THE ROLE OF NATURAL GAS IN ENERGY SECURITY

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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 in Nigeria. This study provides a theoretical exposition of the hindrances to the role of natural gas in providing energy security in Nigeria through the adoption of the IEA model for Short-Term energy security (MOSES) which analyzes the key indicators that affects domestic utilization of natural gas in Nigeria.

Results showed that there is a significant effect of export dependency and domestic pipeline infrastructure on domestic utilization of natural 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 natural 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 various dimensions: long-term energy security mostly deals with timely investments to supply energy in line with economic developments and sustainable environmental needs. Although, literature posits that an

examination of explicit and inferred definitions find that the concept of energy security is inherently slippery because it is polysemic in nature, capable of holding multiple dimensions and taking on different specificities depending on the country (or continent), timeframe or energy source to which it is applied[1]. While short-term energy security centers 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 excessively volatile. Figure 1, depicts the components of energy security [2]

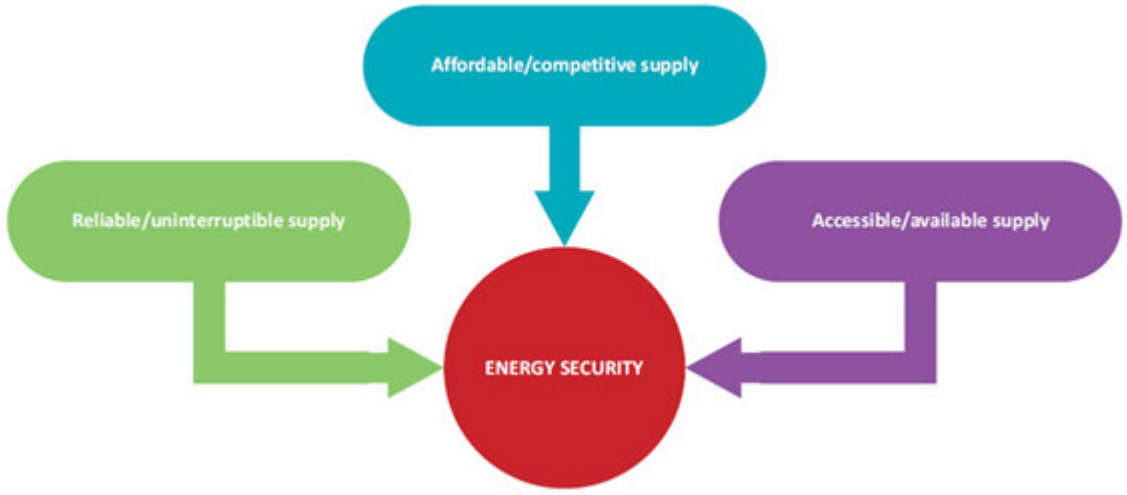

Figure 1: Defining Energy Security, (Source: IEA, 2011)

Historically, energy security was primarily associated with oil supply. While oil supply remains a key issue, the increasing complexity of energy systems requires methodical and rigorous understanding of a wider range of susceptibilities. Thus, analysis of oil supply security alone is no longer adequate for understanding a country's energy security situation as a whole [2]. A critical examination is therefore necessary to find ways to talk about poverty, climate and other issues connected with "energy" that are more coherent and analytically fruitful as well as better attuned to progressive goals [3].

If economic activity is taken to be a measure of welfare and continued growth is an objective, then the implications for future energy demand becomes central to the debate about energy availability, affordability, accessibility and policies [4]. According to the global energy sustainability index report, Nigeria is ranked 79th in terms of energy performance, which is seen as really poor. The index commentary reveals that from 2013 to 2015, there is a decline in Nigeria's energy performance. According to the report, Nigeria has difficulty balancing the three sides of energy (energy security, energy equity, environmental sustainability) with 60% to 70% of the Nigerian population not having access to electricity [5].

With the growing demand for economic development in Nigeria in addition to the United Nations sustainable development goal of providing access to affordable and reliable energy and climate action, there will be a need for an 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 be met by hydrocarbon fuels especially given the abundant resources of fossil the country has. At the same time, because of the raising concerns related to 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.

