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Towards Effective Domestic Natural Gas Utilization

Oluogun Mojeed O.[1*], Aladeitan Yetunde [2], Omolara Ibikunle[3], and Bisola Atanda[4]
[1, 2] African University of Science and Technology (AUST), Abuja, Nigeria
[1,2]University of Abuja,
[3,4]Schlumberger

***Abstract*:- Nigeria currently has the largest proven natural gas reserves in Africa. A Nigeria Liquefied Natural gas (NLNG) exports about 75% of Nigeria's daily gas production. Approximately 52% of her export is to Asia. The discovery of huge natural gas reserves in Eastern Africa, especially Mozambique and Tanzania is a major threat to Nigeria's Asian market in few years. Domestic utilization of Natural gas was proposed as a solution, given the available large market of over 180 million people. Several domestic gas utilization strategies were discussed in this work. However, Gas to Power, Gas as residential fuel and Gas as a feedstock for petrochemical industries were suggested as the most viable options. These options will not only make the country more industrialized, but also cut down unemployment rate in the country, aid her in the quest for diversification to Agriculture and reduce environmental pollution. The Nigerian government was implored to aid this cause by reviewing her local gas pricing, sensitize the populace on usage of natural gas as a domestic fuel and provide incentives for companies into domestic gas utilization.**

Keywords: Natural gas, Nigeria, Mozambique, Tanzania, Domestic gas utilization, Gas to Power, Residential fuel and Petrochemical Industries.

1.0 INTRODUCTION

1.1 Natural gas and its importance

Natural gas is a subcategory of petroleum that is a naturally occurring, complex mixture of hydrocarbons, with a minor amount of inorganic compounds. It was once an almost embarrassing and unwanted by-product-or more correctly a co-product- of crude oil production but that notion has since been abandoned because of the huge potential for gas commercialization and utilization (Wang and Economides, 2009). The quest for gas exploration and production to meet global energy demands has been on the increase, with this drive, many exploration companies are beginning to find natural gas in commercial quantities in many developing countries, both as dissolve gas found in oil during the search for oil reserve or in a large pool of free gas that has no oil associated with it as at the time geologist met the reservoir (Okotie and Ikporo, 2014). This is because natural gas is the cleanest fossil fuel, as it emits least carbon dioxide when burnt. It is being proposed to curb climate change (NRDC, 2012).

1.2 Nigeria's Natural gas resource

Natural gas was initially discovered in Nigeria in 1958 in an incidental exploitation for crude oil (Igbatayo 2005). Nigeria has the largest Natural gas reserve in Africa and the 9th largest in the world in abundance of 180.5 trillion ft^3, and she produces 4.7 Bcf/day (BP, 2016). Nigeria's Natural gas is of high quality – 0% sulphur content and rich in natural gas liquids (David, 2008). The Natural gas in Nigeria is found in relatively simple geological structures along the country's coastal Niger River Delta and the offshore blocks. Other prospective hydrocarbon bearing basins include the Benin basin, Anambra basin, Benue trough, etc. but these are yet to be fully explored (World Energy, 2004). There are also potentials for unconventional gas in the Niger Delta and in the south-south and south-western parts of Nigeria. For example, within the Anambra Basin, the Eze-Aku Shale Formation has been identified as holding considerable shale gas reserves as to warrant active evaluation. Other significant shale gas formations in Nigeria are the Agwu shale formation, the Nkporo/Enugu shale formation and the Afowo shale formation of the Dahomey Basin. All these which are yet to be explored and documented (Olawuyi, 2014).

Only 12% of Nigeria's energy consumption comes from Natural gas (EIA 2016).The amount of natural gas flared in Nigeria has decreased in recent years, from 540 Bcf in 2010 to 379 Bcf in 2014 (OPEC 2015). Nigeria ranked as the world's seventh-largest gas flaring country, accounting for 8% of the total amount flared globally in 2016, down from second position she held in 2011 (EIA 2016).

1.3 Gas Flaring

Gas flaring is the controlled burning of natural gas produced in association with oil in the course of routine oil and gas production, while venting is controlled release of unburned gases directly into the atmosphere (Salahudeen and Amadi, 2014). A significant amount of Nigeria's gross natural gas production is flared (burned off) because some of Nigeria's oil fields lack the infrastructure needed to capture the natural gas produced with oil (fig. 1). The amount of natural gas flared in Nigeria has decreased in recent years, from 540 Bcf in 2010 to 379 Bcf in 2014 (OPEC, 2015). From report, there is an average gas flare rate of 10.15 per cent, which is 734.56mmscf/d, for the period August 2016 to August

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2017. Presently, Nigeria flared 755 million standard cubic feet per day of gas which account for over 30% of gas that should have been well utilised. According to Shell, one of the largest gas producers in the country, the impediments to decreasing gas flaring have been the security situation in Niger Delta and the lack of partner funding that has slowed progress on projects to capture associated gas (EIA 2016). The Nigerian government has been working to end natural gas flaring for several years, but the deadline to implement the policies and fine oil companies has been repeatedly postponed, with the most recent deadline being December 2012.

