

THE ROLE OF NATURAL GAS IN ENERGY SECURITY

Abstract

Natural gas is a fossil fuel with the highest energy efficiency and can provide a transition to a cleaner and more secured energy future as it complements the environmental attractiveness of renewable energy. However there are various, but not insuperable barriers to harnessing natural gas to meaningfully reduce energy challenges, poverty and the over reliance on crude oil. This study provides a theoretical exposition of the role of natural gas in providing energy security through the adoption of the IEA model for Short-Term energy security (MOSES) to analyse the key indicators that affects domestic utilization of gas in Nigeria.

Result showed that there is a significant effect of export dependency and domestic pipeline infrastructure on domestic utilization of gas in Nigeria. Energy security is a necessity for economic development. It is therefore necessary for government and policy makers to drive policies that will improve domestic utilization of gas in Nigeria.

Keywords: Natural gas, Domestic Utilization, Exportation, Energy security, MOSES.

1. Introduction

The International Energy Agency (IEA) defines energy security as “the uninterrupted availability of energy sources at an affordable price”. Energy security has many dimensions: long-term energy security mainly deals with timely investments to supply energy in line with economic developments and sustainable environmental needs. Short-term energy security focuses on the ability of the energy system to react promptly to sudden changes within the supply-demand

balance. Lack of energy security is thus linked to the negative economic and social impacts of either physical unavailability of energy, or prices that are not competitive or are overly volatile.

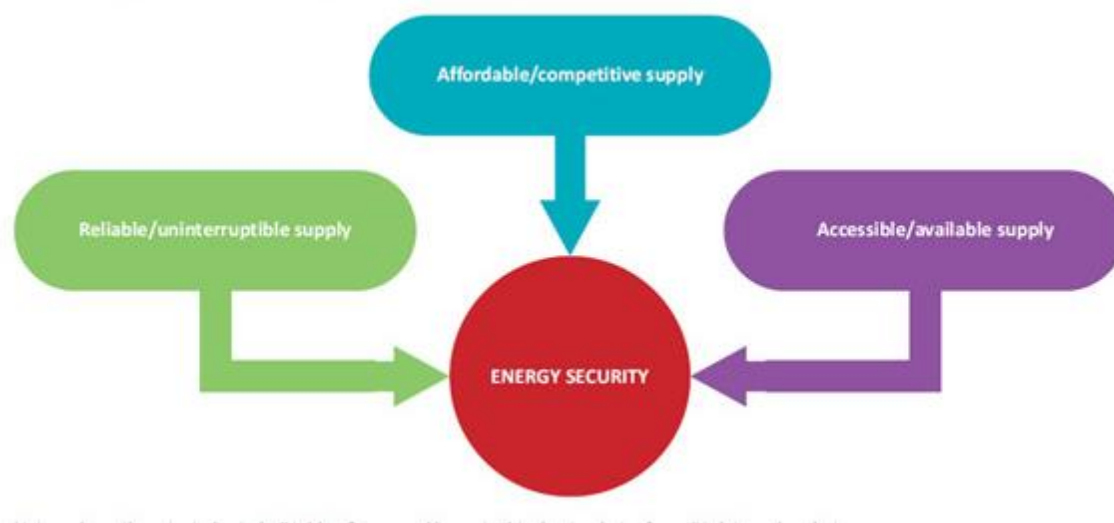


Figure 1: Defining Energy Security, (Source: IEA, 2011)

Historically, energy security was primarily associated with oil supply. While oil supply remains a key issue, the increasing complexity of energy systems requires systematic and rigorous understanding of a wider range of vulnerabilities. Thus, analysis of oil supply security alone is no longer sufficient for understanding a country's energy security situation as a whole.

With the growing demand for economic development in Nigeria in addition to the United Nations sustainable development goal of access to affordable and reliable energy and climate action, there will be a need for energy that improves the local environment with the least possible impact on global emissions. This growth in energy demand will for many years to come have to be met by hydrocarbon fuels. At the same time, because of climate change, which today is considered one of the biggest challenges facing mankind, efforts have to be directed in all parts of the world towards achieving a low-carbon energy mix. Climate researchers believe the only way to limit the rise in global temperatures by a tolerable 2°C is to halve global emissions of

greenhouse gases in the long term, with the industrialized world playing a leading role. Ensuring energy security has been and will continue to be the center of interest for many growing economies like Nigeria's

Natural gas is an important source of energy for achieving the sustainable development in an emerging economy. Natural gas continues to gain global recognition as an important energy source due to the climate change condition that has caught the attention of global leaders. However, Nigeria has huge gas reserves of over 180 trillion cubic feet of gas and holds the 9th position in terms of large gas reserves in the world but continues to have challenges in creating energy security due to the under utilization of her natural gas resources.

