:

- encouraging the oil-producing companies to gather and utilise associated gas in order to eliminate flaring by 2008,
- improving appropriate and effective penalties to discourage gas flaring, encouraging the establishment of the necessary infrastructure for the effective gathering, transmission and distribution of gas nationwide,
- providing incentives to encourage industrial and domestic consumers to use gas or to convert to gas,



- providing incentives to encourage the introduction and use of LPG (Liquefied Petroleum Gas) appliances in areas not accessible to natural gas so as to encourage the consumer preference for gas,
- expanding and promoting gas related R & D (Research and Development) outfits in the country,
- formulating suitable urban and regional planning regulations needed for the effective distribution of natural gas to, and its utilisation by, domestic and industrial consumers.
- providing necessary incentives to indigenous and foreign entrepreneurs to facilitate their participation in the gas industry,
- ensuring that the price of natural gas is cost-effective, while giving due attention to the effect on local consumption, and
- embarking on deliberate exploration for gas deposits in all parts of the country.

The policy, considering especially its objectives and strategies towards its achievement, appear far reaching, touching every area possible in the gas value chain particularly with its concerted effort at ending gas flaring. Natural gas policy was mainly to facilitate an economically optimal strategy to replace oil with gas and gas derivatives considering the fact that, one, gas is more in reserves (in energy terms) than oil, and two, oil is already losing relevance in the global market. Furthermore, experts have said that gas is a more environmentally friendly and cleaner fuel than oil. It is thus believed that, a developed natural gas sector would bring about major economic developments. For instance, natural gas as a relevant resource for domestic and industrial feedstock, e.g for use of power generation in PHCN Thermal Stations, Cement Manufacturing Companies, Fertilizer plants and Aluminum Smelter Companies as well, will help in achieving overall national development.

At the short-term, the policy will embark on:

- review and improvement of existing incentives to producing companies to encourage them to gather and utilise associated gas in order to maximise income from associated gas and eliminate gas flaring by 2008,
- review of existing penalties for gas flaring and ensuring that they achieve the desired effect,
- establishment of appropriate arrangements to ensure the implementation of the incentives and penalties to discourage gas flaring,
- monitoring the implementation of measures to achieve the termination of gas flaring by 2008,
- establishment of appropriate guidelines, regulations and incentives for the participation of indigenous and foreign entrepreneurs in the establishment of the infrastructure for, and business in, gas gathering, transmission and distribution,
- provision of funding for the establishment of a nationwide infrastructure for gas gathering, transmission and distribution,
- review and sustenance of the implementation of incentives to industrial and domestic consumers to use gas or change over to gas,
- sustenance and expansion of the measures presently in place for the establishment of infrastructure and markets for the export of natural gas, and
- formulation of suitable urban and regional planning regulations, which are needed for the effective distribution of natural gas to domestic and industrial consumers.



The natural gas policy is a well thought out formulated piece, having in it all the ingredients needed for it to succeed especially in eliminating gas flaring and revamping the economy through improved natural gas gathering and utilisation. The following are the *medium-term* measures of strategies for the realisation of the natural gas policy:

- termination of gas flaring,
- sustaining funding for the expansion of the infrastructure for gas gathering, transmission and distribution nationwide,
- intensification of promotional activities for the use of gas and change over to gas by industrial and domestic consumers,
- implementation of urban and regional planning regulations for effective distribution of natural gas, and
- embarking on deliberate exploration for gas in promising parts of the country and at the *long term* is the measures to put in place an effective nationwide infrastructure for gas gathering, transmission and distribution and for the export of natural gas.

However, despite these provisions, arrangements and measures towards facilitating successful implementation of the natural gas policy, coupled with other body of laws and policies before and after it and the different efforts and incentives of government, gas flaring especially, which appear to be the highpoint of the natural gas policy has continued in the Niger Delta with its attendant environmental, social and economic effects both on the host communities and the government. For instance, the flare phase-out date had kept on being shifted. The imposed penalties for flaring have not deterred IOCs (International Oil Companies) from continuing the willful combustion of associated gas. Also, it is noticed that the usual inefficiency in the performance of the power sector to deliver uninterrupted electricity supply is blamed on inadequate supply of natural gas to the PHCN's thermal generation stations. These observations among others, has led curious minds to ask, what is wrong with the implementation processes of the robust and well formulated natural gas policy?

b) National Gas Policy (2017)

The purpose of this document is to define the policy of the Federal Government in respect of Nigeria's natural gas endowment, establish its medium to long-term targets for gas reserves growth and utilisation and record strategies to be pursued to ensure the successful implementation of the policy in accordance with Nigeria's national socio-economic development priorities. One of such strategies to be pursued is the establishment of strong linkages of the gas with electric power sector. Meanwhile, the vision of the policy is, "to be an attractive gas-based industrial nation, giving primary attention to meeting local gas demand requirements, and developing a significant presence in international markets", while the mission is: "to move Nigeria from a crude oil export-based economy to an attractive oil and gas-based industrial economy". The gas policy intends to move Nigeria from an oil-based to an oil and gas-based industrial economy. This gas-based industrialisation will be driven by the following core principles:

- Separate the respective roles and responsibilities of government and the private sector;
- Establish a single independent petroleum regulatory authority;
- Implement full legal separation of the upstream from the midstream;
- Implement full legal separation of gas infrastructure ownership and operations from gas trading;
- Realise more of the LNG international downstream value;
- Pursue a project-based, rather than a centrally-planned domestic gas development approach;
- Make a strong maintenance and safety culture a priority;
- Implement international best practice for environmental protection;



