

# Nigeria Natural Gas Supply Preference and the Environment

Author: Wilfred Chinedu Okologume

College of Graduate Studies, Department of Petroleum and Gas Engineering, University of Port Harcourt,  
Nigeria.

\*wilfredokologume@gmail.com

## Abstract

This study evaluates the role of natural gas in the energy supply of Nigeria by focusing on the resource base, growth, opinions surrounding natural gas used in power generation and the environmental impact. A review of unmet energy demand by sector, helped define priority areas where gas would be absorbed in volumes large enough, to justify the heavy investments in gathering, transmission and distribution pipeline networks required for a balanced market growth.

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.

The study found that large users can essentially be classified into four categories, by order of consideration and ultimate consumption.

**Keywords:** Nigerian Gas Master Plan (NGMP), West African Gas Pipeline (WAGP), gas utilisation

## 1. Introduction

Natural gas is the cleanest and most hydrogen-rich of all the hydrocarbon energy sources and it has high energy conversion efficiencies for power generation. As the world's seventh largest, and Africa's largest, deposit of natural gas, with a current reserve of over 185TCF, Nigeria is described as a gas province with some oil in it. Of more significance is that Nigeria natural gas resources discovered but as yet unexploited remain plentiful. However, large quantities of associated gas are flared in the process of oil production. The Federal Government of Nigeria is currently implementing policies to reduce gas flaring by stimulating domestic gas utilization.

### 1.1 Research Objective

This work is aimed at evaluating the role of natural gas in the energy supply of Nigeria, with emphasis on power generation, export project and its environmental impact.

### 1.2 Scope and Limitation of Study

This work is limited to the Nigerian Government formulated ("Regulation") and the ("Policy") on gas, which is to ensure the availability and affordability of gas for domestic utilization aimed at delivering the Government's wider economic agenda of power and industrialization. And also the environmental impact of pipeline gas that is being exported through the West African Gas Pipeline (WAGP) to countries in West Africa.

## 2. Literature Review

The government is continually promoting the developed Nigerian Gas Master Plan (NGMP), which is expected to underpin the development of gas infrastructure, including central processing facilities and transmission pipelines in Nigeria.

### 2.1 Nigeria Gas Supply and Utilisation Framework

To ensure the availability and affordability of gas for domestic utilization, the Government recently formulated and issued the ("the Regulation") and the ("the Policy"), both of which define the policy of the Government in respect of the supply of gas and the pricing of the gas to be supplied to customers in the downstream gas sector.

The Regulations were made pursuant to Section 9 of the Petroleum Act, Chapter P10, Laws of the Federation of Nigeria, 2004 ("Petroleum Act"), and Paragraph 35 of the First Schedule to the Petroleum Act.

The Policy and Regulations were approved by the Nigerian Federal Executive Council in the first quarter of 2008, and published in the Federal Republic of Nigeria Gazette in No. 10, Vol. 95 of 19<sup>th</sup> February, 2008.

### 2.2 New Gas Pricing Policy

The government approved the Nigerian Gas Master Plan (NGMP), which is comprised of three main sections. The first is the Gas Pricing Policy, which does not fix gas prices but provides a framework for establishing the minimum gas price that any category of gas buyer can be charged. The second is the Domestic Gas Supply Obligation Regulation, which assures gas availability for critical domestic gas utilisation projects that will advance the economic growth in Nigeria. The third, the Gas Infrastructure Blueprint, specifically provides for the establishment of three gas gathering and processing facilities, a network of gas transmission lines, which will result in a reduced cost of gas supply from Nigeria.

Pursuant to the NGMP, the Minister has issued the National Gas Supply and Pricing Regulations to regulate the supply of gas to the domestic sector. The pricing equations reflecting the intent of the pricing policy and are dynamic reflecting the peculiarities of each sector is illustrated in figure 2.0.

