



Cost-Benefit Analysis of Gas Flaring Reduction Policies in Nigeria: Implications for Environmental Sustainability and Public Health

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Abstract

This study examined the cost–benefit implications of gas flaring reduction policies in Nigeria using an econometric approach. The study quantified the economic and environmental costs of gas flaring, evaluated the revenue potential of gas utilization alternatives including liquefied natural gas (LNG), gas-to-wire (GTW), and gas-to-methanol (GTM), and assessed the overall cost–benefit relationship of transitioning from flaring to gas commercialization. Secondary time-series data were analyzed using econometric techniques, including Ordinary Least Squares regression, cointegration analysis, and cost–benefit modeling. The findings revealed that gas flaring imposes significant economic losses, with gas flaring volume and gas prices exerting strong positive effects on the cost of flaring. Oil production was also found to contribute to increased flaring, while gas utilization significantly reduced associated costs. The analysis of gas utilization pathways showed that LNG offers the highest revenue potential but is highly capital-intensive, whereas GTW provides a more feasible and efficient option for domestic energy needs. GTM was found to be moderately viable but constrained by market and scalability factors. The cost–benefit analysis indicated that the benefits of gas flaring reduction substantially outweigh the costs, with a high benefit–cost ratio and positive net present value. The study concludes that gas flaring reduction in Nigeria is both economically and environmentally beneficial, and that the continued practice of flaring reflects policy and infrastructural challenges rather than economic infeasibility. It recommends strengthened regulatory enforcement, targeted investment in gas utilization infrastructure, and enhanced public–private collaboration to promote sustainable gas commercialization.

Keywords: Gas Flaring, Cost–Benefit Analysis, LNG, GTW, GTM, Econometric Analysis, Nigeria

Introduction

Nigeria is endowed with vast natural gas reserves, estimated at over 206 trillion cubic feet, making it one of the top ten countries by global gas reserves (Nigerian Upstream Petroleum Regulatory Commission, 2022). Despite this abundance, a significant share of associated gas is wasted through flaring—a practice in which excess gas is combusted during oil extraction because infrastructure for gas capture, storage, or utilisation is lacking. Gas flaring has persisted in Nigeria for decades, especially in the Niger Delta region, and remains a critical environmental, economic, and public health concern.

The economic implications of gas flaring are profound. The country loses billions of dollars annually in potential revenue from gas that could have been commercialised for domestic energy production, liquefied natural gas (LNG) exports, or as an industrial feedstock. Moreover, flaring contributes to energy poverty in a nation where over 40% of the population lacks access to electricity. From an environmental perspective, gas flaring is a major source of greenhouse gas emissions, releasing significant quantities of carbon dioxide (CO₂), methane (CH₄), and black carbon, which contribute to climate change and air pollution. These emissions have severe health consequences for local

communities, including respiratory illnesses, acid rain, and contaminated water sources (Ogbodo, 2015). Successive governments and regulatory bodies in Nigeria have implemented various policies aimed at reducing gas flaring. These include the Associated Gas Re-Injection Act of 1979, the Gas Master Plan, the 2008 Flare Reduction Targets, and, more recently, the Nigerian Gas Flare Commercialization Programme (NGFCP), launched in 2016. While these policies aim to incentivise gas utilisation and penalise flaring, their implementation has yielded mixed results, largely due to enforcement gaps, infrastructural deficits, weak regulatory oversight, and resistance from multinational oil companies (Adewuyi & Olayinka, 2021).

A cost-benefit analysis (CBA) provides a rigorous empirical framework for evaluating the economic justification for reducing or eliminating gas flaring. It helps stakeholders—government agencies, investors, environmental advocates, and local communities—to understand the trade-offs between policy costs (such as infrastructure investment and enforcement mechanisms) and expected benefits (such as improved public health, increased revenue, environmental preservation, and job creation). In contexts like Nigeria, where fiscal resources are limited and must be allocated prudently, empirical evidence from CBA can guide more effective decision-making. Given the urgent need to transition towards sustainable energy practices and to fulfil Nigeria's commitments under international climate agreements such as the Paris Accord, evaluating the cost-effectiveness of gas flaring reduction policies is not only a matter of national interest but also a global environmental responsibility. This study thus seeks to empirically assess the economic, environmental, and social implications of current gas flaring reduction policies in Nigeria and to determine whether the long-term benefits outweigh the associated costs.