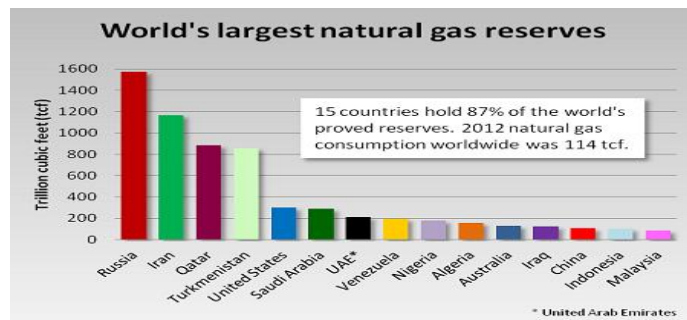


Figure 2 : Counties with the largest gas reserves

In light of the above, this study evaluates key indicators that affect the domestic natural gas utilization in Nigeria using the MOSES model. This will help understand the factors hindering the utilization of gas in Nigeria and help government know what areas of the sector needs to be addressed in terms of policies. Although there are existing policies but these policies might not be enough to address the present situation at and hand and might need to be reviewed. However, most importantly is the implementation of these policies. This study evaluates the current activities in the gas sector and its implications on the economy.

1.1. Background of the Study

Today, natural gas is a vital component of the world's supply of energy. Natural gas currently supplies more than one-half of the energy consumed by residential and commercial customers, and about 41 percent of the energy used by U.S. industry. It is one of the cleanest, safest, and most useful of all energy sources.

Before the 90's, in Nigeria, the natural gas sector was given little attention until 1992 when the Nigerian Liquidified Natural Gas (NLNG) company was established. Even after the establishment of the company and the quantity of gas used by the NLNG, Nigeria still flares gas. Since the discovery and production of oil in Nigeria in 1956, natural gas has always been produced alongside (associated gas) but was usually flared due to lack of infrastructure and lack of market for the gas. In a bid to discourage gas flaring, the Nigerian government enacted the "Associated gas Re-injection Act", which allowed some conditions for specific exemptions or the payment of a fee of US\$0.03 (0.3 cents) per cubic feet which took effect from 1984 but was later increased in 1998 to US\$0.07 per million cubic feet and in January 2008, it was increased to US\$3.50 for every 1000 standard cubic feet of gas flared. This fine obviously did not have any impact on the oil producing companies as they prefer to pay the fine and flare the gas.

Nigeria is also a member country and the major gas supplier of the West African Gas Pipeline with Chevron Nigeria being the major share holder with 37% of the shares. The Chevron Escravos- Lagos pipeline system has a capacity of 800 MMscfd and the West African Gas Pipeline company (WAPCO) system carries about 460 MMscfd. Meanwhile, the quantity of gas

needed locally is about 789.12MMscfd (Engr. Delano, 2014). The domestic market has been limited by the low level of industrialization and lack of adequate gas transmission infrastructure. Although, Oando Plc and Gas link are working on gas infrastructure and distribution network, Pricing is another hindrance to the development of domestic gas market although the present fiscal regime favors the sale of gas locally.

1.2. GAS USES

The multiple application of natural gas makes it a unique fossil fuel that is relevant to every sector of an economy. Figure 3 shows the composition of natural gas and the relevance of each component to various industries.