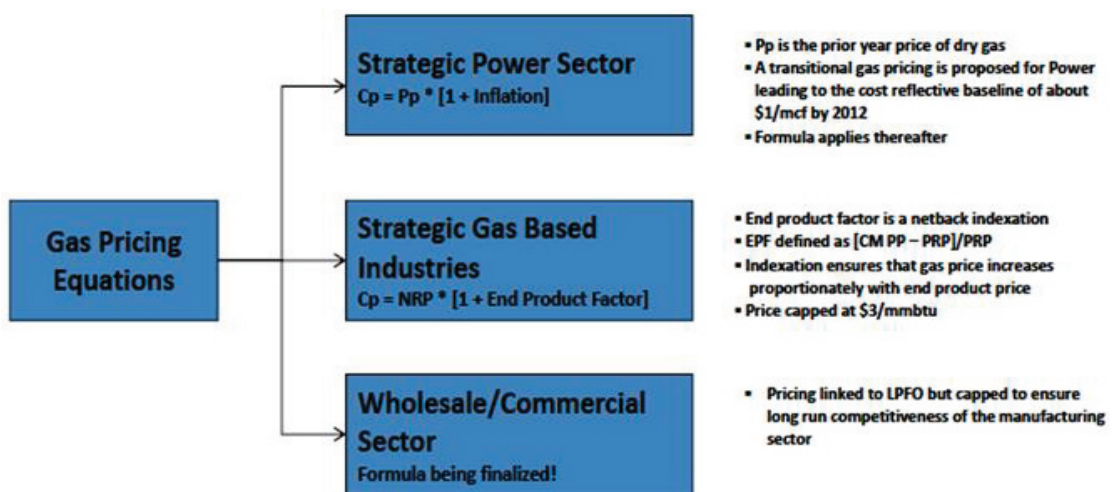


Figure 2.0: The Gas Pricing Equations

Further to the National Domestic Gas Supply and Pricing Regulations, the Gas Aggregation Company Nigeria Limited (GACON) has been incorporated to manage the implementation of the domestic (gas) supply obligation and to act as an intermediary between suppliers and purchasers of gas. A template Gas Sale and Aggregation Agreement has also been finalised and negotiations have commenced between suppliers and purchasers of gas for the supply of gas to the domestic market.

In addition, both the federal government of Nigeria and the World Bank have made effort to develop a domestic gas to power credit risk management arrangement which gives comfort to gas producers regarding payments for the gas sold to government-owned power plants. The World Bank will provide a guarantee directly to local banks issuing standby letters of credit and indirectly to gas sellers for the fulfillment of the financial and payment obligations of government-owned power plants.

### 2.3 Investment Opportunities

Whilst the introduction of the Gas Master Plan has created new investment opportunities in the Nigerian gas sector, significant progress has indeed been made within the sector in the past few years.

Nigeria's Liquefied Natural Gas (LNG) capacity is growing rapidly and should soon account approximately 30% of the total Atlantic LNG. Additional LNG projects such as OKLNG and Brass LNG will further enhance Nigeria's LNG capacity. However, in addition to the export oriented LNG projects, gas in accordance with the Federal Government domestic utilisation policy, is being leveraged as the fuel to power Nigeria's economic growth.

There are presently under construction, 15 gas power plants to meet domestic electricity needs. Regionally, there are three key gas projects, the West African Gas Pipeline (WAGP) project which will supply gas to neighbouring West African countries, the trans-sahara pipeline project which seeks to transport gas to Europe via Algeria and the proposed gas network for the supply of gas to Equatorial Guinea.

The Federal Government invited interested global energy companies to bid as potential core investors in the Nigerian Gas Master Plan Infrastructure Blueprint. Over 50 energy companies expressed their interest of which 15 were short-listed as core investors, thereby underlining the level of interest created as a result of the Nigerian gas master plan.



