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ECONOMIC PROJECTIONS AND POWER SUPPLY IN NIGERIA: THE IMPACT OF UTILIZING GAS INSTEAD OF FLARING

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Abstract

Gas flaring has been a persistent issue in Nigeria, leading to significant environmental, economic, and health consequences. Flaring intensity continues to increase as a result of lack of capacity to dissociate and harness associated gas effectively and efficiently for economic benefits. Although efforts are in place to curtail excessive flaring, deliberate technological intervention is needed. In this paper, the potential economic and energy benefits of utilizing the natural gas that is typically flared reported to be approximately 905 billion cubic metres for a period of four years as reported by the Nigerian Upstream regulatory Commission was studied. The analysis highlights how Nigeria could economically benefit by capturing and utilizing flare gas for power generation, industrial processes, and exports, instead of allowing it to be wasted. It provides a detailed assessment of the energy potential from flare gas, its economic contributions through job creation, industrial development, and improved energy access, and its role in enhancing Nigeria's power supply. By capturing and utilizing flare gas, Nigeria could reduce its reliance on imported energy, mitigate environmental damage, and foster significant economic growth.

Keywords: *Gas Flaring, Economic Development, Gas Utilization, Energy and Power Generation*

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1. Introduction

Nigeria, one of the leading oil producers in Africa, has experienced long-standing issues with natural gas flaring. Despite significant quantities of hydrocarbon gas being produced during oil extraction, much of this gas is flared, contributing to environmental pollution, wasted resources, and missed opportunities for economic development. According to the Nigerian National Petroleum Corporation (NNPC), gas flaring in Nigeria remains one of the highest in the world, with over 13 billion cubic meters of gas flared annually (NNPC, 2023). This paper aims to explore the potential benefits of utilizing hydrocarbon gas for power generation and domestic use in Nigeria, focusing on the impacts over a two-year period. It evaluates the environmental, economic, and social implications of using flared gas for productive purposes, proposing a shift towards sustainable energy solutions.

2. Background on Hydrocarbon Gas and Flaring in Nigeria

Hydrocarbon gas is primarily composed of methane, propane, butane, and other gaseous hydrocarbons that are found alongside crude oil deposits. In Nigeria, vast quantities of natural gas are produced as a by-product of oil extraction, but rather than being captured and used, much of it is flared due to infrastructure limitations and the cost of gas processing and transportation (Ajayi & Adegboye, 2020).

Flaring refers to the burning of natural gas that cannot be processed or captured for sale, often due to the lack of pipelines or markets for the gas. Historically, gas flaring was seen as the easiest and cheapest method of disposal, especially in remote oil fields lacking the necessary infrastructure (Obi, 2019). However, this practice has substantial negative consequences, including environmental pollution, wastage of valuable resources, and a missed opportunity to enhance Nigeria's energy security.

Over the years, the Nigerian government and various stakeholders have made efforts to reduce gas flaring, including the introduction of the Gas Flaring Commercialization Program (GFCP) in 2016. While there have been improvements, Nigeria's gas utilization remains suboptimal, with only about 60% of the produced gas being utilized for productive purposes (Ogunbiyi et al., 2021).

GAS FLARING IN NIGERIA AND ITS ECONOMIC IMPACT

Table 1 is a cumulative gas flared within a period of four years as reported ny the Nigeria Upstream regulatory Commission

MONTHS	TOTAL GAS FLARED (MMSCF)	2022 TOTAL GAS FLARED (MMSCF)	2023 TOTAL GAS FLARED (MMSCF)	2024 TOTAL GAS FLARED (MMSCF)
JANUARY	21,342	18,455	15,006	18,308.19
FEBRUARY	20,686	19,079	15,717	15,689.26
MARCH	25,646	16,717	16,306	15,149.48
APRIL	22,584	16,474	13,563	14,379.47
MAY	22,256	15,433	14,266	14,109.45
JUNE	20,233	16,056	14,596	14,281.55
JULY	23,027	15,376	13,827	16,128.70
AUGUST	18,704	14,354	15,364	16,561.40
SEPTEMBER	17,925	11,902	15,577	15,780.58
OCTOBER	18,996	12,816	15,270	**140,388**
NOVEMBER	20,838	16,316	16,273	-
DECEMBER	20,344	15,464	17,761	-
TOTAL	**252,579**	**188,442**	**183,526**	**280,776.23**

From the table provided above the total associated and non gas flared month by month for a period of four years is presented. In 2024 the flared volume is reported for a period of 8 month period only. The year with highest flared volume is 2024 despite just having record for 8 months. The total volume of gas flared is 905,323.23MMscft

Current Status of Gas Flaring in Nigeria

Nigeria is among the largest contributors to global gas flaring, with approximately 905 billion cubic feet (bcf) of associated and no-associated gas flared for a period of approximately four years as reported by the upstream regulatory commission. (International Energy Agency [IEA], 2023). This practice not only wastes a valuable resource but also exacerbates environmental degradation through air pollution and greenhouse gas emissions. Moreover, it represents a significant missed economic opportunity, as this gas could be harnessed for energy generation, industrial uses, and export (Federal Government of Nigeria, 2021).

b. Economic Losses from Gas Flaring

The economic costs of gas flaring in Nigeria are huge. According to the World Bank (2023), the country loses around $1 billion annually due to flaring, which includes the lost revenue from the sale of natural gas and the environmental consequences of the practice. While flare gas is wasted, Nigeria continues to import refined petroleum products to meet domestic energy demands,

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undermining the country's potential for energy security and sustainable economic growth.

