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Zero Gas Flaring, A Realistic Panacea For Robust Socio-Economic Development Of Nigeria

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Abstract

Gas plays a major role in the economic development and energy security of any oil and gas producing nation. The current world gas reserve stands at 5302TCF while Nigeria gas reserve stands at about 187tcf (about 3.5% of global gas reserve) consisting of 98 TCF of Associated Gas (AG) and 89 TCF of Non Associated Gas (NAG) (Ebogah, 2006). With more dedicated exploration for gas, Nigeria ranking of being 9th in world gas reserve and 1st in Africa will definitely move up on the ladder, most likely closely followed by the United States of America. Nigeria flares about 900 billion cubic feet (BCF) of gas yearly. In this work, we propose a reform model on how to stop gas flaring and make available more gas for power generation; earn substantial revenue from gas sales and make available feedstock for fertilizer, aluminum and steel companies; eliminate environmental degradation occasioned by flaring and in turn reduce emission of gases which are the main causes of global warming, Nigeria being a signatory to the Kyoto Protocol and a member of the World Bank-led Global Gas Flaring Reduction Public-Private Partnership (GGFR). With these initiatives, there will be massive job creation and generation of additional revenue to the tune of about $10bn annually, the amount of money needed for provision of social amenities such as medical facilities, roads and education.

Keyword:- Gas reserve, gas utilization, Job creation and Environmental Degradation.

I. Introduction

Nigeria made a giant stride in its exploration for oil with the first major gas discovery at Afam in 1956 with a reserve of 850 BCF. This discovery, which occurred in the year the Oloibiri oilfield was discovered, resulted from exploration for mainly oil as is the case for all gas discoveries in Nigeria. Subsequent discovery of more crude oil reserves also resulted in an enormous amount of associated and non-associated gas finds in the Niger Delta.

With a current estimated 187 trillion cubic feet (TCF) of proven natural gas reserves, Nigeria is ranked ninth in the World and the largest in Africa (Figure 1). Nigeria has only recently started exploring for gas, specifically drilling NAG Wells. With more dedicated exploration for gas, Nigeria's ranking of being 9th in world gas reserve and 1st in Africa will definitely move up on the ladder, most likely closely followed by the United States of America. (Table 1) The Nigerian gas has high export potentials due to its lack of impurities, high quality –particularly rich in liquids and low in sulphur. Locally also, there are huge demand opportunities with the most prominent ones being power, refining, petrochemical, cement, fertilizer, aluminum and iron and steel. The potential for distribution to industrial complexes for sourcing their energy requirements also abounds as a result of the growth being currently experienced in that sector.

Gas plays a major role in the economic development and energy security of any oil and gas producing nation. It is generally accepted that the main drivers of gas utilization projects in Nigeria is the Government's desire to create more wealth and diversify the economy of the country. Despite the above stated enormous opportunities for the Nigerian gas market, large volumes of natural gas that is associated with oil production (Associated Gas) are flared daily due to limited infrastructure in place to develop the sector, long gestation period involved in gas projects, inadequate gas supply infrastructures, and present low level of industrialization. Gas flaring has had its toll on the economy of Nigeria with its attendant problems on the environment and also in loss in revenue running into trillions of naira over the years. Statistical figures published in the NNPC Annual Statistical Bulletin 2010 reveals that 35% of the gas produced between 2002 and 2010 was flared (Figure 2).

One of the major challenges with gas commercialization and utilization is the commerciality of gas. The gas pricing regime in the domestic market has been historically low relative to global prices. Consequently, there have been cases of supply of gas without payment for years. There have been cases of suppliers making huge supply investment for a market that is not responsive to price trends or not able to pay regularly. In addition, the investments earlier made to supply the domestic markets have been put at risk as many of the buyers such as Aluminum Smelting Company of Nigeria (ALSCON), National Fertilizer Company of Nigeria (NAFCON) etc folded shortly after commencement of operation. For supply to be sustainable, it has to be backed by both credible suppliers and buyers.

II. Gas Flaring In Nigeria

Flaring is a high-temperature oxidation process used to burn combustible components, mostly hydrocarbons, of waste gases from industrial operations. Natural gas, propane, ethylene, propylene, butadiene and butane constitute greater than 95% of the waste gases that is being flared on a daily basis in oil producing fields and gas processing plants. In combustion, gaseous hydrocarbons react with atmospheric oxygen to form carbon dioxide (CO2) and water. In some cases involving some waste gases, carbon monoxide (CO) is the major combustible component. Furthermore, most flared gases are composed largely of low molecular weight hydrocarbons with high heating value and these are the main causes of global warming. The largest flaring operations occur in the Niger Delta region of Nigeria (Bruno Gervet, 2007). Between 1970 and 2006, Nigeria lost about $72billion (an average of $2.5 Billion per annum) to gas flaring (Uwazie et al, 2011). See Figure 3.