**Figure 2.1: Nigeria Natural Gas Investment outlook**

Of recent, report from news media as at June 2013 has it that over 200 investors commenced moves to acquire the 10 National Independent Power Plants to be privatized by the Niger Delta Power Holding Company. The 10 gas-fired power plants have a combined design capacity in excess of 5,453 megawatts. Accordingly, 53% of the NDPHC plants is owned by states and the local governments, while the Federal Government owns the remaining 47%.

### 3. Methodology

Nigeria's gas agenda is robust. It puts gas-to-power at the core, but also envisions an aggressive gas based industrial growth. This in turn will drive further growth of the nation's power demand.

#### 3.1 Nigeria's Domestic Gas Industry Outlook

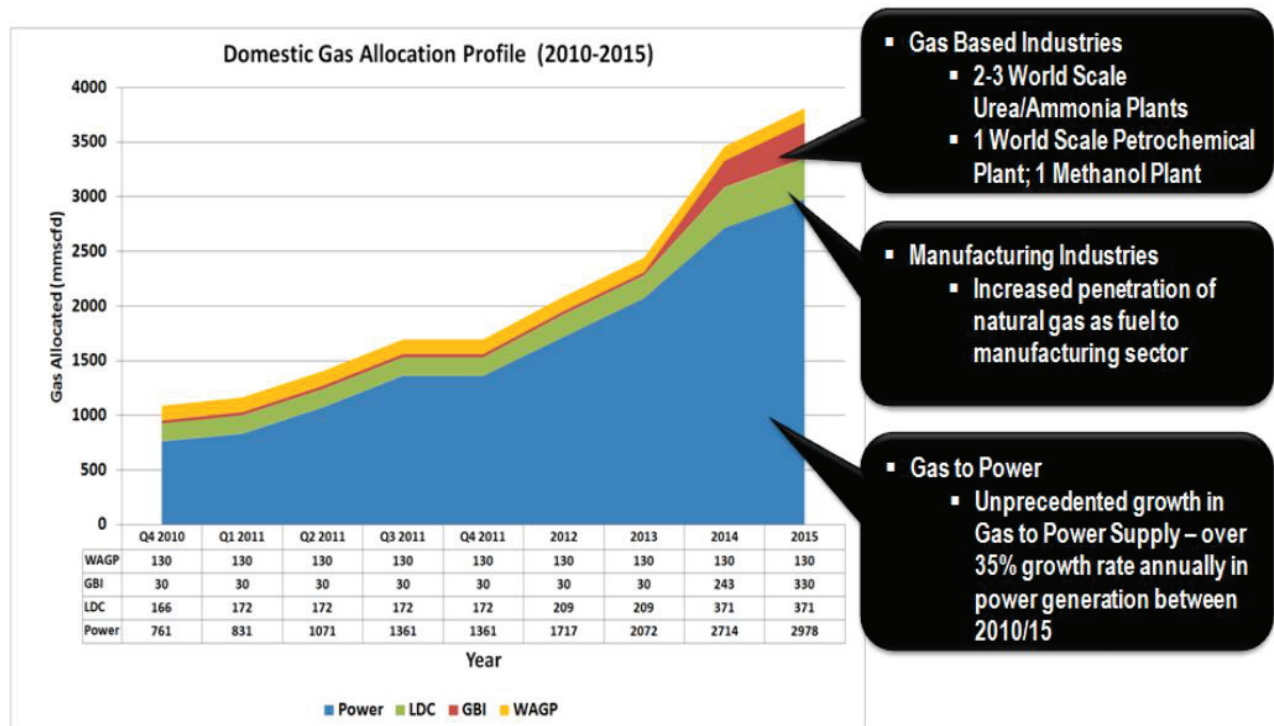
Domestic gas utilization opportunities are tremendous in Nigeria; some of the demand centers are power generation, cement industry, fertilizer, iron and steel plants. Others are petrochemical, aluminum smelting and distribution to industrial centres as source of energy supply.