Developing and emerging economies like Nigeria, faces a two-fold energy challenge in the 21st century: Meeting the needs of billions of people who still lack access to basic, modern energy services while simultaneously participating in a global transition to clean, low-carbon energy systems [6]. Natural gas has often be described as a "transition fuel" to serve as a bridge during a

societal shift away from fossil fuels [7], However, with Nigeria's low economic development resulting mainly from poor electricity supply and continuous gas flaring situation, there is a need to properly harness and utilize her natural gas resources as a means of breaking the shackles of poverty and weak economic growth as well as providing energy security in the country. Ensuring energy security has been and will continue to be the center of interest for many growing economies like Nigeria.

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 182 trillion cubic feet of gas and holds the 9th position in terms of large gas reserves [8] in the world but continues to have challenges in creating energy security due to the under utilization of her natural gas resources. Though Nigeria has a proven oil reserve of 37billion barrels, it is incomparable to the proven reserve of its natural gas. Figure 2 illustrates the top fifteen (15) countries with large natural gas reserves.

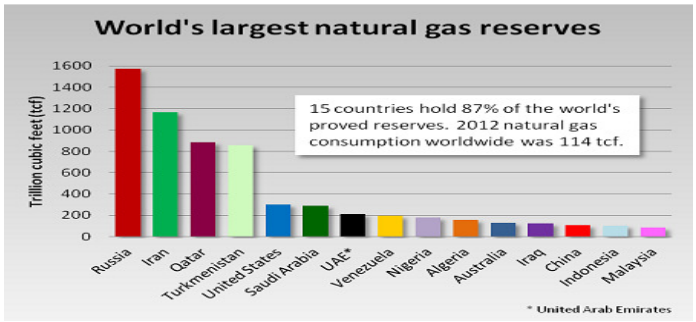

Figure 2 : Counties with the largest gas reserves. Source : CIA; World factbook, 2017.

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 natural gas in Nigeria and help government know what areas of the sector needs to be addressed in terms of policies. Although there are obtainable policies but these policies are not sufficient 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.

Background of the Study

Today, natural gas is a vital component of the world's supply of energy. Natural gas provides 22% of the energy used worldwide, and makes up nearly one quarter of electricity generation, as well as playing a vital role as a feedstock for industry. Natural gas is a multipurpose fuel and its growth is allied in part to its environmental benefits relative to other fossil fuels, particularly for air quality as well as greenhouse gas emissions [2]. 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 about 36 % of its gas [9] .

Since the discovery and production of oil in Nigeria in1956, natural gas has always been produced alongside (associated gas) oil 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 every1000 standard cubic feet of gas flared. This fine obviously did not have any impact on the oil producing companies as they preferred paying 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 800MMscfd and the West African Gas Pipeline company (WAPCO) system carries about 460MMscfd. Meanwhile, the quantity of gas needed locally is about 789.12MMscfd [10]. 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, some investors have argued that pricing is another hindrance to the development of domestic gas market. However, the present fiscal regime favors the sale of gas locally.

Natural 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 in Nigeria.

