

# Review of LPG Usage in Nigeria; Trends, Challenges and Opportunities – A Techno-Social Perspective

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#### ABSTRACT - Over the years, the desire for cleaner sources of energy have gained global attention thus the widespreadeffort pursuing cleaner and abundant sources. Nigeria, a nation endowed with natural gas, which is the cleanest source of fossil fuel, has about 206.53TCF of proven reserve thus its high potential to stand tall in the committee of nations championing the campaign of clean energy. LPG popularly known as cooking gas constitutes mainly of propane and butane are products of natural gas processing and given that cooking accounts for 80% of Nigeria's household energy demand, yet its use is below 5% on average. Factors accounting for this poor figures can be classified as technical and policy concerns. This paper identifies the factors which makes Morocco and Egypt stand tall among nations with LPG industry. This outstanding researchidentifiedopportunities for engineers and researchers to work on technologies such as on cylinder tracking, innovative digital media, advanced cooking equipment, composite cylinders, cylinder sensor, domestic delivery, quick delivery and leak detection systems to the end that affordability, availability and awareness and safety issues are resolved thus the possibility of increasing domestic use by 69%. This is a call for all effort targeted at developing the gas industry to be backed up by policies that favours research and development as well as awareness activities.

**Keywords:** Liquefied Petroleum Gas, Natural Gas, Usage, Domestic, Challenges, Opportunities, Technology, Consumption.

reserve of 206.53TCF (Department of Petroleum Resources, 2021)<sup>1</sup>, with the Department of Petroleum Resources (DPR) setting targets of 2010 TCF by 2025 and 220TCF by 2030. This indeed spells great potential and economic prosperity for Nigeria. Going by the global desire of stakeholders clamoring for clean energy and environmental

Nigeria is described as a gas province with

I. INTRODUCTION

pockets of oil given the estimated proven gas

protection in Africa, Nigeria has the potential to stand tall among the committee of nations with compliance to environmentally friendly economy given its abundance in natural gas reserve as it has lower carbon content compared to other fossil fuels (Habib G. et al, 2019)<sup>2</sup>.In 2021 alone, over \$10 billion have been earmarked by the African Development Bank in this regard making it a continental priority (African Development Bank Group, 2021)<sup>3</sup>.According to the World Bank  $(2004)^4$ , gas flaring costs the global economy US\$20Billion 2018 in а whilePricewaterhouseCoopers, PWC  $(2019)^5$ estimated that the Nigerian economy lost NGN233 billion (US\$761.6 million) in 2018 that is 3.8% of the global total costs in 2018. These losses for Nigeria also comes with other devastating effect of flaring including plant and animal health. However, the percentage of gas flaring has been reducing since 2002 and stood at 10% in 2018 and is further down by 7% in 2020 (NNPC ASB, 2020)<sup>6</sup>, thanks to the gas flare commercialization programme (NGFCP). The NGFCP was designed as the strategy to implement the policy objectives of the Federal Government for the elimination of gas



flares with potentially enormous multiplier and development outcomes.Natural gas has found its use in Nigeria mainly for electricity generation, LPG production, LNG production and export, and feedstock for petrochemical and the pharmaceutical industry (Georgios D. and Konstantinos G., 2014)<sup>7</sup>. However, in all these, the bulk of usage has been mainly for electricity generation for industrial areas and for the Nigeria Liquefied Natural Gas (NLNG). This practice has been rescinded by the advent of the 2008 Nigeria gas master plan which is aimed at growing the Nigerian economy with gas by pursuing three key strategies such as; stimulate the multiplier effect of has in the domestic economy, position Nigeria competitively in the high value export markets and lastly to guarantee the longterm energy security in Nigeria (Richard Ingwe, 2014)<sup>8</sup>. Since then, over 20 licenses have been issued to various companies as shown in Appendix 1.Scholars and research companies<sup>8, 5</sup> have opined that if this Nigeria Gas Master Plan must come to fruition, there has to be increased focus on domestic consumption especially Liquefied PetroleumGas (LPG) production and distribution given the large population of Nigeria with millions of households. It is therefore imperative to give an overview and provide insight into the one most important factor which will guarantee wide local consumption.

## II. STATE OF PRODUCTION AND USAGE OF LPG IN NIGERIA

In Nigeria today, LPG use is basically for cooking and other heating purposes. Household

cooking accounts for nearly 80% of Nigeria's household energy (Gujba H. et al (2015)<sup>9</sup>. Energy for domestic cooking in Nigeria primarily comes from burning traditional fuels such as wood, dung, coal and other biomass variants that are inefficient and hazardous to the environment. Nigeria as a signatory to the United nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, developed the National Gas Policy (NGP), which among other things, targets the promotion if liquefied petroleum gas (LPG) as a sustainable substitute for traditional fuels used for domestic cooking (Ministry of Petroleum Resources, 2017)<sup>10</sup>.

