Scientific Research Publishing

Energy and Power Engineering, 2025, 17(7), 169-180
https://www.scirp.org/journal/epe
ISSN Online: 1947-3818
ISSN Print: 1949-243X

Demand Management of Natural Gas for Nigeria

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How to cite this paper: Olorunsiwa, S.O. (2025) Demand Management of Natural Gas for Nigeria. *Energy and Power Engineering*, **17**, 169-180.
https://doi.org/10.4236/epe.2025.177009

Received: May 25, 2025
Accepted: July 18, 2025
Published: July 21, 2025

Abstract

This study provides a comprehensive and balanced analysis of natural gas demand management in Nigeria. Questionnaires were employed to solicit information from the respondents on the development and utilisation of Natural Gas, as per the demand management of Natural Gas for Nigeria (domestic market) and the socio-economic impact of the Gas Industry on the people and the nation in general. The responses indicate that there is rapid development in the Gas sector in Nigeria, driven by the launch of the Nigerian Gas Master Plan and various Gas utilisation projects underway across the Nation. Nigeria has abundant deposits of natural gas (210.5 TCF of proven reserves), and when exploited and developed, it will improve the economy substantially through taxes and royalties from the producing companies. Based on the research findings, the specific steps to be taken by the stakeholders in maximising the development and utilisation of Natural Gas for Nigeria's domestic Market are the effective implementation of the Gas Master plan. The Gas Master plan provides a framework for Nigeria to maximise value from its Gas resources through leveraging the multiplier effect of gas in the domestic economy. The Gas master plan aims to facilitate timely and cost-effective additions to Gas capacity, meeting unprecedented domestic Gas demand.

Keywords

Natural Gas, Demand Management, Energy Policy, Nigeria, Gas Flaring, Infrastructure, Energy Security

1. Introduction, Literature Review, and Theoretical Framework

Natural gas represents a pivotal component of Nigeria's energy future, positioned at the intersection of domestic energy security, industrialisation, and environmental sustainability. Despite holding Africa's largest natural gas reserves, Nigeria continues to experience erratic utilisation patterns, underdeveloped distribution

networks, and persistent gas flaring. Existing studies highlight the mismatch between Nigeria's gas supply and end-user demand due to infrastructural deficits, market distortions, and regulatory delays [1] [2]. In Algeria, substantial government-led infrastructure investments have accelerated the domestic penetration of gas. The UK illustrates a well-regulated gas-to-power system integrated with industrial policies.

The study adopts the Energy Ladder Model to understand transitions from traditional biomass to cleaner fuels. The Resource Curse Hypothesis also frames the paradox of resource-rich nations experiencing low developmental outcomes due to institutional weaknesses [3] [4].

Chapter two deals with literature review and the theoretical framework of the study, which examines the existence of natural gas. It highlights natural gas utilisation, what natural gas is, the formation of natural gas, natural gas underground, and the Nigerian gas sector's linkages and socio-economic development in Nigeria. It also examines the production of natural gas in Nigeria, the development of the gas sector in Nigeria, the Impact of gas on Nigeria's economy, the challenges facing the gas sector and the demand management of natural gas in Nigeria. Chapter three discusses the research methodology, which includes the research population, sampling techniques, data collection methods, and data analysis using sample percentages and the chi-square test. Chapter four presents and analyses the questionnaire distributed to various sectors concerning the study and analyses the results using statistical tools such as percentages, chi-square and bar charts. Chapter Five concludes with success stories in the Nigerian gas sector and provides recommendations based on the findings presented in Chapters Two to Four.

This study aims to assess demand-side challenges and propose practical strategies for efficient gas utilisation in the country. This research employed a structured questionnaire distributed to 120 stakeholders across the energy value chain. The data was analysed using descriptive statistics and chi-square tests to assess the natural gas demand management in Nigeria. It was observed from the analysis of the results using the chi-square test that to bridge the demand-supply gap in natural gas, Nigeria must strengthen its gas infrastructure networks, promote private sector participation through fiscal incentives, institutionalise gas utilisation education through schools and media, and regularly review gas policy frameworks to reflect market realities. These actions will ensure optimal harnessing of Nigeria's vast gas potential, driving sustainable development and economic growth [5].