- Establish strong linkages with electric power, agriculture, transport and industrial sectors;
- Establish payment discipline throughout the energy chain;
- Honour stability of contract terms;
- Ensure security of assets;
- Ensure compliance with the Nigerian Content Act.

c) Natural Gas Master Plan, NGMP (2008)

The National Gas Master Plan, NGMP (2008), was government's initiative to bring about private sector involvement towards an effective working of the production, transportation and supply of natural gas both to end-users and for exports. To achieve the stated policy objectives and successfully implement the strategies, various instruments, including economic measures, information and education, legislative measures and institutional arrangements are put in place and incorporated within the policy itself. Consequently, the strategies are prioritised into short, medium- and long-term stages respectively.

Element of the Nigeria Gas Master Plan

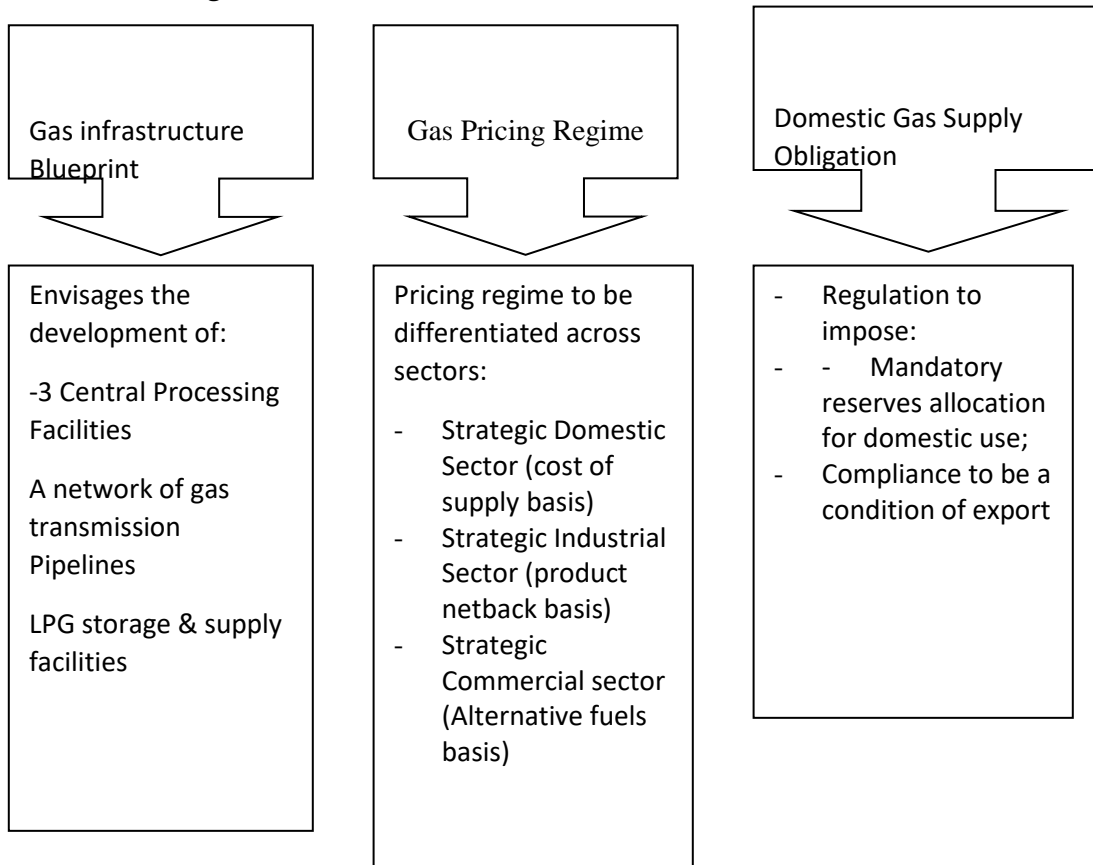


Fig 3: Element of the NGMP (adopted from Adefulu, Nigerian Gas Policy, 2009)

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. To accomplish this, it aims to create fully liberalised market within five years which is underpinned by:



- A robust, scalable and fully connected gas infrastructure that supports the three markets concurrently and cost-effective gas from any source can get to any market.
- Transformation of the domestic market into a vibrant and fully commercial gas market where the gas price stimulates investment in supply and the sustainability of the market compliments the other regional and export LNG markets enabling a balance portfolio.
- Attracting a more widespread participation by new players so as to stimulate competition and efficiency.

Elements of the Gas Master Plan

In order to achieve the above said objectives, the Nigeria Gas Master Plan was developed into three critical elements:

Gas Pricing Policy: this policy is to ensure natural gas is supplied at affordable prices to all domestic sectors, mainly power and other sectors that have a significant multiplier effect on the nation's economy. A stratified pricing mechanism have been adopted for this policy as listed below;

- The strategic Domestic Sector: this being the sector with the greatest multiplier effect on the economy namely power and also to residential and light commercial users. Thus, this sector will be supplied at the lowest commercially sustainable price.
- The Strategic Industrial Sector: This comprises industries that require gas as their main feedstock, such as fertilizers, methanol, GTL etc. The policy is expected to make prices as competitive as obtainable in other parts of the world.
- The Commercial Sector: this being the sector that uses gas as industrial fuel e.g. manufacturing industries. Each of these sectors has a dedicated pricing regime which sets out a transparent structure for the determination of the floor price of gas.

