



# Bayelsa Gas Evolution: A Catalyst for Industrialization, Job Creation and Energy Sufficiency

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## ABSTRACT

Most of the regions in Nigeria have huge deposits of natural resources that are liable of transforming them from agrarian society into industrialized state. Notwithstanding, poor utility and management can be detrimental to the ecosystem. Efficient utilization can result in job creation, energy efficiency and sustained livelihood. In this study, questionnaires were administered in the three LGAs of the State to ascertain the effect of gas evolution: a catalyst for industrialization and job creation. Mean and Standard deviation were used for analysis while a one-way ANOVA was used to test the result of the null hypotheses; there is no significant difference between the responses from the three different LGAs. The result indicates that there is little or no awareness regarding the use of gas (LPG, CNG and Biogas) for electricity generation and as automotive fuel in the state and the recent increase in the market value of goods is affiliated to the increased gasoline/diesel price. Furthermore, if flared gases and biomasses generated from industrial and commercial waste are commercialized, it will not only boost the nation's economy but also salvage the problem of unemployment and energy inefficiency.

Keywords: Industrialization, Gas Flaring, Gas Evolution, Biomass

## 1 Introduction

The current economic state of Nigeria resulting from fossil fuel subsidy removal especially gasoline, kerosene and diesel (which are the basic energy sources for automotive engines for electricity generation, transportation and cooking) is a wake-up call for harnessing and investing in other energy generation sources which are not only cheaper but also sustainable and eco- friendly. Most of the transport and private vehicles in Nigeria run on petrol or diesel and only a hand full of imported cars use gas. Presently, the pump price of gasoline is about N1000 to N1100 for independent marketers depending on the state and location. More also, diesel price is approximately N1200 per litre while kerosene is sold for N1250 per litre. This has led to an increase in transportation price impeding the mobility of majority of citizens and giving rise to an exponential increase in the market value of goods and services. The resulting effect being increased poverty and crime rate. Recent data from the World Bank paints a sobering picture; out of a population exceeding 200 million over 104 million Nigerians live below the poverty line (ERA, 2005). The federal government in a means to cob the present hunger situation resolved that most of the cars in Nigeria be converted to run on gas rather than gasoline and diesel. These fossil fuel products; liquefied petroleum gas (LPG) and compressed natural gas (CNG) are a lot economical when utilized as transport fuel and also for electricity generation. Studies have shown that, in terms of fuel consumption about 20 -50% can be saved running and engine on the aforementioned gases compares to running the same engine on gasoline. This minimized operating cost over a long-term period can be beneficial not only to individuals but also entrepreneurs. Apart from LPG and CNG gases, engines can run on other gases like bio-methane which is generated from biomasses respectively. The major draw backs of utilizing these products are limited refilling stations; distribution mode; poor expertise in the engine conversion techniques of gasoline/diesel engines and lack of awareness of rural based citizens. In regions rich in natural minerals and good vegetation, harnessing these minerals and ensuring proper conversion of the considered waste into energy generation sources to prevent environmental hazard is pertinent as this can be a means of further industrialization, job creation and efficient energy management. Gas flaring and indiscriminate disposal of biomasses like Palm Oil Mill Effluent (POME) etc. are major areas of concern. Several studies have been conducted in the light of this. some studies conducted depicted that gas is a favoured feed stock for many Petrochemical industries from which a variety of products can be derived [7]. It is only these gas-based petrochemical complexes/industries that can consume the large volumes of natural gas needed to eliminate flaring. Natural gas flaring (a practice where by unutilized hydrocarbon gases associated with crude are discharged into the atmosphere mainly by burning) is as old as the petroleum industry in Nigeria. Apart from the climatic and health related issues it poses, it is also a huge economic waste because it is an important energy source and petrochemical feedstock that can salvage the economic crisis. Another work was carried out using Methanol Based Process to generate Natural Gas and Liquefied Petroleum Gas from Gas Flare [8]. An energy integrated methanol-based gas processing method for treatment and recovery of Liquefied Petroleum Gas (LPG) using a high flaring intensity close to an existing gas pipeline was achieved. ASPEN HYSYS V9 Cubic Plus Association (CPA) and equation of state was used to optimally predict methanol (used as a hydrate inhibitor) partitioning in the methanol-hydrocarbon system. This process produced of natural gas, LPG, and stabilized condensate in line with Nigerian gas transport code specifications. The equipment count in comparison to other gas processing schemes, operational flexibility, and ease of scalability indicates that it is an economic technology that will be well suited for solving the gas flare scenario in the Nigeria. Natural gas as an engine