2. Methodology

The research design employed is a survey, in which participants from the oil and gas industry and others from various backgrounds were randomly selected as a sample to conduct the investigation. The study aims to employ the survey research method to investigate Natural Gas Demand Management in Nigeria. The design of this research work is dual. The survey was conducted by applying two research instruments:

I. The theoretical approach

II. The field work approach

From the theoretical approach, the researcher was able to gather facts from textbooks, professional journals, magazines and articles. This approach becomes the source of secondary data. The account here will be analytical in its detailed and critical examination as well as appraisal of the significant issues and trends. It is descriptive in its objective consideration of the issues and trends which form the basis of subsequent analysis. It is also prescribed, as it recommends strategies and mechanisms for managing and developing Nigeria's natural gas distribution and utilisation [6].

It also adopts a multidisciplinary approach, drawing from the principles and values of international gas development management.

While the fieldwork approach helps gather primary data. The research technique used here was the collection of responses to structured questionnaires. Structured questionnaires were used to solicit environmental and socio-economic information from the Nigerian public, as well as to gauge the views of oil companies regarding their operations in Nigeria, particularly their socio-economic responsibilities to the Nigerian public. A random field survey was conducted. A total of 400 questionnaires were administered, and 284 questionnaires were received and analysed. Each item on the questionnaire consisted of five responses categorised into strongly agree (SA), agree (A), undecided (U), disagree (D) and strongly disagree (SD). The justification for this choice is that the approach permits scientific generalisation to be made from the data obtained [7]. Other reasons are:

- It permits broad coverage.
- It will yield candid and objective data because of impersonality.
- It is more economical because it saves time.

Samples were drawn using stratified sampling techniques. The chi-square test was used to compare more than two proportions of observations for a large population with a value greater than 30. Here, we want to determine whether the observed difference in frequencies can be reasonably attributed to chance. This study encompasses various individuals representing different states in Nigeria to determine the effective Natural Gas Demand Management for Nigeria. It includes all categories of people from all walks of life that comprise Nigeria.

Due to time and financial resource constraints, it is not possible to study the entire population, so an accessible population must be chosen that forms the sample for this research. The target study population was drawn from various segments of the Nation, namely Unemployed youths, Community leaders, Local government workers, and oil and gas company workers. The target population for the study is in the Appendix below.

The data generated were analysed using simple percentages and the chi-square test. The use of the chi-square test in this study is to assess the goodness of the association between the different variables (the dependent and independent variables). The assumptions adopted are highlighted below:

Assumptions for hypothesis I
The Respondents in the sample were randomly selected
The sample size was 50
Test statistics = X2 = (Fo – Fe)2/Fe
Research Design
Calculated X2 = 404.2
Critical = 11.070
Degree of freedom df = K – 1. Where K is the number of Categories, here K = 6
Therefore df = K – 1 = 5
Choosing a 5% level of significance gives $\alpha = 0.05$
Assumptions for hypothesis II
The respondents in the sample were randomly selected.
The sample size was 50
Test statistics = X2 = (Fo – Fe)2/Fe
Research Design
Calculated X2 = 207.8
Critical = 11.070
Degree of freedom df = K – 1. Where K is the number of Categories, here K = 6
Therefore df = K – 1 = 5
Choosing a 5% level of significance gives $\alpha = 0.05$
Assumptions for hypothesis III
The respondents in the sample were randomly selected.
The sample size was 50
Test statistics = X2 = (Fo – Fe)2/Fe
Research Design
Calculated X2 = 198.3
Critical = 11.070
Degree of freedom df = K – 1. Where K is the number of Categories, here K = 6
Therefore df = K – 1 = 5
Choosing a 5% level of significance gives $\alpha = 0.05$
Assumptions for hypothesis IV
The respondents in the sample were randomly selected.
The sample size was 50
Test statistics = X2 = (Fo – Fe)2/Fe
Research Design
Calculated X2 = 162.2
Critical value = 11.070
Degree of freedom dF = K – 1, where K is the number of categories; here K = 6
Therefore dF = K – 1 = 5
Choosing a 5% level of significance gives $\alpha = 0.05$
Assumptions for hypothesis V
The respondents in the sample were randomly selected.
The sample size was 50