The floor price of gas for the strategic domestic sector will be determined on a cost-of-supply basis using pseudo-regulated pricing regimes. This regime establishes the lowest cost of supply that will allow a 15% return for the supplier. The forecasted average domestic price from all three sector will be known as the Aggregate Domestic Price (i.e. the price all gas supplier will be paid). The aim is that buyers will pay for gas at the sector price while suppliers receive an aggregate gas price.

The government policy introduces a floor price of US\$0.4 /mmbtu at power plants based on a price of US\$0.10/mmbtu at 2008 at the wellhead and transmission charge of US\$0.30/mmbtu. The price of gas to non-power consumers is expected to cross subsidise the price to the power plants resulting in a pooled price of US\$0.50/mmbtu at 2008 to increase to \$1.30/mmbtu by 2012 to the gas producers. This arrangement of a pooled price is expected to be managed through the proposed institutional arrangement of a Strategic Aggregator.

The Strategic Aggregator will be the first contact point for the gas trade and will issue Gas Purchase Orders after due diligence on buyer. The proposed Gas Aggregator will be empowered to open and manage an escrow account with an escrow agent approved by the Department of Gas and direct purchasers of gas to make payment for gas supply into the account in accordance with the payment agreed by the suppliers, gas purchasers and the Aggregator. The Gas Aggregator shall prepare and provide annual detailed audit report of the escrow account to suppliers of gas and ensure transparency dealings between gas suppliers and purchasers. Price of gas for the power sector is set to go up as high as US\$1.30/mmbtu by 2012 by which time the cross subsidy is expected



to be phased out. The Government also introduced a securitization framework to assure investment in gas supply to the power sector. Both of these steps will provide a much-needed boost to gas supply.

Gas supply challenges are rooted in the absence of activated gas supply agreements. Gas Supply and Aggregation Agreements/ Gas Supply Agreements are signed but have not been activated because the conditions precedent have not been met, namely payment guarantees. Because of this, gas in Nigeria is supplied on a best endeavor basis, and there is no penalty to the international oil companies for not supplying the designated amounts of gas to power generators. Another is the absence of reliable payment of gas invoices. Power sector illiquidity and the resulting inability of power generators to fulfill obligations and pay suppliers for gas is the largest challenge in the sector and limits the amount of gas available to the power sector. Reliable payment in U.S. dollars makes the export of gas as liquefied natural gas, liquefied petroleum gas, or natural gas liquids to the global market far more attractive to producers than selling to the domestic market.

Gas supply is also challenged by lack of cost-reflective tariffs. Although some gas prices are determined on a contract basis, the gas-to-power price for domestic supply obligations and the transmission tariff are regulated by the government. Because these payments are passed through to the power sector, they directly impact power sector pricing and should be cost-reflective. The lack of an independent gas regulator is another of the gas supply challenges in Nigeria. Limited regulatory certainty and oversight of Nigeria's oil and gas sector disincentivizes investment and participation by companies across the value chain. Finally, is the lack of consistent policy implementation. Despite a comprehensive policy framework in place to guide the development of a sustainable gas sector, implementation of these policies has been inconsistent, with many initiatives unimplemented, and subsequent legal and regulatory efforts sometimes failing to reflect original policy intent.

The Domestic Gas Supply Obligation: To ensure the success of the Gas Master plan, the Domestic Gas Supply Obligation was formulated as part of the elements. The regulation mandates all gas players in the country to set aside a predetermine amount of the produce gas for the domestic market. Following the Gas Management Model through which the demand and supply of gas in the country will be forecasted, each of these producers will be required to submit a gas production and supply plan consistent with the obligation under the Domestic Gas Supply Obligation Regulation. The regulation will penalise any defaulter as they will be made 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 is levied over this.

The Gas Infrastructure Blueprint: A robust gas infrastructure blueprint has been developed to foster the Gas 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 between major gas reserves sources and the demand centres, thus providing a roadmap that would guide future investment in the gas sector in a bid to ensure proper utilisation of gas resources in the key sectors of the economy and the regional market. The process is designed to ensure that synergies are maximised and infrastructure aligned to deliver the aspiration of the Gas Master Plan



Empirical Review

Linkages of the Gas with Electric Power Sector

Inadequate or insufficient gas supply to thermal plants is the single largest constraint hampering optimum power generation capacity. Others are: inadequate and obsolete distribution infrastructure, poor water management at hydro-power plants, operational inefficiencies, non-cost reflective electricity tariff and liquidity constraints, and limited transmission lines. As a result, power generation capacity falls short of pre-privatisation target. Nigeria has more than a conservative estimate of 216 million people (the largest in Africa) including large industrial and commercial ventures scatter unevenly across the country. About 40% of the population have no access to electricity and supply is usually epileptic for those that have access. However, the country's current operational capacity stands at less than 4,000MW, less than 8,400MW projection for 2018 in Multi-Year Tariff Order (MYTO). The installed capacity of 7,000MW is also less than the pre-privatisation target of 11,879 MW by 2012 and post-privatisation target of 14,218 MW and 40,000 MW by 2013 and 2020 respectively. The bulk of electricity generated comes from thermal sources (gas-fired power plants). As a result, the inadequate gas supply often affects power generation.