Figure 1- Gas flaring (source: http://justiceinnigerianow.org/gas-flaring)

Apart from release of greenhouse gases into the atmosphere, gas flares are said to release some 45.8 billion kilowatts of heat into the atmosphere of Niger Delta daily (Salahudeen and Amadi, 2014). There is also revenue loss; Nigeria flared 593 Bscf of natural gas in 2007, which, according to NNPC, cost the country US$ 1.46 billion in lost revenue (Ogbe 2010). In addition to these is economic loss in form of unemployment and low industrialization.

1.4Nigeria's Natural gas market

The Nigeria Liquefied Natural Gas (NLNG) is the country's major exporter of Natural gas, in from of Liquefied Natural Gas (LNG). Nigeria's LNG exports accounted for about 10% of LNG traded globally.NLNG mops up gas that would otherwise be flared, thus making significant contributions to the nation's income, delivering in the last thirteen years over USD15 billion in dividends. In 2015, the company's corporate income tax amounted to about 220 Billion Naira, thus making NLNG by far the highest tax payer in Nigeria and Sub-Sahara Africa. The company, since 2008, contributed about four per cent of Nigeria's annual Gross Domestic Product (GDP). About 75% of Nigeria's daily natural gas production is exported through NLNG (NLNG, 2016). A large chunk of Nigeria's oil and gas revenue is from NLNG. One of Nigeria's largest importers of Natural gas -THE UNITED STATE-no longer imports Nigeria's gas. Currently, Japan is the largest importer of Nigerian LNG and imported 26% of the total in 2014, followed by South Korea (17%), Spain (11%), and Mexico (10%) (EIA,2016). Therefore about 53% of Nigeria's Natural gas is exported to Asia (fig. 2).

Figure 2 – world gas trade movement (Source: BP statistical review 2016)

This work puts forward the future threat posed to Nigeria's natural gas export earnings due to the emergence of potential major Natural gas exporters in the Eastern Africa- Mozambique and Tanzania especially. It further establishes Nigeria's domestic market as a viable option and reviews major gas utilization strategies the country could adopt.

2.0Nigeria's Legislation in favour of Natural gas utilization

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Efforts are being made to halt the gas flaring era in Nigeria to encourage more gas utilization opportunities. However, there have been no visible results yet. These legislations include the Nigerian Petroleum Industry bill and the Nigerian Gas Master Plan.

Nigerian Petroleum Industry Bill

Sequel to the problems associated with domestic Crude oil and Natural gas utilization, the Nigerian government is presently considering the Petroleum Industry Bill (PIB), which is aimed at re-structuring the oil and gas sector. Parts of the PIB have been made into law, while the bill in its entirety continues to be debated by the National assembly (Ogbe, 2010).

Nigerian Gas Master Plan

Efforts to address the issue of infrastructure were put into action when in February 2008 the Nigerian government announced a comprehensive new "Gas Masterplan" that seeks to improve supply to a domestic market that has become a feasible destination for gas in recent years, boost production for exports and provide much needed energy to the power sector. However, progress has been slow due to the issue of pricing and absence of a clear legal and regulatory framework. Part of the new gas policy would oblige oil producers to sell increased amounts of gas to the domestic sector at prices that are a fraction of international export markets. Oil producers are reluctant to comply with such a request, as it would effectively force them to lose money (Onyeukwu, 2010).

2.1Potential African Natural Gas Exporters

The Eastern Africa, especially Mozambique and Tanzania, have in a short space of time become focus of attention as a source of new global gas supply (David 2013). The United States' Energy Information Administration in January 2013 reported proven reserves in Mozambique and Tanzania as only 4.5 Tcf and 0.23 Tcf respectively (EIA, 2014).. These figures have risen rapidly as recent discoveries were incorporated. With the discovery of 180 Tcf of natural gas reserves in the Rovuma basin by Texas-based Anadarko and ENI (Italy), Mozambique is expected to become a major exporter in 2023.

Mozambique has been catapulted onto the international investment radar by a nascent natural gas and coal boom. Major gas finds in Mozambique's northern Rovuma basin – potentially in the region of 180 Tcf – and still counting, could represent an economic game changer for one of the world's least developed countries (Anne 2014). Also, Natural gas in place in Offshore Area 1 is now estimated at 45–70 Tcf and 85 Tcf in Offshore Area 4 (EIA 2013). Arguably Sasol, the early market entrant, has not made the biggest FINDS, as Anadarko and Eni have led exploration efforts in the northern Rovuma basin (Anne 2014). Sequel to these discoveries, a draft Gas Master Plan was drawn by the government in 2012 (ICF, 2012). With at least 150 Tcf undiscovered gas resources, over and above 100 Tcf of discovered reserves, there would be significant gas to support at least 10 trains of LNG (50 mtpa of LNG) (fig. 3).

