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## Natural Gas as the Best Energy Option for Climate Change Mitigation in Nigeria

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### ABSTRACT

*Natural gas is the best option for mitigating climate change in Nigeria. This study shows that Nigeria is a global player in natural gas endowment having the 9<sup>th</sup> largest gas reserves in the world. The study has highlighted the various advantages of natural gas over petrol and diesel. These advantages include that natural gas emits less carbon emissions, sulphur dioxide, nitrous oxide and air particulates than other fossil fuels. Natural gas is also cheaper and healthier as a domestic fuel and if well deployed by households in Nigeria will greatly reduce thousands of annual deaths emanating from cooking with dirty biomass and kerosene by most of the households in Nigeria. This study shows that gas flaring is a sore aspect of Nigeria's gas industry and gas flaring is likened to assembling Nigeria's precious assets and setting them on fire. Nigeria will only benefit maximally from her gas resource if the necessary gas infrastructure are in place and if desired aspects of the Nigerian 2017 gas policy are fully implemented.*

**Keywords:** *Climate Change, Natural gas, Low Air Pollution*

### INTRODUCTION

Climate change is one of the greatest risks confronting humanity globally. It is a serious environmental and developmental risk. It is one of the greatest challenges of our time as affirmed by The Cancun Agreement (2011). While all countries face climate change impacts, this imperative is particularly urgent for vulnerable communities in developing countries (Caring for Climate Report, 2011). Climate change is exacerbated by the accumulation of greenhouse gases in the atmosphere as a result of human activities such as energy generation, industrialization, transportation, land

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use changes and massive deforestation. Impacts of climate change are already here and are not distant threats. These impacts include rising and more frequent, extreme weather events especially floods, storms, droughts, heat waves and forest fires. According to Intergovernmental Panel on Climate Change (1996) switching to fuels with a low carbon-to-hydrogen ratio, such as from coal to oil or natural gas or from oil to natural gas can reduce emissions. This study is affirming that since energy is the principal problem of the current anthropogenic climate change, the good news is that energy can also be the solution.

The truth is that the global community is dependent on fossil fuels such as coal, petroleum and natural gas. According to the International Energy Agency estimates, wind turbines, solar farms, tidal barriers, geothermal power stations and the likes produced just only 1.3% of global energy in 2013 (The Economist, 2015). So it follows that the bulk of the energy that powers development across the globe is still sourced from coal, petroleum and natural gas.

The true path to follow if the world is to reduce her carbon emissions is to curtail the use of fossil fuels and invest in the use of renewable, and more energy efficient technologies. For example, Human Development Report (2008) suggests that climate change can be mitigated by cutting emissions of carbon dioxide via increased energy efficiency, reduced demand for carbon intensive goods and changes in energy mix. But Stan (2006) prescribes four main ways in which greenhouse gases can be reduced to include:

- i. Reducing demand for emissions- intensive goods and services.
- ii. Increased efficiency
- iii. Avoiding deforestation
- iv. Switching to lower-carbon technologies for power, heat and transport.

Natural gas has many strong qualities such as being relatively clean, relatively cheap and can help in filling world's energy needs during transition to a truly green economy (Walsh, 2011). Switching to natural gas which is the least carbon emission fossil fuels is the best option for Nigeria given that the country is well endowed with high quality natural gas deposits that are located in the various geographic regions of the country. The aim of this work is therefore to make a case for the adoption

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of natural gas as the best energy option for Nigeria in her climate change mitigation goal. Consequently, the objectives of this study include:

- a. highlighting the low carbon qualities of natural gas
- b. presenting the various possible uses of natural gas in Nigeria
- c. Explaining why natural gas is the best energy option for Nigeria in achieving her climate change mitigation goal especially as proposed in her Nationally Determined Contribution (NDC) to the 2015 Paris Climate Change Agreement.