According to *Phillip E Agbonifo*, the first gas supply for power generation started in 1963, through unco-ordinated attempt, leading to the establishment of facilities within producing fields for relatively small but steady off takes. The initial efforts at gas utilisation involved supply to the National Electric Power Authority (NEPA) at Afam Power Station, NEPA Delta Power Station, Ughelli, five private industries in Aba as well as the old Port Harcourt Refinery (Omiyi 2001). These aforementioned gas projects were executed by Shell between 1964 and 1966. Apart from the uncoordinated attempts, the first major gas pipeline system did not come up until 1978 when the Nigerian National Petroleum Corporation (NNPC) and Shell implemented the gas supply to NEPA Sapele station, quickly followed with the execution of 2 gas pipeline projects: Aladja Systems and Oben-Ajaokuta in 1981 and 1983 respectively (Gaius-Obaseki 1996). These projects with a combined system capacity of 270 million standard cubic feet/day were designed to deliver gas to the Steel Complex at Ajaokuta. In 1985, a Gas Division was created in NNPC to ensure the realisation of the government objectives for gas utilization and monetisation. In furtherance with a clear vision for commercialisation, focused growth and development of the gas industry, a subsidiary company, the Nigerian Gas Company Ltd (NGC) was created out of the NNPC in 1988. The NGC is now shouldering the responsibility of the control and further development of the network of domestic gas infrastructure in Nigeria.

Thus, a major opportunity for investment in the electric power sector is gas production and transportation; there would be no more FGN-only commitments to new gas-fired power plants and also that, all new gas-fired power plants were to be private sector driven. Government's role in this restructuring process would be to develop and deploy effective policy. Meanwhile, government is asserting its Will to carry-through its policies; effective manager(s) for process implementation are to be worked out; there are also to be managers in decisions that may be unpopular but good for the economy and the populace. Government is also to educate the public about the benefits of the power sector Policy.



The two sectors of electricity and gas are operationally symmetric. The policy being examined is expected to strengthen this linkage. However, it has not been smooth sailing. The existing liquidity crunch between them has strained the relationship. This liquidity crunch is the biggest challenge of the Nigerian electricity sector today. The eleven (11) DisCos have been struggling to meet their obligations to the Nigerian Bulk Electricity Trading Plc (NBET) and Market Operators (MO) as evidenced in their low remittances to NBET and MO. In the first quarter of 2019 (Q1'2019), only about 28% of the N190 billion invoice (comprising invoice of 161.4 billion for energy purchased from NBET and an invoice of N28.8 billion for administrative services from MO) of DISCOs were remitted. In one year (Q1'2018 – Q1'2019), DisCos' outstanding remittance to NBET and MO stood at about N523.8 billion and N80.3 billion respectively. Consequently, NBET have in turn been unable to meet their obligation to the generation companies (GENCOs) thus creating a liquidity challenge that has plagued the electricity industry since the privatisation exercise in 2013.

None of the DisCos have been able to offset the invoice due to NBET and MO. The proportion of remittances relative to market invoice is low across all the DisCos as none could attain 50% of the total bill owed. This situation creates liquidity challenges to the generation and transmission segment of the industry.

The Supply Policy focuses on three strategic demand sectors of the economy as identified under the NGMP i.e.

- (i) the strategic domestic sector mainly referring to the power sector (residential and light commercial users only);
- (ii) the strategic industrial sector, comprising of industries utilising gas as feedstock such as methanol, GTLs and fertilizer; and
- (iii) the commercial sector, comprising of industries that use gas as fuel such as manufacturers of cement or steel.⁸⁸ It recognises the diversities in the ability of various consumer categories and industrial sub-sectors to pay the actual price 'competitive market' for gas supply.

In relation to the power sector, the strategic policy objective is to facilitate and ensure low cost gas access in order to spur rapid economic growth.⁸⁹ A vital question here is- what happens if 'low cost' gas is undeliverable or unavailable due to some international gas market dynamics which often arises in reality due to:

- (i) the increasing interconnectedness of international gas markets and commoditisation of gas in major foreign consuming markets;
- (ii) escalating domestic transaction and administrative costs as well as security of supply issues: and
- (iii) considerable loss of global market share by 'Nigerian' gas due to oversupply or increased supply from other jurisdictions. It is argued here that a responsive price regulation model which provides sufficient incentive for the efficient producer to invest and remain in business while supporting innovative ways to reduce pass-through costs ought to be adopted.

According to the Supply Policy, the stipulated national pricing framework is a transitional one. It seeks to determine the floor (minimum) price for gas supplied to the three core demand sectors.



Additionally, the pricing framework is to be monitored in real-time by the Minister of Energy for (Gas), who shall also determine when the domestic market is fully developed, and an alternative pricing approach is required. One challenge that could be highlighted with the stated policy provisions is that there is currently no designated Minister of Energy for (Gas), but only a Minister for Petroleum as provided under the PET Act and NNPC Act. However, one could safely assume that this function is to be carried out by the extant Minister of Petroleum.

Another consequential issue is: how will the Minister efficiently monitor the environment for a strategic domestic sector like 'power' when there is already a distinct Ministry and Minister of Power as well as a designated 'independent' regulator (i.e. the Nigerian Electricity Regulatory Commission (NERC)) for power? Such institutional and policy misalignment will perhaps lead to greater transaction and administrative costs, coordination problems, prioritising politics over economics and commerciality, as well as time wasting challenges and information gathering or sharing gaps. The Supply Policy prescribes a cost of supply or regulated pricing model for the gas supply to power value chain. In this regard, the floor price is to be determined primarily by establishing the lowest cost of supply that allows a 15% rate of return to the supplier. This was stipulated as \$0.1/MMBtu for a limited volume of gas reserves. Furthermore, the final adopted price will be based on an indexation formula that will be agreed between supplier and purchaser during the negotiation process of the relevant GTA and GSPAs.