The Nigerian Gas Company (NGC), a subsidiary of the Nigerian National Petroleum Corporation (NNPC) is responsible for gas transmission in Nigeria through an un-integrated gas pipeline network. Current pipeline infrastructure comprises basically of two un-integrated pipeline networks totaling approximately 1,100 kilometers: the Alakiri-Obigbo-Ikot Abasi Pipeline, (the Eastern Network), and the Escravos-Lagos Pipeline System (ELPS), (the Western Network), and dedicated pipeline infrastructure owned by the NLNG and the NNPC/SPDC/Total joint venture. There are also local distribution companies such as Gaslink Limited and Shell Nigeria Gas, which distribute natural gas to major industrial areas in the western and eastern parts of Nigeria.

### 3.2 Nigeria Gas to Power Demand

Currently the largest single consumer of natural gas in Nigeria is the Power Holding Company of Nigeria (PHCN). The company currently operates power generating gas plants at Afam, Ughelli, Sapele and Egbin. The combined daily requirements of these plants at peak are about 1500mmcfpd. It is estimated that about 80% of natural gas utilised in Nigeria is used for power generation. The remaining 20% is utilised as industrial fuel in the cement, fertiliser, rubber, manufacturing, aluminium and steel industries “as illustrated in figure 3.0...”.

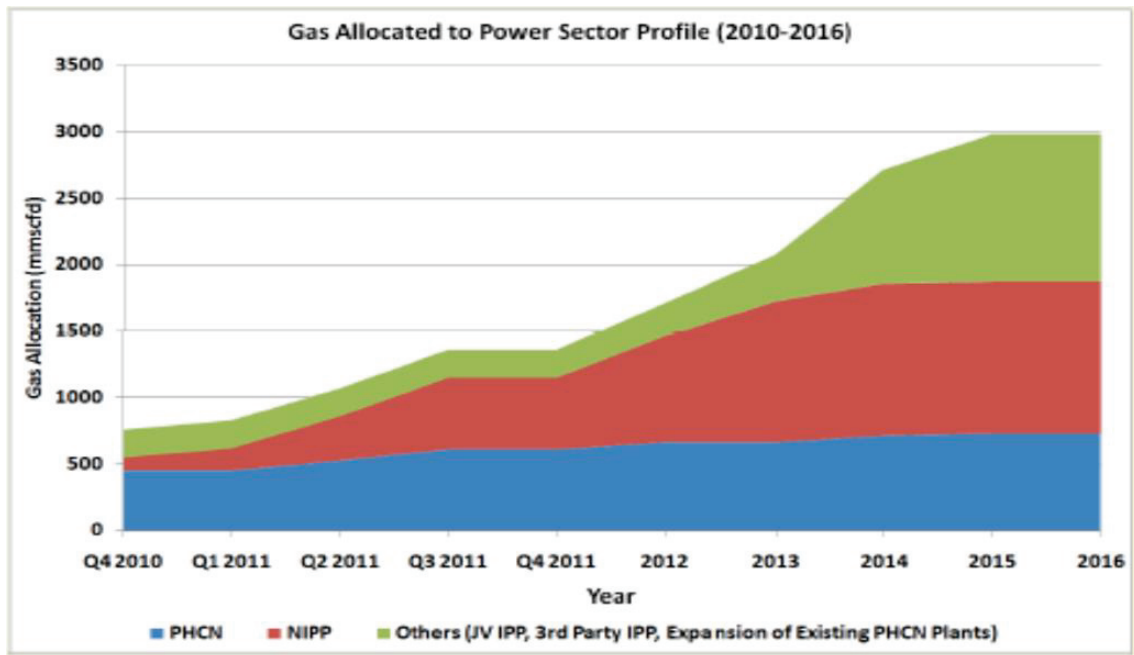
Government has encouraged Joint Ventures and multinational oil companies operating in Nigeria to embark on Independent Power Plant (IPP) Projects as part of the power sector reforms.