### **Natural Gas Status of Nigeria**

There is no consensus about the total gas reserves of Nigeria. It varies from one source to another and from time to time probably because of different estimation methods employed by the different organizations and operators in the gas sector. This work will therefore attempt to show these varying figures of Nigeria's natural gas reserves. According to Cervigni, Rogers and Henrion (2013), Nigeria is the world's seventh largest gas reserves, with 187 trillion cubic feet (TCF) of high quality proven reserve of which about half is associated gas (AG). But Idigbe and Onwuchi-Iheagwara (2014) in their study of Nigeria's gas assets record that the country has about 225 (TCF) of gas reserves distributed as 105 TCF of associated gas (AG) and 120 TCF of non-associated gas (NAG) Table 1 shows Nigeria's Conventional Natural Gas Reserves.

**Table 1:** Reserves of Conventional Natural Gas

<b>Category</b>	<b>Reserves in (TCF)</b>
Associated Gas (AG)	105.00
Non-Associated Gas (NAG)	120.00
Total	225.00

**Sources:** DPR (2013); Idigbe and Onwuchi – Iheagwara (2014)

Shell in Nigeria's unlocking Nigeria's Potential in Natural Gas (2017) captures Nigeria natural gas reserves as the largest in Africa and the ninth largest in the world with total proven reserve of about 181 trillion cubic feet (TCF).

### **Gas Flaring**

Nigeria is a major gas flaring nation. And gas flaring contributes very high



percentage to the country's carbon emission stock. Indeed, Nigeria flares more natural gas associated with oil extraction than any other country of the world. For example, Nwafor (2006) has observed that the country flares an estimated 2.5 billion cubic feet of associated gas or about of 70 percent of associated gas is wasted by flaring. The contribution of gas flaring by oil companies to carbon emissions is huge and it accounted for more than half of the estimated 96.513 million tons of  $\text{CO}_2$  emissions from industrial sources in Nigeria in 1992 (Jaiyeoba, 2002 and Nwafor 2006).

Also, the World Bank on their account of volume of gas flared in the world admits that Nigeria contributes about 12.5 percent of the total flared natural gas in the world and also flares about four times the volume of natural gas burnt by Saudi Arabia (The Guardian, 31st March, 2006). The good news is that gas flaring in Nigeria is reducing. For example, Egbogah (2013) reports that gas flaring reduced from 68 percent of produced in 1998 to only 37 percent in 2007. And Shell in Nigeria in their publication, *Unlocking Nigeria's Potential in National Gas Reports* (2017) admits reduction in gas flaring volume between 2002 and 2017 to be 90 percent in their areas of operation.

### **Nigerian Liquefied National Gas (NLNG)**

The NLNG was established in 1988 and was incorporated in 1989 with shareholding of 60 percent (NNPC); 20percent (Shell Gas BV); 10 percent (Cleag Limited, now Total Fina Elf LNG Nigeria Ltd); and 10 percent (Agip International NV.BV). But by 1993, the shareholding structure changed and NNPC had (49%) Shell, Elf and Agip (ENI) increased their shares to 25.6, 15 and 10.4 percent respectively.

### **Low Air Pollution Qualities of Natural Gas**

Natural gas has the lowest  $\text{CO}_2$  emissions per unit of energy of all fossil fuels, at about 15kgC/GJ, compared to oil with about 20kgC/GJ and coal with about 25kgC/GJ. Switching from coal to natural gas while maintaining the same fuel-to-electricity conversion efficiency would reduce emissions by 40percent (IPCC, 1996). Wright (2012) submits that in generating electricity from gas, the process releases up to 50percent of less carbon dioxide emissions when compared with coal and switching from petrol to

gas in transportation can produce around 25 percent less carbon dioxide.

Apart from carbon dioxide emissions, fossil fuels especially coal and petroleum yield pollutants in the form of particulates such as nitrogen dioxide and sulphur dioxide. Rooke (1993) notes Natural gas has an advantage over other fossil fuels in that the amount of carbon dioxide per unit of energy used is lower owing to the higher hydrogen to carbon ratio. Sulphur dioxide and nitrogen oxides are major particulates in air whenever fossil fuels such as coal and oil are burnt in air. But with natural gas, the amount of sulphur dioxide released to the atmosphere is very low because the level of sulphur dioxide per unit of energy used when compared with coal and oil products in whatever sector such as power stations, industry, domestic and motor spirit (Rooke, 1993).