The Supply Policy prescribed a floor price of US\$0.40/MMBtu at power plants based on a price of US\$0.10/MMBtu at the well head and a transmission charge of US \$ 0.30/MMBtu. Note that the Supply Policy and Supply Regulations were made in 2008 based on projections, calculations and trends at the time. It is therefore reasonably expected that unforeseen events (such as the developments in the international gas market or new security threats in the Niger Delta), new price and cost scenarios would have arisen since then that would make the stated figures obsolete or commercially inefficient under current circumstances. Thus, rather than fix or stipulate rates, charges, penalties or royalties in the texts of statutes and regulations, there is a quintessential need for a responsive regulatory institution with the required expertise and capacities to determine such figures in a methodological and transparent manner.

The Development of the Gas Sector in Nigeria.

Nigeria is richly endowed with both energy resources, such as coal, tar sand, crude oil, petroleum and other derivatives of crude oil, natural gas, and various gas liquids and condensates. With proven gas reserves of 188 trillion cubic feet (tcf) of gas, the natural gas industry presents an opportunity to diversify the economy through domestic commercial utilisation of its natural gas. Historical non-viability of domestic commercial production and utilisation of gas continues to severely constrain private investments in the industry. Consequently, the low level of investment in the industry has resulted in the minimal production and utilization of Compressed Natural Gas (CNG) and Liquefied Petroleum Gas (LPG) as clean alternative sources of domestic energy in Nigeria. Failure to harness its gas resources has had negative consequences for the country – economic, environmental, fiscal and social, particularly as the industry has the potential to engender rapid growth in Nigeria's non-oil economy.



To this end, the National Gas Expansion Programme (NGEP) was introduced to make CNG the fuel of choice for transportation and LPG, the 3 Classified as Confidential fuel of choice for domestic cooking, captive power and small industrial complexes. Equally, gas-based industries, most especially the petrochemical (fertilizer, methanol, etc) are to be enabled to support large industries, such as agriculture, industrial applications, textile and so on.

Therefore, as part of its efforts at stimulating finance to critical sectors of the economy, the Central Bank of Nigeria (CBN) introduces the N250 billion intervention facility to help stimulate investment in the gas value chain. Large-scale projects under the intervention will be financed under the Power and Airlines Intervention Fund (PAIF), in line with existing guidelines regulating the PAIF, while small-scale operators and retail distributors will be financed by the NIRSAL Microfinance Bank (NMFBS) and / or any other Participating Financial Institution (PFI) under the Agribusiness/Small and Medium and Medium Enterprises Investment Scheme (AGSMEIS).

The initiative is to be implemented in collaboration with the Ministry of Petroleum Resources (MPR). This framework outlines the operational modalities for the intervention.

The objectives of the Facility include:

- i. Improved access to finance for private sector investments in the domestic gas value chain;
- ii. Stimulate investments in the development of infrastructure to optimise the domestic gas resources for economic development; 4 Classified as Confidential.
- iii. Fast-track the adoption of CNG as the fuel of choice for transportation and power generation, as well as LPG as the fuel of choice for domestic cooking, transportation and captive power;
- iv. Fact-track the development of gas-based industries particularly petrochemical (fertilizer, methanol, etc) to support large industries, such as agriculture, textile, and related industries;
- v. Provide leverage for additional private sector investments in the domestic gas market;
- vi. Boost employment across the country.

Eligible activities under the intervention shall include:

- i. Establishment of gas processing plants and small-scale petrochemical plants;
- ii. Establishment of gas cylinder manufacturing plants;
- iii. Establishment of L-CNG regasification modular systems;
- iv. Establishment of auto gas conversion kits or components manufacturing plants
- v. Establishment of CNG primary and secondary compression stations;
- vi. Establishment and manufacturing of LPG retail skid tanks and refilling equipment;
- vii. Development/enhancement of auto gas transportation systems, conversion and distribution infrastructure,
- viii. Enhancement of domestic cylinder production and distribution by cylinder manufacturing plants and LPG wholesale outlets; 5 Classified as Confidential
- ix. Establishment/expansion of micro distribution outlets and service centres for LPG sales, domestic cylinder injection and exchange; and



- x. Any other mid to downstream gas value chain related activity recommended by the Ministry of Petroleum Resources (MPR).

Developing Gas Resources:

- i. Enable an environment that encourages exploration specifically targeting gas;
- ii. Encourage exploration and development of new gas supply sources from the inland and offshore basins;
- iii. Develop portfolio management methodologies to prioritise low-cost gas development;
- iv. Clarify gas terms for PSCs;
- v. Achieve gas flare-out through gas utilisation projects utilising mature flare reduction technologies;
- vi. Produce a Gas Resource Management Plan

Theoretical Review

This study was anchored on the Systems Theory to indicate that both the gas and electricity sectors are systems with sub-systems represented with their value chain arrangement in such a manner that each of them and even the gas and electricity sectors are dependent variables on each other.

The Systems Theory of David Easton (1965) could lend some useful explanation in this study. The systems theory sees political life as a system of behaviour with established set of interactions for the authoritative allocation of the values of society through an input-output matrix. David Easton devised a model of 'political systems, a major post-war invasion which contributed to an understanding of politics by simplifying reality but in some cases departed from reality.