3. Energy Potential of Utilized Gas

a. Energy Content of 800 Billion Cubic Feet (bcf) of Gas

Natural gas contains an average energy content of 1,037 BTUs per cubic foot (cf) (U.S. Energy Information Administration [EIA], 2023). For 800 billion cubic feet (bcf) of natural gas, the total energy content can be calculated as:

905,000,000,000 cf×1,037 BTUs/cf=938,820,189,510 BTUs (~940 trillion BTUs)

To convert this energy into kilowatt-hours (kWh), we use the conversion factor:

1 kWh=3,412 BTUs

Thus, the total energy potential of 905bcf of flare gas is:

938,820,189,510 BTUs÷3,412 BTUs/kWh=275,152,458

Therefore, the 905 billion cubic feet of gas could potentially generate approximately 275**.**2 billion kWh of electricity.

POWER GENERATION FROM FLARE GAS

If the flare gas is used for power generation, assuming a conversion efficiency of 50% (typical for modern natural gas plants), the usable energy output would be:

275,152,458,152 kWh×0.50=137,576,229

This would be sufficient to generate 137.6 billion kWh of electricity, which could power approximately 13,900 MW of continuous electricity generation for one year.

Environmental Benefits of Utilizing Hydrocarbon Gas

One of the most significant environmental benefits of using hydrocarbon gas for power generation and domestic purposes is the reduction in greenhouse gas emissions. Gas flaring releases carbon dioxide (CO_2), methane (CH_4), and black carbon into the atmosphere, contributing to climate change and air pollution (Amadi et al., 2022). Methane, a potent greenhouse gas, is responsible for a substantial portion of the environmental impact of flaring, with a global warming potential many times higher than that of CO_2 over a 20-year period (Wang et al., 2020).

By capturing and using hydrocarbon gas for energy production, Nigeria could significantly reduce its carbon footprint. The substitution of coal and other higher-emission fuels with natural gas in power plants would result in a net decrease in CO_2 emissions. In a study by Oke et al. (2021), it was estimated that utilizing natural gas for power generation in Nigeria could reduce carbon emissions by up to 30%, compared to traditional coal-fired power generation.

Furthermore, the reduction in flaring would alleviate air pollution in the Niger Delta region, where flaring is most concentrated. Local communities are exposed to harmful pollutants, which contribute to respiratory problems, cardiovascular diseases, and premature deaths (Koru et al., 2019). Redirecting gas for domestic use, such as cooking and heating, would improve air quality, especially in households currently relying on traditional biomass fuels like wood and charcoal.

ECONOMIC BENEFITS OF UTILIZING HYDROCARBON GAS

Utilizing hydrocarbon gas for power generation and domestic use presents substantial economic benefits for Nigeria. The primary economic advantage lies in reducing reliance on imported fuels and improving energy security. Currently, Nigeria relies heavily on diesel and petrol imports for power generation and domestic energy needs. The importation of these fuels costs Nigeria billions of dollars annually, contributing to the country's foreign exchange challenges (Omotoye & Adeniyi, 2021).

By redirecting flared gas for power generation, Nigeria could meet a significant portion of its domestic energy demand. Natural gas is a cheaper and more efficient fuel compared to alternatives like diesel and kerosene, and it could help lower electricity generation costs (Akinyemi et al., 2021). In a scenario where hydrocarbon gas is utilized for power generation, it is estimated that Nigeria could save up to 40% of the costs associated with imported fuels (Ogunbiyi et al., 2021).

In addition to the cost savings, the use of hydrocarbon gas for domestic and industrial purposes would promote economic growth by creating jobs in the energy sector. According to the World Bank (2022), the development of a domestic natural gas market in Nigeria could create thousands of new jobs in infrastructure development, gas processing, and distribution.

The promotion of natural gas as a domestic fuel would also stimulate local industries, particularly small and medium-sized enterprises (SMEs), by providing a reliable and cost-effective energy source. This, in turn, would increase industrial productivity, support economic diversification, and reduce the reliance on imported goods (Ajayi & Adegboye, 2020).