Nitrogen Oxides (Nox) are two harmful gases (nitric oxide) (No) and nitrogen dioxide (No<sub>2</sub>). They are associated with acid rain and smog (Kubasek and Silverman (1994). Smog is major air quality issue in many cities especially in China where coal is still the predominant energy source. Early morning smog is becoming observed in many cities of Nigeria but especially in Port Harcourt and Lagos. In Port Harcourt, there is evidence of thick smoke and sooth in the air and on roofs and on canopies of trees. These sooth and smoke whose sources are yet to be scientifically established are evidence of high pollution levels of air around Port Harcourt and environs. Rooke (1993) suggests that one possible remedial measure for pollution from traffics is the use of natural gas vehicles (NGV). Such vehicles have much lower emissions and could be especially beneficial for urban fleets. Rooke (1993) equally makes a case for natural gas as the energy mix of the future interms of its low emissions of NOx, and carbon dioxide and negligible particulate and sulphur dioxide emissions.

Massive deployment of liquefied petroleum gas for domestic cooking will not only reduce greenhouse gas emissions but will also reduce deaths usually attributed to respiratory causes because of indoor smokes associated with cooking with biomass such as wood, charcoal, dung and food residues. Hui and Sanchez (2012) admits that about 2.7 billion people cook with solid biomass and estimated 2 million people die yearly globally due to respiratory illnesses, mostly caused by smoke from biomass. Nigeria is a major consumer of biomass especially as fire

wood and as charcoal. It is estimated that 80 percent of Nigeria's annual demand (51 to 88 million cubic metric) of wood is consumed as fire wood (Report on National Fuel Wood Substitution Programme, 1992). But with increasing population, scarcity and high cost of kerosene many more Nigerians are now cooking with firewood and charcoal even in cities such as Abuja and Lagos.

Consequently, it is now estimated that about 91 percent of rural households and poor urban households now depend on fuel wood and charcoal for their domestic energy needs (Federal Republic of Nigeria, 2002). Nigeria is not only consuming a lot of wood and charcoal but also fast becoming a major exporter of charcoal to India, China and Saudi Arabia as high as 48,000 metric tons of charcoal are produced in between 4-6 months in Kwara State alone (Ibiroga, 2018). Harvesting of wood and charcoal has a lot of environmental impacts on air quality, deforestation and emission of carbon dioxide.

Increasing use of wood and charcoal for cooking by millions of households in Nigeria has serious health implications. For example, Salihu (2012) highlights the impact of cooking smoke in Nigeria that causes over 95,000 deaths annually. According to Salihu (2012) Nigeria experiences the highest number of smoke-related deaths in Africa and cooking smoke-related deaths could be attributed to the third highest killers of women and children in Nigeria after malaria and HIV/AIDs. Cooking-smoke related death in Nigeria is preventable and avoidable if Nigerian households could adopt clean fuel such as liquefied petroleum gas in their daily cooking.

### **Case Studies of Natural Gas Powered Vehicles**

At least two attempts have been made to introduce the use of natural gas in the form of Compressed Natural Gas (CNG) to power vehicles in Nigeria. The first was when Nipco PLC and BORKIR International Gas and Energy Company owned by the Dangote Group in collaboration with the Nigerian Gas Company (a subsidiary of Nigerian National Petroleum Corporation (NNPC)). This partnership led to the provision of various CNG infrastructure in the form of CNG conversion workshops and eight CNG service stations in Benin City. Figure 1 shows one of the CNG Service Stations in Benin City.



Figure 1: One of the CNG Service Stations and workshop located on Aduwawa Road, Benin City. **Source:** Fieldwork 2013.