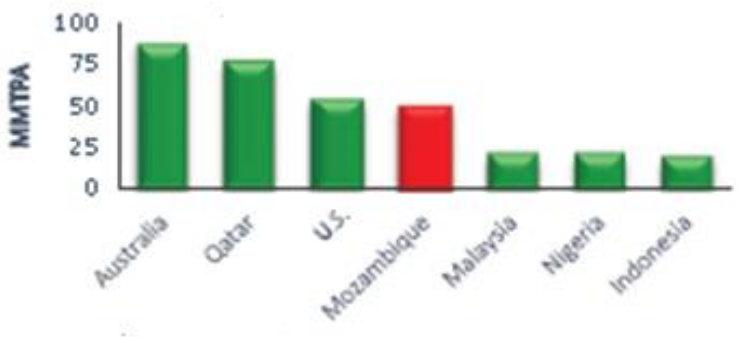

Figure 3 – Projected Liquefaction Capacity (source: Anadarko Petroleum,2016)

The plan calls for two LNG trains to be operational by 2018, with another two trains added every two years, with ten trains to be operational by 2026 (David 2013). Proposed markets have been same as Nigeria's (figs. 4&5). In 2012, Japan and Mozambique signed a MoU aimed at supplying energy to the Asian country. The deal will allow Japan to tap the African country's natural resources to replace nuclear energy as its main power driver (SPTEC 2013).

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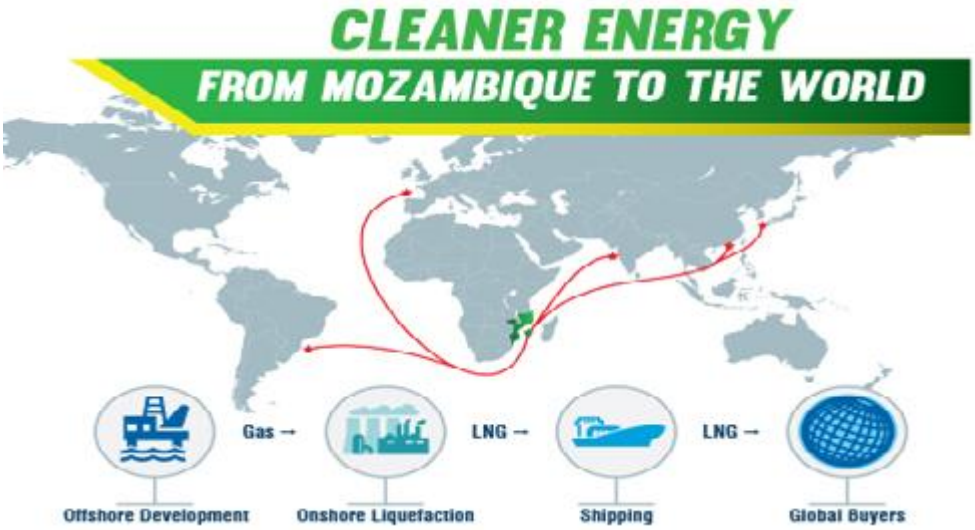

Figure 4- Mozambique proposed gas markets (Source: http://www.mzlng.com/Marketing/)