Conceptual Review

Gas Flaring

Gas flaring is the controlled burning of natural gas associated with oil extraction, typically carried out when gas cannot be processed or sold. In Nigeria, this practice is prevalent due to inadequate infrastructure for gas capture, storage, and utilisation. The flared gas, which consists of hydrocarbons such as methane and ethane, is often released through stacks or pipes into the atmosphere, leading to massive energy waste and air pollution. Despite legal frameworks and international pressure, Nigeria continues to rank among the top gas-flaring countries globally, particularly in the Niger Delta region. The environmental and social costs of flaring are immense, including acid rain, destruction of farmland, respiratory illnesses, and a contribution to global warming (Alegbeleye & Adeyemi, 2020). The economic implications of gas flaring also raise significant concern, as Nigeria loses billions of naira annually in flared gas that could be monetised or reinjected to boost national energy supplies. Beyond revenue loss, gas flaring stifles local economic development by affecting agriculture, fishing, and livelihoods in affected communities. While various policies, such as the Gas Master Plan and the National Gas Policy, have been introduced, enforcement remains weak. Consequently, reducing gas flaring is not just an environmental imperative but also an economic necessity. A conceptual understanding of gas flaring requires analysing the technical, regulatory, and socio-political dimensions that influence its persistence and the effectiveness of reduction strategies (Aminu & Olawuyi, 2020).

Cost Analysis

Cost analysis is the process of assessing the financial and non-financial implications of implementing or failing to implement specific policies or projects. In the context of gas flaring, it identifies the direct and indirect costs of continued flaring, such as environmental degradation, public health burdens, and the opportunity costs of wasted gas resources. It also covers the expenditures required to develop and operate gas capture infrastructure, enforce regulations, and compensate communities for environmental harm. Accurate cost analysis is critical for policy design, enabling decision-makers to weigh the economic burden of current practices against the potential benefits of intervention. Furthermore, it supports budgetary planning and helps prioritise funding for the most impactful measures. In Nigeria, many past gas flaring initiatives have failed due to underestimating the financial and operational costs of implementing alternatives, such as gas reinjection or processing for domestic use. The complexity of infrastructure development, especially in remote oil-producing regions, necessitates a nuanced approach to cost evaluation. Understanding the full range of costs, including externalities borne by affected populations, enables policymakers to advocate for more transparent and equitable energy transition policies (Oyewole & Ajayi, 2020).

Benefit Analysis

Benefit analysis involves systematically estimating the advantages or gains derived from a project or policy intervention. When applied to gas flaring reduction, it assesses both tangible and intangible outcomes, such as improved public health, environmental restoration, reduced greenhouse gas emissions, and economic diversification.

A major benefit of flaring reduction is the potential to convert previously wasted gas into electricity, liquefied petroleum gas (LPG), or compressed natural gas (CNG) for domestic and industrial use. This contributes to energy security and reduces Nigeria's dependence on imported fuel (World Bank, 2022). Moreover, benefit analysis highlights the positive externalities of gas flaring reduction. These include enhanced investor confidence, compliance with international environmental standards, and fulfilment of Nigeria's climate change commitments under the Paris Agreement. Other social benefits include job creation through the development of gas-based industries and improved quality of life for communities exposed to flaring-related pollution. An effective benefit analysis enables policymakers to build the case for long-term investment and stakeholder engagement by quantifying the rewards of gas flaring reduction not only in monetary terms but also in terms of human well-being and ecological preservation (UNDP, 2019).