for growth (UNCTAD XII, 2012) exposes the numeral dangers associated with flared gases and concluded that, monetizing these resources would be beneficial because of its economic and environmental value like reduction in greenhouse gas emissions, creation of export opportunities for developing countries, production of energy products like LPG among others.

## **2. Materials and Method**

### **2.1 Description of Study Area**

The Niger Delta is one of the major hydrocarbon provinces in the world with an estimated reserve of about 23 billion barrels of oil and 18 trillion cubic meters. Bayelsa, a state located in the heart of Niger Delta is where oil was first discovered in Nigeria in Oloibiri oilfield. Even though it accounts for about one percent of Nigeria's population, it produces between 18-20% of oil generating an output of around 290,000 barrels per day as well as 18 trillion cubic feet of gas (NEITL, 2019). The State which was created October 1<sup>st</sup> 1996 located in the south-south region of Nigeria was carved from Rivers state landmass, 10,773km<sup>3</sup>. Apart from its riches in hydrocarbon, it is also blessed with good vegetation and has extensive commercial fishing industries and produces oil palm, raffia, palm rubber and coconut making the region a favourable location for siting gas industries. This will pave way for industrialization, transforming the state from an agrarian society into industrialized society manufacturing useful products and creating jobs for the citizens while efficiently utilizing the available energy sources and managing the generated wastes.

### **2.2 Gas classification and characteristics:**

The major cases in this study are LPG, CNG and biomethane.

#### **2.2.1 Properties of LPG:**

LPG is a fuel that contains a flammable mixture of hydrocarbon gases especially propane, n-butane and isobutene and can also contain butylene and propylene. It can be used in heating appliances, cooking equipment, vehicles etc. it is prepared by refining petroleum or wet natural gas and is almost entirely derived from fossil fuel sources being manufactured during the refining of petroleum (crude oil) or extracted from petroleum or natural gas streams as they emerge from the ground. It provides about 35% of all energy consumed and burns clearly with no soot and very little sulphur emissions.

#### **2.2.2 Properties of CNG:**

compressed natural gas is a fuel mainly composed of methane, compressed to less than 1% the volume it occupies at standard atmospheric pressure. It is stored and distributed in containers at 20-25MPa or 2900-3600Psi. It poses less treat in the event of spill because it is lighter than air and disperses quickly when released.

#### **2.2.3 Biomethane:**

Bio-methane is the gas obtained from the purification of biogas:- a gas produced from the anaerobic digestion (AD) of biomasses. Biomass is any material generated from plant and animal including their waste. It can be converted to energy via several conversion techniques such as: pyrolysis, gasification, combustion and anaerobic digestion (AD) in the presence or absence of oxygen. AD is the conversion of biomass in the absence of oxygen to produce a saleable product called biogas; the biogas is a constituent of about 30-40% carbon dioxide (CO<sub>2</sub>) and 50-60% methane (CH<sub>4</sub>) and other gases like Ammonia (NH<sub>3</sub>), Nitrogen (N<sub>2</sub>) and water (H<sub>2</sub>O) in minute quantity. The gas when purified (by removing all the other gases except methane) becomes bio methane and gains application in automobiles and can also be used as fuel for cooking, electricity generation etc.