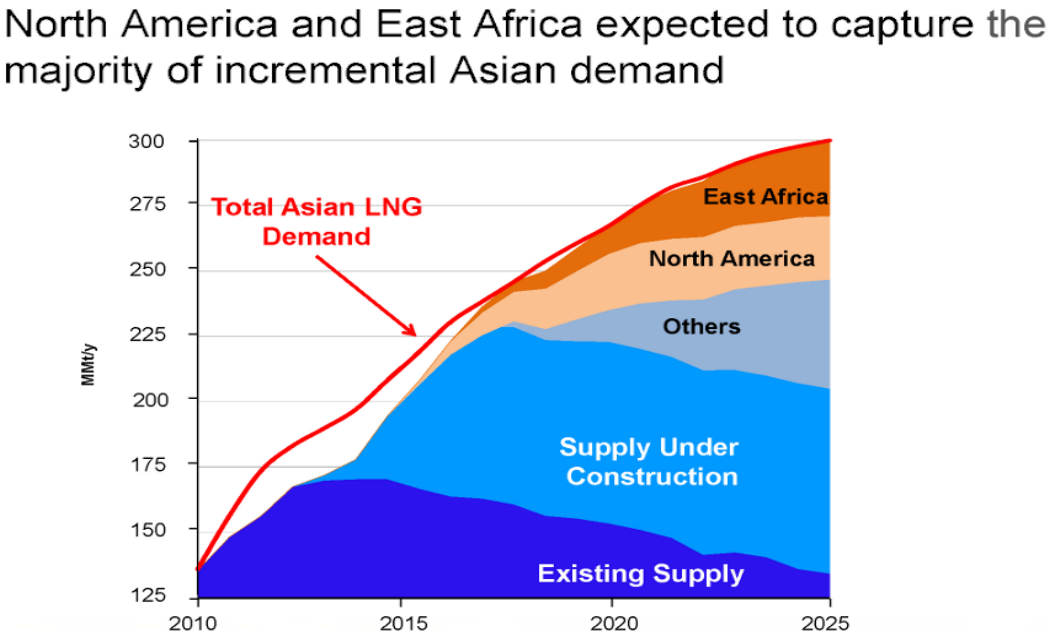

Figure 5 – Projected Asia energy demand and potential suppliers
Source: http://www.safety4sea.com/lng-market-overview-looks-at-supply-and-demand/

Major gas discoveries have been made offshore Tanzania and the country emerges as a potential large gas producer in East Africa (Statoil, 2015). Tanzania's natural gas proven reserves is estimated at 53.28 Tcf, composed of deep sea at 45.28 Tcf and onshore at 8 Tcf (John, 2015). The Government of Tanzania has requested the partners in Block 1 & 4 and Block 2 to cooperate in the development of a joint onshore LNG facility. Such facility will receive gas from all blocks to capture synergies and associated cost savings. As a response, an integrated project team with representatives from all the licence holders of Block 1, 2 and 4 has been established with the purpose of developing a common onshore LNG facility. The offshore developments remain as independent projects operated by Statoil and BG respectively (Statoil 2015). In early October 2012, BG announced that it would go for duel FEED on an LNG export plant in early 2015 with FID not until 2016, which would indicate a plant start-up in late 2020/21. Statoil in February 2013 also indicated that Tanzania is unlikely to see first LNG before 2020 (David 2013).
International companies are of the view that Kenya may have similar geology to Tanzania and Mozambique and companies such as Total, Apache, Tullow and Premier are buying up stakes from smaller companies. In September 2012, ENI announced its first major gas discovery offshore the coast of Malindi (Reuters 2012).
It cannot be assumed that all the planned East African LNG projects will proceed as scheduled. But, Mozambique and Tanzania are both well located with respect to potential LNG markets, with access to Asian, South American and Indian markets. With regards to the ''Elephant gas consumers'' – Asia, Australia is geographically closer but her gas has higher development costs. USA has low development costs, but she's farther than the African countries. The East

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African countries and their potential biggest ‘‘African rival’’- Nigeria, all have ‘‘clean gas’’, but they’re closer to the market than Nigeria (fig. 2&4). Securing the market is therefore key, and this ‘‘Battle for Asia’’ will be waged over the coming years. What next for Nigeria?

3.0 Domestic Gas Utilization in some OPEC Countries

The following OPEC countries have had success stories in domestic utilisation of their natural gas.

Saudi Arabia: From 1997, a major program to utilize natural gas in the country’s industrialisation program was initiated. All seven ethylene based petrochemical plants and three nitrogenous fertilizer plants have been built.

Iraq: Two fertilizer plants are currently operating in Southern Iraq using gas feedstock. Plants are available for producing ammonia, urea, various petrochemicals, high and low density polyvinyl chloride.

Algeria: A gas-based petrochemical industry is expanding rapidly in Algeria. Since 1966, several fertilizer complexes have been built using anode phosphate and ammonia. It is designed for production of 200,000 TPA of super phosphate.

Investigation shows that most of the OPEC countries are converting their natural gas into feedstock for fertilizer plants and other petrochemical industries (Akpan, 2009).

3.1 Strategies for Domestic Natural Gas Utilization in Nigeria

The domestic market for natural gas is readily available. With a population of over 180 million, Nigeria is the most populous country in Africa and the eighth most populous country in the world (NESP, 2015). Presently, Nigeria is the seventh most populous country in the world. Therefore, it is essential to map out strategies for exploiting the domestic markets and ensure industrialisation of the country through domestic utilisation of natural gas.

The following have been identified as the possible ways natural gas can be domestically utilised.

3.1.1 Gas to Power

The present peak production of about 4.3GW is about 2.8% of what Nigeria needs to become an industrialized nation. The Federal Government has a target of about 10 GW by the year 2020. This represents about 6% of the expected 1.0 MW per 1000 population for the country. Thus, the country projection for 2020 is 94% below what is actually needed to fulfil industrial revolution dream. South Africa with a population of about 53 million has a generating capacity of about 43 GW, which is approximately 0.8 GW per a thousand populations (Igbokoyi and Iledare, 2015).

