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Optimising Gas Reserve in Nigeria For Sustainable Development

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Abstract

This study is undertaken to x-ray the need to optimise gas reserve in Nigeria to create a more robust and sustainable economy for future generation. Gas reserves in Nigeria is estimated in the region of 187TCF and this report affirmed that 7.1 billion SCF/day is produced daily and a volume of 3.4 billion SCF/day is utilised averagely while 3.7 billion SCF/day may have been flared. Also discussed in this work is the importance of local content policy which is pivotal to gas development in any modern society. This work is conceptualised as part of on-going efforts to promote inclusiveness in oil and gas industry in Nigeria.

Keywords: Gas flaring, Local content, Energy, Government, Environment

1.0 Introduction

Gas reserve in Nigeria has been reported to be in the volume of 182 trillion cubic feet [1] which place Nigeria as a huge producer of Natural gas among oil producing countries (Table 1). Various authors[2, 3]have reported enormous potential of Natural gas as a future energy use in view of its peculiarities. This has resulted in the need to optimise the current gas reserve in Nigeria for future generation. Gas flaring has consistently been a drawback to gas growth and expansion in Nigeria as volume of gas flared in Nigeria is reported in the range of 42.6% of the produced gas[4, 5]**.** This estimate is considerably high for a developing country like Nigeria as enormous gas is still in high demand in other area of the economy. Crude oil reserves are reported to be in the barrel of 36.5billion and gas reserves is predicted to surpass the current value if adequate gas exploration is intensified. Figure 1 shows global energy demand and utilization in key sector of various energy sources. It is clearly seen from the Figure 1 that Natural gas accounted for 24% of energy supply and this is a far departure from the untapped potential from gas as many authors[6, 7]have reported that gas may likely take the centre stage in search of cleaner and sustainable energy.

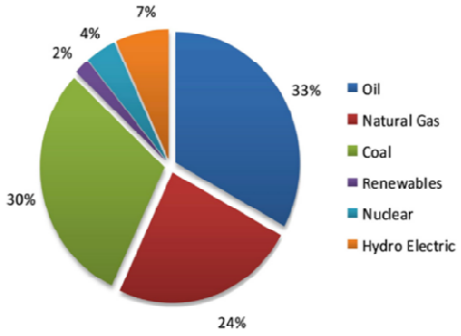

Fig.1. Global energy utilization as at 2012. Adpted from Nwaoha, C and Wood, D.A

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Table 1: Potential energy reserves in Nigeria as at 2005.

Energy source	Reserve
Crude	36.7 billion barrels
Natural gas	187.44TCF
Tar sand	30 billion barrel of oil equivalent
Coal and lignite	Over 400 billion tonnes
Large hydropower	11235MW
Fuel wood	13,071,464ha
Animal waste	61 million tonnes/year
Crop residue	83 million tonnes/yr.
Solar radiation	3.4-7.4 kWh/m^2 day
Wind	2-4m/s at 10m height

Source: Nigeria energy master plan, Energy commission of Nigeria, 2007

Table 1 clearly shows that gas in Nigeria may end up to be the last resort for government to explore as it is still the most abundant resource among the natural resources. Gas flaring appears to be most ravaging phenomenon which cut across developing and developed countries[4]. In a report released by World Bank in 2004 on the top twenty gas flaring countries in the world, countries like United States, Russia still featured prominently on the list which call for greater synergy among the oil producing countries and oil company to develop a clear-cut plan to mitigate gas flaring. Although the release gave USA absolute clean bill of health in terms of volume flared. It is generally believed the world can achieve zero gas flaring [8, 9]. Table 2 presents volume and percentage of gas flared in some of the gas producing countries with Nigeria on the high pedestal. This study clearly showed that 90% of gas produced in Nigeria is flared and this is a necessity that needed urgent and pragmatic solution[4, 10].

Table 2: Volume of gas production and percentage flared

Country	Volume of gas production(BCM)	Gas flaring(BCM)	Percentage left for domestic utilization*
Nigeria	56.4	24.1	57.4
Russia	640	14.9	97.3
Iran	152.5	13.3	91.3
Iraq	11.4	8.6	24.6
Angola	8.5	6.8	20
Venezuela	57.8	5.4	90.7
Qatar	57.6	4.5	92
Algeria	186	4.3	98
Indonesia	88.9	3.7	96
Equatorial Guinea	3.8	3.6	5
USA	664.2	2.8	99.6
Kuwait	15.1	2.7	82
Kazakhstan	26	2.7	90
Libya	20	2.5	87
Azerbaijan	5.8	2.5	57
Mexico	45	1.5	97
United kingdom	95	1.6	98
Brazil	18	1.5	92
Gabon	2.1	1.4	33
Congo	8	1.2	87

Source: Energy international Administration report, 2006. *Note: the value was calculated by the author.

