



## **ENVIRONMENTAL FRIENDLY USE OF NATURAL GAS: AN ALTERNATIVE SOURCE OF FUEL FOR NIGERIA.**

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### **ABSTRACT**

The Nigerian environment: air, water and land, is heavily polluted by human and natural activities necessary for the sustenance of life and socio-economic practices. Energy production (conversion) and utilization contribute a major portion of the pollutants in the environment. The various forms of energy sources available in Nigeria include forest products, crude oil, natural gas, coal, wind, solar and hydro sources. Pollutants from each source differ in types and concentrations during production and utilization processes. Natural gas, however, is much lower in SO<sub>2</sub>, CO, NO<sub>x</sub>, and particulate matter content than fossil fuels and coal. Non-reactive hydrocarbons are the products of natural gas combustion. This paper discusses the various ways that natural gas can be used for more efficient domestic and commercial applications with minimum damage to the environment.

### **INTRODUCTION**

Natural gas (NG) or Liquefied Natural Gas (LNG) consists primarily of methane and other non-reactive hydrocarbons in the gaseous state at ambient temperature and atmospheric pressure. It can be found in existence with crude oil (associated gas) or free (non-associated gas) on its own. Since whatever form the gas is found, it has to be processed before use as an efficient fuel, environmental consideration for the gas must therefore encompass waste emanating from extraction, refining and application. (DPR, 1991; Telliard et al, (1981); Nwankwo and Irrechukwu, 1981; FEPA, 1991; AGA, 1986). Other fuels have been compared with natural gas and it has been shown that unquestionably natural gas is a clean fuel in all the areas mentioned above (AGA, 1986). It is therefore surprising to find that natural gas has low utility in Nigeria in spite of its abundance and environmental friendly characteristics.

This low domestic and industrial utilization of the gas could be due to its non-availability compared to wood, kerosene, petrol, low pour fuel oil (LPFO), diesel and electricity. These alternative sources contribute significantly to environmental degradation arising from deforestation, emission of solid, liquid and gaseous wastes. Also Government has made huge investments in the production and distribution of electricity, fuel oil and



petroleum products while natural gas remains almost untapped. The provision of Liquefied Petroleum Gas (LPG) is not reliable, widespread, and affordable.

Recent government moves to harness the nation's natural gas through the Liquefied Natural Gas project in Bonny, is still in the construction phase. The Aluminum Smelting plant at Ikot Abasi was designed to use gas as its primary energy source but operated at less than 20% installed capacity due to operational problems including insufficient gas supply among other things. These projects fail due to lack of effective supply of the natural gas necessary to achieve their design objectives and capacity utilization. If we need industrialization and a clean environment, the low level of utilization and the inherent low pollutant content of natural gas should be seen as an incentive by government to encourage production and distribution of natural gas for domestic, industrial and export purposes.

This paper takes a look at the advantages of natural gas as a fuel source; used alone or in combination with other sources. It explores its impact on pollution control and a safe environment and recommends its use as an alternative source of fuel for Nigeria.

### FUEL TYPES AND COMPARISON

Nigeria has many energy sources, some of which have remained underutilized. Proven energy sources include: wood, coal, crude oil and oil products, natural gas, wind and solar. The harnessing of any energy source for effective consumer use follows common process routes such as: extraction, refining, transportation and application. Pollutants are generated at each step of the process, and must be controlled through appropriate government regulations to ensure a safe environment. The methods of control and type of control will depend on whether the waste is solid, liquid or gas. It will also depend on the factors of production such as the technology, raw materials, energy requirement, size of facility and management practices. A fair comparison of the various energy sources or any combination thereof would require standardizing the type of pollutants, their method(s) of control and the factors of production. These standards are enshrined in the Federal Republic of Nigeria Guidelines and Standards for Environmental Pollution Control in Nigeria (Nwankwo and Irrechukwu, 1981). Similar standards are available in most developed and some developing nations and institutions. In the USA the Environmental Protection Agency (EPA) gives the guidelines while in Europe (UK) the Department of Environment (DOE), and in the United Nations, World Health Organization (WHO) formulate and monitor these standards. It is therefore appropriate to use such standards for effective classification and comparison of the pollutants associated with each energy source.