Figure 6 shows Nigeria’s natural gas production and consumption data. LNG export started in September 1999, and as at 2012 consumes about 79% of the total gas production (Igbokoyi and Iledare, 2015). A lot of works have been done on strategies to be adopted for Nigeria’s Gas to Power (Salahudeen and Amadi, 2014; Igbokoyi and Iledare, 2015; Nnamdi et al. 2016).

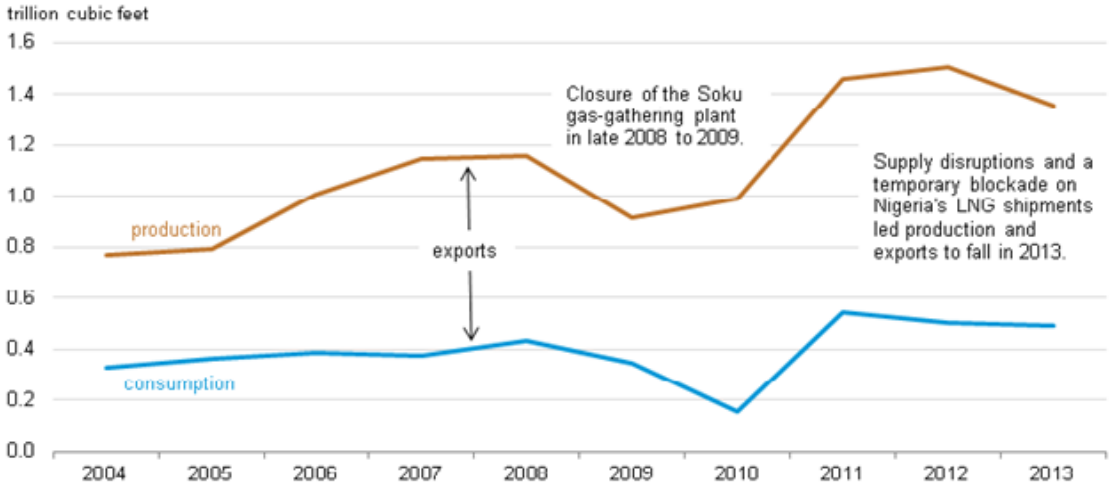

Figure 6– Nigeria’s natural gas production and consumption data
(Source: http://www.marcon.com/print_index.cfm?SectionListsID=30&PageID=2269)

- There’s no way a county can be industrialized more than her power generating capability and sustainability. However Igbokoyi and Iledare suggested the current reserves of the country will only suffice in short to median time, even if LNG export is halted. However, natural gas can be supplemented with solar, hydro and wind energies which Nigeria has in abundant, and even NUCLEAR! Also, Nigeria has abundant sources of unconventional natural gas which are yet to be explored.

3.1.2 Gas to Liquid (GTL)

Gas to liquids (GTL) is a refinery process to convert natural gas or other gaseous hydrocarbons into longer-chain hydrocarbons such as gasoline or diesel fuel (Wikipedia, 2016). GTL technology generally refers to the chemical conversion of natural gas into readily transportable liquids such as methanol or conventional petroleum refinery type distillate fuels (Chinenye et al, 2007). Methane-rich gases are converted into liquid synthetic fuels either via direct conversion or via syngas as an intermediate, for example using the Fischer-Tropsch (fig. 7) or Mobil processes. It is an

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emerging technology which involve chemical transformation of natural gas, either into synthetic fuels (syncrude, diesel, kerosene, etc) or chemicals (methanol, DME, etc) (Balogun and Onyekonwu, 2009).

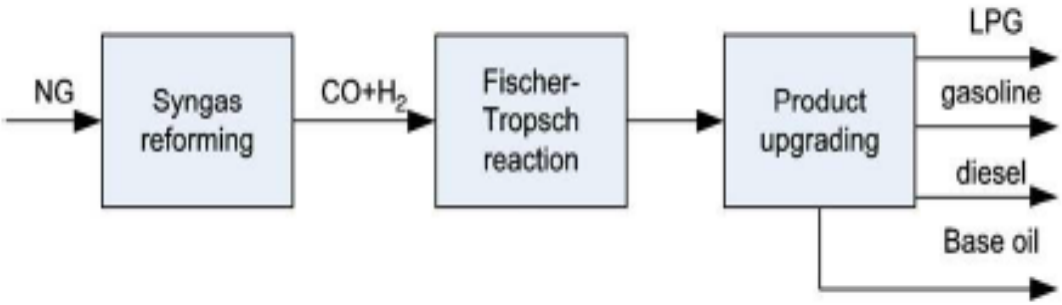

Figure 7- Fisher-Tropsch GTL process (source: Lukman, 2014)

Presently, Nigeria is suffering from huge shortages in the production ofpetroleum products, especially the light and middle distillates. These shortages aredue to the low production capacity of the old fashioned petroleum refineries.Nigeria needs at least 695,000bbl/d of light and middle distillates to balancepresent local consumption of liquid fuels, while all the local refineries produce lessthan 380,000bbl/d. The differences in local consumption could be covered inseveral ways like importing, building at least two new big oil refiners, or investingin natural gas by building GTL project.Unlike liquefied natural gas (LNG), GTL products are sold on the spot market.It does not require long term sales and purchase agreements. Currently, GTL has avery small market share in Nigeria, but the market potential for GTL products canessentially be considered unlimited. Given the superior quality and marketability, itis perhaps only a matter of time before GTL production becomes a formidableindustry (Stanley, 2009). It can be achieved without the cost of modifying vehicleor installing much new infrastructures (Lukman, 2014).

