



Gas Flaring, Energy Consumption and Economic Growth in Nigeria: Evidence from VECM Granger Causality Analysis

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Abstract

This study examined the causal link among gas flaring, energy consumption and economic growth in Nigeria. Annual time-series data covering 1984–2024 were sourced from the World Bank Development Indicators, the Central Bank of Nigeria, EIA International Energy Statistics, and the OPEC Annual Statistical Bulletin. The study employed the Vector Error Correction Model-based Granger causality/block exogeneity Wald test after confirming that the variables were integrated of order one and cointegrated. The findings revealed that macroeconomic, energy and oil-sector variables jointly Granger-cause gas flaring in the short run. Specifically, the value of crude oil production positively and significantly influences gas flaring, while crude oil production quantity negatively affects economic growth. The results suggest that gas flaring is not merely an environmental problem but also an energy-waste and economic-efficiency issue. The study recommends stronger regulation of gas flaring, investment in gas-utilisation infrastructure, and the expansion of gas-to-power projects in Nigeria.

Keywords: Gas flaring, energy consumption, economic growth, VECM, Nigeria.

Introduction

Energy consumption remains a major driver of economic growth because it supports industrialisation, transportation, communication, technological advancement, and overall productive activities. Globally, studies have established a strong relationship between energy consumption and economic growth, although the direction of causality differs across countries and stages of development (Opoku et al., 2025; Peñasco & Anadón, 2023; Effiong et al., 2024). In advanced economies, energy efficiency and diversified energy sources have strengthened long-term economic performance. In contrast, in developing economies, especially in sub-Saharan Africa, limited energy access and affordability continue to constrain growth (International Energy Agency [IEA], 2023). This challenge is more severe in Nigeria, where abundant natural gas reserves coexist with persistent energy poverty, unreliable electricity supply, and weak industrial productivity (World Bank, 2024a). Thus, the Nigerian energy situation reflects a development paradox in which available gas resources are not sufficiently converted into productive energy for economic growth.

Gas flaring is central to this paradox because it represents both an environmental problem and a waste of valuable energy resources. Nigeria remains one of the leading gas-flaring countries despite possessing large proven natural gas reserves and despite global efforts to reduce routine flaring (World Bank, 2024a; Aigbe et al., 2023). Between 2012 and 2021, Nigeria reportedly flared gas valued at over USD 6.3 billion, which could have generated substantial electricity and reduced the country's chronic power shortages (Abu et al., 202a; Ripples



Nigeria, 2021). Gas flaring also contributes to greenhouse gas emissions, including carbon dioxide and methane, with methane having a much higher warming potential than carbon dioxide over a short-term period (Intergovernmental Panel on Climate Change [IPCC], 2023). Beyond its environmental consequences, gas flaring has adverse social and economic effects, including air pollution, health risks, reduced agricultural productivity, and livelihood insecurity in oil-producing communities (Esavwede & Oyibodoro, 2025; Nwokolo, 2025). Although Nigeria has introduced several policy measures to reduce gas flaring, including gas-flaring penalties and the Nigerian Gas Flare Commercialisation Programme, weak enforcement, inadequate infrastructure, and limited investment in gas utilisation have continued to undermine progress (Federal Government of Nigeria, 2018; Afiotan, 2022; Nigerian Upstream Petroleum Regulatory Commission [NUPRC], 2024).

Existing studies have examined the relationships among energy consumption, environmental pollution, and economic growth. However, the causal interactions among gas flaring, energy consumption, and economic growth in Nigeria remain insufficiently established. Some studies focus largely on carbon emissions while giving limited attention to methane emissions and the role of flared gas as a wasted energy resource (Shabestari, 2018; Bodin, 2022). Others examine energy consumption and economic growth without adequately incorporating gas flaring as a structural constraint on energy optimisation and sustainable growth (Adedoyin et al., 2020; Alkhathlan & Javid, 2013). This creates a gap in understanding whether gas flaring merely reflects oil production activities or has a measurable causal relationship with Nigeria's energy consumption patterns and economic performance. Therefore, this study investigates the causal link among gas flaring, energy consumption, and economic growth in Nigeria, with a view to providing empirical evidence on how gas flaring interacts with energy use and economic development within the Nigerian economy.