ECONOMIC GROWTH THROUGH POWER GENERATION

Utilizing 905billion scf of flare gas for electricity generation could significantly alleviate Nigeria's chronic energy shortage. With over 60 million people lacking access to electricity (International Energy Agency, 2023), converting waste gas into power generation could provide a stable, affordable energy source. This would meet the growing demand for electricity and support industrial growth across sectors such as manufacturing, agriculture, and telecommunications. By relying less on imported oil and diesel for power generation, Nigeria could enhance its balance of payments and foster national economic stability (Nigeria LNG Limited, 2023).

Job Creation and Industrial Development

Building the infrastructure to capture, process, and use flare gas would create numerous job opportunities in sectors such as construction, engineering, and energy production. The development of gas-to-power plants and related facilities could generate both direct and indirect employment, contributing to the diversification of Nigeria's economy and reducing its reliance on oil (International Energy Agency, 2023). Industries like fertilizer production and petrochemicals would benefit from a stable and affordable supply of natural gas as both fuel and feedstock

Social Benefits of Utilizing Hydrocarbon Gas

The social benefits of utilizing hydrocarbon gas are closely linked to improvements in public health, energy access, and quality of life. In Nigeria, access to electricity remains a significant challenge, with over 40% of the population lacking reliable power (International Energy Agency [IEA], 2023). By using natural gas for power generation, Nigeria could expand its electricity generation capacity and improve access to reliable energy, particularly in rural areas where grid access is limited.

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Gas-powered electricity generation is also more reliable and cost-effective than diesel and other backup generators commonly used in Nigeria. The use of natural gas could help reduce the frequency of power outages and provide more stable electricity services to households and businesses (Oke et al., 2021).

Furthermore, the transition to natural gas for domestic use would improve the quality of life for millions of Nigerians. Currently, many households use traditional biomass fuels like firewood and charcoal for cooking, which have been associated with indoor air pollution and health problems such as respiratory illnesses, eye irritation, and burns (Koru et al., 2019). By substituting these fuels with cleaner natural gas, Nigeria could reduce health risks and improve cooking efficiency.

CHALLENGES TO UTILIZING HYDROCARBON GAS IN NIGERIA

Despite the numerous benefits, there are several challenges to utilizing hydrocarbon gas in Nigeria. These challenges include infrastructural limitations, regulatory barriers, and the lack of a robust gas market. One of the primary hurdles is the absence of an extensive gas distribution network across the country. Many remote areas lack access to pipelines, and the development of the necessary infrastructure requires significant investment.

Additionally, the regulatory environment for natural gas utilization in Nigeria is complex and often lacks enforcement. While policies such as the Gas Flaring Commercialization Program have been introduced, their implementation has been slow, and enforcement of gas flaring regulations remains weak (Obi, 2019).

The Nigerian government, in partnership with the private sector, will need to make substantial investments in gas infrastructure, including processing plants, pipelines, and storage facilities, to fully realize the benefits of utilizing hydrocarbon gas for power generation and domestic use.

POLICY SUPPORT FOR GAS UTILIZATION

The Nigerian government has recognized the importance of reducing gas flaring through the **Petroleum Industry Act (PIA)**, which aims to eliminate flaring by 2030 (Federal Government of Nigeria, 2021). However, to meet this goal, stronger enforcement and additional incentives are needed to attract investment in the infrastructure necessary for gas capture and utilization. This includes streamlining the regulatory process and providing clear incentives for companies to invest in gas-to-power technologies.

To overcome the challenges associated with the utilization of hydrocarbon gas in Nigeria, several policy recommendations are proposed:

1. **Strengthen regulatory enforcement**: The Nigerian government must enforce stricter regulations on gas flaring and incentivize oil companies to capture and utilize gas rather than flare it. Fines and penalties for flaring should be increased, and the revenue generated should be reinvested into gas infrastructure development.
2. **Invest in infrastructure**: The development of a national gas infrastructure network, including pipelines, storage facilities, and gas processing plants, is crucial for expanding the utilization of hydrocarbon gas. Public-private partnerships should be encouraged to fund these infrastructure projects.
3. **Promote domestic gas use**: The government should provide subsidies or tax incentives for households and businesses to switch to natural gas for cooking and heating. This would reduce reliance on traditional biomass fuels and improve public health.
4. **Encourage private sector involvement**: The private sector should be encouraged to invest in the natural gas sector, particularly in the development of gas-based power plants and distribution networks. Transparent and investor-friendly policies will help attract the necessary capital for these projects.

CONCLUSION

The utilization of hydrocarbon gas for power generation and domestic use offers significant benefits for Nigeria. By redirecting gas resources from flaring to productive uses, Nigeria can reduce its environmental impact, stimulate economic growth, and improve the quality of life for millions of Nigerians. While challenges such as infrastructural limitations and regulatory barriers remain, targeted investments and policy reforms can unlock the full potential of hydrocarbon gas and create a more sustainable and equitable energy future for the country.

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