GTL technology with the principal interest in the production of diesel would be economically feasible when applied to a typical offshore Niger Delta large resource at oil prices of above US $35/bbl and feedstock gas price in the range US $0.25/mmBTU (Balogun and Onyekonwu, 2009).

3.1.3 Enhanced Oil Recovery (EOR)

EOR is the third stage of hydrocarbon production proceeding primary and secondary recovery, during which sophisticated techniques that alter the original properties of the oil are used. Enhanced oil recovery can begin after a secondary recovery process or at any time during the productive life of an oil reservoir. Its purpose is not only to restore formation pressure, but also to improve oil displacement or fluid flow in the reservoir (Schlumberger, 2016). Some EOR processes utilize natural gas for enhanced recovery of oil, e.g. miscible gas injection. Miscible gas injection is the most widely applied light oil enhanced oil recovery (EOR) process. A methodology, based on well-established physical principles, has been developed for estimating the conditions under which gas will be miscible with oil. The methodology enables rapid screening of a range of potential gas injectants (such as CO2, enriched hydrocarbon gas, N2, or H2S) through the use of readily available gas and oil properties. The methodology has been applied to numerous reservoirs worldwide (Teletzke et al., 2005).

3.1.4 Feedstock for Petrochemical Industries

The petrochemical market is the foundation of many chemicals industry, as it provides the building blocks for most chemical products. For instance, Olefins (Ethylene, propylene, butadiene) and aromatics (benzene, toluene and xylene) are used in end-user markets such as paints, plastics, explosives and fertilizers. Natural gas and natural gas liquids are used to manufacture a gamut of intermediate chemicals and finished products (fig. 8).

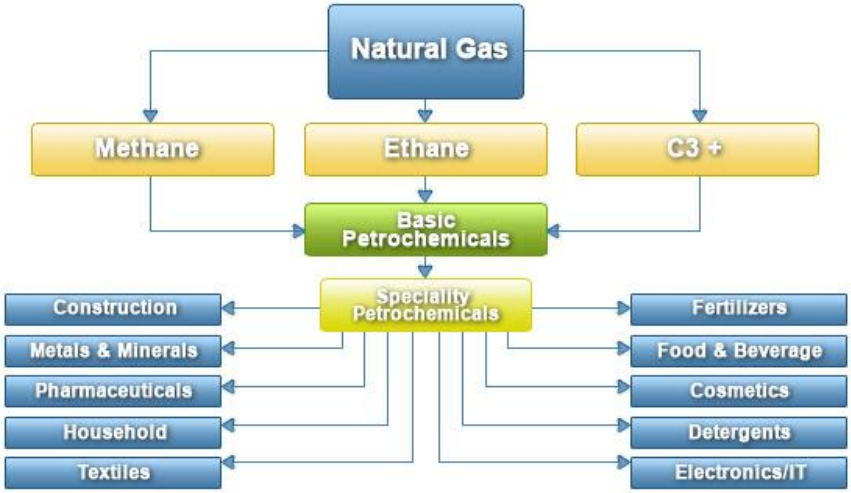

Figure 8- Petrochemical products from Natural gas.

(Source: http://www.gascities.com/products-process.html)

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Nigeria depends on imports of petrochemical products, despite the presence of large oil and gas reserves. This is attributed to the country's low refinery-capacity utilization (approximately 40% of the full capacity), which results in lower petrochemical yields, creating a need for imports (Kehinde, 2016).
Kehinde also performed quick SWOT analysis of some petrochemical projects to show that there are good prospects in the establishment of petrochemical projects in Nigeria.