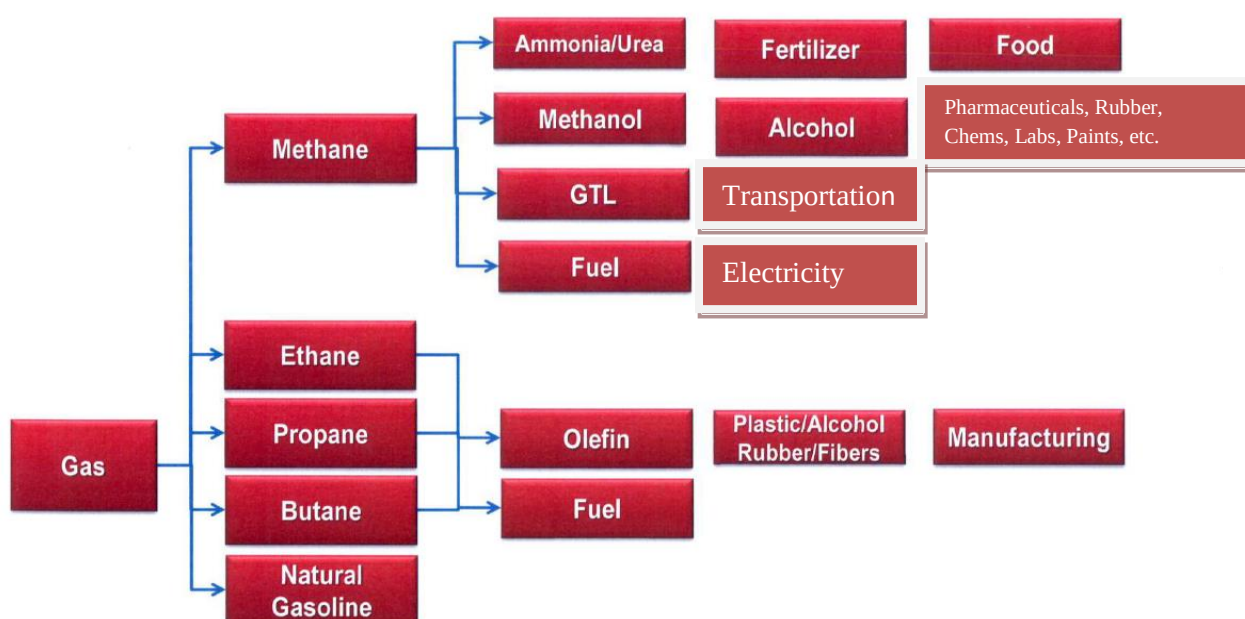


Figure 3 : Gas Uses

Gas can be used to achieve the local content development goal as the manufacturing industries can be revived through the use of natural gas. Natural gas is important to every aspect of the economy ranging from agriculture , transportation, power, aluminum and steel, rubber, etc. the

manufacturing sector has suffered over the years due to lack of raw materials which can be produced from natural gas.

Natural gas can be used to power the economy in various ways, they are;

I. Natural Gas and Power Generation:

Natural gas is unique among energy choice because of its vast domestic and industrial applicability. Natural gas can play a key role in the electricity sector if it is fully harnessed and utilized, which will in turn create employment opportunities for its citizenry through attraction of both local and foreign investment. At present, Nigeria has twenty-two(22) gas station with a capacity of 11,563Mega watts(MW), yet only one of the gas power station are fully operational, 7 of these power stations are non operational while 14 of them are partially operational. Yet Nigeria has a gas reserve of about 182 trillion cubic feet of gas and it is the major supplier of the West African gas pipeline(WAGP). Gas comes out top, when compared to other renewable source of energy in terms of power generation and meeting peak demand in predictable manner. In fact, there is no comparison between reliability in peak hour supply of power generation from renewable such as wind, wave, solar and from gas fired plants. when compared with nuclear, nuclear power is more expensive and has its own environmental and security concerns. Until there is a solution for increasing the efficiency and reliability of renewable technologies, natural gas will continue to be their natural partner. Figure 5 shows electricity production by country in kilowatts per hour, Nigeria is ranked the 67th position in the world while South Africa is ranked the 15th position.