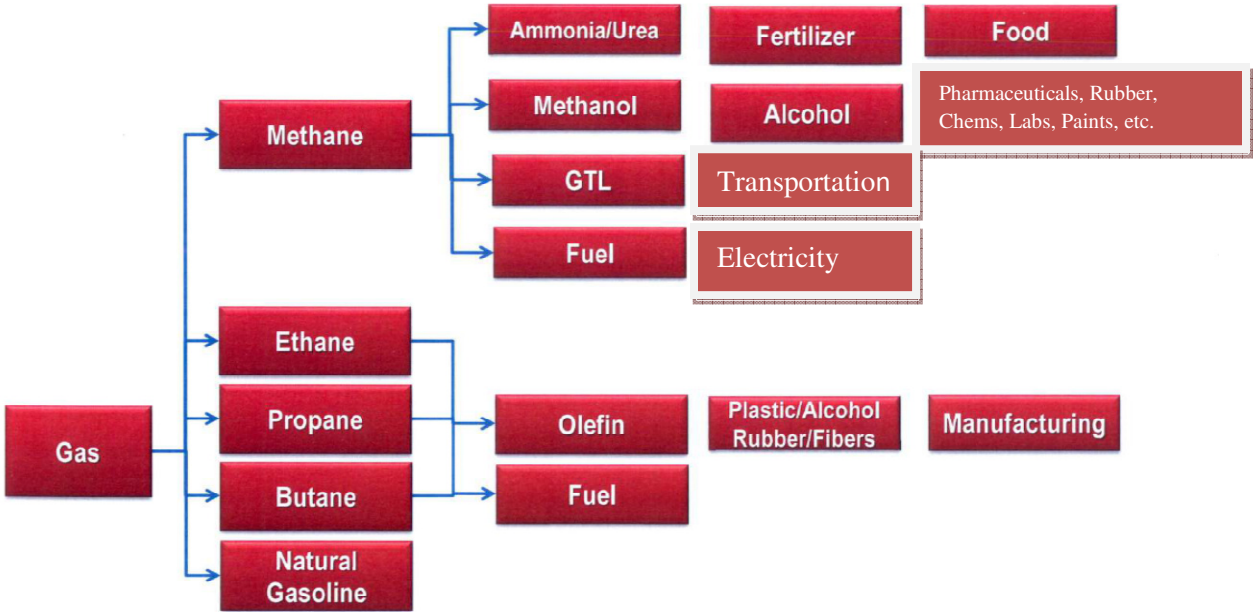

Figure 3 : Gas Uses in Nigeria

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 play a key role in the electricity situation in the country if fully harnessed and utilized, which will in turn create employment opportunities for its citizenry through attraction of both local and foreign investment. Given Nigeria's huge natural gas reserve and being a major supplier of the West African gas pipeline (WAGP), yet Nigeria is ranked in the 67th position of electricity production in the world [11].

Natural gas is also a source of clean energy which can be used in addressing the environmental challenges in the country while meeting the United Nation's goal of reducing $C0_2$ emission. With

this goal at heart, many countries are exploring the options for better use of natural gas as an alternative energy source [12].

Currently, natural gas is considered as an attractive option because of its efficiency, better operational flexibility, reduced $C0_2$ emission, and lower capital cost when compared to other energy sources except hydro. It is also a complement for renewable energy.

Natural gas can be compressed into what is called Liquefied natural gas (LNG) which is used as an alternative to the traditional automotive fuel or Liquefied Petroleum Gas (LPG). 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 CO_2 emitted from wood fuel. The use of LNG as an automobile fuel can be a game changer for the world gas market as well.

Natural Gas a source of Energy Security

Energy is an important tool for developing any economy and for creating wealth; energy is an important sector of any economy that generates jobs and adds value by extracting, transforming and distributing energy goods and services throughout the economy [13]. 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 has a 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. Natural gas can also be credited with being the driver behind smart energy systems, including integrated energy systems; small scale storage; load response and balancing and renewable gas.

The challenges of Natural Gas Utilization in Nigeria are mainly due to: Lack of adequate domestic supply infrastructure, Unavailability of capital, Regulated gas pricing, weak institutional structure for gas supply, Pipeline vandalism and Competition between the international and domestic markets. While the natural gas industry is faced with these challenges, the energy demand continues to grow and meeting this rising demand has become problematic for the government. Figure 4 illustrates the trend in the demand for natural gas in Nigeria.