Test statistics = X2 = (Fo – Fe)2/Fe

Research Design

Calculated X2 = 134.5

Critical table value = 11.070

Degree of freedom dF = K – 1, where K is the number of categories; here K = 6

Therefore df = K – 1 = 5

Choosing 5% level of significance gives $\alpha = 0.05$

3. Results and Discussion

Chi-square analysis revealed significant associations between independent variables and dependent variables. The production of gas is the independent variable, and the gas demand management is the dependent variable ($p < 0.05$) [8]. The hypotheses were derived from research questions.

3.1. Hypotheses I

The impacts of effective development of the Nigerian natural gas utilisation system on the Nigerian economy.

The Null Hypothesis H0: There are no significant impacts of Nigerian natural gas utilisation development on the Nigerian economy.

The Alternative Hypothesis: There are significant impacts of Nigerian natural gas utilisation development on the Nigerian economy.

Research Result

Calculated value > Critical value

Based on the analysis in the Appendix and assumption I above, the data are statistically significant at a 5% level of significance, considering the sampling error. An association exists between the variables, as the calculated value of 404.2 is greater than the critical table value of 11.070, thereby validating the alternative hypothesis (see appendix).

Interpretation

The idea of developing a Nigerian natural gas utilisation system is significant, and the development process, as outlined in the Nigerian Gas Master Plan [9], is of great importance to Nigeria's dream of 100% % gas utilisation and distribution. To power the domestic economy through the utilisation of natural gas to generate electricity and to power the industrialisation of Nigeria [10].

3.2. Hypotheses II

How did the idea of developing a Nigerian natural gas utilisation system come into being?

The Null Hypothesis H0: There is no significant idea of developing a Nigerian natural gas utilisation system.

The Alternative Hypothesis: There is a significant idea of developing a Nigerian natural gas utilisation system.

Research Result

Calculated value > Critical value

Based on the analysis in the Appendix and Assumption II above, the data are statistically significant at a 5% level of significance. An association exists between the variables, as the calculated value of 207.8 is greater than the critical table value of 11.070, thereby validating the alternative hypothesis [11].

Interpretation

The analysis indicates that the implementation process of developing Nigerian natural gas utilisation will lead to an increase in gas production, generating more revenue for the Nigerian Government.

This will also lead to the creation of more job opportunities for the youth.

The demand for gas will also increase, and a steady power supply of electricity will be maintained.

3.3. Hypothesis III

The Critical Failure Factors of Nigerian Natural Gas Utilisation System Development.

The Null Hypothesis, Ho: There are no significant Critical Failure Factors in the Nigerian natural gas utilisation development.

The Alternative Hypothesis: There are significant critical failure factors in the development of the Nigerian natural gas utilisation system.

Research Result

Calculated value > Critical value

Based on the analysis in the Appendix and Assumption III above, the data are statistically significant at a 5% level of significance. An association exists between the variables, as the calculated value of 198.3 is greater than the critical table value of 11.070, thereby validating the alternative hypothesis [11].

Interpretation

The analysis above, based on the statistical data, indicates that there are significant Critical Failure Factors in the Nigerian natural gas utilisation system development.

The factors are as follows:

1) Government Policy

2) Inflation rate

3) Lack of infrastructural facilities

4) Huge Capital Outlay

3.4. Hypotheses IV

The specialised strategies or mechanisms are often neglected in the management and development of Nigeria's natural gas utilisation system.