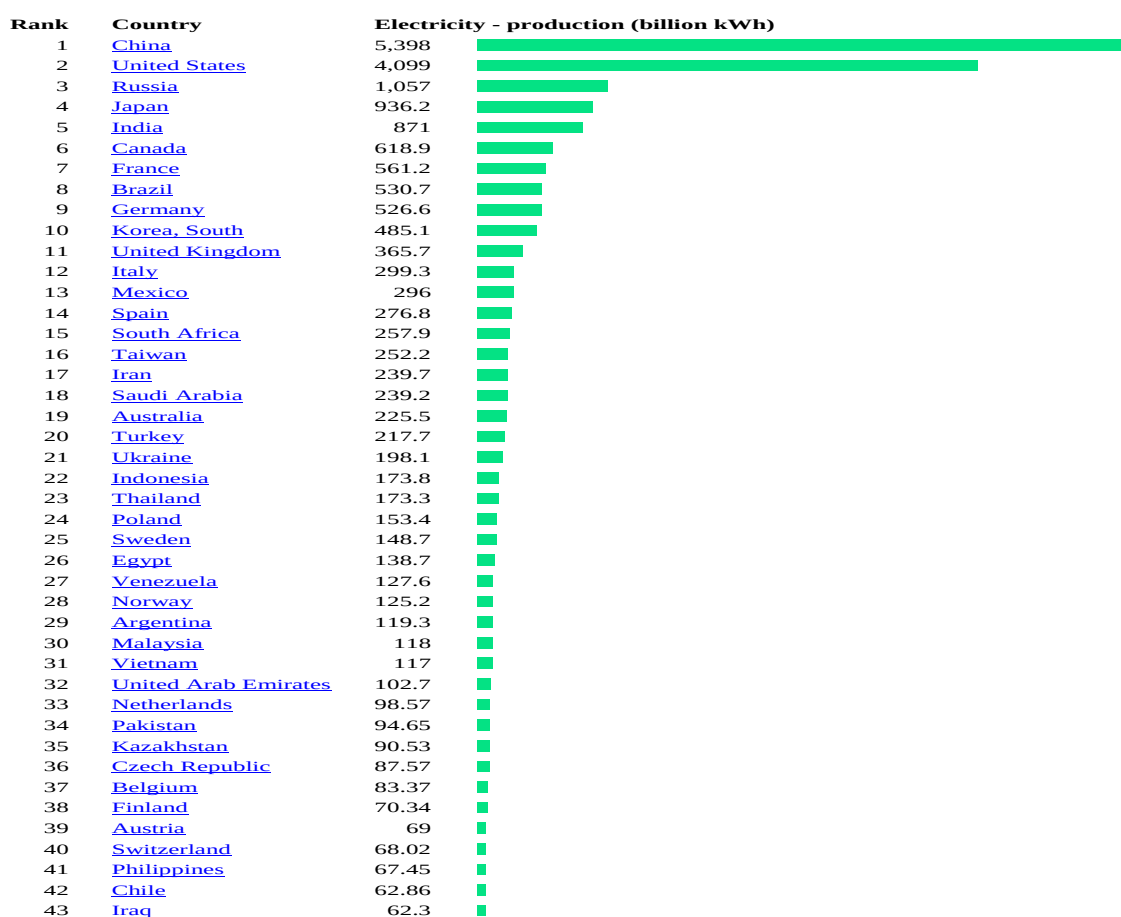


Figure 4: Electricity production by country as at 2014, (CIA World factbook)

II. Natural Gas as a Source of Clean Energy

Natural gas is a kind of fossil fuel that generates relatively less carbon-dioxide emission (CO₂) than other fuels. Therefore, it would be efficient to optimize the use of natural gas by industries and households to meet the United Nation's goal of reducing CO₂ emission. With this goal at heart, many countries are exploring the options for better use of natural gas as an alternative energy source (Pergis, A & Payne, 2010).

Currently, natural gas is considered as an attractive option because of its efficiency, better operational flexibility, reduced CO₂ emission, and lower capital cost when compared to other energy sources except hydro. It is also a complement for renewable energy. Natural gas is a

cleaner and more efficient source of electricity compared to coal and oil as it provides a 50 to 60 percent reduction in carbon dioxide emissions and eliminates mercury emission and other harmful pollutants are greatly reduced. Nigeria's energy demand can be met and exceeded through the utilization of natural gas.

III. Natural Gas as a Vehicle Fuel and a Cooking Energy Source

Natural gas can be compressed into what is called liquified natural gas (LNG) which is used as an alternative to the traditional automotive fuel or Liquified Petroleum Gas(LPG).

Natural gas has significant advantages over-gasoline and diesel fuel. Natural gas vehicles emit 60-90% less smog-producing pollutants and 30%-40% less greenhouse gas emissions. It also costs less per mile to operate a natural gas vehicle compared to a gasoline or diesel vehicle. The use of natural gas as a cooking energy source will reduce deforestation; with endangers our environment and reduce the health hazard pose by the smoke emitted from wood fuel. The use of LNG as an automobile fuel can be a game changer for the world gas market.

IV. Natural Gas a source of Energy Security

Energy is an important tool for developing any economy and for creating wealth. As such, issues of development cannot be seriously addressed without an effective energy planning and management that enhances optimal utilization, regular supply and availability of energy resources.

Natural gas is the clean energy and stable energy future, technological advances in natural gas production and utilization means natural gas can be easily produced and transported to end uses either through pipelines or as CNG. From the energy sustainability index seen in

figure 5 below, it is seen that Nigeria is ranked 79 which is seen as really poor. The index commentary explains it all.