### **2.3. Current trends in Nigeria Energy generation:**

A greater volume of gas is flared in Nigeria than any other petroleum exporting countries in the world. Over billions of cubic feet of gas associated with crude oil is wasted every day which is equal to 40% of all Africa's gas consumption and annual financial loss to the country. The flared gas has contributed more greenhouse gas than other sub Saharan Africa combined and also generates toxins that affects the health and livelihood of the indigenous communities exposing them to respiratory related diseases, cancer and premature deaths. Development of gas reserves and facilities for transporting the gas to utility sites in locations where the crude is refined will be a mitigation measure for these health and environmental hazards and also industrialize the host communities. Other Organization of the Petroleum exporting Countries (OPEC) countries have made effort to these flared gases to useful energy generation sources, Saudi in the past was recorded to flare about 80% of tits generated gas, however, initiated a major programme for natural gas industrialization in 1977 across all seven ethylene-based petrochemical plants and also built three nitrogenous fertilizer plants leading to a drastic reduction in gas flaring. Iraq has also built two fertilizer plants using gas feedstock for producing ammonia, urea, various petrochemicals, high and low density polyethylene and polyvinyl chloride (PVC). Lybia has built two major plants one with a capacity of 1,000 TPA of ammonia and the other with a similar capacity to manufacture methanol. Also, a petrochemical manufacturing complex was set up which manufactures among others 60,000 TPA of PVC alongside a gas separation plant for producing 23,500 TPA of propane and 350,000 TPA of butane.

Iran now has a gas-based fertilizer plant that produces 440,000 TPA of ammonia, and 550,000 TPA of urea. Alongside a petrochemical plant which treats 'sour' gas from the offshore fields and produces 230,000 TPA of sulphur and 200,000 TPA of LP. An expansion programme has been initiated to raise outputs to 460,000 TPA of sulphur and 590,000 TPA, of LPG for exports. Another petrochemical complex treats gas to produce olefins, aromatics and 60,000 TPA of PVC, as well as urea and ammonia. Carbon black is manufactured also, in a plant with a capacity of 15,000 TPA.

Biogas technology is still in its infancy in Africa. Recent initiative has resulted in accelerated uptake and understanding of the technology; few countries have implemented biogas programmes like Kenya, Uganda, Ethiopia, Rwanda, Cameroon, Burkinafaso and Benin etc. In South Africa, 38 biogas production operation (predominantly of fixed dome type) are registered by national energy Regulator of South Africa. Home and office size biogas plants are on sale in the market that is affordable for average citizens. In Nigeria, the technology has not yet gained popularity and in states where some plants are sited, it is majorly in Institutions as outcomes of experimental research or private individuals who use it in their homes for cooking. Only a few persons have developed the skills on using it for electricity generation. Small biogas plant can be found in big cities like Abuja, Lagos, Port Harcourt etc but not in the rural communities. Majority of the masses rely on cow dung and poultry waste from their farms as the feedstock for gas production ignoring the enormous energy that can be generated from the large mass of daily waste generate from their farms and municipal waste. Bayelsa state, because of its good vegetation and location, it generations large tonnes of waste that if properly harnessed can generate energy for all the homes and businesses and commercialize the reserves.

#### 2.4. Research design

In order to investigate the positive impact of gas evolution geared towards industrialization and job creation for the indigenous communities in Bayelsa State; a four-point scale questionnaire (strongly agreed, agreed, disagreed and strongly disagreed) was generated and administered. The collected data was analysed statistically using an average mean acceptance mean of 2.5, standard deviation and one way ANOVA. Table 3.1- 3.10 shows the demography of the respondents and the results of the analysis respectively.

### 3 Results and Discussions

#### 3.1 Results

Table 3.1: Background information of the respondents that participated in the exercise

Gender	Respondent	Frequency (%)
Female	66	47.1
Male	74	58.9
Total	140	100

Table 3.2: Background information of the marital status of the respondent

Marital Status	Respondent	Frequency (%)
Single	67	47.9
Married	68	48.6
Divorced	5	3.5
Total	140	100

#### Research Question 1

In your opinion what is the major cause of the recent increase in transportation in Bayelsa state?