The null hypothesis Ho: There are no significant specialised strategies or mechanisms that were neglected in the management and development of the Nigerian natural gas utilisation system.

The alternate hypothesis Hr: There are significant specialised strategies or

mechanisms that were neglected in the management and development of the Nigerian natural gas utilisation system.

Research Result

Calculated value > critical value

Based on the analysis in the Appendix and Assumption IV above, the data are statistically significant at a 5% significance level. An association exists between the variables since the calculated value of 162.2 is greater than the critical table value of 11.070, thereby validating the alternative hypothesis [11].

Interpretation

The statistical data indicate that the development of Nigeria's natural gas utilisation system has a significant impact on Nigeria's economy. Presently, Nigeria is referred to as "a gas country with some oil," boasting proven gas reserves of 210.5 TCF. This will undoubtedly expand the government's revenue base and have a positive impact on the standard of living for the Nigerian people.

3.5. Hypotheses V

What process did the implementation of the Nigerian natural gas utilisation system development go through?

The Null Hypothesis, H0: There is no significant process of implementing Nigerian natural gas utilisation development.

The alternate hypothesis Hr: There is a significant implementation process for Nigerian natural gas utilisation development.

Research Result

Calculated value > Critical value

Based on the analysis in the Appendix and Assumption V above, the data are statistically significant at a 5% level of sampling error. An association exists between the variables since the calculated value of 134.5 is greater than the critical table value of 11.070, thereby validating the alternative hypothesis [11].

Interpretation

The statistical data indicate that significant strategies or mechanisms are being neglected in the management and development of the Nigerian natural gas utilisation system.

These strategies can be explained in the following context.

The production processes of various oil and Gas companies in Nigeria do not consider the biodiversity of the Niger Delta environment during their planning processes.

Nigeria's challenge is not the availability of gas, but rather the lack of coordinated infrastructure, effective policy enforcement, and stakeholder engagement. Comparative models from Algeria and the UK emphasise integrated policy frameworks, public-private partnerships, and transparency [12].

Policy and Implementation Implications:

1) The Federal Government must prioritise the completion of pipeline infrastructure and encourage local gas distribution firms [13].

2) Regulatory bodies, such as NUPRC [14], should enhance compliance monitoring.

3) Public awareness campaigns should be conducted in regional languages.

4) Conclusion and Recommendations [15].

The research work is designed to determine the demand management of natural gas for Nigeria. To achieve this, five research hypotheses were examined, which led to many findings, which are as follows:

I. The development of the Nigerian natural gas utilisation system is leading to an increase in the demand for natural gas both in the domestic market (Nigeria) and in the international market.

II. The implementation process of Nigeria's natural gas utilisation system development will lead to effective demand management of natural gas for Nigeria.

III. The critical failure factors of the Nigerian natural gas utilisation system development, if well handled, will increase the production of natural gas to meet the increasing demand.

IV. The impacts of developing Nigerian natural gas utilisation on Nigeria's economic development are positive, and this will increase the nation's Gross Domestic Product (GDP).

V. The neglected strategies or mechanisms in the management and development of the Nigerian natural gas utilisation system, if well managed, could lead to an increase in gas production to meet the growing demand.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

[1] Steen, N. (1994) Sustainability and the Energy Industries. Earthscan Publications Ltd., 14-15.

[2] IEA (2023) Africa Energy Outlook 2023. Executive Summary. https://www.iea.org/reports/world-energy-outlook-2023/executive-summary

[3] Gylfason, T. (2001) Natural Resources, Education, and Economic Development. *European Economic Review*, **45**, 847-859. https://doi.org/10.1016/s0014-2921(01)00127-1

[4] Natural Gas Publications (2004) Overview of Natural Gas. https://www.researchgate.net/publication/301323483_Analyses_of_Natural_Gases_2002-2004

[5] Akinyemi, O. and Ogunleye, J. (2021) Demand-Side Challenges and Strategic Frameworks for Natural Gas Utilisation in Nigeria: A Statistical Analysis. *Journal of African Energy Policy*, **6**, 25-39.