According to *Chih-Hui Lai & Sapphire Huili Lin (2011)*, Systems theory aims to explicate dynamic relationships and interdependence between components of the system and the organization-environment relationships. A system is established based on the structure and patterns of the relationships emerging from interactions among components. As a result of these emergent patterns and relationships, each system is different from another. In other words, unlike biological systems, components of social organizations have their own wills and intended purposes. In general, systems theory focuses on three levels of observations: the environment, the social organisation as a system, and human participants within the organisation. This multi-level focus can be traced back to the original pursuit of initiating dialogue among disciplines through systems theory.

It is argued that this pursuit can be accomplished through different ways. One of them is to find general phenomena that are observable across many disciplines. For instance, it is common to find in any social systems where aggregations of individuals interact with one another and with the environment and develop interdependent relationships. The biological notions of population change and individuals' interaction with the environment can apply to human organisations. Populations refer to the aggregates of individuals defined by common attributes and experiencing dynamic growth and declines of individual components. Each population exhibits dynamic patterns of its own and engages in dynamic interactions with other populations. These are essentially the tenet of the ecological and evolutionary perspectives, which will be explained in a later section. The other approach is to examine the empirical fields through a nine-level hierarchy, arranged according to the complexity of the constituent unit of behaviour. These nine levels include: frameworks, clockworks, thermostat, cell, plant, animal, human organism, social



organisation, and transcendental system (Boulding, 1956). Systems at levels four (cells) or above are seen as more open and complex, operating on permeable boundaries and the mechanisms of self-maintenance (Schneider & Somers, 2006).

The advantage of this latter approach in the form of a hierarchy helps expose the theoretical and empirical gaps that have not been covered in different disciplines. For example, it was shown that in the 1970s, theoretical systems were not fully developed to understand open systems and social organisations. This hierarchy is also used to explicate the degree to which the characteristics of agency are realised in systems. Six levels of the continuum include determined systems, reactive systems, goal driven systems, problem-solving systems, self-aware systems, and multivocal systems (Poole, 2014). In determined systems (level one), there is a lack of consideration of agency because systems function in a predetermined fashion whereas in multivocal systems (level six), agents can dynamically construct multiple selves in different situations that involve problem-solving and monitoring processes. In other words, if a system possesses higher levels of agency, it is likely to be flexible and adaptable to change. According to systems theory, components of each system are structured in a hierarchical ordering, and components are interdependent with one another in the system to the extent that one component cannot function without the support of other components.

Components of a system can be tightly coupled, where the components are closely interdependent, or loosely coupled, where the smaller subsets of tightly connected components are loosely connected to one another. At the organisational level, the organisations and other organisations in the environment are also interdependent on one another. Underlying this interdependence are the permeable boundaries, both within and among organisations. Invariably, social organizations have to maintain permeable boundaries of a certain degree in order to receive materials or export products to survive. The process of receiving resources (input) and exporting products (output) is the exchange process. When the raw materials are received, components of a system will work together to transform the materials into products exported to the environment. During this throughput process, the system is engaged in two types of feedback mechanisms: negative and positive. Negative feedback is to correct errors in order to maintain the current state of the system whereas positive feedback is to change the system through improvement or growth.

A system desires to maintain its steady state or homeostasis by balancing the energy imported. If the produced output is below the goal based on the feedback, a system will import more resources and adjust the throughput process in order to maintain its desired state.

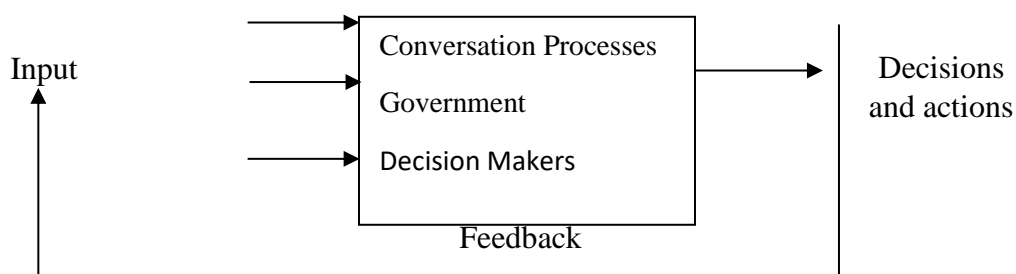


Fig. 4: A model of political system (Adopted from David Eastein's *A system Analysis of political life*) - extracted from Roskin et al (2008:29).

The idea of looking at complex entities are systems originated in Biology. Living entities are complex and highly integrated. The heart, lungs, blood, digestive tract and brain perform their



functions in such a way as to keep the animal alive. Take away one organ and the animal dies. Damage one organ and the other components of the system alter their function to compensate and keep the animal alive. The crux of the systems thinking according to Roskin et al (2008) is that: you cannot change just one component, because a change in one component affects the other entire component. In the political system's model, many argued that the politics of a given country worked the same way as a biological system. According to the Easton Model as above, citizens demands, 'inputs', are recognised by the government decision makers who process them into authoritative decisions and actions, 'output'. This output has an impact on the social, economic and political environment which the citizens may or may not like.