As at 2019, LPG consumption in Nigeria stood at 840,596.37MT which is 60.6 percent over the 2018 figure<sup>11</sup>. According to the Nigeria Liquefied Petroleum Gas Association (2021), Nigeria's annual LPG consumption for the year 2020 was 1 million metric tons. This is considered a laudable feat and the leadership of the Nigeria Liquefied Petroleum Gas Association is hopeful that by the year 2022 set target of 5 million metric tons will be met given the Nigeria Gas Policy (NGP) of 2017. This is an improvement in the awareness and effort of the Nigeria government. However, there remains an enormous room for improvement. Neeka et al.  $(2018)^{12}$  established that the domestic utilization of LPG in Nigeria ranked below acceptable annual projections from other seemingly developed African countries like Morocco and Egypt where natural gas resources contribute significantly to their annual income and gross domestic products (GDP).

S/N	Type of fuel	Percentage	
1	Electricity	0.45	
2	Liquefied Petroleum	0.74	
	Gas		
3	Natural Gas	1.26	
4	Biogas	0.23	
5	Kerosene	19.84	
6	Coal, Lignite	0.26	
7	Charcoal	3.13	
8	Wood	72.18	
9	Agricultural residue	1.91	

 Table 1: Distribution of Households' Choice of Cooking fuel in Nigeria, 2013<sup>13</sup>

Source: Buba et al. (2017)International Journal of Research –Granthaalayah, 5(10), p353

Large metropolitan cities like Lagos in 2017, LPG usage still stands at 12.1 percent (Ozoh O.B et al, 2018)  $^{14}$ . The table is shown in Appendix 2.

From the 2013 Demographic and Health Survey of Nigeria (DHS), Buba et al. (2017)<sup>13</sup> estimated the distribution of household cooking choice of energy, 2.68% was computed as the total contribution of clean energy – electricity, LPG,



Natural gas and Biogas combined. The estimates were not different from that of 2014 distribution of household cooking energy extracted by Ogwumike et al. (2014)<sup>15</sup>.

Based on IEA and UN Data, ENEA and Mencecon Consulting presented an LPG Per capita consumption rate for domestic usage in selected developing countries in Asia and Africa, 2017<sup>16</sup>.



Figure 1: Per capita consumption rate for domestic usage in selected developing countries in Asia and Africa, 2017<sup>16</sup>.

Source: ENEA Consulting and Menecon Consulting in LPG Safety, Innovation and Market Growth.

Here, Nigeria is doing very badly on LPG consumption in Household on a per capita basis and this has improved just a little in the last 5 years.

From the NNPC 2020 Annual Statically Bulletin, there have been gross fluctuation and inconsistency in production and lifting of LPG as seen in the graph below:



Figure 2: Graph of LPG Production vs Lifting 2020 based on data from NNPC, ASB 2020. (see Appendix 3 for Data).



One clear deduced from the plot above raises a fundamental concern with respect to LPG transportation which calls for policy and governance checks to ensure continuous and consistent LPG off take to end users amongst other concerns.

There have been numerous research on the attributes of consumers' choice of household fuel focuses on income and demographic issues with little research on the effect of the affordability and accessibility of LPG on the consumer choice. There is limited experimental or fact based evidence on the impact of affordability and accessibility on LPG adoption.Saheed O. L (2021)<sup>17</sup>identified a significant effect of LPG affordability and LPG accessibility on LPG adoption for cooking in Nigeria's households with the use of Pearson's correlation analysis and binomial logic regression models thus a call for fuel transition, substitution, and LPG adoption that might help in the domestic LPG adoption policy.

In 2019, the World Economic forum ranked Nigeria 109 out of 115 countries on its energy transition index. The forum reported persistent gaps in universal access to clean cooking fuel in Sub Saharan Africa, where affordability and reliability of power supply are still critical challenges due to poor policy governance and policy stability and noted that Nigeria is lagging in the transition to clean energy and LPG holds lots of potential for the Nigerian Market<sup>18</sup>.