**Figure 3.0: Domestic Gas Allocation Profile**

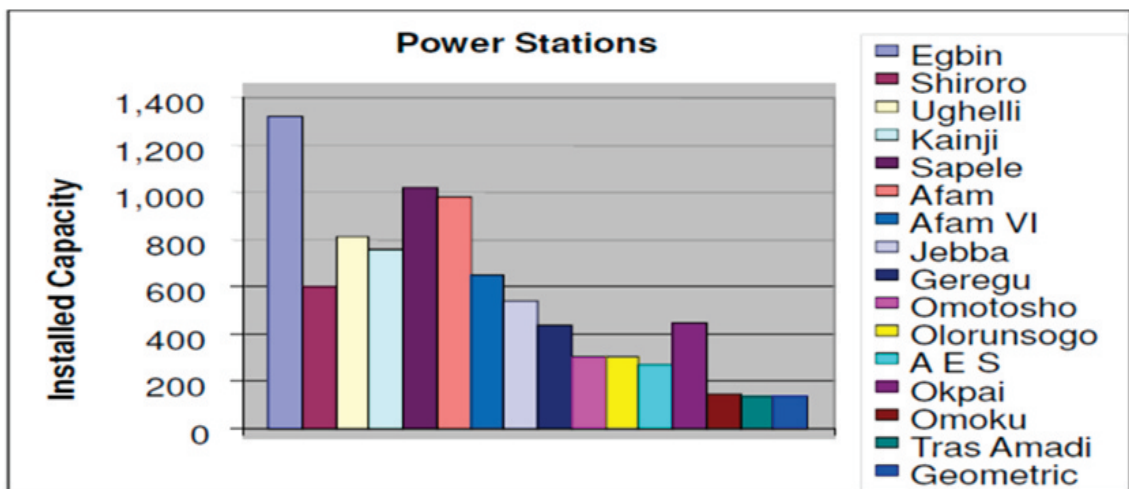
Electricity consumption growth from 1993 to early 2000 was approximately 0.5% per year whereas growth rate for developing countries such as Nigeria is estimated at 8% per year. An analysis of KWh use of electricity per capita in various countries correlated to Gross Domestic Product (GDP) per capita indicated an average of 425KWh, per capita electricity consumption is only 136KWh in Nigeria compared to neighbouring West African country Ivory Coast, which is not endowed with such resources of natural gas reserves, with per-capita electricity consumption of 174KWh. There is therefore considerable room for growth of gas demand for power generation. Using a growth factor of 2.5 as the base estimate would result in increase gas consumption by the power sector of Nigeria from 1999 level of 270mmcfpd to 2400 mmcfpd in 2010 to over 4900 mmcfpd by 2015.

The Reform Act reviewed the generation, transmission and distribution of electricity in the country to improve its performance. The IPPs are expected to contribute about 3000MW to the national grid. Figure 3.1 below shows the estimated power sector gas allocation profile.



**Figure 3.1: Power Sector Gas Allocation**

Nigeria’s efforts in Power are focused on meeting a projected 3bcf/d of gas demand by about 37 existing and proposed power plants which have a collective potential to generate about 12GW by 2015. The total capacity of proposed plants is over 8000MW. (See figure 3.2)