It is imperative to stop flaring in Nigeria in order to make available more gas for power generation; earn substantial revenue from gas; eliminate environmental degradation occasioned by flaring and keep to global commitment. Technologies for gas commercialization which can be deployed in Nigeria include but not limited to:

- Gas compression systems
- Gas processing and treatment systems
- Central processing facilities
- Early production facilities
- Mechanical refrigeration gas plant
- Natural gas liquids NGL/LPG extraction gas plant
- Liquefied natural gas (LNG) plant
- Compressed natural gas (CNG) plant

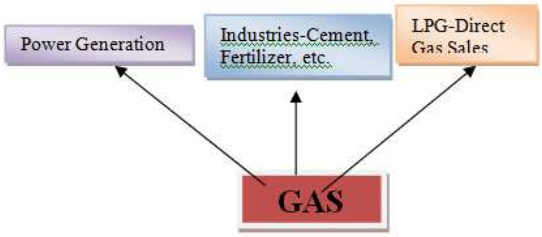
III. Gas Utilization: The Norwegian Experience

When oil production started in Norway on Efofisk in 1971, all associated gas was flared. However, in 2001, Norway initiated a project led by the World Bank which introduced voluntary global standards for restricting gas flaring. Oil companies in Norway were required to lift, process and use associated gas in their operations. Accordingly, they are to submit a development plan with a provision for gas re-injection, gas export solution or other associated gas utilization schemes. Strict regulation and financial incentive has helped in reducing flaring. More than a quarter of the gas produced has been re-injected into the reservoirs to sustain or boost reservoir pressure and improve oil recovery. Companies were made to find ways of exploiting associated gas from day one either by piping it to the market or re-injection where there were no pipeline infrastructures. In 2004, only 0.16% of the total annual associated gas from oil production was flared in Norway but slightly rose to 0.4% in 2008 due to emissions from Snohvit Facility on Melkoya outside Hammerfest.

IV. Our Proposed Model For Gas Utilization In Nigeria:

It is a well established fact that gas will play a vital role in the world's future energy supply, and invariably, it will be a major driver of economic growth and sustainable development in Nigeria. Figure 4 shows the different oil and gas fields in the Niger Delta. Nigeria currently export 41% of her natural gas as LNG, re-injects 32%, consumes domestically 15% for industries and power generation and flares 15% (Ige David, 2012). In this work, we looked at various gas utilizations that can easily be adapted to stop gas flaring, generate revenue, stimulate socio-economic

development and in turn create jobs for teeming Nigerians (See Table 2) as shown in a study carried out by Mckinsey.



V. Power Generation

this is the highest valued use of gas in Nigeria as it has the potential of stimulating various job creations. IEA data for 2009 indicate that electrification rates for Nigeria were 50 percent for the country as a whole, meaning approximately 78 million people do not have access to electricity in Nigeria. This shows that the vast natural gas resources that could be used for domestic electricity generation is mostly being flared due to lack of effective policies to harness resources (Figure 7). Associated gas can be used in microturbine generators to produce electricity. Microturbines are small gas-fired turbines that produce electricity. Microturbines can burn natural gas that would otherwise be flared. The electricity is used to provide power for industry operations (such as pumping, compression or gas processing) or sold to the regional grid. In co-generation applications, the microturbines also produce steam for industry operations or nearby activities such as drying grain or heating greenhouses.

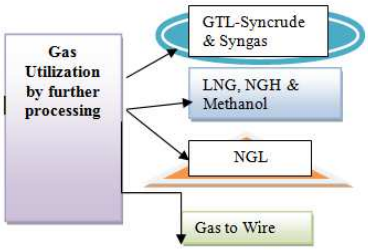
Before the recent privatization/deregulation, the Power Holding Company of Nigeria (PHCN) gets its supply of natural gas from the Nigerian Gas Company (NGC), but never developed and/or improved its existing electricity infrastructure to take advantage of the available gas resources to boost its power generation. The Nigerian government has had several plans to address the need for power, including a recent announcement to generate 40,000 megawatts (MW) of capacity by 2020 (compared to 2008 installed capacity of 6,000 MW). Realizing this target will depend on the ability to utilize currently flared natural gas. Figure 5 shows Federal Government planned national power transmission grid that will link major industrial and population centres. With guaranteed source of power, Micro, Small and Medium Enterprises(MSME) will thrive and this will have multiplier effect on the economy as the cost of production will be reduced and in turn lead to an estimated establishment of 2,500 – 3,000 MSME units.