In light of the above**,**gas flaring activities are causing Nigeria great economic loss as the country has not met domestic demand in terms of manufacturing and energy generation. Domestic and local industrial demand of gas continues to receive little or no attention and this gas shortfall continue to hamper on economy growth in Nigeria. Key industries are being deprived gas to run operations which ultimately affect employment generation among the youth. In a report presented by Department of petroleum resources which are presented in Table 3, attempts were made to asses future gas demand in various key industrial sectors in Nigeria and the analysis were presented as shown in Table 3. To further buttress effective gas utilisation, Oseni [11] emphasised the need to rejuvenate energy sector through gas integration. Gas supply is instrumental to energy need and many authors have equally affirmed in this direction. Oyedepo [12] was critical in energy concept as evidenced in his view on fundamental element on sustainable development. The author identified energy as one of the most pressing issues among cardinal objective of millennium development goal (MDG).

Table 3: Nigeria gas consumption (mmscfd)

Utilization	Year 2000	Year 2010	Year 2020
power	225	1390	3770
Cement	25	82	275
Fertilizer	70	80	172
Aluminium	15	39	102
Iron and steel	02	15	129
Others	86	200	358
Total	423	1806	4806

Source: Department of Petroleum Resources, Nigeria.

Table 4 also illustrated natural gas production in Nigeria between 1998-2002 and various techniques employed by oil companies to contain gas due to non-availability of framework to convey gas for consumer benefit. This concept further bring to fore some disposal method that are detrimental to human survival. Many researchers [13, 14] had criticised re-injection of gas as detrimental and should be discountenanced. Associated gas seemed to be the worst hit as this category of gas are continuously flared due to the cost involved in its separation[15].

Table 4: Natural gas production and utilization in Nigeria as at 1998-2002[R]

Designation	Quantity (million m^3)				
	1998	1999	2000	2001	2002
Net production (annual)					
Associated gas	200002	19341	21961	24053	23429
Non-associated gas	11747	11359	12898	14127	13760
Disposition(annual)					
Re-injection	4200	4000	4000	4000	4253
Domestic market	5900	1000	6510	6780	6220
Exported(LNG)	-	5950	5950	8900	8900
Shrinkage	750	900	1200	1700	200
Flaring	20,900	18,850	17200	18800	15607

[R]Source: Nigerian National Petroleum Company(NNPC)

2.0 Environmental Concerns and Associated Risk

According to Anejionu et al. [16], Gas flaring in Niger Delta is taking toll on agricultural investment in oil producing area. The authors developed a series of geospatial technologies and modelling methods to assess the impact of air pollution in the domain of gas flaring area in order to ascertain environmental impact of gas on human health and animals. Preliminary evaluation showed that gas flaring is the major cause of pollution in the area and this could further worsen the economic and lifespan of human race in the affected area.In a similar vein, some authors[17-19]have called on Nigerian government to declare Niger Delta a disaster zone in view of its huge neglect in terms of replenishing the nature.Nature is in dire need of attention in Niger delta and active participation of all may save the oil rich area from imminent and looming danger. In Fig. 2, a clear illustration of onshore gas flaring is presented and from all indication, this scenario is very close to farm area. One can imagine what the aftermath effect.

Fig. 2: Gas Flaring at onshore field location in Rumuekpe, Rivers State.
Adapted from [16]

Ajayi [20] had affirmed Nigeria as the leading country in gas flaring as shown in Fig.3. Nigeria is believed to be flaring completely all the associated gas and this portends danger to gas development architecture in Nigeria. Government had

earlier developedstringent compliance to zero gas flaring as at December 2012 and the effort has not seen the light of the day[21]. Associated gas contains carbon and hydrogen which is key element to the formation of hydrocarbon and processing this particular content has been reported to be highly expensive in terms of cost and transportation through pipelines[14]. Among African countries that currently in the business of oil, Nigeria appeared to have relaxed effective gas framework and legislation to mitigate this scourge. Studies have shown **t**hat oil producing areas are worst affected and virtually grounded as daily oil spillage and environmental degradation beckoned. Some of these environmental issue are extensively discussed and analysed by Giwa et al. [7].

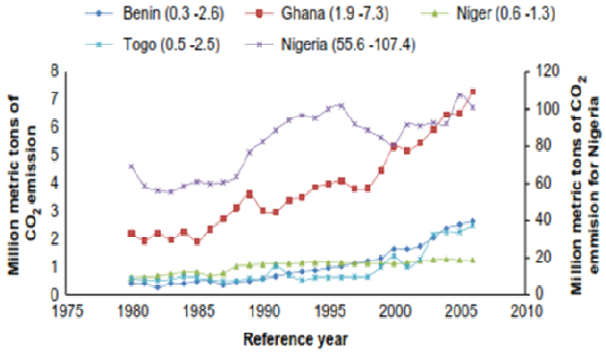

Fig. 3. CO_2 emission as a result of gas flaring. Adapted from Ajayi, 2013.