**Figure 3.2: Power generating stations versus installed capacity.**

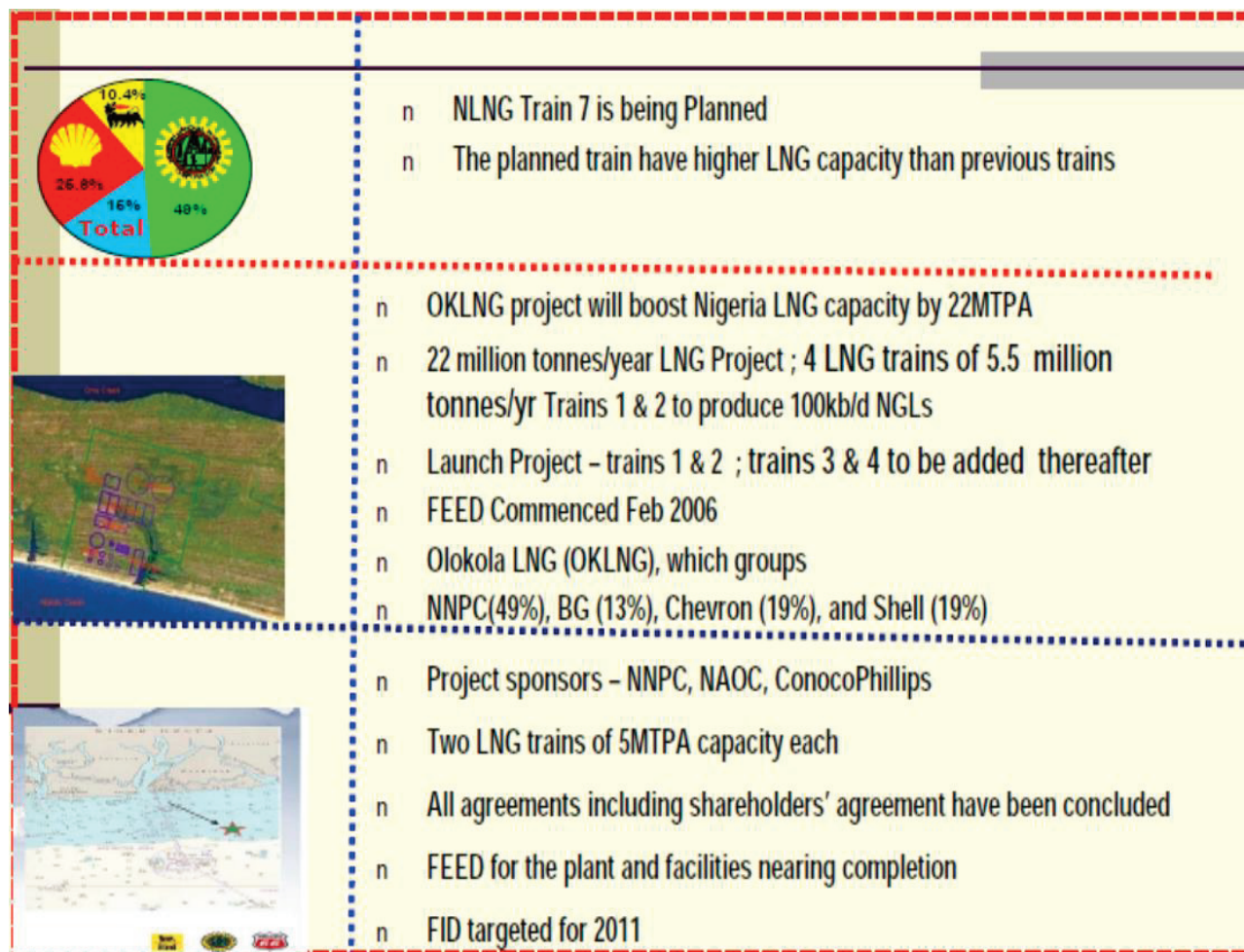
The impact of improved gas supply to power is the recent improvement in power availability across Nigeria. This is set to grow as the reforms in gas take a foothold in delivering sustainable supply.

### 3.3 Planned Export Projects - LNG Projects

The Nigerian Liquefied Natural Gas Company (NLNG) is the only company that produces liquefied natural gas in Nigeria. It is jointly owned by NNPC (48%), Shell (25.6%), Total (16%) and Eni (10.4%). LNG activities are regulated under the Petroleum Act and its subsidiary regulations, which include Petroleum Refining Regulations. LNG export is regulated by the Oil Terminals Act, Crude Oil (Transportation and Shipment) Regulations, the Nigerian Ports Authority Act, the Pre-shipment Inspection of Export Act, the Customs and Excise Act, the

Foreign Exchange (Monitoring & Miscellaneous Provisions) Act, and the Foreign Exchange Manual (issued by the Central Bank of Nigeria).