Cement Industry- There are eight cement factories in Nigeria which are sited close to the raw materials sources (limestone deposits), except the plant at Okpilla in Edo State, which uses marble. While Lafarge WAPCO has factories in the south-west, Ashaka is situated in the north-eastern region of the country. Both Benue Cement Company (BCC) and Obajana Cement Company have their factories in north-central region (both part of the wider Dangote Group). UNICEM Cement Company and the Cement Company of Northern Nigeria (CCNN) are strategically positioned to serve the south-eastern and the north-western markets respectively while Bua Cement is located in Edo State. This regional segmentation of the cement market in the country is largely due to high haulage costs, given the lack of basic transport infrastructure such as rail and good roads. However, capacity utilization rates have historically been low across the industry, due to fuel supply problems and power outages. Average utilization was probably around 60% for the industry as a whole in 2008 (**Furnivall and Abidoye, 2009**), although this is now improving because of enhanced supply of fuel and improvement in electricity generating capacity. Of the existing cement companies, only WAPCO (Ewekoro and Shagamu), UNICEM and Dangote (Ibese Cement Company) are direct customers of Nigerian Gas Company where they get gas supply for their factory and plants. UNICEM has added 2.5 million tonnes of capacity, while Lafarge WAPCO is also working on increasing its available production by 2.2 million tonnes due to the favourable access to gas, all in a bid to cope with the country's critical infrastructure and housing needs. The increasing demand for good quality housing, which is estimated at around 16 million housing units, is also expected to be a key catalyst for industry sales growth and the attendant boost in the economy.

Efforts should be made to extend the supply of gas to the remaining cement plants in order to boost their production as Dangote is already working on 90km gas pipeline for the supply of natural gas to its Obajana Cement Factory from Ajaokuta. A typical cement factory has the capacity to generate at least 60,000 jobs directly and indirectly.

Fertilizer Companies: Nigeria has a population of about 150 million and an arable land space of 71.2 million hectares. However, the vast arable land is not being utilized as the country is bedeviled with food insecurity. There is only one nitrogenous and one supersulphate fertiliser plants in the country at the moment and these do not satisfy the needs of the country. The establishment of gas-based fertiliser plants is very fertile area of investment within the country as it will also diversify the economy, reducing the largely dependent oil and gas source of income. Food processing industries will also be built as a result of the boost in the agriculture sector, creating employment to teeming Nigerians, in addition to revamping the textile industries through access to needed raw materials locally. Great potential also exists for export of agricultural products if fully developed.

LPG- for both domestic use and export for heating and cooking purposes. Most of the current LPG production is for the export market, leaving the local market starved of it (Table 3). According to the International Energy Agency (IEA), in 2008, Nigeria's total energy consumption was 4.4 Quadrillion Btu. Of this, combustible renewable and waste accounted for 81.3% of total energy consumption while natural gas recorded a lowly 8.2%. The high percent share of combustible renewable and waste represents the use of biomass to meet off-grid heating and cooking needs, mainly in rural areas.



Gas to Wire: in this process, natural gas is converted to high voltage direct current and then transported to markets. For offshore operations, high power lines to reach the shoreline seem to be very costly at this time (Rajnauth, 2008). For long distances, DC Cables are recommended since DC requires less core number (Watanabe, 2006).

Gas to Liquid (GTL) – In the Gas to Liquid technology, natural gas is converted directly to liquid such as syncrude (synthetic Crude oil) and indirect conversion via synthesis gas(syngas). Several direct conversion processes have been developed but none have been commercialized (Rajnauth, 2008). Both processes however, result in production of clean diesel, jet fuel, middle-distillates, lubricants and wax from associated gas (Petrosyan, 2004). With a skid mounted at the Wellhead or at the flare point, synthesis gas can be generated by combining CO_2 and H_2 by means of a multiple gliding arc plasma reactors in the presence of highly selective and high yield catalyst in Fischer Tropsch Reactors to produce Synthetic Crude Oil (mostly Naphtha and Diesel fractions). This technology will bridge the present shortfall in supplies of diesel from refineries and serve as good energy source for heavy diesel engines and machineries.

A Chevron-operated Escravos Gas to Liquids (GTL) project had been ongoing but has been plagued by multiple delays and cost overruns but is currently scheduled to be operational by 2013. Gas-To-Liquids (Fischer-Tropsch) projects, in contrast to LNG, are not constrained by market or terminal constraints and can have economics comparable to those of LNG. Also, GTL Projects are scalable, allowing design optimization and application to small reserves.