Common to the extraction or production processes of most fuels, except wood, are the following pollutants: drilling mud, cuttings, oil and grease, salinity (Cl), sulphides, turbidity, suspended and dissolved solids, heavy metals, oxygen concentration, organic matter and temperature (Nwankwo and Irrechukwu, 1981; FEPA, 1991). Similar pollutants are produced from the refining and transportation steps. Comparison of natural gas with other fuel sources takes into account the various contaminants and the form of waste in which they are found.

To establish the merit of natural gas as a primary source of environmental friendly fuel consideration is given to the following pollutants:



- Particulates
- Nitrogen Oxides (NO<sub>x</sub>)
- Sulphur Oxides (SO<sub>x</sub>)
- Reactive Hydrocarbons (HC)
- Carbon Monoxide (CO)
- Water Pollutants (dissolved and suspended solids and organics)
- Solid waste (sludge, sand, cuttings, etc.).

Table 1 compares the values of the above pollutants for coal (3.5% sulphur by weight), oil (3% sulphur by weight), solid waste, wood and natural gas.

Table 1  
Typical Uncontrolled Emission Factors for Natural Gas and Other Steam Generator Fuels  
(Pounds per MMBtu Heat Input) (AGA, 1986)

	SO <sub>x</sub>	Particulate	NO <sub>x</sub>	HC	Trace Metals
Coal	5.70	2.54	0.90	0.005	0.009
Oil (residual)	3.22	0.23	0.39	0.01	0.0002
Solid Waste	0.49	3.22	0.31	-	-
Wood	0.02	4.88	0.25	-	-
Natural gas	0.001	0.01	0.23	0.003	0.00

**Advantages:** The superiority of natural gas over other fuel types as a clean fuel is seen in the low overall content of SO<sub>2</sub>, particulate matter, nitrogen oxides, reactive hydrocarbons and trace metal. This means that natural gas will be much cheaper to solve its associated environmental problems than other fossil fuels.

Contrary to long held belief that natural gas is in short supply (low reserves), it has been shown today that these views appear to be wrong. Natural gas is abundant in Nigeria 112 trillion cubic feet (untapped), compared to other fossil fuels; crude oil at 21 billion barrels (Bayero, 1998). We therefore must consider natural gas as an effective and efficient alternative to other fossil fuels in all kinds of uses. The significant economic and environmental advantages associated with it cannot be ignored.

Natural gas has been mixed with other fuels to enhance reduction in the level of pollutants emitted into the environment. The level of emission of SO<sub>2</sub>, which is responsible for acid rain, was reduced by about 50% in 31 states in the USA (AGA, 1986) when natural gas was used in combination with other fuel forms, within a ten-year period. Combined use of natural gas has also been effective in reducing particulates and nitrogen oxides. Moreover, this select use, is highly adaptive to most installations. After all, it is gas that is used during maintenance or seasonal switching and when other forms of fuel are in short supply.

The full cycle environmental impact of natural gas, i.e. from production, processing and distribution or utilization, for residential consumption was carried out in the United States of America. This study revealed that the use of natural gas for space heating and other appliances results in only 15 to 20 percent of the total air emissions and less than one percent of both the total water pollutants and non-combustible solid waste compared with electric appliances (AGA, 1984).



The economic advantages include:

**Low Capital Requirements**  
**Lowest Total Cost**

The installed capital cost for a 240 Megawatt electric power generating stations was compared with a gas combined cycle station of the same capacity. It was found that it costs US\$ 1,700/KW to install a coal-fired electric plant while the corresponding cost for gas fired plant was US\$ 500/KW (Electric Power Research Institute, 1982). The operating and maintenance costs were \$19/KW/yr for coal plant and \$6.50/KW/yr for gas plant fixed cost. The gas plant variable cost was about 50% lower than the coal-fired plant.

*Space Limitations:* The installation of gas systems take up very limited space. It is therefore an added advantage in situations where space is a problem.

*Use of Locally Available Fuels:* It was pointed out earlier that natural gas can be combined with other fuel forms to achieve increased efficiency and reduction in emission to the air. Up to 50% reduction in the sulphur emission of high sulphur coals can be achieved by combined use of natural gas and coal at 70% coal mix.

*Supply Security:* Having more than one fuel offers supply security. If there is disruption in one supply source, the alternate will be available for the continuous operation of the system. It is also possible to negotiate fuel prices knowing that one can fall back on the alternate fuel if the price of the other is economically prohibitive.