Literature Review

Gas flaring, energy consumption and economic growth are closely connected within the energy-growth-environment nexus. Conceptually, gas flaring refers to the burning of associated natural gas released during crude oil production when it is not captured, processed, or utilised for productive purposes. Morakinyo (2015), Agboola et al. (2011), Ojjiagwo (2017), and McEwen and Johnson (2012) describe gas flaring as both a waste of valuable energy resources and a major source of environmental degradation. This means that gas flaring is not only an oil-sector operational practice but also an economic and environmental problem, because the gas that is flared could have been converted into electricity, industrial energy, or domestic fuel. Energy consumption, on the other hand, is widely regarded as a major input in production, industrialisation and economic expansion. Thus, in an energy-deficient economy like Nigeria, the continued flaring of gas raises important questions about the country's ability to convert its natural gas endowment into productive energy use and sustainable economic growth.

The Environmental Kuznets Curve theory provides the theoretical foundation for this relationship. The EKC theory argues that environmental degradation increases at the early stage of economic growth but declines after a certain income threshold as economies adopt cleaner technologies, efficient energy systems and stronger environmental regulations. This theory is relevant to Nigeria because crude oil production has contributed to revenue generation and economic activity. However, it has also intensified gas flaring, methane emissions and environmental degradation. Therefore, Nigeria appears to reflect the early phase of the EKC, where resource extraction and energy use are associated with environmental costs. The Dutch Disease theory further explains how oil dependence can



weaken broader productive sectors and reduce the developmental benefits of resource wealth. In contrast, Endogenous Growth theory emphasises the role of technology, innovation and infrastructure in transforming natural resources into long-term growth. However, the EKC remains the most suitable theoretical anchor because it directly links economic growth, energy consumption and environmental degradation.

Empirical studies on energy consumption and economic growth have produced mixed results. Adegioriola and Agbanuji (2020) found that electricity consumption positively affects economic growth in Nigeria in the short run, but negatively and insignificantly in the long run. Similarly, Balogun et al. (2024), Evans et al. (2025), and Ngwu and Ofoegbu (2024) found that energy consumption and gas utilisation contribute to economic growth. These studies support the argument that energy is essential for economic performance. However, they focus mainly on electricity consumption, natural gas utilisation or aggregate energy use, without adequately considering gas flaring as a form of wasted energy that could weaken energy availability and long-run growth. This creates a gap because energy consumption cannot be fully understood in Nigeria without accounting for the large volume of associated gas lost through flaring.

Related studies have also examined the environmental dimension of energy use. Adegioriola and Adolphus (2020) found that oil consumption, gas fuel and fossil fuel consumption significantly increase carbon emissions in Nigeria. Jato (2023) similarly showed that fossil-fuel-based energy supply worsens CO₂ emissions. These findings confirm the EKC argument that fossil-fuel-dependent growth can worsen environmental degradation. However, most of these studies focus mainly on carbon emissions, giving limited attention to gas flaring and methane emissions, even though methane is strongly associated with oil and gas operations and has serious environmental implications. This limitation is important because gas flaring is both an emissions problem and an energy-waste problem.

Studies that directly focus on gas flaring in Nigeria also provide useful insights but remain incomplete. Okoro et al. (2021), Yayah and Obi (2022), and Eze et al. (2021) found relationships among gas flaring, gas utilisation and economic growth. However, some of these studies treat gas flaring mainly as an oil-sector variable linked to production and revenue, without fully accounting for its environmental costs and energy-loss implications. Other studies, such as Osuoha and Fakutiju (2017), Abu et al. (2023b), Aigbe et al. (2023), and Olujobi et al. (2022), emphasise the health, technological, legal and policy dimensions of gas flaring. While these studies are useful, they do not adequately model the causal interactions among gas flaring, energy consumption, and economic growth within a unified econometric framework.

Methodology

This study employed annual time-series data covering 1984–2024 to examine the causal link among gas flaring, energy consumption and economic growth in Nigeria. The data were sourced from the World Bank Development Indicators, Central Bank of Nigeria, EIA International Energy Statistics, and OPEC Annual Statistical Bulletin. The variables used are gas flaring (GFLR), gross domestic product per capita (GDPC) as a proxy for economic growth, energy consumption (ECON), methane emissions (MEMN), quantity of crude oil production (QCOP), and value of crude oil production (VLOP). Missing 2024 values for some variables were extrapolated using a linear trend based on the most recent 10-year data pattern. The model is specified in functional form as:

$$GFLR_t = f(GDPC_t, ECON_t, MNEM_t, QCOP_t, VLOP_t, \mu_t) \quad \text{--} \quad \text{--} \quad (1)$$



The explicit log-linear model is stated as:

$$\ln GFLR_t = \beta_0 + \beta_1 \ln GIPC_t + \beta_2 \ln ECON_t + \beta_3 \ln MNEM_t + \beta_4 \ln QCOP_t + \beta_5 \ln VCOP_t + \varepsilon_t \quad (2)$$

The logarithmic transformation allows the estimated coefficients to be interpreted as elasticities and helps to reduce heteroscedasticity.