Table 3.3 Mean and Standard deviation of the respondents from three LGA

S/N	Item	BRASS				SAGBAMA				YENAGOA			
		N	x	SD	Decision	N	x	SD	Decision	N	x	SD	Decision
1	Present price of vehicle spare parts is too high for the masses.	37	3.13	0.77	AGREE	71	3.14	0.56	AGREE	32	3.16	0.84	AGREE

2	The transport vehicles are too few for the masses	37	2.21	0.54	DISAGREE	71	3.25	0.56	AGREE	32	2.19	0.54	DISAGREE
3	The poor road condition is affecting the market price	37	2.51	0.67	AGREE	71	3.36	0.58	AGREE	32	2.02	0.50	DISAGREE
4	The current Petrol/diesel pump price is related to the subsidy removal	37	3.32	0.79	AGREE	71	3.23	0.56	AGREE	32	3.25	0.86	AGREE
5	The pump price of petrol/diesel is high for the poor masses	37	3.54	0.87	AGREE	71	3.53	0.63	AGREE	32	3.54	0.96	AGREE
6	The maintenance and repair cost of cars is moderate	37	3.18	0.77	AGREE	71	3.16	0.56	AGREE	32	3.12	0.84	AGREE
7	The tax force charges are relatively high	37	3.32	0.87	AGREE	71	3.30	0.57	AGREE	32	3.29	0.87	AGREE

**Research Question 2**

How has gas flaring influenced the condition of the people?

H<sub>03</sub>: There is no significant difference in respondents' (from the three LGAs) assessment of the major causes of the recent increase in transportation in Bayelsa state.

H<sub>03</sub>: There is no significant difference in the respondents' (from the three LGAs) assessment of the effect of gas flaring on the condition of the people.

H<sub>03</sub>: There is no significant difference in the respondents' (from the three LGAs) assessment of the level of awareness of the citizens in utilizing LPG, CNG and Biomethane state.

H<sub>03</sub>: There is no significant difference in the respondents' (from the three LGAs) assessment of how Bayelsa gas evolution has generated employment for the indigenous people

Table 3.4: Mean and Standard deviation of the respondents from three LGA

S/N	Item	BRASS				SAGBAMA				YENAGOA			
		N	x	SD	Decision	N	x	SD	Decision	N	x	SD	Decision
8	The increase rate of cancer is associated with gas flaring	37	2.50	0.61	AGREE	71	2.30	0.57	DIAGREE	32	2.29	0.56	DISAGREE
9	Most respiratory tract infections are associated with gas flaring	37	3.16	0.78	AGREE	71	3.12	0.77	AGREE	32	3.16	0.78	AGREE
10	Premature mortality rate is as a result of gas flaring	37	2.21	0.54	DISAGREE	71	3.18	0.78	AGREE	32	3.22	0.79	AGREE
11	The recent change in climatic is caused by gas flaring	37	3.40	0.84	AGREE	71	3.42	0.84	AGREE	32	3.45	0.85	AGREE
12	Farmers experience poor crop harvest due to gas flaring	37	3.37	0.83	AGREE	71	3.38	0.83	AGREE	32	3.38	0.83	AGREE

**Research Question 3**

What is the level of awareness of the citizens in utilizing LPG, CNG and Biomethane?

Table 3.5: Mean and Standard deviation of the respondents from three LGA

S/N	Item	BRASS				SAGBAMA				YENAGOA			
		N	X	SD	Decision	N	X	SD	Decision	N	X	SD	Decision
13	Majority of the vehicles in the state run on gas	37	2.35	0.58	DISAGREE	71	1.02	0.25	DISAGREE	32	2.09	0.51	DISAGREE
14	There are a good number of gas refilling stations	37	1.37	0.34	DISAGREE	71	2.36	0.58	DISAGREE	32	2.25	0.55	DISAGREE
15	The gas conversion kit is provided for all citizens	37	1.23	0.30	DISAGREE	71	1.23	0.32	DISAGREE	32	1.29	0.32	DISAGREE
16	There are a good number of experts handling petrol engine conversion.	37	2.18	0.54	DISAGREE	71	2.21	0.54	DISAGREE	32	2.22	0.55	DISAGREE
17	There are on-going sensitization programs on the efficiency of gas utility	37	2.04	0.50	DISAGREE	71	2.19	0.54	DISAGREE	32	1.19	0.29	DISAGREE
18	There are biogas refilling stations in the city	37	1.21	0.30	DISAGREE	71	1.23	0.30	DISAGREE	32	2.17	0.53	DISAGREE
19	More than 50% of household have a portable biogas plant	37	1.08	0.27	DISAGREE	71	1.08		DISAGREE	32	2.09	0.51	DISAGREE

**Research Question 4**

In what way has Bayelsa gas evolution generated employment for the indigenous people?