Above all else, lack of infrastructure has been most implicated as the reason behind Nigeria's low performance in the use of cleaner source of energy especially natural gas of which LPG is a component. KPMG LPG Survey, 2015 submits that if affordability, availability and awareness and safety can be tackled, up to 69% on non-users in the country can be converted to users of LPG<sup>19</sup>. Currently, the leading producer of LPG in Nigeria is the Nigeria Liquefied Natural Gas (NLNG) in its Bonny plant. After production in Bonny, the LPG is transported to Lagos, where the operational storage facilities are located. From this storage terminal, the haulage tankers from different parts of the country will load and supply to the dispensing stations across the country. This movement of the commodity from Finima, Bonny (Rivers State) to Atlas Cove in Lagos for storage before distribution to other parts of the country, creates a bottleneck, which makes LPG landing cost expensive. Also, the imported LPG volumes are discharged at the Lagos facility, from where it is distributed. Although there are LPG storage facilities in the coastal cities of Port Harcourt and Calabar, the facility in Port

Harcourt was only commissioned recently. At the same time, the facility in Calabar is barely functional. It remains to be seen whether these facilities would be fully operational in the coming years (Ihemtuge, T.U and Aimikhe, V.J., 2020)<sup>20</sup>.

## III. THE FURURE OF LPG DOMESTICATION IN NIGERIA

With the advent of the approval of lots of gas development plans by the Federal Government of Nigeria as shown in Appendix 1 and in combination with the Nigeria LPG policy, we expect a significant rise in clean energy production and utilization. More licenses will be issued in the coming years in pursuance of the aims and objectives of Nigeria Gas Master Plan of 2018.

The Department of Petroleum Resources (DPR) have already drawn guidelines published in 2020 in a bid to promote gas penetration and usage in the country as well as ensuring that safety is not compromised. The Federal Government of Nigeria (FGN) have increased incentives for companies and investors interested in gas utilization ventures. They include (pwc, 2021)<sup>22</sup>:

- A tax-free period for up to 5 years
- Accelerated capital allowance after the tax-free period
- Tax-free dividends during the tax-free period.
- For the upstream gas utilization (NAPIMS, NNPC 2021)<sup>21</sup>,
- Capital allowance: 20% per year (year 1 4) and 19% in year 5.
- Petroleum Investment Allowance (PIA): 10% as for oil.
- Income tax is based on CITA (30%) where expenses are identified as exclusively for gas.
- Custom Duty: 2.5% (Government Circular of 2002).
- Royalty: Zero %.

From the Petroleum Industry Bill (PIB) recently signed into law, it makes provision for the authority to collect gas flare penalty from midstream operations. This will discourage flaring in no small manner and foster other gas utilization methods of which LPG production is obviously one (PIB, 2020).

## IV. THE GAPS AND OPPORTUNITIES IN THE LPG SECTOR

Domestic LPG consumption remain the major influencer to the increased gas utilization plan<sup>14</sup>. Thereforegas pipeline networks technology must be developed which feeds homes directly. Given population in Nigeria and the millions of housing units even in the urban areas, natural gas



utilization will experience a significant increase in domestic utilization rate.

Development of indigenous technologies for running vehicles and power generation using LPG in place of the conventional gasoline is one area to be explored and exploited. Adegoriola and Ibrahim (2020)<sup>24</sup>proposed the use of LPG and CNG as transport fuel in Nigeria by showing the policies and incentives that have been utilized by other countries and an analysis of the cost efficiency and environmental effect of the use of auto-gas fuels; lessons drawn therein are worth emulating.

Reports<sup>16</sup> have shown that LPG safety related issues are a major limitation to the uptake of LPG by consumers hereby causing a decline to potential market growth and doubt in likely return on investment for both investors and companies. This is a call for creative ideas and other technological solutions that alleviate safety concerns both directly and indirectly.For tech solutions, the following is advised:

- Cylinder tracking
- Innovative digital media
- Advanced cooking equipment
- Composite Cylinders
- Cylinder sensors
- Domestic delivery solutions
- Quick delivery
- Leak detection systems

## V. TECHNOLOGY SOLUTIONS AND ASSESSMENT

Some proficient technological solutions are emerging for LPG which hold the promise of operating cost reduction and increased opportunities for investors, and also promotes safety at the various stages of the LPG supply chain. Typically, private sector companies place a high demand for these technologies. In some cases, with the explicit support of the authorities. Clean Alliance (2020) identified Cooking eight innovations as the leading safety innovation in the LPG sectoras outlined in section IV.

## **VI. SUMMARY**

Domestic consumption of liquefied petroleum gas (LPG) is one major driver in the promotion of clean energy and environmental protection as well as high economic growth, vis-àvis the achievement of the Nigerian Gas Master Plan. This is due to the growing population of Nigeria and the rising need for energy especially for use in domestic cooking.Technical and policy issues must be clearly substantiated and addressed for the significant improvement of the LPG sector. Technological improvement have is identified as one major factor which gives existing LPG users and will give the potential user confidence with regards to safety concerns both actual and perceived. It significantly affects the will to adopt or continually use LPG for domestic cooking or other household uses. Other factors such as affordability and availability can be taken care of by both technology and policy.