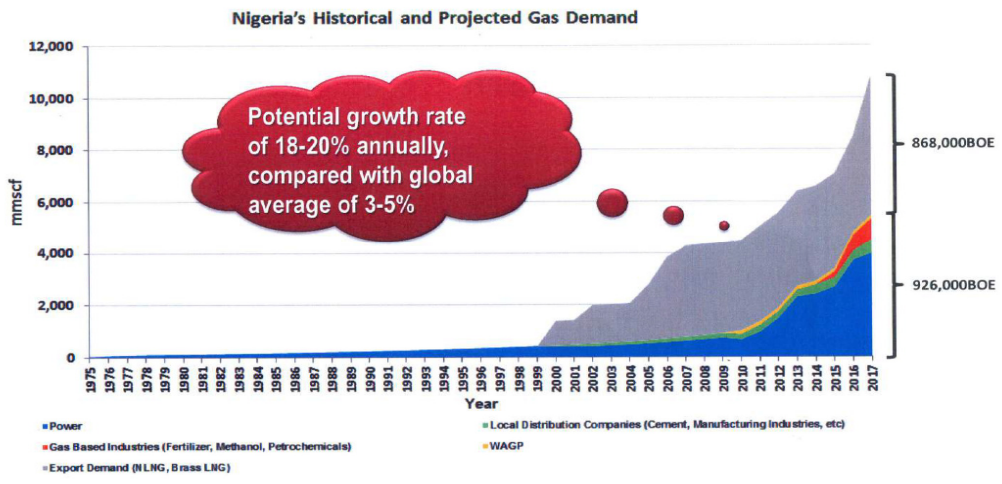

Figure 4 : Nigeria's Historical and Projected Gas Demand (source: David Ige, 2013)

However, it has been estimated by the world Bank in 2012 that Nigeria loses $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 which Nigeria has signed with the United Nations [14], 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 reserves. Since the signing of the bill, gas flaring has been reduced to 10% and putting Nigeria on the 7th position from the 2nd position of countries with the highest gas flaring rate [15]. This has also encouraged gas utilization.

However, government still has a crucial role to play in ensuring domestic utilization of natural gas and empowering the economy as government has to address the challenges hindering the utilization 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 needs to put in place infrastructure and policies to bring the future of natural gas to reality and using it to provide energy security for Nigeria. .

2.0.Literature review

Energy security is a concept notorious for its vague and slippery nature, no less so because it is bound to mean different things at different times to different actors within the international energy system [16]. Affixing energy to security affects not only energy policy but also the manner in which we understand security itself [17]. While the security of oil supplies remains imperative, current energy security policies must address all energy sources and cover a comprehensive range of natural, economic and political risks that affect energy sources, infrastructures and services [2]. MOSES contains a novel approach to analyzing energy security, which can be used to identify energy security priorities, as a starting point for national energy security assessments and to track the evolution of a country's energy security profile [2] (IEA, 2011). Based on critical analysis of some energy security models, authors suggested IEA model of Short Term Energy Security (MOSES) as the 'best fit' model in the Indian context to determine the short term energy security profile of each energy constituent of the country [18].

Access to clean modern energy services is an enormous challenge facing the African continent because energy is fundamental for socioeconomic development and poverty eradication [5]. Many experts believe that, in the long term, climate change and other concerns will necessitate a shift to natural gas [19]. Natural gas is the cleanest and most hydrogen-rich of all the hydrogen energy sources with high energy conversion efficiencies for power generation [20]. 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 [21]. 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 [22].

A study conducted by the Centre for Manufacturing Research [23], shows that the domestic natural gas has transformed the US economy through creation of 1.9 million jobs in 2015, creation of additional 347,000 jobs from the construction of new pipeline, made companies more competitive with the emergence of 60,000 manufacturing companies, and added an extra $1,337 back to the pocket of every average American. Domestic natural gas utilization should be the primary goal of Nigeria's petroleum and energy policies [24]. 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 storage [25]. 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 [20] (Okologome 2014).

Although various researches have been conducted on natural gas and economic growth, little or no research has been done on the importance of creating energy security through the utilization of natural gas in Nigeria. This study therefore establishes the major risk and resilience related to natural gas utilization in Nigeria.

Methodology

MOSES takes an energy systems approach, dealing with all parts of the energy system from supply to transformation, distribution and end□use energy services. For energy security, this means understanding how vulnerabilities of different parts of the system may affect energy services. In its current version, MOSES starts by analyzing vulnerabilities of primary energy sources and assessing how these affect the security of secondary fuels.