To investigate causality, the study employed the Vector Error Correction Model-based Granger causality/block exogeneity Wald test. This approach was adopted because the variables were integrated of order one (I(1)) and cointegrated, indicating the existence of a long-run equilibrium relationship. The general VECM is specified as:

$$\Delta Y_t = \pi Y_{t-1} + \sum_{i=1}^{p-1} \tau_i \Delta Y_{t-1} + \varepsilon_t \quad (3)$$

Where:

$Y_t = [\ln GIPC_t, \ln ECON_t, \ln MNEM_t, \ln QCOP_t, \ln VCOP]$. In this specification, Δ denotes the first-difference operator, π is the long-run relationship among the variables, τ_i is the short-run relationship, and ε_t is the stochastic error term.

Pre-estimation tests included descriptive statistics, correlation analysis, the Variance Inflation Factor, Augmented Dickey-Fuller and Phillips-Perron unit root tests, and Johansen cointegration test. The optimal lag length was selected using FPE, AIC, HQIC and SBIC criteria. The causality analysis was then carried out using the VECM Granger causality/block exogeneity Wald test. The null hypothesis of no causality is rejected when the Wald probability value is less than 0.05. Post-estimation diagnostic tests were also conducted to check for serial correlation, heteroscedasticity, normality and model specification.

Results

Preliminary analysis

The preliminary results include descriptive statistics of the variables in their natural form, correlation analysis, tests for multicollinearity, unit root tests, cointegration tests, and lag length selection tests. The descriptive statistics in Table 1 show substantial variation in gas flaring, economic growth, energy consumption, methane emissions, crude oil production and value of crude oil production in Nigeria over the study period. Gas flaring recorded an average value of 42.674 million cubic metres, with a maximum of 71.265 million cubic metres, indicating the persistence of routine flaring. GDP per capita averaged US\$1,430.683, while energy consumption averaged 1.059 quadrillion Btu, reflecting Nigeria's uneven growth pattern and persistent energy access challenges.

Table 1: Descriptive Statistics

Variable	Mean	Std. Dev.	Min.	Max.	Observation
GFLR	42.674	13.260	20.629	71.265	41
GIPC	1430.683	783.633	465.488	3088.721	41
ECON	1.059	0.434	0.542	1.822	41
MEMN	226.937	38.840	151.457	317.184	41
QCOP	1763.393	304.459	1137.913	2365.845	41
VLOP	33814.65	25901.64	4121.9	95619.7	41

Source: Author's computation, 2025

The large variations in GDP per capita and crude oil production value suggest that Nigeria's growth path remains vulnerable to oil-sector volatility. Similarly, the fluctuations in gas flaring and methane emissions confirm the environmental implications of hydrocarbon extraction.



Furthermore, the correlation results in Table 2 show that gas flaring is negatively and significantly associated with economic growth and energy consumption. Specifically, the correlation between gas flaring and GDP per capita is -0.536, while the correlation between gas flaring and energy consumption is -0.762. This implies that higher gas flaring is associated with weaker income performance and lower effective energy utilisation.

Table 2: Correlation Matrix

	Year	GFLR	GDPC	ECON	MEMN	QCOP	VLOP
Year	1.000						
GFLR	-0.692**	1.000					
GDPC	0.707***	-0.536***	1.000				
ECON	0.916***	-0.762***	0.664***	1.000			
MEMN	0.219	0.528***	0.179	0.071	1.000		
QCOP	-0.1505	0.617***	-0.015	-0.365**	0.599***	1.000	
VLOP	0.702***	-0.525***	0.797***	0.580***	0.109	0.168	1.000

Note: ***, ** and * are 1%, 5% and 10% respectively

Also, in Table 2, Gas flaring is positively correlated with methane emissions and crude oil production, confirming that flaring is closely linked to oil extraction activities and environmental pollution. The positive relationship between GDP per capita and energy consumption also confirms the energy-dependent nature of Nigeria's growth process.

Regarding multicollinearity, the Variance Inflation Factor results in Table 3 indicate that it is not a serious problem in the model. All VIF values are below the common threshold of 10, while the mean VIF is 3.53.