3.1.5 Gas as a residential fuel

In temperate countries, because of the climatic conditions, a sizable gas market exists in the distribution of natural gas for domestic heating and cooking, and for refrigeration and air conditioning (Akpan, 2009). Natural gas can be used for this purpose in form of Liquefied Petroleum Gas (LPG). Liquefied petroleum gas (LPG) is a term describing a group of hydrocarbon-based gases derived from crude oil and or natural gas. Natural gas purification produces about 55 percent of all LPG, while crude oil refining produces about 45 percent. LPG is mostly propane, butane or a mix of the two. It also includes ethane, ethylene, propylene, butylene, isobutene and isobutylene; these are used primarily as chemical feedstocks rather than fuel (TCPA, 2008).
The average employment and wages in the third quarter of 2007 for a series of industries linked to LPG were about 3,021 LPG dealers who employed about 300 thousand employees and earned a total of $31.9 million in Texas (TCPA, 2008). About 60.83% of Nigeria's population still cooks with firewood and coal, which leads to deforestation and climate change (Oyekale et al. 2012). LPG is also more efficientand cleaner option to kerosene (Olasunkanmi and Ogunjobi, 2015). However, a large percentage of Nigeria's population are comfortable with the use of Kerosene and coal. Some of the problems associated with low usage of LPG as a cooking fuel are; initial investment needed to acquire LPG appliances (e.g. gas cylinders), low infrastructure of LPG distribution, a general lack of information, social and cultural issues. However, the Managing Director of NNPC, Dr. Ibe Kachikwu stated gas cylinders will be distributed to Nigerians freely, but this promise is yet to be fulfilled (Nigerianbulletin, 2015).

3.1.6 Underground Storage (UGS)

This is another utilization option when natural gas utility is to be deferred for future use by injecting into underground storages. This gas resource can be accessed for later use when it is convenient. This is a gas preservation method which is unused in Nigeria till date. Gas storage is principally used to meet seasonal load variations. Gas is injected into storage during periods of low demand and withdrawn from storage during periods of peak demand. Atoyebi in 2010stated that it is also used for a variety of secondary purposes, including:

(i) Balancing the flow in pipeline systems: This is performed by mainline transmission pipeline companies to maintain operational integrity of the pipelines, by ensuring that the pipeline pressures are kept within design parameters.
(ii) Levelling production over periods of fluctuating demand: Producers use storage means to store any gas that is not immediately marketable, typically over the summer when demand is low and deliver it in the winter months when the demand is high.
(iii) Meeting regulatory obligations: Gas storage ensures to some extent the reliability of gas supply to the consumer at the lowest cost, as required by the regulatory body. This is why the regulatory body monitors storage inventory levels.
(iv) Reducing price volatility: Gas storage ensures commodity liquidity at the market centers. This helps contain natural gas price volatility and uncertainty.
(v) Offsetting changes in natural gas demands: Gas storage facilities are gaining more importance due to changes in natural gas demands. First, traditional supplies that once met the winter peak demand are now unable to keep pace. Second, there is a growing summer peak demand of natural gas, due to electric generation via gas fired power plants.

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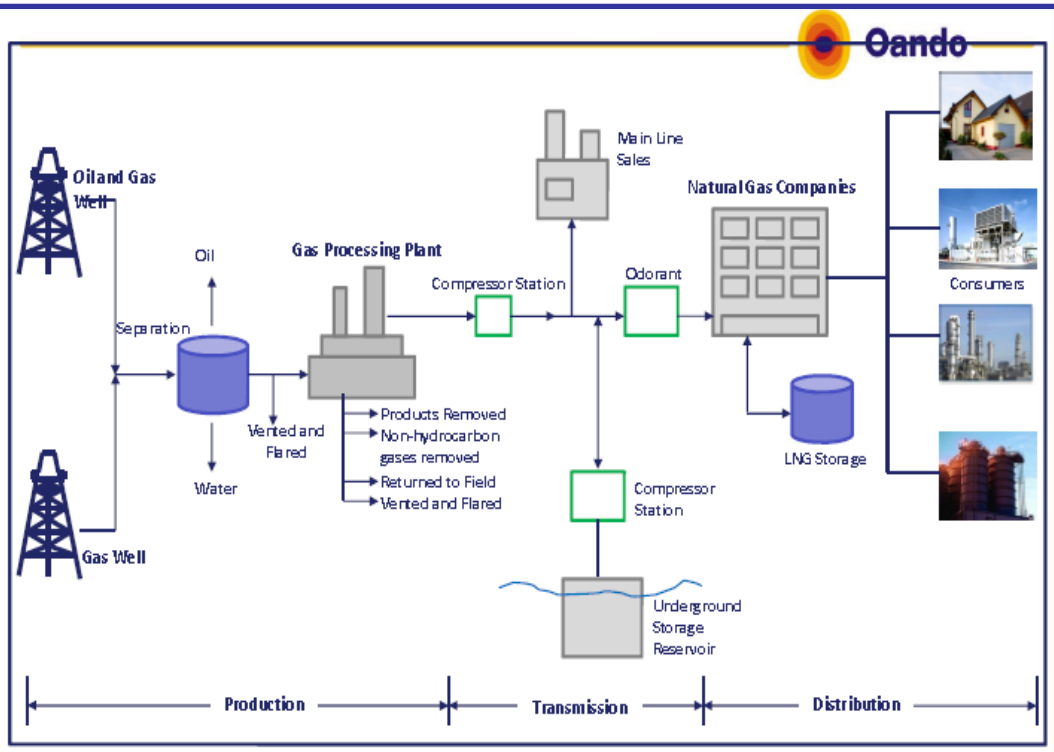