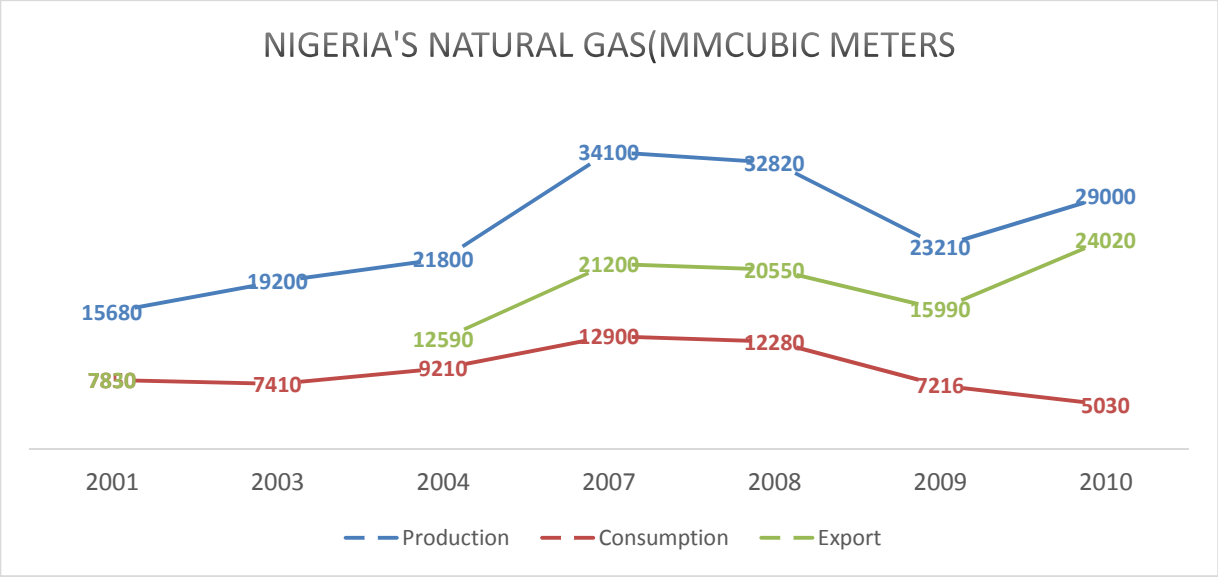

Figure 5: Nigeria's gas production, consumption and export, Source: Nigerian National Petroleum Corporation (NNPC)

Figure 5 shows the natural gas production, consumption and export in Nigeria from 2001 to 2010. Figure 6 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.

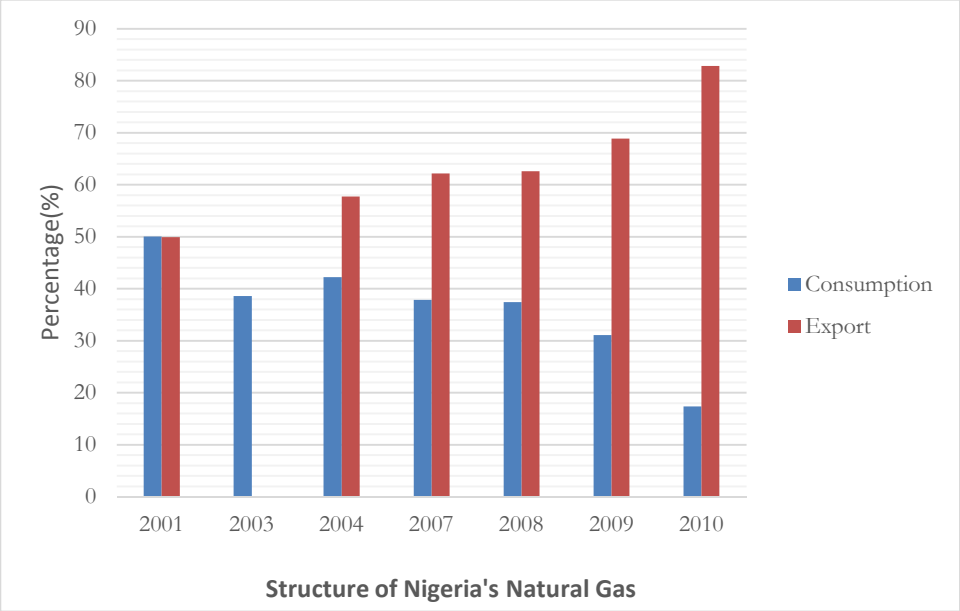

Figure 6: structure of Nigeria's natural gas, Source: Nigerian National Petroleum Corporation (NNPC)

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 5 & 6, 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 declined over this period which has directly impacted electricity generation in Nigeria.

Table 1 Natural gas: ranges for indicators.