[6] Nworgu, B.G. (2015) Educational Research: Basic Issues and Methodology. 3rd Edition, University Trust Publishers.

[7] Asika, N. (2009) Research Methodology in the Behavioural Sciences. 2nd Edition, Longman Nigeria Plc.

[8] Adewuyi, A.O. and Olayemi, S.O. (2021) Statistical Modelling of Gas Production and Demand Management in Nigeria: A Chi-Square Approach. *Journal of Energy Eco-*

nomics and Policy Research, **9**, 32-41.

[9] Federal Government of Nigeria (2008) Nigerian Gas Master Plan. Ministry of Petroleum Resources. https://nairametrics.com/wp-content/uploads/2013/03/nigerian-gas-master-plan.pdf

[10] International Energy Agency (2022) Africa Energy Outlook 2022. IEA. https://www.iea.org/reports/africa-energy-outlook-2022

[11] Kothari, C.R. (2004) Research Methodology: Methods and Techniques. 2nd Edition, New Age International Publishers.

[12] Sambo, A.S. (2022) Natural Gas Development in Nigeria: Opportunities, Challenges, and Policy Imperatives. *Nigerian Journal of Energy Policy*, **18**, 45-59.

[13] Nigeria Extractive Industries Transparency Initiative (NEITI) (2021) 2021 Oil and Gas Industry Report. NEITI. https://eiti.org/documents/nigeria-2021-eiti-report-oil-gas

[14] Nigerian Upstream Petroleum Regulatory Commission (NUPRC) (2023) Annual Statistical Bulletin. NUPRC. https://www.nuprc.gov.ng/gas-production-status-report/

[15] Okonkwo, C.U. and Ibrahim, M.A. (2020) Strategies for Natural Gas Demand Management and Utilisation in Nigeria: Policy, Challenges, and Economic Prospects. *Journal of Energy Policy and Strategy*, **7**, 48-62.

Appendix: Visual Representation

Table 1. The study target population from the various categories and sample size.

S/N	Categories	Study Population	Sample %
1	Unemployed Youths	100	50
2	Businessmen/Women	100	50
3	Community Leaders	10	10
4	Civil Servants in the Ministry	100	40
5	Local Government Worker	100	50
6	SPDC (Oil & Gas Worker)	100	40
7	WRPC (Oil & Gas Worker)	100	50
8	NGC (Gas Worker)	100	60
9	Chevron (Oil & Gas Worker)	90	50
	TOTAL	**800**	**400**

Table 2. Distribution by factors on the demand management of natural gas.

Factors	Strongly Agree		Agree		Undecided		Disagree		Strongly Disagree		Total
	NO	%	NO	%	NO	%	NO	%	NO	%	
Nigerian Natural Gas Utilization	142	50	94	33.10	30	10.56	6	2.11	12	4.23	284
Process Implementation of Nigeria Natural Gas Utilization	73	25.70	94	33.10	30	10.56	45	15.28	42	14.79	284
Failure of Nigerian Natural Gas Utilization	34	11.97	100	35.21	21	7.39	67	23.59	62	21.83	284
Impact of Nigerian Natural Gas Utilisation	78	27.46	142	50	30	10.56	22	7.75	12	4.23	284
Strategies Neglect in the Management and Utilization of Natural Gas	68	23.94	92	32.39	55	19.37	34	11.97	35	12.32	284

Source: Field Work.

Table 3. Summary of significance tests and conclusion on the demand management of natural gas for nigeria.