3.0 Natural Gas Optimising Theory for Sustainable Future.

Sonibare and Akeredolu [22] had reported the need to completely eliminate gas flaring in upstream petroleum sector in the Niger Delta. There is currently energy deficit in Nigeria and gas is consequentially being flared[12]. This author predicated his position on the fact that area of natural gas usage has not been fully explored and most of the industries need to be adapted and conditioned in a way that gas development in Nigeria will be encouraged in a market driven economy. Gas is reported to be in reserve of 4 trillion $m^3$and many authors[15, 23] have predicted that this source of energy needs to be diversified to create more jobs for the teeming youth of Nigeria.Table 5 below depicts an average of 5% natural gas currently being used in homes which is a far cry from energy need in Nigeria. Petroleum product seemed to have overtaken gas in Nigeria and the environmental impact of petroleum product has been studied extensively by Tassou et al. [24].

Table 5: Energy source and percent utilization. Adapted from Oyedepo [12].

Type	Average % of total						
	2002	2003	2004	2005	2006	2007	Average
Coal	0.03	0.03	0.03	0.03	0.05	0.05	0.037(insignificant)
Hydro	11.93	14.20	17.39	12.04	17.03	23.90	16.08
Natural gas	2.84	1.9	4.54	5.5	7.52	8.73	5.17
Petroleum Products	85.20	83.87	78.04	82.45	75.44	67.32	78.72

Another scenario is presented in Table 6below whichshows daily production of natural gas in the range of 7.1 billion CF/day and a huge volume of 3.4 billion SCF/day is consumed averagely while 3.7 billion SCF/day may have been flared[9].

Table 6: Existing sources of energy in Nigeria. Adapted from Oyedepo [12].

S/N	Resource type	Reserves		Production	Domestic utilization
		Natural units	Energy units		
1	Crude oil	36 billion barrels	4.76	2.5 million barrels/day	445,000 barrels/day
2	Natural gas	187 trillion SCF	4.32	7.1 billion SCF/day	3.4 billion SCF/day
3	Coal and lignite	2.734billion tonnes	1.92	-	-
4	Tar sand	31 billion barrels of equivalent	4.22	-	-
5	Large hydropower	11,250MW	1.11	1938MW	167.4 millionMWh/day

Wolde-Rufael [25] has presented a model which improves the earlier theory represented as TY version of the Granger non-causality test, for VAR(2), (k=1and d_{max}=1),we estimate the followingsystemequations

$$\begin{bmatrix} {}^{L}Y_t \\ {}^{L}E_t \\ {}^{L}K_t \\ {}^{L}L_t \end{bmatrix} = A_0 + A_1 \begin{bmatrix} {}^{L}Y_{t-1} \\ {}^{L}E_{t-1} \\ {}^{L}K_{t-1} \\ {}^{L}L_{t-1} \end{bmatrix} + A_2 \begin{bmatrix} {}^{L}Y_{t-2} \\ {}^{L}E_{t-2} \\ {}^{L}K_{t-2} \\ {}^{L}L_{t-2} \end{bmatrix}$$

This equation is 4 by 4 matrices of coefficients A_0 +A_1 and A_2. This can be used to test the hypothesis optimising the gas reserves with the coefficients highlighted earlier.

4.0 Bridging the Gap Through Local Content Policy

Ovadia [8] has thrown his weight behind local content policy which according to him encourages public participation in the oil and gas industries. According to Levett et al. [26], there is urgent need for communities to involve in oil and gas development which may promote inclusiveness and reduce friction that is currently ravaging Niger Delta communities. In Nigeria, natural resources are seen as a sole property of Federal government and attentions are not paid to operation and processing of these resources by the concerned communities. Oil communities in Niger Delta are currently in penury and precarious situation which is against international best practises. This concept has further aggravated gas development in Nigeria on a number of reasons [15]. Most of the restiveness in part of Nigeria is reported to be as a result of non-active participation of youth in resource management. Local content policy could foster a new relationship between the oil communities and oil companies if fully adopted in Nigeria.This idea has been widely reported in many literatures[27, 28]and some of the problems currently battling gas growth in Nigeria are presented in Table belowwhich ordinarily may not be relevant if local content policy is fully operationalized in Nigeria.

Table 7: Challenges confronting gas growth in Nigeria.

Operational reasons	Economic and social factors	Policy and Law issues
Absence of Pipeline framework	Low market price for gas	Complete monopoly of gas transportation by government
Inefficient metering / gauge system	Potential marketers are not easily reached.	Metering and gauges for gas are not harmonised.
Cost of constructing pipeline architecture is highly expensive.	Penalty on gas flaring are not enforced and most often overtaken by political interference.	Laws are ambiguous and need to be harmonised.
High operational cost including cost of maintaining expatriate.	Lack of incentives for compliance.	Communal upheaval due to lack of inclusiveness.
Underdeveloped gas and less return on gas market.	Lack of proper awareness on usage of gas by the public	Complete absence of local content policy.

5.0 Conclusion

This research gives a glooming picture of gas flaring situation in Nigeria and its consequential implication. Many literatures have equally reported similar issue about gas flaring in Nigeria but this research clearly defined specific policy that should be embarking upon by government to discourage gas flaring. The author also noted that drastic action has to be taken to avert a looming disaster as illustrated in some of the scenarios presented. Gas flaring has been reported as one of the contributing factor to ozone depletion and ultimately global warming. Farming and source of livelihood of oil producing communities are continuously being eroded as a result of gas flaring which needed pragmatic solution.

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