Dimension	Indicator	Low	Medium	High
External Risk	Export dependency	-	-	≥ *70%*
Domestic Risk	Domestic gas Consumption	≤ *40%*	-	-
External Resilence	Export points	-	-	3
Domestic Resilence	Number of domestic gas pipelines(Domestic Points)	-	1	-
	Natural gas intensity(Gas Consumption/GDP)	≤ *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.

3.0. 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 provide incentives to gas suppliers to supply domestically.

4.0.Conclusion

This study has shown that the major threat to the role of natural gas as an energy security is the high percentage of export, and the negligence in the domestic infrastructure for natural gas. Furthermore, Nigeria must understand that her energy future lies on its natural gas, it is therefore important for Nigeria to take advantage of her huge natural gas reserves in meeting her energy needs. 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 7, there are three (3) export points and one domestic point in Nigeria, it also shows the potential gas pipeline network in Nigeria. However, there have been challenges facing the implementation of the proposed gas pipeline network, one of which is availability of finance. 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. Figure 7 illustrates the potential future gas infrastructure.

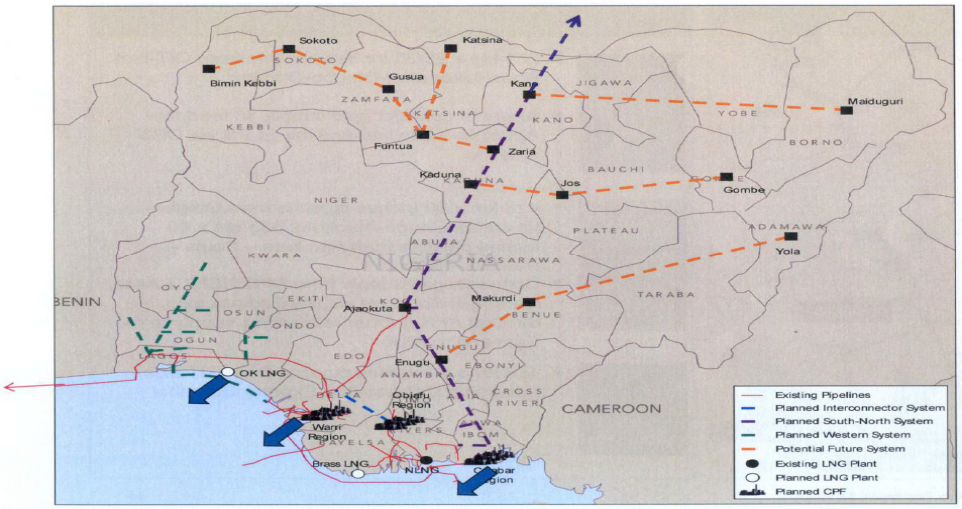

Figure 7 : **Potential future gas infrastructure in Nigeria, (source: David Ige)**

- Institutional Framework – there are a lot of policies on natural gas development and utilization in Nigeria including the Gas Master Plan geared towards addressing four key critical issues of gas availability, infrastructure, commercialization framework and gas affordability, 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 that 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.

References

1. Chester, L. 2010. 'Conceptualizing Energy Security and Making Explicit its Polysemic nature', Energy Policy, 38(2), pp.887 – 895. Elsevier [Online]. Available at : http://doi.org/10.1016/j.enpol.2009.10.039. Accessed : August 15, 2017.
2. IEA Model of short-term Energy Security (MOSES); primary sources and secondary fuels, A working paper, 2011 Edition., 48 pages. Retrieved from www. Iea.org/publication
3. Hildyard, N., Lohmann, L., Sexton, S. (2012) Energy Security for what? For whom? Dorset: The Corner House.
4. Onolemhemhen, R.U., Saheed, L.B., Iwayemi, A.P. (2017). Evaluating the Nexus between Energy Demand and Economic growth using the VECM Approach; Case study- Nigeria, China and the United States. Journal of International Science Index, 11(6)
5. Oyedepo, S.O. 2012. 'Energy and Sustainable Development in Nigeria: the way forward', *Sustainability and Society,* 2(15). Springer [online]. Available at: https://energsustainsoc.springeropen.com/articles/10.1186/2192-0567-2-15. Accessed: March 5, 2016.
6. Ahuja, D and Tatsutani, M. 2009, Sustainable Energy for Developing Countries. SAPIENS, 2(1). Available at : https://sapiens.revues.org/823. Accessed: August 25, 1027.
7. Brinded, M. (2011) 'The case for Shale and Tight gas', Shell Webcast [Webcast]. 9 October. Available at: http://www.shell.com/home/content/ media/speeches_and_webcasts/archive/2011/ brinded_london_09112011.html. (Accessed : 8 February 2011)