Figure 8- Natural gas industry value chain (source: Franklin, 2013)

4.0 Discussion of the proposed domestic gas utilisation options

Natural gas utilisation entails devising a strategy for converting natural gas from the wellhead to several market options for economic and environmental benefits. Nigeria has natural gas in abundance, even as her gas reserves are under estimated. Majority of the produced gas are being exported through NLNG, while a percentage is being flared till date. The need for effective local utilisation of natural gas cannot be over emphasized, as data and analysis as proven.

The use of Natural gas as a residential fuel for cooking and heating is a major business opportunity for Nigeria if she decides to tap into it. The population is large enough to make this a juicy venture for investors. This will in turn create job opportunities and reduce emission of poisonous gases to the atmosphere. It has also been shown that Nigeria has under-utilised natural resources in natural gas. Power generation is the back bone of any country to sustain industrialisation. The power sector is key to any emerging economy attracting investors and encouraging local productivity. About 75% of Nigeria's population has no access to electricity (The Vanguard, 2015). Natural gas which is being flared can provide a cushion in power generation, and it can be supplemented by other renewable energies.

The dilapidated state of the Government owned refineries has hindered the exploitation of Nigeria's natural gas. The only Petrochemical plant in the country is owned by Indorama, Portharcourt. Notore chemical industry also makes use of Natural gas in making fertilizers. However, the 650,000bpd Dangote refinery under construction which has both petrochemical and fertilizer plants attached to it is a light at the end of the tunnel for Nigeria's petrochemical industry.

Water injection is the most used recovery method in Nigeria's oil fields, as it is cheap and suitable to Niger delta oil fields. This has made the usage of Natural gas for EOR in Nigeria an almost undoable task. GTL and underground storage are yet to be practised in Nigeria; these are also possible ways of ensuring effective domestic gas usage in the country.

5.0 CONCLUSION AND RECOMMENDATIONS

Analysis has proven that Nigeria's foreign market for LNG is likely be threatened by her African neighbours in the nearest future, especially the East African countries – Mozambique and Tanzania, while Kenya, Uganda, Ghana and troubled Sudan are coming up. It is imperative for the Federal Government to start preparation for the ''rainy day''. Even as the country is calling for diversification to agriculture, due to over dependence of the country's economy on oil and gas revenue, natural gas utilisation will aid this course, for it can be a source for fertiliser production, stable power generation for mechanized farming, transportation fuel for conveying farm produce to the market amongst others.

Power generation and domestic fuel have been identified as the most demanding areas where natural gas is needed domestically. Stable power supply will tend to revive other sectors e.g. the mining sector. It will also attract foreign investors and thereby creating more jobs. In other to save our environment from degradation, it is paramount the government swings into action by replacing unclean fuel with natural gas. The market for natural gas as domestic fuel is available, if the right steps are taken to sensitize and make it readily available to the people.

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The petrochemical industry can provide a safe haven for Nigeria in terms of both job creation and diversification. It will heighten research culture for industry products; ensure sustainable development of local economy, a new product for West African markets.

This work does not in any way downplay the relevance of NLNG in the future if Nigeria's LNG export isn't as lucrative as it is today. Rather, NLNG can be a source of storage (fig. 8) for future regasification of the natural gas when needed.

The following are recommended:

(i) All efforts to be geared towards actualising the dream of ''zero flare''.

(ii) A Research committee should be set up to come up with realistic plans of exploring local markets for natural gas.

(iii) Assessment of Nigeria's unconventional gas resources should be done, to determine a concrete unconventional hydrocarbon reserves in the country. It is believed Nigeria's gas reserves are under-estimated.

(iv) The government should make the gas pricing regime conducive for companies intending to go into gas exploration. This is to ensure gas is able to compete healthily with other alternative sources of energy.

(v) There should be sensitisation on the efficiency of Naturalgas as a domestic fuel.

(vi) Efficient distribution channels should be set up for LPG distribution.

(vii) Efforts should be made in realising the Nigeria Gas Master plan laid down since 2008.

(viii) Preferential tax treatment for firms into local gas utilisation will encourage investments in Petrochemicals, GTL, and so on.

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ABBREVIATIONS

LNG- Liquefied Natural Gas
NOC- National Oil Company
IOC- International Oil Company
TCF- Trillion cubic feet
FEED- Front End Engineering Design
FID- Final Investment Decision
OPEC- Organization of Petroleum Exporting Countries
TPA- Tonnes per annum
BTU- British thermal unit
GW- Giga watt
BBL- Barrels
M= 1000