Table 3.6: Mean and Standard deviation of the respondents from three LGA

S/N	Item	BRASS				SAGBAMA				YENAGOA			
		N	X	SD	Decision	N	X	SD	Decision	N	X	SD	Decision
20	There are gas based petrochemical industries in the state	37	1.10	0.27	DISAGREE	71	2.09	0.51	DISAGREE	32	2.09	0.51	DISAGREE
21	There are gas based fertilizer plants in the state	37	1.54	0.38	DISAGREE	71	2.38	0.58	DISAGREE	32	2.38	0.58	DISAGREE

22	Majority of the jobs are energy related	37	2.13	0.52	DISAGR EE	71	1.37	0.3 4	DISAGR EE	32	1.90	0.44	DISAGR EE
23	Majority of the populace work in gas industries.	37	2.40	0.59	DISAGR EE	71	2.10	0. 52	DISAGR EE	32	2.28	0.56	DISAGR EE

A one-way ANOVA was used to analyse the obtained results at 0.05 level of significance and four hypotheses were put forth herein.

Table 3.7: ANOVA for question 1

Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	0.173217	2	0.086608	0.734194	0.506562	4.256495
Within Groups	1.061675	9	0.117964			
Total	1.234892	11				

Table 3.8: ANOVA for question 2

Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	0.08848	2	0.04424	0.184893	0.833517	3.885294
Within Groups	2.87128	12	0.239273			
Total	2.95976	14				

Table 3.9: ANOVA for question 3

Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	0.348838	2	0.174419	0.613469	0.55241	3.554557
Within Groups	5.117686	18	0.284316			
Total	5.466524	20				

Table 3.10: ANOVA for question 4

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.418717	2	0.209358	0.818072	0.471587	4.256495
Within Groups	2.30325	9	0.255917			
Total	2.721967	11				

### 3.2 Discussions

There is no great difference in the mean values for all four samples. For the first the values are 3.03, 3.27 and 3.3 with a p- value of approximately 0.51. The second had mean values of 2.92, 3.08 and 3.1 with a corresponding p-value of 0.83; the third had mean values of 1.64, 1.62 and 1.9 and a p- value of 0.55 while the last had mean values of 1.81, 1.74 and 2.16 with a p- value of 0.47. The p- values for all sample is greater than the 0.05 which means the null hypotheses is accepted. This is an indication that the pump price has a greater influence on the increased price of transportation in the state amidst other factors like increase servicing cost which are also associated with the fuel price. Secondly, most of the health-related issues like increased cancer rate and other respiratory diseases and pre mature mortality can be related to gas flaring in the state. More so, the people are ignorant on other promising alternative energy sources like gas; the few who are aware have changes with acquiring the gas conversion kits and those who are able to purchase it have

problem with installation and repair facilities. Finally, the Federal Government of Nigeria has taken lightly the problem associated with gas flaring and riches tied to it.

#### 4 Conclusions

Gas generated from crude operations instead of being flared causing both environmental and health hazards can be sources of income to both the government and the indigenous people in communities with large crude reserves. Localization of industries (that use these flared gases as raw materials for manufacturing) in communities where there are large reserves of these hydrocarbons would not only create wealth for the government by boosting the economy but also create jobs for the masses reducing hunger and crime rate. More so, other biomasses especially waste generated on daily basis from manufacturing industries and small-scale businesses as well as homes can also be converted to useful energy sources thereby maintaining a cleaner environment and friendly ecosystem.

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