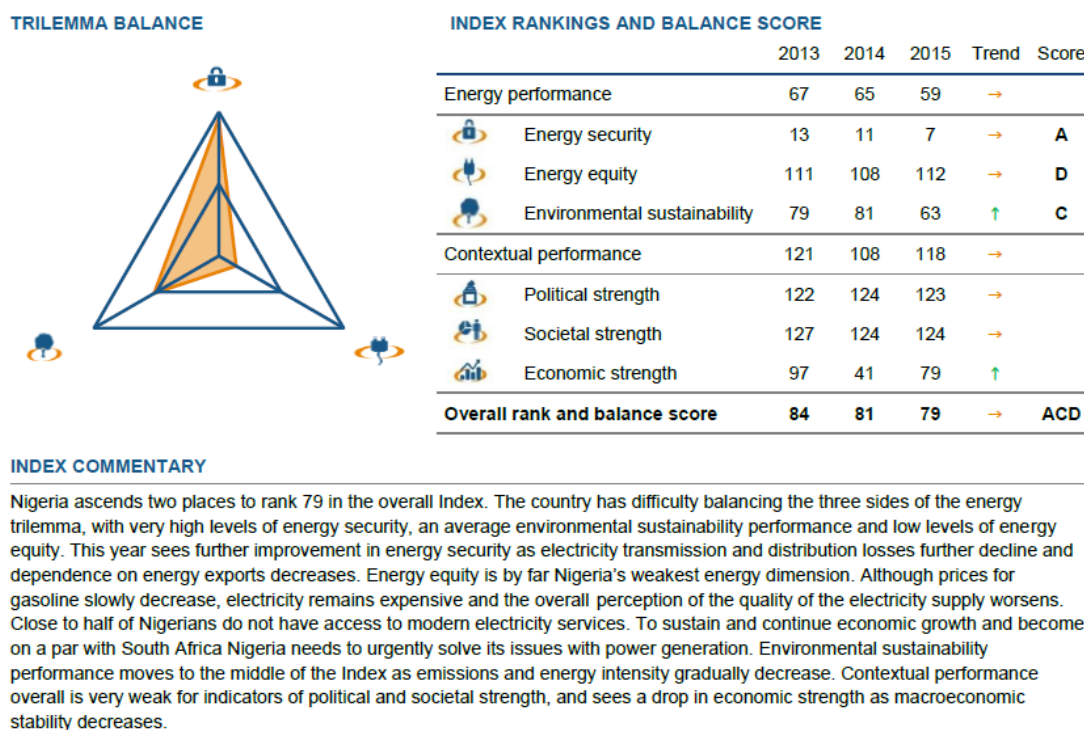


Figure 5: Energy Sustainability index ranking for Nigeria

The challenges of Natural Gas Utilization in Nigeria

The gas industry has suffered a lot of setback due to challenges it is faced with, these challenges are;

- Lack of adequate domestic supply infrastructure
- Unavailability of capital
- Regulated gas pricing
- Weak institutional structure for gas supply
- Pipeline vandalism
- Competition between the international and domestic markets

While the gas industry is faced with these challenges, the energy demand continues to grow as illustrated in figure 6 below.

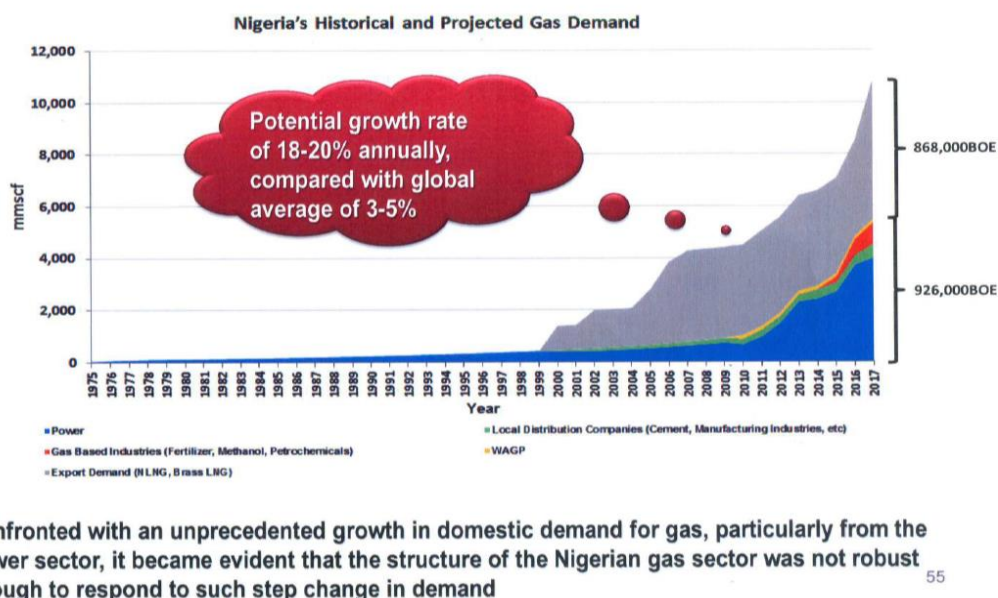


Figure 6 : Unprecedented Natural Gas Demand Growth (source: David Ige)

However, It has been estimated by the world Bank that Nigeria losses \$2.5 billion annually due to gas flaring and about 35million tonnes of carbon dioxide is released into the air annually. The zero flaring bill that Nigeria is about to sign with the United Nations is coming at a crucial time when Nigeria should realize it can do better with her gas than her oil. The reserve of the country's natural gas far triples the oil reserve. Signing this bill will discourage gas flaring and encourage gas utilization. This will also encourage government to address the challenges hindering the use of gas in the country.

Let us bore in mind, that the natural gas industry has a compelling story to tell policy makers and the general public. It can make an enormous contribution towards delivering carbon reduction goals with a level of certainty that no other fuel or technology can promise and at an all-in cost that cannot be matched.

The long term future for natural gas is bright but government has a lot of role to play in terms of infrastructure and policies to bring the future of natural gas to reality.

1.3. Policy Developments

Weak institutional framework is one of the barriers of domestic gas utilization. Various policies and institutions have been developed to promote the utilization of gas in Nigeria, the lack of political will to implement these policies and to achieve the goals of these various institution has tarred the gas industry and limited its relevance. Below are the policies and institutions for gas in Nigeria.