The NGMP and its policy tools, including the Domestic LPG Penetration Program (DLPGPP), need to focus on those determinants that can foster the transition to LPG by households nationwide.

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## APPENDIX

#### Table 3. Approved Associated Gas Development Plans

S/N	Company	Block	FDP	AG	Off-Take
				Reserves,	Rate,
				Bscf	MMscf/d
1	NPDC	OML-20	Egbema AG Dev.	97.72	6.7
2	NPDC	OML-20	Egbema West AG	310.7	6.2
3	NPDC	OML-20	Ugada AG Dev.	5.30	0.4
4	NPDC	OML-18	Alakiri AG Dev.	64	80.97
5	Eroton	OML-18	Cawthome Channel	400	133.6
	E&P				
6	Eroton	OML-18	Akaso AG Dev.	299	41
	E&P				
7	Eroton	OML-95	Opolo Gas AG Dev.	25	5
	E&P				
8	Chevron	OML-95	Mejo AG Dev.	12.9	3.7
	Nig Ltd				
9	Dubri Oil	OML-96	Gili-Gili Gas AG Dev.	311.44	18
10	Platform	OML-38	Egbaoma AG Dev.	176.25	55



11	Addax	OML-123	Adanga AG Dev.	8.2	5.3
12	Seplat	OML-41	Sapele AG Dev.	462.4	2.5
13	Mid-Wes.	OML-56	Umusadege AG Dev.	58.8	16
14	NAOC	OML-63	Ogbainbiri-Afuro AG	59.15	-
15	NAOC	OML-60	Beniku AG Dev.	2.38	3
16	NAOC	OML-63	Osiama Creek South	14.25	2.4
17	NAOC	OML-60	Odugri	90.41	-
18	NAOC	OML-60	Clough Creek AG	97.56	3.0
19	NAOC	OML-61	Orri-Oleh AG Dev.	457.06	-
20	NAOC	OML-61	Isoko South AG	204	-
21	MoniPulo	OML-114	Abana AG Dev.	26.48	2.5
22	Amni Pet.	OML-52	Tubu AG Dev.	73	33
23	NPDC	OML-34	Ugheli-East AD Dev.	874.06	-
		Total		4,130.06	418.27

Source: 11

#### **Table 4: Approved Non-Associated Gas Development Plans**

S/N	Company	Block	FDP	Gas Reserves (BSCF)	Condensate (MMSTB)	Gas Off-Take Rate (MMSCFD)
1	NPDC	OML-34	Ugheli East NAG Dev.	417.7	9.4	123
2	NPDC	OML-111	Oredo NAG Dev.	903	35.54	100
3	SPDC	OML-21/53	AssaNorth- Ohaji South	4003	197	600
4	NAOC	OML-61	Manuso NAG Dev.	485.84	56.14	144.43
5	NAOC	OML-63	.Emette NAG Dev.	93.93	1.01	38
6	NAOC	OML-63	Ekedei NAG Dev.	393.69	150	9.94
		Total		6,296.46	449.09	1,015.37

Source: (Department of Petroleum Resources, 2021)

**Table 5**: Distribution of Households' Choice of Cooking fuel in Lagos, Nigeria, 2017

S/N	Type of fuel	Percentage
1	Kerosene	70.1
2	Charcoal	17
3	Liquefied Petroleum Gas	12.1
4	Electricity	0.4
5	Wood	0.4

Source: Cooking fuels in Lagos, Nigeria: Factors Associated with Household Choice of Kerosene or Liquefied Petroleum Gas (LPG), International Journal of Environmental Research and Public Health, 15(4), p. 5.



Unit: Metric Tone	95			
MONTH	PRODUCTION		LIFTINGS MT	
	NGL (C3,C4,C5)	LPG	NGL (C3,C4,C5)	LPG
JANUARY	137,594	124,294	125,508	105,702
FEBRUARY	140,327	115,056	115,570	29,880
MARCH	131,036	100,071	110,070	101,760
APRIL	153,864	104,921	113,839	106,597
MAY	148,971	107,558	210,758	102,249
JUNE	163,664	119,731	95,811	34,057
JULY	187,893	65,343	197,552	
AUGUST	184,750	64,241	172,888	46,199
SEPTEMBER	169,092	65,673	202,099	45,282
OCTOBER	139,510	69,169	121,668	47,151
NOVEMBER	123,954	72,090	170,708	29,858
DECEMBER	92,727	83,803	110,081	43,406
TOTAL	1,773,381	1,091,949	1,746,552	692,142

Table 6 2020 Upstream Gas Liquid (NGL/LPG) Production/Lifting (mt)

Source: NNPC 2020 Annual Statistical Bulletin, 1<sup>st</sup> Edition.