There are many advantages in the use of natural gas as a fuel. These advantages include economic, environmental, supply security, technical and competitiveness. Under-utilization of natural gas is therefore not of any advantage to Nigeria. There are sufficient domestic outlets for application as well as export market potentials.

## USE OF NATURAL GAS

Attempt has been made to present natural gas as a fuel form and to compare it with other forms currently in use in Nigeria. It has been shown that natural gas is clean, abundant (112 trillion cubic feet), less expensive in implementation, and versatile in its utilization. It is intended at this point to present some critical areas in which natural gas must be used as a primary source of energy. These areas include:

Domestic Heating  
Industrial Boilers  
Industrial Furnaces and Select Use

### DOMESTIC HEATING

**The Present Situation:** Wood is extensively used as fuel in all parts of Nigeria. This has resulted in significant deforestation and the attendant deleterious consequences on the



environment and agricultural production. The wastes from the full cycle use of firewood include land erosion, flooding, air pollution and water contamination. Today, these problems have assumed dimensions beyond the resources of government to provide immediate solution(s). Tree planting which was intended to stem deforestation has become political ceremonies with annual fanfare for the ruling class.

The switch to kerosene became necessary to urban dwellers who have no immediate and inexpensive source of firewood. Incessant fuel scarcity (kerosene for this matter) render kerosene-burning appliances useless as prices and demand perform their economic functions. Few can afford electrical appliances and they have to face the "NEPA Syndrome" of no power supply or ridiculously low voltage. Ajayi (1998) summarizes the state of NEPA.

There is no solution either in bottled gas, LPG. The fuel scarcity that hindered the use of kerosene also affects the use of LPG. The monetary and psychological hardship encountered with the present domestic fuel use calls for a review.

**What is Needed:** The recognition of the advantages of natural gas over other fuel forms suggests that natural gas should be used for heating at homes. Government and/or private investors should build gas processing plants and set up a distribution network of pipes to individual homes. This will follow in the form of water and electricity distribution network. Appropriate metering of consumption for the purpose of tariff collection should be put in place. This will provide clean and less expensive energy source for the home.

The gas system can be used for cooking, water heating, clothes drying, etc, for which electricity is presently, the primary fuel. The use of natural gas will provide 30% to 40% reduction in cost for the end user and 50% reduction against electric resistance heat (AGA, 1986).

Natural gas system, in total fuel cycle, is superior to electric heating sources in terms of objectionable discharges in residential space. About 300% to 450% efficiency in NO<sub>x</sub>, SO<sub>x</sub> and suspended particulates can be obtained with gas compared with oil; the advantage is 120% to 220% on the discharge characteristics (AGA, 1985a, 1985b). These advantages are bound to increase as technological improvements in appliance design will bring about more efficient systems for residential users.

#### INDUSTRIAL BOILERS

Natural gas is economically and environmentally preferable to coal for use in most industrial boiler applications. The seeming low cost of coal is offset by the low capital cost associated with gas systems. The near absence of particulate matter in gas burning systems is equally attractive: scrubbers will be eliminated. The recent call for private sector participation in the nations power generation and distribution by government gives the use of gas or coal as a pre-condition for interested investors (The Guardian, 1999).

#### INDUSTRIAL FURNACES AND SELECT USE

Great advantages come to industries that adopt natural gas systems. The abundance of natural gas would be of immense advantage to industries utilizing high temperature



operations. The simplicity in technology and operation of gas fired furnaces will also be useful to these industries.

Dual fuel burners for fuel security.

Adaptation of mixed fuel for better and cleaner environment.

Flexibility in siting plants in or near residential areas / non-attainment areas.

Decrease dependence on imported energy (such as refined petroleum products).

These advantages will result in potential reduction in actual fuel cost and increased profit margin while preserving the environment.

### CONCLUSIONS

Natural gas is abundant in Nigeria and is largely untapped. The full cycle fuel use of natural gas offers excellent advantages in terms of clean environment, low cost overall and flexibility in technology over other forms of fossil fuel. Natural gas processing projects have not been effectively pursued by government and as a result, domestic use of natural gas is not achieved. Significant economic and social benefits would be derived by industries using natural gas as a primary source of energy or in select use with other forms of fuel.

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