POLICY	PURPOSE
National Oil and Gas Policy 2004	In line with the National Energy Policy. Broad policy statements for petroleum industry, provides the policy frame work for a liberalized and functional gas industry, especially the domestic gas utilization
Downstream Gas Bill, 2005	Proposed to implement the liberalization of the domestic gas market.
Nigerian Gas Master Plan (NGMP) 2008	Domestic gas development agenda in line with the National Energy Policy and National Oil and Gas Policy. -Domestic gas supply obligation -Gas infrastructure blueprint -Gas Pricing Policy
National Domestic Gas Supply and Pricing Regulations 2008 National Domestic Gas Supply and Pricing Policy 2008	Extant legal and policy framework to implement the NGMP.
Petroleum Industry Bill (PIB) 2012	Following the industry reforms that began in 2000, the PIB proposes a comprehensive legal framework for exploitation of petroleum, including gas.

GAS REGULATORS

The Gas Aggregator Company of Nigeria (**GACN**) was incorporated in 2010. It was created to manage domestic gas supply obligations volumes and to act as first point of contact for gas buyers to access gas for domestic market use. While the Nigerian Gas Company (**NGC**) was established in 1988 as one of the eleven (11) subsidiaries of the Nigerian National Petroleum Corporation (NNPC), whose roles are to develop an efficient gas industry to fully solve Nigeria's energy and industrial feed stock needs through an integrated gas pipeline network and also export natural gas, its derivatives to west African Sub- region.

2.0. Literature review

Access to clean modern energy services is an enormous challenge facing the African continent because energy is fundamental for socioeconomic development and poverty eradication (Oyedepo, 2012). While the security of oil supplies remains important, contemporary energy security policies must address all energy sources and covers a comprehensive range of natural, economic and political risks that affect energy sources, infrastructures and services (IEA, 2011). Many experts believe that , in the long term, climate change and other concerns will necessitate a shift to natural gas and then to hydrogen economy that is dependent on the introduction of non-carbon energy sources and the sustainable use of biomass (Ausubel, 1996). Natural gas is the cleanest and most hydrogen-rich of all the hydrogen energy sources with high energy conversion efficiencies for power generation (Okologume, 2014). Beyond providing a cleaner, market-ready alternative to oil and coal, natural gas can facilitate the systemic changes that will underpin the development of a more energy-efficient and renewable energy-based economy (Christopher and Saya, 2010). However, Climate change challenge means we have to make the most efficient use

of all available energy sources. Natural gas, a cleaner burning fuel than coal and oil, offers solutions to the world's economic and environmental challenges in a secure and sustainable way (International gas union). Today, more than ever, energy powers human civilization (Voser, 2012).

Domestic natural gas utilization should be the primary goal of Nigeria's petroleum and energy policies. (Onolemhemen et al, 2015). As a consequence of the liberalization process in the natural gas industry, the natural gas markets have become more dynamic. The spot markets and the possibility to trade gas in forward markets have increased the importance of gas storages (Tomasgard et al, 2004). The Nigeria gas sector aspiration, though anchored around gas to power in the immediate term, is essentially much broader. It is aimed at delivering the Government's wider economic agenda of power and Industrialization (Okologome 2014).

Although various researches have been conducted on natural gas and energy security, Little or no research has been done to connect energy security and natural gas to the Nigerian economy. This study therefore establishes the major risk and resilience related to natural gas consumption in Nigeria.

3.0. Methodology

The question before us now is “what is the role of natural gas in a sustainable energy future”?

The role of natural gas in securing a sustainable energy future cannot be overemphasized. The multiple applications of natural gas and its availability make it an important energy source for Nigeria and its economy. Access to affordable and clean energy is one of the sustainable

development goals stated by the United Nations of which Natural gas can be used to achieve this goal.