The first six gas utilization methods are recommended mostly to strategically position Nigeria as a major consumer of gas with the baseline being rapid industrialization and diversified economy. However, achieving them will largely

depend on the role played by government as the major setback lies in lack of infrastructure which will require huge initial investment to kick-start. There is need for government to be generous at this stage by subsidizing the price for gas producers and also granting them access to large gas resources. When the gas resources starts dwindling and becomes scarce at low price (meaning flaring is at its lowest level), then Nigerian Government can deregulate the market by removing the subsidy. By the very nature of the physical transportation constraints of the commodity, natural gas will have a different price for delivery in each of the many regions throughout the country.
Other forms of natural gas utilization which are mostly meant for the international markets are discussed in the following. Since they are profit-driven and not based on national policy (power, politics e.t.c.), cost considerations and profit motivation will continue to be the major criteria in decision making by players in the value chain.

Natural Gas Liquids (NGL) is a relatively unexploited resource in Nigeria and offer attractive gas export opportunities. Nigerian gas is rich in liquids, providing the opportunity for NGL recovery projects and liquid credits from condensate recovery during sale gas production. NGL reserves are estimated at about 15 billion barrels (or about 8 billion barrels, excluding ethane). NGL reserves are about half the size of Nigeria's current oil reserves, but their exports are less than 5% of the oil export volume. As ethane is currently not exported, and as the NGL reserves contained in non-associated gas are not available until production of the non-associated gas, exclusion of these are required to determine the NGL resource base that is currently exploitable. After the adjustment noted above, the currently exploitable portion of the NGL resource base, which is the associated gas portion of the propane and heavier components, is some 4.8 billion barrels. This volume amounts to about 14% of the oil reserves, while the NGL production only amounts to about 5% of the oil production volume. NGL export is among the most economically attractive gas export opportunities. Ready markets exist, and international trade is well established for propane and heavier components.
NGL exports also have the advantages of not being subject to OPEC quota limitations, unlike crude oil exports. It is expected that gathering of AG will stimulate the recovery of NGL's as the flares are reduced. The NGL recovery would also provide some economic offset to the cost of such flare gas gathering. Ethane export offers new opportunities for export earnings. Supply and demand balances now indicate a potential attractive export market for ethane in the United States and Europe. Ethane export would provide a new source of export revenue for Nigeria. The storage and shipment of ethane is somewhat more challenging than for propane and heavier components but is well within the reach of current technology. An Ethane-based chemical industry should be developed in stages with Ethane export the likely first stage.
Ethane export will allow a market for ethane to be established in Nigeria. After the ethane market grows to a sufficient size to establish that enough supply exists for a world-scale chemical manufacturing complex, including expansion possibilities (an estimated 120,000 B/D of Ethane is required), then a Nigeria-based chemical manufacturing complex for export could be considered. In a staged development process, the complex would first manufacture ethylene for export and then be expanded to include manufacturing of polyethylene and ethylene glycol derivatives.

LNG, NGH and Methanol (Fuel Quality) projects are required for large-scale utilization of gas, and can be attractive. Large-scale LNG exports are limited by available markets and substantial competition among LNG suppliers in the near term, except for the United States market, where the principal competition is with pipeline gas sold under short-term contracts. Though the United States may offer a larger and more readily available market, it would also likely result in lower netback prices in Nigeria. Natural Gas Hydrates is a new concept of transporting gas. NGH contains 170times as much as gas in its volume under milder conditions such as at higher temperature than LNG. Therefore, initial cost of NGH process is estimated lower than LNG. Methanol fuel markets have not yet been established, and the chemical use in the manufacturing of MTBE is not growing as anticipated.

Re-injection: associated gas produced during oil production could be re-injected into the formation to maintain reservoir pressure during production thereby improving oil recovery and to serve as a good natural sink pending the

construction of facilities for utilization and securing markets for it (Table 4). All these can be done in addition to the current gas utilization initiative in Nigeria which include (Table 5):

1. West African Gas Project
2. Trans-Saharan Gas Project
3. Nigerian Liquified Natural Gas (NLNG)
4. Gas Master Plan (Figure 6) - IPPs (Independent Power Plant)
5. CNG Commercialization

VI. Benefits Of Gas Utilisation In Nigeria

Efforts must be made to stop gas flaring by insisting that all new gas development projects must achievable gas utilization schemes. Gas utilization in Nigeria holds the promise of:

- Reliable Power supply and establishments of microturbines power plants
- Diversification of the economy
- Reduced energy cost
- Massive job creation
- Increased income and economic growth
- Low feedstock cost and establishment of new industries using natural gas as feedstock.
- Replacing existing energy carrier (fuel oil) with natural gas
- Monetization of gas resources
- Flare reduction and cleaner environment resulting in reduced CO_2 and NO_x emissions
- Stimulation of Nigerian Local Content Development
- Not Constrained by OPEC
- Foreign Direct Investment
- Opportunities for improvement through Lessons learned

VII. Challenges Of Gas Utilization In Nigeria

- Gathering of stranded gas for commercialization
- Lack of infrastructure for large scale distribution of gas in Nigeria
- Technological breakthrough for new technologies such as synthesis gas production, natural gas hydrates which are still in pilot stage
- Gas utilization project capital intensive and require long development time (long gestation period).