8. Central Intelligence Agency. 2016. Electricity Production by Country. Available at: https://www.cia.gov/library/publications/the-world-factbook/geos/ni.html. Accessed: July 10, 2017.
9. NNPC 2015 Annual statistical bulletin, NNPC ASB 2015, 1st edition .pdf Available:www.nnpcgroup.com
10. Delano. F, (2014), Lecture 4: Overview of Natural gas value chain-Discovery to end use" Natural gas Economics Lectures 2014. 15 July.
11. Central Intelligence Agency. 2014. Electricity Production by Country. Available at: https://www.cia.gov/library/publications/the-world-factbook/geos/ni.html. Accessed: June 12, 2015.
12. Apergis, N. and Payne, J.E. 2010. 'Energy consumption and growth in South America: Evidence from a panel error correction model' Energy Economics, 32 (2010), pp. 1421–1426. Elsevier [Online]. Available at: journal homepage: www.elsevier.com/locate/eneco.
13. IHS and CERA. 2012. 'The role of the Energy Sector in Job Creation', Energy for Economic growth; Energy Vision Update. pp.16 – 24. Available at: http:// reports.weforum.org/energy-for-economic-growth-energy-vision-update-2012/#
14. Mernyi, D. (2016) 'Nigeria signs agreement on zero flare by 2030'. Sunnews, March 15 [Online]. Available at: http://sunnewsonline.com/nigeria-signs-agreement-on-zero-flare-by-2030/. (Accessed: 28 March 2016).
15. NNPC 2017 Annual statistical bulletin, NNPC ASB 2017, 1st edition .pdf Available:www.nnpcgroup.com/public relations/oil &gas statistics.aspx
16. Natorski, M. and Surrallés, A.H. 2008. 'Securitizing Moves to Nowhere? The Framing of the European Union Energy Policy', Journal of Contemporary European Research, Vol. 4, No. 2, pp.71-89.
17. Cuita, F. 2010. 'Conceptual Notes on Energy Security: Total or Banal Security?', Security Dialogue, 41(2), pp.123 – 144. Sage Journals [Online]. Available at : http://journals.sagepub.com/doi/abs/10.1177/0967010610361596.
18. Pahwa, M.S. and Chopra, A.S. 2013. 'Energy Security Models – A critical Review and applicability in Indian Context', A management Review, 2(2), pp. 17 – 20. International Journal of Research and Development [Online]. Available at: www. Papers.ssrn.com. Accessed: August 25, 2017.
19. Ausubel, J. (1996). The Liberation of the Environment, in Daedalus, Journal of the American Academy of Arts andSciences, Summer pp.1-17
20. Okologume, W.C . 2014, Nigeria's Natural Gas Supply Preference and the Environment, Journal of Energy technologies and policy. ISSN 2224-3232, 4(4)

21. Flaavin, C. and Kitasei, S. 2010. 'The role of natural gas in a low-carbon Energy Economy' *Natural gas and sustainable Energy Initiative.* World watch Institute. Available on : www.worldwatch.org . Accessed : June 12, 2016
22. Voser, Peter. *2012. Natural gas; An important part of suistainable energy future. Environmental Leader, Available at : www. natural gas.org. Accessed: August 20, 2016.*
23. Centre for Manufacturing Research (CMR). 2016. Energizing Manufacturing: Natural gas and Economic Growth. Available at : www.nam.org. Accessed: August 22, 2017.
24. An Evaluation of Domestic Utilization of Natural Gas on the Nigerian Economy". British Journal of Economics, Management & Trade. 16(1), 2017; Article no.BJEMT.30438, ISSN: 2278-098X
25. Tomasgard, A., Romo, F., Fodstad, M., Midthun, K. 2004. Optimization models for natural gas value chain, (SINTEF), Technical Report.