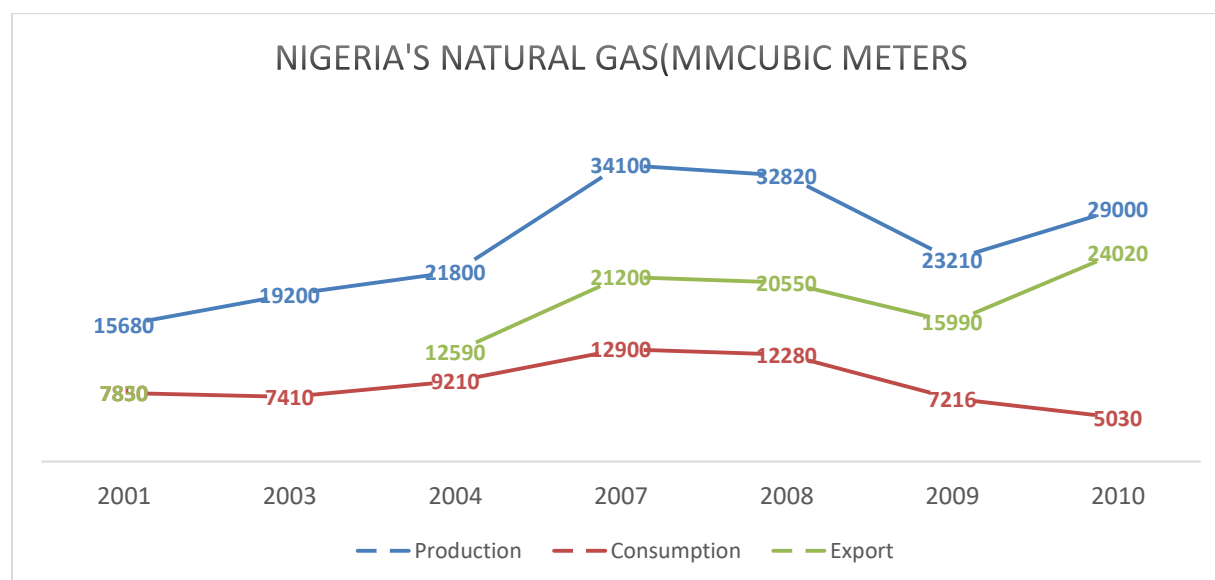


Figure 7 : Nigeria's gas production, consumption and export, Source: Nigerian National Petroleum Corporation (NNPC)

Figure 7 shows the natural gas production, consumption and export in Nigeria between 2001 to 2010. Figure 8 shows the percentage of gas exported and gas locally consumed in Nigeria from 2001 to 2010, which shows that Nigeria is more of gas export country than a gas consumption country.

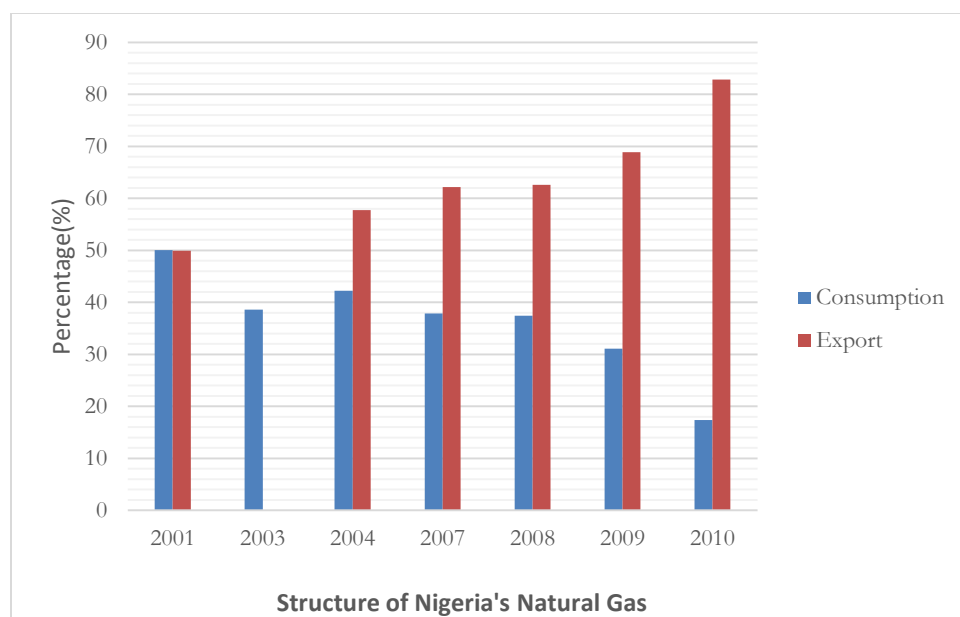


Figure 8 : structure of Nigeria’s natural gas, Source: Nigerian National Petroleum Corporation (NNPC)

This study adapts the IEA model of short-term energy security (MOSES) which is used to evaluate security of supply of individual sources and fuels. As indicated in the Figures 7 & 8, Nigeria exhibited a moderate export dependency of natural gas in 2001 as both domestic use and export constituted the same share. The status of the country still remained the same in 2004 but natural gas export accounted for about 60 percent of gas production in Nigeria. From 2004 onwards, the share of natural gas export experienced an increase to the extent that it accounted for over 80 percent of natural gas production. This changes the status of the country to high natural gas exporter. This implies that domestic utilization of Natural gas has been declined over these periods which have had a direct effect on electricity generation as Nigeria is ranked 67th position in terms of electricity production in the world as seen in figure 4.

Table 1 Natural gas: ranges for indicators.

Dimension	Indicator	Low	Medium	High
External Risk	Export dependency	-	-	$\geq 70\%$
Domestic Risk	Domestic gas Consumption	$\leq 40\%$	-	-
External Resilience	Export points	-	-	3
Domestic Resilience	Number of domestic gas pipelines(Domestic Points)	-	1	-
	Natural gas intensity(Gas Consumption/GDP)	$\leq 20\%$	-	-

Natural gas intensity: It is the indicator of domestic resilience. It is calculated by dividing gas consumption with Gross Domestic Product (GDP) as a sign of a country's economic exposure to gas disruption.