With six LNG trains now producing at Bonny, Nigeria is set to become the third largest LNG exporter after Qatar and Indonesia with some 37bcm capacity. Nigeria LNG (NNPC, Shell, ENI, and Total) has a diverse base of customers in Europe, North America and trades short-term cargoes to Asia. Two additional large plants, Brass LNG (NNPC, ConocoPhillips, ENI, Total) and OKLNG (NNPC, Shell, Chevron, BG) are close to final investment decisions, and other LNG projects are in planning along with a more speculative trans-Saharan pipeline project linking Nigerian gas into Algeria's pipeline export routes. IOCs are motivated to participate in gas utilization projects by penalties due for not complying with 'no gas flaring rules' introduced in 2008.



**Figure 3.3: Nigeria LNG Projects.**

### 3.3.1 Other Export Projects - Other Pipeline Projects

Before the WAGP project, Nigeria contributed to 12.5% of the total worldwide gas flaring. The associated gas was flared while the non-associated gas was being used for LNG production. With the development of WAGP, it is estimated that the emission of greenhouse gases (GHG) to the environment would reduce by 100 million tons in the first 20 years (Ayodele, 2010). As per the estimates of WAGPA, the emission of GHG will be reduced by 52%. The gas producers in Nigeria are expected to earn additional revenues by selling the associated gas to WAPCO (West Africa Pipeline Company).

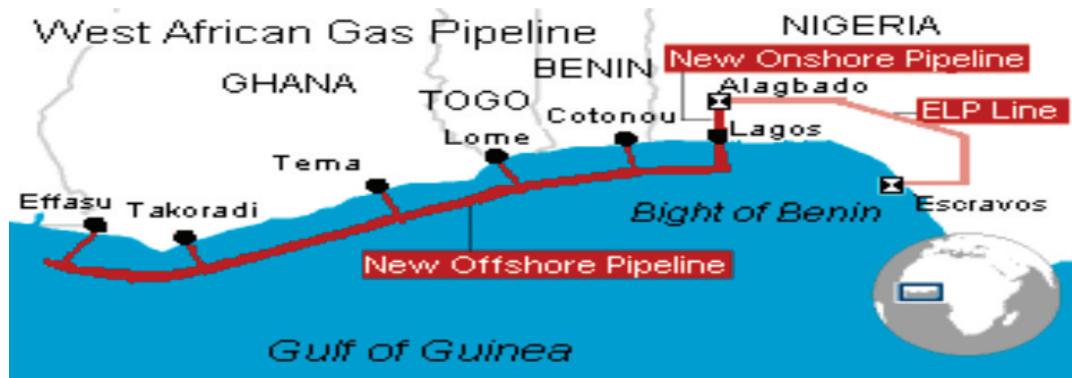


Figure 3.4: Layout of the West African Gas Pipeline

Other benefits of WAGP include (Yeboah, 2009)

- Economic growth for the countries Ghana, Benin, Togo and Nigeria
- Long term supply of clean and cheaper fuel (Natural Gas) by Nigeria to Ghana, Benin and Togo
- The co-operation and the economic integration due to the project could result in an increased regional stability under ECOWAS
- The pipeline as an energy infrastructure is expected to catalyze direct foreign investment in the project states.
- West African Power Protocol (WAPP) was set up to develop integrated electric power infrastructure throughout the region. Electricity will be made more reliable and will help in migration to cleaner hydropower and gas fired power plant. The electricity generation cost is also expected to be reduced by 50%.
- A single fiscal regime is adopted between the four countries for the WAGP activity. The income tax rate is fixed at 35%. There are no transit royalties for the pipeline. There is a 5 year tax holiday period. Once the tax free period is completed, WAPCO has to start paying the income tax. The income tax which each country receives is calculated using the formula (Barandao, 2007)

$$APs (\%) = 45 \times [(LS \div LT) + (RCS \div RCT)] + 2.5 \dots\dots\dots \text{Eqn. 1}$$

Where,

APs = Apportionment percentage for a state

LS = Length in state

LT = Total length of pipeline

RCS = Reserved Capacity by State

RCT = Total Reserved Capacity

### 3.4 Impact of Nigeria Natural Gas Supply on the Environment

The impact of Nigeria Natural Gas Supply on the environment and society covers a range of issues from health, water supply, population, environment, and cultural heritage. But focus in this context will be on the environment.