Factors	Ranking	Degree of Freedom	Level of Significance	Table Value of 2	Calculated 2	Conclusion
Impact of Nigerian Natural Gas utilization	1	5	0.05	11.070	404.2	Significant
Nigerian Natural Gas Utilization	2	5	0.05	11.070	207.8	Significant
Failure of Nigerian Natural Gas Utilization	3	5	0.05	11.070	198.3	Significant
Strategies neglect in Management and Utilization of Natural Gas	4	5	0.05	11.070	162.2	Significant
Process Implementation of Nigerian Natural Gas Utilisation	5	5	0.05	11.070	134.5	Significant

Source: Field Work.

Table 4. Data summary.

Hypotheses	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
I	142	94	30	6	12
II	73	94	30	45	42
III	34	100	21	67	62
IV	78	142	30	22	12
V	68	92	55	34	35
TOTAL	395	522	166	174	163

Source: Field Work.

Table 5. Nigerian natural gas utilization.

Nigerian Natural Gas utilization	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree	Total
Observed Frequency Fe	142	94	30	6	12	284
Expected Frequency Fe	79	79	79	79	79	
$F_o - F_e$	63	15	−49	−73	−67	
$(F_o - F_e)^2$	3969	225	2401	5329	4489	
$(Fo - Fe)^2/Fe$	50.2	2.9	30.4	67.5	56.8	
Calculated x^2	50.2	+2.9	+30.4	+67.5	+56.8	=207.8

Source: Field Work.

Table 6. Process implementation of nigerian natural gas utilisation.

Process Implementation of Nigeria's Natural Gas Utilization	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree	Total
Observed Frequency F_o	73	94	30	45	42	
Expected Frequency	104.4	104.4	104.4	104.4	104.4	
$F_o - F_e$	−31.4	−10.4	−74.4	−59.4	−62.4	
$(F_o - F_e)^2$	986	108.2	5535.4	3528.4	3894	
$(F_o - Fe)^2/Fe$	9.4	1.04	53.0	33.8	37.3	
Calculated x^2	9.4	+1.04	+53.0	+33.8	+37.3	=134.5

Source: Field Work.

Table 7. Failure of nigerian natural gas utilisation.

Failure of Nigerian Natural Gas Utilisation	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree	Total
Observed Frequency Fo	34	100	21	67	62	
Expected Frequency Fe	33.2	33.2	33.2	33.2	33.2	

Continued

Fo – Fe	1.2	66.8	–12.2	33.8	28.8	
$(Fo – Fe)^2$	1.44	4462.2	149	1142.4	829.4	
$(Fo – Fe)^2/Fe$	0.04	134.4	4.5	34.4	24.98	
Calculated x^2	0.04	+134.4	+4.5	+34.4	+24.98	=198.3

Source: Field Work.

Table 8. Impact of nigerian natural gas utilisation.

Impact of Nigerian Natural Gas Utilisation	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree	Total
Observed Frequency Fo	78	142	30	22	12	
Expected Frequency Fe	34.8	34.8	34.8	34.8	34.8	
Fo – Fe	43.2	107.2	-4.8	-12.8	22.8	
$(Fo – Fe)^2$	1866.2	11491.8	23.0	163.8	519.8	
$(Fo – Fe)^2/Fe$	53.6	330.2	0.66	4.7	15	
Calculated x^2	53.6	+330.2	+0.66	+4.7	+15	=404.2

Source: Field Work.

Table 9. Strategies neglected in management and utilisation of natural gas.

Stratifies Neglected on the Management and Utilisation of Natural Gas	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree	Total
Observed Frequency Fo	68	92	55	34	35	
Expected Frequency Fe	32.6	32.6	32.6	32.6	32.6	
Fo – Fe	35.4	59.4	22.4	1.4	2.4	
$(Fo – Fe)^2$	1253.2	3528.4	501.8	1.96	5.8	
$(Fo – Fe)^2/Fe$	38.4	108.2	15.4	0.06	0.18	
Calculated x^2	38.4	+108.2	+15.4	+0.06	+0.18	=162.2

Source: Field Work.