The second was on the 6th of July, 2017 when a company, THLD International Logistics Limited launched an air-conditioned tricycle powered by liquefied petroleum gas (LPG) at the palace of Oba Adeyeye Ogunwase, the Ooni of Ife in Ile Ife, Osun State. The managing Director THLD, Oluwasegun Olajuwon said that his company was introducing a tricycle capable of accommodating six passengers at once and the THLD vehicles could run on both petrol and LPG as they are fitted with two tanks (Tell July 24, 2017).

Outside Nigeria, SEAT a Barcelona, Spain-based manufacturer is promoting the use of Compressed Natural Gas (CNG) vehicles in Europe. SEAT is highlighting both the economic and ecological qualities of natural gas. The company introduced four CNG models namely; The Mii, the Leon TGI, the Ibiza and the Arona (the worlds only CNG SUV) into the European market in 2018 (Time July 30, 2018). SEAT is also collaborating with Gas Natural Fenosa to increase the number of gas stations in Spain. There are currently millions of gas powered vehicles especially in India, Brazil, Pakistan, Argentina and Iran. Many auto companies including Fiat of Italy, Volkswagen of Germany, Peugeot of France, Toyota of Japan now manufacture and promote Natural Gas Vehicles (NGVs).

Nevertheless, this study clearly shows that natural gas is a fossil

fuel of the future which can serve humanity for many more years even when the current clamour for cleaner energy would have ensured that dirtier fuels such as coal, diesel and petrol are relegated. This is so because natural gas has some unique qualities such as being cleaner, safer and cheaper than other fossil fuels. Natural gas if well utilized as domestic fuel of choice for cooking in Nigeria will save thousands of lives especially those who die because of inhalation of noxious air from their homes while cooking with dirty fuels such as wood, charcoal and kerosene.

Apart from saving lives, massive use of natural gas will also reduce deforestation associated with harvesting of wood and charcoal for cooking. Reducing deforestation is one sure way of reducing carbon emissions in Nigeria because forests sequester carbon. Moreover, forests can be positioned to earn carbon credit and cash under the reduced emissions from deforestation and forest degradation (REDD) platform. Migrating from petrol and diesel to natural gas in Nigeria's transportation sector will greatly reduce carbon emissions in that sector and ensure that the country's strong dependence on foreign refined petroleum products (petrol, diesel and kerosene) are reduced to the barest minimum and ultimately stopped. Importing refined products and associated subsidies drain our foreign exchange. In addition, payments for refined petroleum products are linked to corruption and frauds in our nation. Also, deployment and adoption of natural gas will create millions of technical, distributive and transportation and retail jobs in Nigeria.

## **CONCLUSION AND RECOMMENDATIONS**

Natural gas is energy of the future. It will subsist for many more decades even when other fossil fuels (coal, diesel and petrol) and primary biomass are in decline in the global energy mix. This is so because natural gas is safer, cleaner and cheaper and it is projected to complement renewables such as solar, wind and hydro which are the recommended energy for the green economy and which the 2015 Paris Climate Change Agreement accepted as the energy sources that could ensure that global temperatures do not exceed 2°C or at best 1.5°C by the end of this century in order to avoid possible catastrophic climate change.

For the full benefits of natural gas economy to be realized, the following suggestions must be implemented in Nigeria's natural gas sub-sector. First, Nigeria must have energy policy whose fulcrum is natural gas. Second, the country to consider developing all aspects of natural gas infrastructure including full development of LNG in Brass and Olokola. More gas terminals and pipelines to be built to make natural gas readily available and affordable to consumers including the rural ones. Third, taxes on gas cookers, cylinders and accessories should be reduced to enable every household in Nigeria to want to cook with natural gas. The Eko Gas Scheme of 2013 should be scaled up to enable more Nigerians to embrace cooking with LPG. Fourth, the Benin Pilot CNG for vehicles should be scaled up and implemented nationwide. For this to happen, more awareness should be created on the benefits of CNG powered vehicles especially in respect of safety, cost effectiveness and as the cleanest fossil fuel. Fifth, Nigeria should end gas flaring now. It makes no ecological and economic sense to be burning and wasting our important asset. Indeed, flaring gas is analogous to opening the Central Bank vault and collecting all the currencies (local and foreign) and setting them on fire.

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