Gas Flaring Reduction Policies

Gas flaring reduction policies are government-led initiatives, legal instruments, and regulatory frameworks designed to curb emissions from gas flaring during oil and gas production. These policies may include penalties for flaring, incentives for gas utilisation, and mandatory requirements for gas capture infrastructure in new projects. In Nigeria, notable policies include the Associated Gas Re-injection Act of 1979, the Nigeria Gas Flare Commercialisation Programme (NGFCP), and the National Gas Policy of 2017. Despite their presence, enforcement has been a major bottleneck due to institutional weaknesses and the influence of powerful oil multinationals (Omisore & Okafor, 2021). These policies are often shaped by international climate change protocols and the rising global demand for cleaner energy sources. By mandating oil companies to capture and commercialise flared gas, these policies aim to transform an environmental liability into an economic asset. However, effective implementation requires coordination among regulatory agencies such as the Nigerian Upstream Petroleum Regulatory Commission (NUPRC), robust monitoring systems, and transparent enforcement. A conceptual understanding of these policies entails analysing their design, implementation mechanisms, and the socio-political dynamics that affect compliance (Akinyemi & Fagbenro, 2018).

Theoretical Framework

To provide a sound academic foundation for this study, two relevant theories are adopted: Externality Theory and Cost-Benefit Analysis (CBA) Theory. These theories explain the rationale for gas flaring regulation and provide analytical tools for evaluating the implications of such policies. Externality Theory, rooted in welfare economics, was popularised by economist Arthur Cecil Pigou in 1920. The theory explains how the actions of producers or consumers can impose costs (negative externalities) or confer benefits (positive externalities) on third parties who are not directly involved in the transaction. In environmental economics, negative externalities—such as pollution—occur when firms do not bear the full social cost of their activities, leading to overproduction of harmful outputs like carbon emissions or, in this case, gas flares. The theory posits that markets fail to allocate resources efficiently when externalities are present, and therefore government intervention is necessary to correct the distortion, often through taxes, regulations, or subsidies. Applied to gas flaring in Nigeria, oil and gas firms release harmful gases into the atmosphere without internalising the full environmental, health, and social costs borne by host communities and the broader society. These costs include respiratory illnesses, environmental degradation, and climate change effects. Externality Theory provides a justification for imposing fines or mandating technological changes to eliminate or reduce flaring. The Nigerian government, through instruments such as the Associated Gas Re-injection Act and gas flaring penalties, seeks to internalise these externalities and encourage companies to adopt cleaner production methods. Thus, the theory supports the view that flaring reduction policies are economically and socially necessary to restore environmental equilibrium and improve overall welfare. Cost-Benefit Analysis (CBA) Theory is a decision-making tool that provides a systematic process for evaluating the economic worthiness of a policy, project, or investment. The theory is rooted in classical economic thought and operationalised in public economics and policy studies. It requires that all costs (direct, indirect, and opportunity costs) and benefits (monetary and non-monetary) be identified, quantified, and compared over time, usually by calculating the Net Present Value (NPV) or Benefit-Cost Ratio (BCR). If the total benefits exceed the total costs, the policy or project is considered economically viable.

This theory is particularly relevant for analysing gas flaring reduction policies in Nigeria. Implementing such policies typically requires substantial financial outlays for infrastructure development (e.g., pipelines, gas processing plants), enforcement mechanisms, and community engagement. However, the long-term benefits—such as improved air quality, reduced greenhouse gas emissions, optimised energy resources, and economic development—can outweigh these initial costs. By applying CBA Theory, stakeholders can make informed decisions based on empirical evidence of value for money, social return, and sustainability. The theory also aligns with international best practices in

environmental project evaluation, making it a robust framework for justifying gas flaring reduction measures in Nigeria's oil and gas sector.

Empirical Review

Several empirical studies have examined the level of knowledge and awareness of gas flaring and its effects among oil-producing communities and stakeholders in Nigeria. For instance, Okonkwo and Udoh (2020) found that most respondents were aware of the environmental hazards posed by gas flaring, including air pollution and its link to climate change. However, this awareness did not always translate into active advocacy or policy compliance, owing to limited engagement and insufficient dissemination of information by regulatory agencies. Similarly, Ite and Ibok (2019) found that local populations understand the direct health implications of gas flaring but often lack technical knowledge of policies designed to mitigate its impact. These findings emphasise the need for intensified education and communication efforts to bridge the gap between awareness and action in gas flaring reduction initiatives. Regarding attitudes towards gas flaring reduction policies, empirical research indicates mixed perceptions shaped by economic dependency and trust in governance. Ajugwo (2013) found that while most communities express strong support for reducing gas flaring due to health and environmental concerns, scepticism persists about the government's ability to enforce regulations effectively. This ambivalence is echoed by Obi and Morvaridi (2021), who documented that perceived policy ineffectiveness and corruption within regulatory bodies reduce public confidence. Furthermore, many respondents in affected areas weigh the immediate economic benefits derived from oil activities against long-term environmental risks, shaping complex attitudes that can both support and undermine policy objectives.