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Appendix

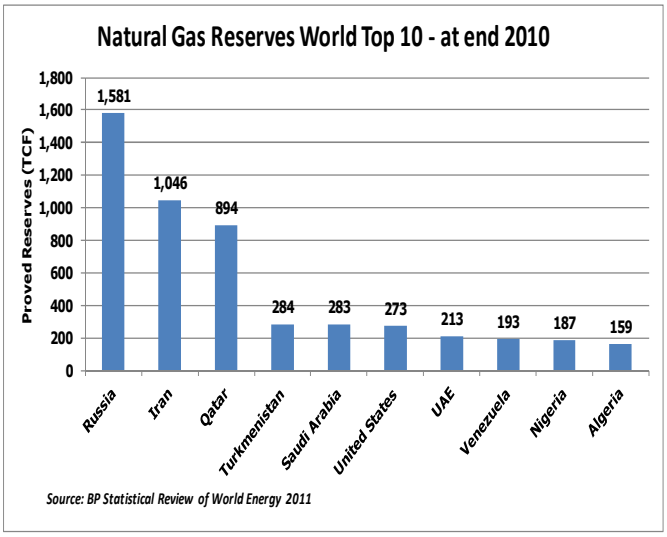

Figure 1: Natural Gas Reserve World Top 10

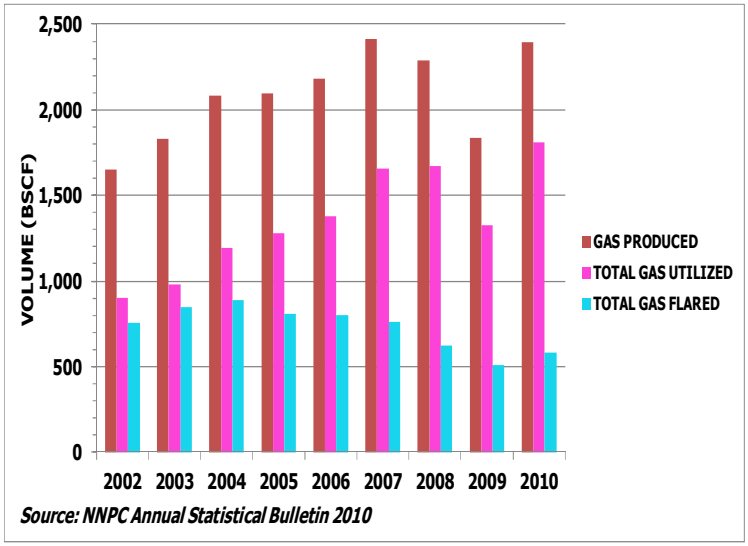

Figure 2: Nigeria Gas Production & Utilization 2002-2010

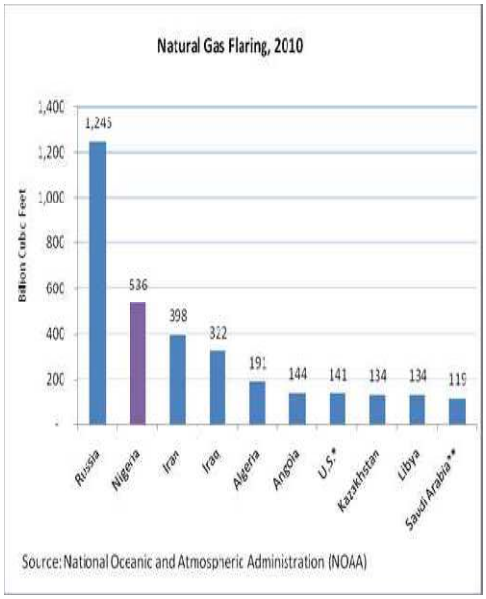

Fig 3. National Gas Flaring, 2010.