#### 3.4.1 Environmental Impact of NGMP and WAGP

The switch from conventional fuels such as coal and oil to Natural gas has seen a shift in attitudes towards the environment. Natural gas is known to burn cleaner than both oil and coal. However this does not mean processing or transporting of Natural gas is without its own environmental risks and impacts. The inherent risks of oil leakage in pipelines especially in Nigeria are well documented but for this project we look at how the construction of the Nigeria Gas pipeline synergy with the West Africa Gas Pipeline has affected the environment and communities.

A World Bank report on the WAGP project stated that ““The major positive environmental impact of WAGP will be the development and use of gas currently flared in Nigeria.” (Goodland, 2005). This cessation of flaring on-pre-WAGP levels in the Niger Delta has contributed to the reduction in the global greenhouse gas emissions and hence positive impacts on the issue of global climate change. According to some estimates about 100 million tons of CO<sub>2</sub> emissions reduction will be recorded with the WAGP in a twenty year period, of which 78% will be achieved by reducing gas flaring in Nigeria (FOE 2006) but these figures are disputed by some environmental groups. The impact of using gas which hitherto would have been flared also makes much economic and environmental sense, because” Gas flaring costs Nigeria about US\$2.5 billion annually, while about 66% of its population live on less than US\$1 a day. Capturing gas that is currently flared in Nigeria alone could produce about 50% of the current power consumption of the African continent. While Nigeria has approximately 30% of African gas reserves, it flares 75% of the gas it produces. This accounts for 19% of the total amount of gas flared globally” (FOE 2006).

Another issue is that the first part of the WAGP route from Escravos to Lagos beach pipeline was built many years ago but crucially without an environmental impact assessment done on it. This exposes the indigenes along that route to potentially catastrophic accidents, in brief; it is sitting on a time-bomb. The social and environmental challenges encountered in the Niger Delta do not seem to abate and the WAGP project did the situation no good. Operators have been accused of destroying fishing waters in that region. Perhaps resolving such challenges are best done in the political arena and not in a term paper like this work.

Most of the challenges associated with the WAGP project is mainly located where the gas is taken from, the Niger Delta Region. It should be noted that problems such as pollution of water, destruction of farm lands and cash crops (as seen in figure 3.5) by oil companies like the global Oil and Gas Companies, existed even before the Nigeria Gas Master Plan and WAGP came on stream and trying to separate and identify unique environmental challenges of the NGMP and WAGP will be a hard task.



**Figure 3.5: On-going Pipeline Project**

So any unforeseeable negative environmental effect during the lifetime of the Nigeria Gas Master Plan and the West African Gas Pipeline is yet to be realized and reported.

#### **4. Conclusion**

The Nigeria gas industry has entered an exciting phase of rapid growth from all supply chain and technology perspectives. The gas sector aspiration, though anchored around gas to power in the immediate term, is aimed at delivering the Government’s wider economic agenda of power and industrialization. NNPC has played the most pivotal role in developing the Gas Master Plan. There is now an unprecedented domestic gas market opportunity.

Natural gas supplies will continually flow in Nigeria and beyond in increasing quantities throughout the 21st Century, because:

- demand for it as an energy source is growing rapidly and new markets are opening
- natural gas is in abundant supply and available in Nigeria’s Niger Delta region, where it is found in gas reservoirs or produced along with oil as associated gas
- the industry is capable of providing the technological innovation required to produce, transport and handle it in remote locations



- Natural gas is more environment-friendly, as it has lower sulphur content than liquid fuels.

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