Table 3: Variance Inflation Factor Test for Multicollinearity

Variables	VIF	Tolerance (1/VIF)
ln_VLOP	4.61	0.217
ln_ECON	4.43	0.226
ln_QCOP	3.38	0.096
ln_GDPC	2.78	0.360
ln_MEMN	2.45	0.408
Mean VIF	3.53	

The results from Table 3 confirm that the explanatory variables are not highly collinear, and the estimated coefficients can therefore be interpreted with reasonable confidence. In the same vein, the Augmented Dickey-Fuller and Phillips-Perron tests were used to test for unit roots in the variables. The test was performed in accordance with the specifications, with a constant. The results, as shown in Table 4, indicate that all variables are non-stationary at the level but become stationary after first differencing. This means that the variables are integrated of order one (I(1)), thereby justifying the use of the Johansen cointegration test and the VECM framework.

Table 4: Summary of Unit Root Results

Variable	ADF at First Difference	PP at First Difference	Order of Integration
lnGFLR	-6.292***	-6.292***	I(1)
lnGDPC	-4.746***	-4.746***	I(1)
lnECON	-7.949***	-7.949***	I(1)
lnMEMN	-5.225***	-5.225***	I(1)
lnQCOP	-6.023***	-6.023***	I(1)
lnVLOP	-7.370***	-7.370***	I(1)

Note: *** indicates significance at 1%.



The Johansen cointegration result in Table 4 confirms the existence of one cointegrating relationship among the variables. This indicates that gas flaring, economic growth, energy consumption, methane emissions, crude oil production and value of crude oil production move together in the long run.

Table 5: Cointegration test results

Trace Test			Maximum Eigenvalue test		
Cointegration rank (r)	Trace Statistics	5% Critical Value	Cointegration rank (r)	Max-Eigen Statistics	5% Critical Value
r=0	103.997	94.15	r=0	52.747	39.37
r≤1	51.250	68.52	r=1	22.744	33.46
r≤2	28.506	47.21	r=2	11.090	27.07
r≤3	17.416	29.68	r=3	9.220	20.97
r≤4	8.196	15.41	r=4	8.186	14.07
r≤5	0.010	3.76	r=5	0.010	3.76
r≤6			r=6		

Since both the trace and maximum eigenvalue statistics reject the null hypothesis of no cointegration at rank zero, the result supports the use of VECM-based Granger causality/block exogeneity analysis. As for the lag length used in the study, the lag length selection results in Table 6 indicate that lag 1 is optimal based on FPE, HQIC, and SBIC criteria.

Table 6: Lag Length Selection

Lag	LL	LR	FPE	AIC	HQIC	SBIC
0	37.5144		7.3e-09	-1.703	-1.611	-1.442
1.	199.943	324.86	8.1e-12*	-8.537	-7.893*	-6.701*
2.	229.438	58.99	1.4e-11	-8.186	-6.989	-4.790
3.	274.109	89.342	1.3e-11	-8.655	-6.905	-3.691
4.	334.35	120.48*	1.1e-11	-9.965*	-7.662	-3.434

Note: * indicates lag selected by the criterion.

Although AIC selected lag four, the study adopted lag one because it is supported by FPE, HQIC and SBIC, which are more parsimonious for a relatively small annual time-series sample.

VECM Granger Causality/Block Exogeneity Wald Test

The VECM Granger causality/block exogeneity Wald test in Table 7 reveals important causal linkages among gas flaring, energy consumption and economic growth in Nigeria.

Table 7: VECM Granger Causality/Block Exogeneity Wald Test

Dependent Variable	Independent variables	Coefficient	Wald test
$\Delta \ln GFLR_t$	$\Delta \ln GFLR_t$	0.225	14.529*
	$\Delta \ln GDPC_t$	-0.022	
	$\Delta \ln ECON_t$	-0.047	
	$\Delta \ln MEMN_t$	0.023	
	$\Delta \ln QCOP_t$	-0.329	
	$\Delta \ln VLOP_t$	0.123***	
$\Delta \ln GDPC_t$	$\Delta \ln GFLR_t$	0.135	7.610
	$\Delta \ln GDPC_t$	0.139	
	$\Delta \ln ECON_t$	-0.146	