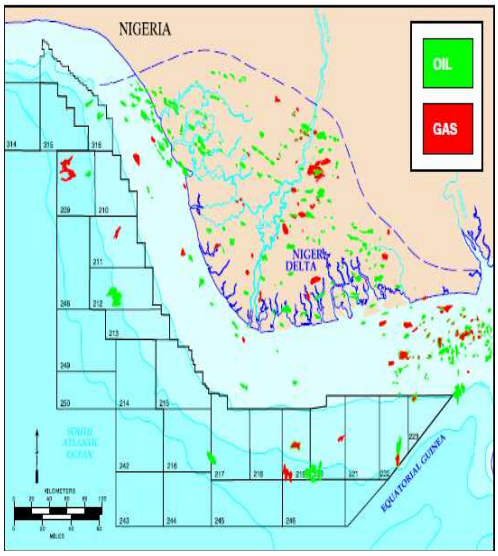

Fig 4. Niger Delta Oil and Gas Field

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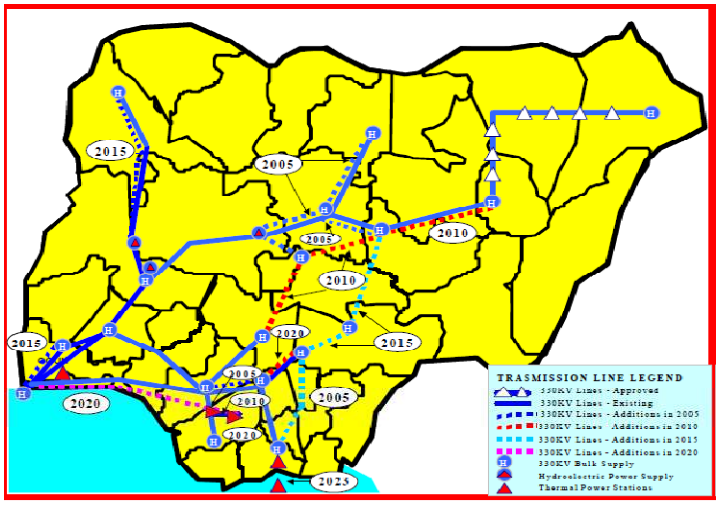

Figure 5: Nigeria National Power Transmission Lines

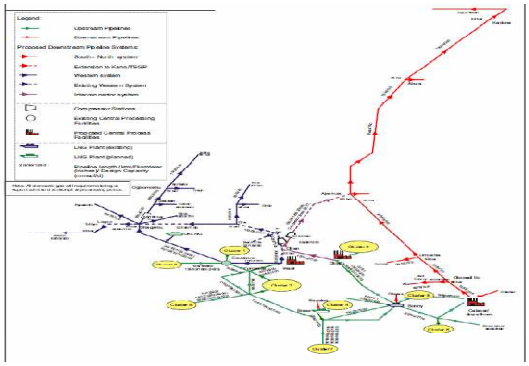

Fig 6. Nigerian Gas Master Plan

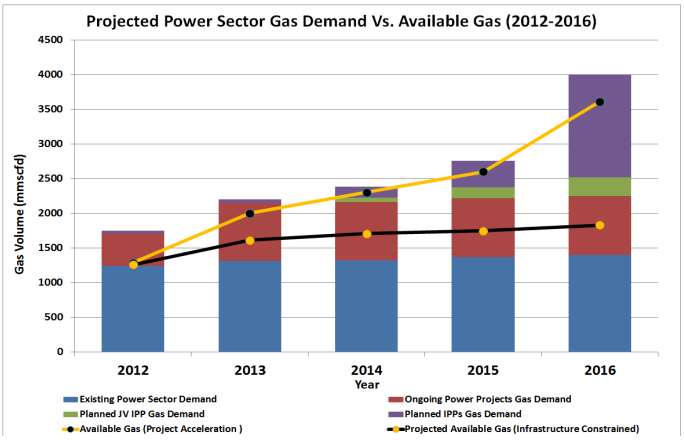

Figure 7. Projected power sector gas demand vs available gas (2012-2016)

Table 1: Proved Reserves of Natural Gas (Trillion Cubic feet)

	2007	2008	2009	2010	2011
Africa	484.433	489.63	494.078	495.25	517.706
Algeria	161.74	159	159	159	159
Angola	2	9.53	9.53	9.6	10.94
Benin	0.04	0.04	0.04	0.04	0.04
Botswana	0	0	0	0	0
Burkina Faso	0	0	0	0	0
Burundi	0	0	0	0	0
Cameroon	3.9	4.77	4.77	4.77	4.77
Cape Verde	0	0	0	0	0
Central African Republic	0	0	0	0	0
Chad	0	0	0	0	0
Comoros	0	0	0	0	0
Congo (Brazzaville)	3.2	3.2	3.2	3.2	3.2
Congo (Kinshasa)	0.035	0.035	0.035	0.035	0.035
Cote dIvoire (IvoryCoast)	1	1	1	1	1
Djibouti	0	0	0	0	0
Egypt	58.5	58.5	58.5	58.5	77.2
Equatorial Guinea	1.3	1.3	1.3	1.3	1.3
Eritrea	0	0	0	0	0
Ethiopia	0.88	0.88	0.88	0.88	0.88
Gabon	1	1	1	1	1
Gambia, The	0	0	0	0	0
Ghana	0.8	0.8	0.8	0.8	0.8
Guinea	0	0	0	0	0
Guinea-Bissau	0	0	0	0	0
Kenya	0	0	0	0	0
Lesotho	0	0	0	0	0
Liberia	0	0	0	0	0