Application of systems theory

When general systems theory's hierarchy of systems was introduced in the 1950s, theoretical and empirical gaps existed for levels 4 and above in Boulding's hierarchy. That is, much less was known about the mechanism of self-maintenance in the social world. Nonetheless, theories listed below have filled these gaps over time by enriching the constructions of various mechanisms of sustaining a social system. Undoubtedly, applications of systems approach to organisational communication cover a wide range of theories, including structural functionalism, communication network models, structuration theory, chaos theory, complex adaptive systems and self-organizing systems theories, social systems theory, and self-reflective systems theory (Poole, 2014).

Below is an elaboration of four systems approaches that have gained growing interest in organisational communication research. Thus, public policy may be seen as a response of the political system to the demands, expectations and aspirations of the citizens or to the demands arising from its environment. An input (from the environment) into the system consists of demands and supports. Output then becomes the converted demands (inputs) upon the system. Of course, there is the Feed-back element which represents new demands from the policy output which leads to further outputs in a never-ending flow of public policy. Our interest in this theory is the output of policy which manifests when policy is implemented and the demands of the people are met.

Gap in Literature

The main emphasis of this study is the fact that natural gas is a feedstock for electric power generation in the thermal power stations which are more than the hydro stations. The implication of this is that the power sector, as it were, rely on the gas sector for its operations. In other words, without adequate supply of gas to the power generation stations, they cannot perform at full capacity and the quality of power supply would be everything but epileptic as the situation has been even in spite of privatisation of the sector. this position is worsened by the liquidity challenges in the failure or inability of DisCos to meet upon with their financial obligations to the GenCos for amount of electricity sold to it.

The position of the present study is that, both government and stakeholders in both the electricity and gas sectors should realise and in fact accept the fact that, given this interdependence, the linkages should be strengthened for purposes of helping to achieving the intentions of the power



sector reform Act, among others. For this to happen, all liquidity issues across should be settled so that adequate gas could be supplied to the generation stations of the power sector. However, most

Methodology

The methodology adopted for the study is explorative approach to unravel the nuances involved in the relationship that subsists between the natural gas and the electric power sectors respectively. Thus, data was gathered through the use of secondary means, namely: published journal articles, internet sources, textbooks and documents.

Data Analysis

The data was analysed using descriptive and content analyses. This study was anchored on the Systems Theory to indicate that both the gas and electricity sectors are systems having sub-systems represented with their value chain arrangement in such a manner that each of them and even the gas and electricity sectors are dependent variables on each other.

Research Findings

The study findings revealed that, the four major generation companies and several other NIPP plants scattered all over the country owe their operation at full capacity to adequate supply of gas. The Electric Power Sector Reform Act, 2004 provides that, the generation companies shall, in accordance with their licences, sell electrical power to distribution companies and eligible customers, under the terms of any contracts existing prior to the declaration by the Minister, pursuant to section 24 (3), or under the terms of any new contracts with distribution companies and eligible customers;

Furthermore, generation companies shall, in accordance with their licences, sell ancillary services either to the successor company identified in section 25 (b) of the Act, under the terms of the contracts entered into prior to the declaration by the Minister, under section 24 (3), until such contracts are novated to an independent system operator, or under the terms of any new contracts with such successor company; provided that such contracts should allow for novation to the independent system operator in the same manner.

Discussion on Findings

If the gas sector is to develop in Nigeria, especially as envisaged by the policy (NGP, 2017) that is being reviewed, a strong linkage should be established with the electricity sector and vice-versa. This is mainly because the bulk of the nation's power generating stations are thermal and rely on gas for their operation.

The demand for electricity in Nigeria far exceeds supply. This widely known fact informed the drive for major expansion of generation facilities by government. To this end, the Niger Delta Power Holding Company Limited (NDPHC) was established to implement the speedy execution of the National Integrated Power Project (NIPP). The NIPP, a public sector funded initiative, is the principal tool being used to combat power shortages in the country. This project is expected to



deliver significant new generation capacity to the electricity supply system including transmission and distribution and natural gas infrastructure throughout Nigeria (NIPP, online).

However, the Nigeria's gas-to-power sector is a very critical part of her on-going power sector reform, which appears to be totally overwhelmed by various forms of challenges that experts in the country's energy sector consider too significant to be ignored by the federal government. Several challenges confront the gas compression industry in Nigeria. These include security. Host communities' problems and its effects on the cost of doing business constantly stare at the face of operators and their service providers. thereby slowing down development of oil and gas infrastructures. Local groups seeking a share of the wealth often attack the oil infrastructure, forcing companies to declare *force majeure* on production.

Supply disruption is one critical challenge of low gas supply – the gap between gas requirement and gas availability – to power plants resulting from absence of appropriate structures including regulations and laws guiding the mining of gas resources – associated and non-associated gas inclusive. Aging infrastructures and poor maintenance that result in all too frequent outages are a common phenomenon in the industry. These disruptions mostly stem from pipeline damages associated with oil theft resulting in shut-in of trunk lines. Failure of power plant owners to pay their bills to the gas companies also contributes to supply shortages. Nigeria currently loses 1,476MW to gas shortage (Gas to Power, 2014B). Natural gas wastage also constitutes a problem in entire gas-to-power processes. Aside from the well-known and documented wastage associated with gas flaring – Nigeria flares the 2nd largest amount of gas globally – a less well-known phenomenon is the wastage at the power generation plants due to inefficient system processes and machinery coupled with behavioral issues of the human interface (EIA, 2013).