	$\Delta \ln MEMN_t$	1.620	
	$\Delta \ln QCOP_t$	-1.218*	
	$\Delta \ln VLOP_t$	0.256	
$\Delta \ln ECON_t$	$\Delta \ln GFLR_t$	-0.083	10.298
	$\Delta \ln GDPC_t$	0.047	
	$\Delta \ln ECON_t$	-0.037	
	$\Delta \ln MEMN_t$	0.368	
	$\Delta \ln QCOP_t$	-0.217	
	$\Delta \ln VLOP_t$	0.058	
$\Delta \ln MEMN_t$	$\Delta \ln GFLR_t$	0.335	9.949
	$\Delta \ln GDPC_t$	-0.015	
	$\Delta \ln ECON_t$	0.066	
	$\Delta \ln MEMN_t$	0.025	
	$\Delta \ln QCOP_t$	-0.368**	
	$\Delta \ln VLOP_t$	0.073**	
$\Delta \ln QCOP_t$	$\Delta \ln GFLR_t$	0.366	9.998
	$\Delta \ln GDPC_t$	-0.066	
	$\Delta \ln ECON_t$	-0.305**	
	$\Delta \ln MEMN_t$	-0.322	
	$\Delta \ln QCOP_t$	0.002	
	$\Delta \ln VLOP_t$	0.051	
$\Delta \ln VLOP_t$	$\Delta \ln GFLR_t$	1.801	14.559*
	$\Delta \ln GDPC_t$	-0.199	
	$\Delta \ln ECON_t$	0.521	
	$\Delta \ln MEMN_t$	-1.761	
	$\Delta \ln QCOP_t$	-1.229	
	$\Delta \ln VLOP_t$	0.198	

Note: ***, ** and * indicate significance at 1%, 5% and 10%, respectively.

The VECM Granger causality/block exogeneity results in Table 7 show that gas flaring is jointly influenced by the system of macroeconomic, energy and oil-sector variables in the short run. This is confirmed by the Wald statistic of 14.529, which is significant at the 10% level. The implication is that gas flaring in Nigeria is not an isolated petroleum-industry activity; rather, it responds to changes in the broader energy and oil-revenue environment. At the individual level, crude oil production has a positive, statistically significant effect on gas flaring, with a coefficient of 0.123. This suggests that increases in oil production value intensify gas flaring in the short run, especially when higher oil-sector earnings are not matched with adequate investment in gas-gathering, gas-processing and domestic gas-utilisation infrastructure. This finding aligns with Okoro et al. (2021), who found that gas flaring in Nigeria is persistent and linked to economic and energy-sector conditions. It also aligns with Yayah and Obi (2022) and Eze et al. (2021), whose studies suggest that gas flaring is linked with oil production and GDP through Nigeria's oil-dependent growth structure. However, the finding differs from studies that treat gas flaring mainly as a policy or regulatory failure, such as Olujobi et al. (2022), because the present result shows that short-run oil-revenue incentives also drive flaring.

For the economic growth equation, the result indicates that the variables do not jointly Granger-cause GDP per capita in the short run. However, crude oil production quantity has a negative and statistically significant effect on economic growth, with a coefficient of -1.218. This implies that higher crude oil production does not automatically translate into improved



income levels in Nigeria. The result supports the resource curse argument, which suggests that resource extraction may fail to promote broad-based economic welfare when weak institutions, rent mismanagement, Dutch disease effects, and poor domestic linkages are present. This finding agrees with Mustapha (2022), who found that oil production and carbon emissions negatively affect real per capita growth in Nigeria. It also supports the position of Tijani et al. (2023) that emissions from gas flaring and fossil-fuel dependence weaken sustainable economic growth. However, it contradicts Yayah and Obi (2022) and Eze et al. (2021), who reported positive relationships between gas flaring, oil production and economic growth. The difference may be because those studies captured the revenue effect of oil extraction. At the same time, the present result points to the welfare and structural costs of oil dependence.

For the energy consumption equation, the Wald statistic is not statistically significant, indicating that gas flaring, economic growth, methane emissions and oil-sector variables do not jointly Granger-cause energy consumption in the short run. This suggests that energy consumption in Nigeria is driven more by structural factors, such as weak electricity access, inadequate transmission and distribution infrastructure, poor domestic gas utilisation, and dependence on diesel- and petrol-based self-generation, than by short-run movements in gas flaring or crude oil production. This finding aligns with Chuma-Udeh and Okereke (2024), who observed that Nigeria's abundant natural gas reserves have not translated into adequate domestic energy access due to infrastructure, pricing, and power-sector constraints. It also agrees with Eko-Raphaels et al. (2022), who found that the contribution of natural gas to the Nigerian economy remains limited due to inadequate utilisation, high investment cost and storage constraints. However, the result differs from Adegioriola and Agbanuji (2020) and Balogun et al. (2024), who found stronger evidence that energy consumption contributes significantly to economic growth in Nigeria. The difference suggests that while energy may support growth, Nigeria's current energy structure does not respond quickly to changes in oil-sector conditions or flaring.