Libya		52.65	50.1	54.38	54.362	54.68
Madagascar		NA	NA	NA	NA	NA
Malawi		0	0	0	0	0
Mali		0	0	0	0	0
Mauritania		1	1	1	1	1
Mauritius		0	0	0	0	0
Morocco		0.058	0.055	0.053	0.053	0.051
Mozambique		4.5	4.5	4.5	4.5	4.5
Namibia		2.2	2.2	2.2	2.2	2.2
Niger		0	0	0	0	0
Nigeria		181.9	183.99	184.16	185.28	186.88
Reunion		0	0	0	0	0
Rwanda		2	2	2	2	2
Saint Helena		0	0	0	0	0
Sao Tome and Principe		0	0	0	0	0
Senegal		0	0	0	0	0
Seychelles		0	0	0	0	0
Sierra Leone		0	0	0	0	0
Somalia		0.2	0.2	0.2	0.2	0.2
South Africa		NA	NA	NA	NA	NA
Sudan		3	3	3	3	3
Swaziland		0	0	0	0	0
Tanzania		0.23	0.23	0.23	0.23	0.23
Togo		0	0	0	0	0
Tunisia		2.3	2.3	2.3	2.3	2.3
Uganda		0	0	0	0	0.5
Western Sahara		0	0	0	0	0
Zambia		0	0	0	0	0
Zimbabwe		0	0	0	0	0

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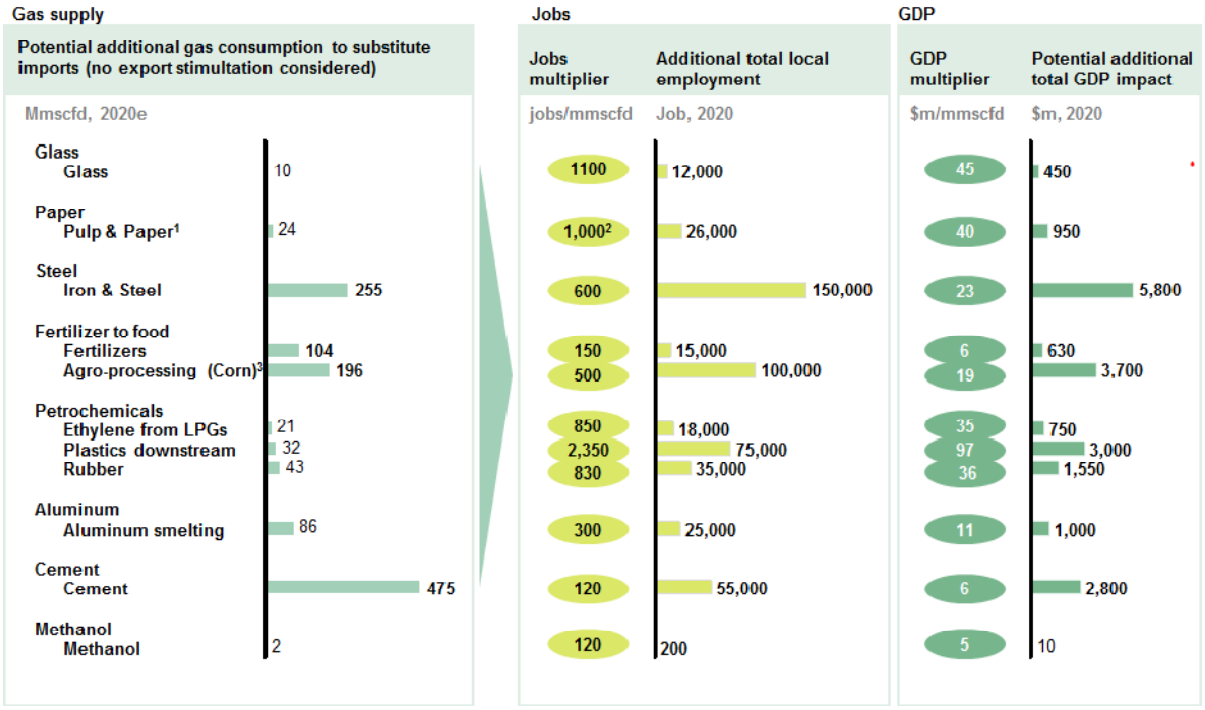
Table 2: Economic Potential of Gas – Job Creation and GDP Impact