Summary

Electricity in Nigeria is generated through thermal and hydropower sources. The main source of electricity generation comes from fossil fuels especially gas which accounts for 86% of the capacity in Nigeria with the remainder generated from hydropower source. Before the beginning of the 4th Nigerian republic, power generation was mainly federal government's responsibility through NEPA. But reforms started in 2005 with the electric power Sector Reform Act (EPSRA) opening up the industry to private investors with an aim at achieving better efficiency in electricity services delivery.

Electricity energy production in Nigeria over the last 40 years varied from gas –fired, oil – fired, hydroelectric power stations to coal-fired with hydroelectric power system and gas – fired system taking precedence. This is predicated by the fact that the primary fuel sources (coal, oil, water, gas) for these power stations are readily available. Nigeria's coal reserves are large and estimated at 2 billion metric tonnes of which 650 million tonnes are proven reserves. About 95% of Nigeria's coal production has been consumed locally; mainly for railway transportation, electricity production and industrial heating in cement production (A. S. Sambo, B. Garba, I. H. Zarma and M. M. Gaji, 2010). Electricity plays a very important role in the socio-economic and technological development of every nation. The electricity demand in Nigeria far outstrips the supply and the supply is epileptic in nature. The country is faced with acute electricity problems, which is hindering its development notwithstanding the availability of vast natural resources in the country. It is widely accepted that



there is a strong correlation between socio-economic development and the availability of electricity (Sambo, A.S. *et al*, 2010).

The National Gas Policy (2017) provides for the establishment of strong linkages with electric power sector, for the development of the gas sector in Nigeria. Inadequate or insufficient gas supply to thermal plants is the single largest constraint hampering optimum power generation capacity. Others are: inadequate and obsolete distribution infrastructure, poor water management at hydro-power plants, operational inefficiencies, non-cost reflective electricity tariff and liquidity constraints, and limited transmission lines. As a result, power generation capacity falls short of pre-privatisation target. Nigeria has more than a conservative estimate of 216 million people (the largest in Africa) including large industrial and commercial ventures scatter unevenly across the country. About 40% of the population have no access to electricity and supply is usually epileptic for those that have access. However, the country's current operational capacity stands at less than 4,000MW, less than 8,400MW projection for 2018 in Multi-Year Tariff Order (MYTO). The installed capacity of 7,000MW is also less than the pre-privatisation target of 11,879 MW by 2012 and post-privatisation target of 14,218 MW and 40,000 MW by 2013 and 2020 respectively. The bulk of electricity generated comes from thermal sources (gas-fired power plants). As a result, the inadequate gas supply often affects power generation.

Conclusion

This study concluded that an attempt at solving the electric power generation, transmission and distribution problems should of necessity begin with what is happening to the supply of natural gas to the thermal plants. This is on the premise that, most of the nation's power generating plants, including the IPPs, are gas-fired. For Improved electricity supply, a synergy, and indeed, a strong linkage between the gas and electricity sectors is inevitable. However, the liquidity issue between the Distribution and the Generation subsectors of the electricity company, namely: the failure of DisCos to pay for 100% of power generated, should be resolved and the gas sector will then supply gas effectively to the generation companies.

Generation companies (GenCos) currently active in Nigeria can be divided into three types: PHCN successor companies which have been privatised or put under concession, IPPs, and privatised NIPPs. At the time of privatisation, all private investors made Post Acquisition Plans which promised an improvement in generation performance. But outcomes have differed between generators. Transcorp and Sahara are two companies that have reported significant progress in repairing and overhauling previously unavailable generation capacity (Giwa, 2016; Udo, 2015). However, these generators have also raised concerns about the negative impact of upstream gas constraints and downstream power transmission constraints on their actual generation levels. Moreover, the failure of DisCos to pay for 100% of power generated is leading to a sector-wide liquidity crisis. DisCos have only remitted between 20% and 30% of the amount invoiced by GenCos through NBET, the state-owned single buyer. Between November 2013 and November 2016, the amount owed to GenCos amounted to more than N400 billion (Oketola, Adeoye, Nnodim, & Alagbe, 2016). NBET, established to remove counterparty risk in contracting between GenCos and DisCos, has been blamed by GenCos' representatives for ineffective collection from DisCos and for its failure to buffer the liquidity gap, in the event of DisCo non-payment.



Recommendations

The gas and electricity sectors are critical sectors of the Nigerian economy. Besides, they are mutually exclusive and interdependent, especially the latter which depend on the former for gas supply to its generation plants. In other words, a synergy has been established between them. This study thus comes up with the following suggested recommendations to help strengthen this relationship:

- ❖ The stakeholders in both sectors should address their minds to the fact that, the two sectors are closely related.
- ❖ All liquidity issues between DisCos and GenCos on one hand, and between the gas sector and electricity generation companies.
- ❖ There should be a conscious effort to develop both sectors. Consequently, all on-going programmes in both sectors should be pursued to fruition
- ❖ Gas processing infrastructures should be provided. For instance, at the time of privatisation, all private investors made Post Acquisition Plans which promised an improvement in generation performance. They should be reminded of this promise.
- ❖ The Supply Policy which in 2008 prescribed a floor price of US\$0.40/MMBtu at power plants based on a price of US\$0.10/MMBtu at the well head and a transmission charge of US \$ 0.30/MMBtu, should be given full implementation.
- ❖ Both the National Energy Policy (2003)'s portion on natural gas and National Gas Policy (2017) provides effective operation of both gas and electricity value chains. Again, these provisions should be implemented and thus, encourage gas generation to installed capacities, and serve the electricity sectors towards effective electricity services delivery.

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