For the methane emissions equation, the results show that the variables do not jointly Granger-cause methane emissions in the short run. Nevertheless, crude oil production quantity has a negative and significant effect. In contrast, crude oil production value has a positive and significant effect on methane emissions. This means that higher oil revenues tend to increase methane emissions, probably because favourable oil prices encourage intensified production activities and associated gas handling. In contrast, the negative effect of crude oil production quantity may reflect periods of improved operational control, gas reinjection, or changes in production efficiency. This finding partly agrees with Adegioriola and Adolphus (2020), who found that fossil fuel consumption, gas fuel and oil consumption significantly increase carbon emissions in Nigeria. It also aligns with Ericsson (2022), whose study found that higher energy consumption is associated with increased methane emissions. However, the negative effect of crude oil production quantity on methane emissions differs from studies that assume a direct positive link between production volume and emissions, suggesting that emissions outcomes may depend not only on production scale but also on operational efficiency and gas-management practices.

In a nutshell, the results suggest that the causal link among gas flaring, energy consumption, and economic growth in Nigeria is largely indirect, structural, and oil-revenue-driven. The strongest short-run evidence is that the value of crude oil production drives gas flaring. In contrast, crude oil production quantity weakens economic growth. This implies that gas flaring should not be treated only as an environmental problem but also as an energy-waste



and economic-efficiency problem. The finding supports Abu et al. (2023b) and Otuagoma et al. (2024), who argued that gas-to-wire, LNG and other gas-utilisation options can convert flared gas into productive energy. It also agrees with Tijani et al. (2023) and Echebiri et al. (2023), who found that gas flaring undermines environmental quality, welfare and sustainable growth. Therefore, reducing gas flaring through domestic gas utilisation, expanding energy infrastructure, and strengthening regulatory enforcement could improve energy availability, reduce methane emissions, and strengthen Nigeria's long-run economic performance.

Conclusion

This study examined the causal links among gas flaring, energy consumption, and economic growth in Nigeria using a VECM Granger-causality/block exogeneity framework. The findings show that gas flaring is jointly influenced by macroeconomic, energy, and oil-sector variables in the short run, indicating that it is not an isolated environmental activity but a structural outcome of Nigeria's oil-dependent energy system. Specifically, crude oil production was found to have a positive and significant effect on gas flaring, suggesting that increases in oil-sector value tend to intensify gas flaring when production expansion is not matched by adequate gas utilisation infrastructure.

The results further show that the system of variables does not jointly Granger-cause economic growth and energy consumption in the short run. However, crude oil production quantity negatively affects economic growth, supporting the argument that oil production does not automatically translate into improved welfare in Nigeria. The absence of direct short-run causality from gas flaring to economic growth and energy consumption suggests that the adverse effects of flaring operate primarily through long-run structural channels, such as energy waste, environmental degradation, weak domestic gas utilisation, and reduced productivity.

In conclusion, the study shows that gas flaring in Nigeria is both an environmental and economic problem. It represents a loss of usable energy, contributes to methane emissions, and weakens the potential contribution of energy consumption to sustainable growth. Therefore, reducing gas flaring and converting associated gas into productive domestic energy use are essential for improving energy availability, environmental quality and long-term economic performance in Nigeria.

Recommendations

Based on the findings, the study recommends that:

- i. The government should strengthen enforcement of gas-flaring regulations by ensuring that penalties are high enough to discourage routine flaring and that oil companies comply with gas capture and utilisation requirements.
- ii. Oil and gas operators should invest in gas-gathering and processing infrastructure to convert associated gas into productive uses such as electricity generation, liquefied petroleum gas, compressed natural gas and industrial feedstock.
- iii. Nigeria should expand domestic gas-to-power projects to redirect flared gas for electricity generation, thereby improving energy consumption and reducing dependence on self-generation.
- iv. Policy makers should link oil-sector expansion to mandatory gas utilisation plans, ensuring that increases in crude oil production and oil revenue do not lead to higher gas flaring.



- v. The government should promote a cleaner energy transition by integrating methane-emission control, renewable energy development, and gas commercialisation into Nigeria's broader economic growth strategy.

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