SOURCE: McKinsey

Table 3. Nigerian Liquified Gas Petroleum Inventory

Liquefied Petroleum Gas (LPG) Inventory (MT)

MONTH	PRODUCTION			LIFTINGS		
	NNPC	CHEVRON	TOTAL	NNPC	CHEVRON	TOTAL
January	0.00	0.00	0.00	-	-	0.00
February	0.00	0.00	0.00	-	-	0.00
March	0.00	0.00	0.00	-	-	0.00
April	9,518.99	6,345.99	15,864.98	-	-	0.00
May	11,830.21	7,886.81	19,717.02	29,826.19	-	29,826.19
June	11,038.74	7,359.16	18,397.90	-	-	0.00
July	11,796.18	7,864.12	19,660.30	-	29,853.71	29,853.71
August	10,610.81	7,073.88	17,684.69	14,953.60	-	14,953.60
September	8,243.15	5,495.43	13,738.58	14,907.35	-	14,907.35
October	10,472.27	6,981.51	17,453.79	-	28,643.40	28,643.40
November	11,432.22	7,621.48	19,053.69	-	-	0.00
December	12,032.84	8,021.89	20,054.74	29,733.17	-	29,733.17
Total	96,975.41	64,650.27	161,625.68	89,420.30	58,497.10	147,917.40

Source: NNPC Annual Statistical Bulletin 2010

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Table 4: Gas Production and Utilisation 2002 – 2010: (mscf)

YEAR	GAS PRODUCED	GAS USED AS FUEL	GAS SOLD TO THIRD PARTIES	GAS RE-INJECTED	FUEL GAS TO EPCL	GAS FOR LPG/NGL AS FEEDSTOCK TO EPCL	GAS FOR LNG	GAS TO NGC	GAS LIFT	TOTAL GAS UTILIZED	GAS FLARED	% Flared
2002	1651,591,488	71,895,558	101,619,643	210,402,167	9,159,870	47,721,060	290,045,558	89,794,378	17,151,356	897,789,582	753,801,906	45.64
2003	1828,541,855	66,234,516	35,871,813	167,246,149	9,037,946	35,046,246	463,380,371	116,320,144	19,425,784	983,562,969	844,978,886	46.21
2004	2082,283,189	71,534,048	239,513,290	330,806,436	9,979,511	47,100,859	410,167,378	77,758,476	11,883,045	1,196,747,993	886,540,196	42.58
2005	2093,628,859	64,137,382	526,288,967	397,744,644	10,339,647	45,337,150	187,287,551	0	30,177,141	1,282,313,082	811,315,777	38.75
2006	2182,432,084	76,797,392	629,596,866	333,687,178	7,926,235	44,410,864	240,915,583	0	45,436,202	1,378,770,261	803,661,823	36.82
2007	2415,649,041	76,524,311	760,747,361	354,610,374	9,417,626	34,980,978	368,626,236	0	51,053,728	1,655,960,315	759,688,726	31.45
2008	2207,547,344	83,730,316	708,159,550	391,075,575	7,640,304	23,582,179	331,569,374	63,831,255	50,560,235	1,660,148,499	619,398,054	27.00
2009	1837,278,307	80,573,380	440,941,863	409,848,718	8,086,525	42,401,451	269,095,956	21,021,894	55,966,116	1,327,926,402	509,351,905	27.72
2010	2,192,838,898	72,233,697	857,225,685	21,182,685	493,309,826	5,204,476	25,866,822	167,190,149	169,057,005	1,811,270,545	581,568,354	24.30

Source: NNPC Annual Statistical Bulletin 2010

Table 5. Upcoming Gas Utilisation Projects in Nigeria

Nigeria: Upcoming Projects			
Project	Capacity ('000 bbl/d)	Est. Startup	Operator
Agbami 2**	100	2011-2014	Chevron
Usan	180	2012	Total
Gbaran Ubie Phase 1	70	2012+	Shell
Ehra North Phase 2	50	2013+	ExxonMobil
Bonga North, Northwest	50-150	2014+	Shell
Bonga Southwest and Aparo	140	2014+	Shell
Egina*	150-200	2014+	Total
Bosi	135	2015	ExxonMobil
Nsiko	100	2015+	Chevron
Uge	110	2016	ExxonMobil