Domestic Resilience: It is evaluated using the number of domestic pipelines and natural gas intensity.

External Resilience: The indicators include the number and type of exit points

Export dependency: Includes the percentage of produced gas that is exported.

4.0. Result and Analysis

Table 1 illustrates the dimension and indicators involved in domestic Natural gas supply and consumption. The most important indicator in terms of natural gas supply in Nigeria, is infrastructure and the implementation of gas policies to drive domestic use.

The implication of the above scenario is that if any external shock occurs either from major buyer of Nigeria's natural gas or an increase in the number of gas suppliers in the international market as in the case of the United states who used to be a buyer of the Nigerian gas but now an exporter of LNG, this can lead to a fall in natural gas price. This might have serious effect on the Nigerian economy as is the experience with crude oil presently. Therefore, there is a need for the country to increase its domestic use of natural gas by improving natural gas infrastructure, as well as addressing the issue of gas pricing in order to incentivize gas suppliers to supply domestically.

5.0. Conclusion

It is important for Nigeria to take advantage of her huge natural gas reserves in meeting her energy needs. Natural gas is the future of the country as it can move her from being a developing country to a developed country. Countries such as the US, Saudi Arabia, China, Russia, Japan, Canada, Germany, India, Italy etc, are evidences that natural gas is an agent of economic transformation.

However, government has a huge role to play in making use of natural gas as a tool for the country's economic transformation. There is a need for government to reduce dependency on crude oil, develop gas infrastructure and implement policies that will enhance domestic gas

utilization. Government should be more interested in long term economic development rather than short term revenue generation.

Policy Recommendations

- Infrastructure- as shown in figure 9, there are 3 export points and one domestic point in Nigeria. It also shows the potential gas pipeline network in Nigeria, however, there has been challenges facing the implementation of the proposed gas pipeline network. Therefore the issue of infrastructure can be addressed by a public private partnership. Simply put, is that government can partner with foreign companies to build the required domestic infrastructure. The investment cost will be allowed to be recovered including the required profit for a stipulated number of years. The contract must be signed, sealed and respected irrespective of the government in place in order to protect the investment of the contractor. Once the contract is over, the infrastructure belongs to the government. The figure below illustrates the potential future gas infrastructure.

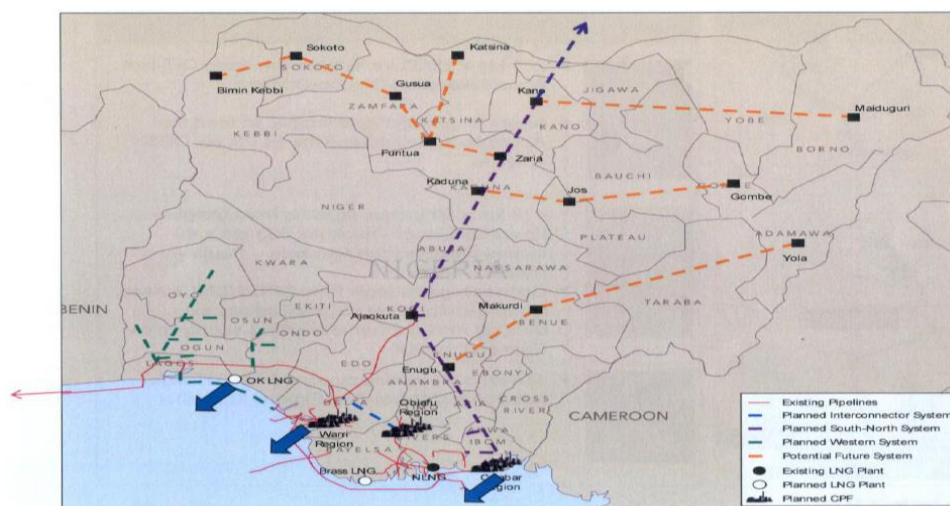


Figure 9 : Potential future gas infrastructure in Nigeria, (source: David Ige)

- Institutional Framework – there are a lot of policies on natural gas development and utilization in Nigeria but implementation of these policies seems to be the greatest challenge facing the gas industry. Policy makers should ensure that policies are not just formulated in the books but also implemented.
- Gas pricing – Government should allow the market forces determine the gas price rather than regulating the price. Studies have shown that when the forces of demand and supply are tampered with, issues tend to arise in such market.
- Pipe line Vandalism – the issue of unemployment should be addressed and the public should be educated on the hazard of pipe line vandalism poses to life. offenders should also be prosecuted. However, pipelines could be buried 12ft below ground level to prevent vandals from having easy access to the pipelines.

Disclaimer: NAEE/IAEE Conference, April 22-24, 2016. Sheraton Hotel Abuja.

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