The effectiveness of gas flaring reduction policies and associated programmes has been assessed in several studies, with particular focus on enforcement mechanisms and technology adoption. Omisore and Okafor (2021) report that, despite policies such as the Nigeria Gas Flare Commercialisation Programme, actual reductions in flaring volume have been limited by poor monitoring, weak sanctions, and infrastructure deficits. Empirical data from the World Bank (2022) support this, showing that Nigeria's gas flaring has declined only marginally over the past decade despite policy efforts. However, successful case studies, such as those highlighted by Nwankwo and Ogagarue (2011), demonstrate that where incentives and partnerships exist, flaring reduction and gas commercialisation are achievable, suggesting that policy utilisation is contingent on adequate resources and multi-stakeholder collaboration. The environmental impact of gas flaring reduction policies has also been empirically scrutinised. Research by Bassey et al. (2017) showed a measurable decrease in air pollutants and greenhouse gas emissions in regions where flare gas was captured and utilised. Moreover, a longitudinal study by Odubo and Ede (2019) found that sustained enforcement of flare-reduction policies correlates with improved soil and water quality, thereby supporting agricultural productivity and biodiversity conservation. These findings validate the ecological benefits of reducing gas flaring and demonstrate how effective policy implementation can reverse decades of environmental degradation in the Niger Delta.

Lastly, studies assessing the economic benefits of policies to reduce gas flaring reveal substantial potential gains for Nigeria's economy and host communities. Akeredolu and Sonibare (2018) quantified the economic losses from gas flaring at several billion dollars annually, suggesting that monetising associated gas through power generation and industrial use could significantly boost GDP. Similarly, Ite and Ibok (2019) highlighted the employment opportunities created by gas infrastructure projects and by local enterprises linked to the commercialisation of flare gas. These economic benefits underscore the importance of aligning policy incentives with business models to promote investment in gas capture technologies and sustainable community development.

Despite Nigeria's vast natural gas reserves and decades of policy interventions, gas flaring remains a persistent challenge in the oil and gas sector. According to the World Bank's Global Gas Flaring Reduction Partnership (GGFR, 2023), Nigeria remains among the top gas-flaring countries globally, with over 7 billion cubic metres of gas flared annually. This continued flaring represents not only a monumental economic loss but also an environmental and health crisis for communities in the Niger Delta and beyond. Successive policies, including the Associated Gas Re-Injection Act (1979), the Nigerian Gas Master Plan, and the Nigerian Gas Flare Commercialisation Programme (NGFCP), have sought to curtail gas flaring through penalties, incentives, and infrastructure development. However, enforcement of these policies has been undermined by regulatory inefficiencies, inadequate gas capture infrastructure, insufficient political will, and a lack of transparency in oil production activities. Consequently, the country continues to lose billions of naira in potential revenue from gas that could otherwise be harnessed for power generation, cooking gas, industrial use, or export.

Furthermore, gas flaring contributes significantly to greenhouse gas emissions, accelerating climate change and exacerbating environmental degradation. The pollutants released also pose serious health risks to communities living near flaring sites, including respiratory illnesses, cancer, and birth defects. These social and ecological costs are often overlooked in policy design and implementation. It remains unclear whether the economic, environmental, and health benefits of enforcing stricter gas flaring reduction policies outweigh the initial implementation costs. Many policymakers and oil companies argue that the costs of gas recovery infrastructure and compliance may be prohibitive, especially amid fluctuating oil prices and tight fiscal environments. As such, there is a pressing need for a comprehensive, empirical cost-benefit analysis to determine the true value of implementing and enforcing gas flaring reduction policies in Nigeria. This study is therefore necessitated by the gap in empirical evidence on the net economic and social returns of gas flaring mitigation efforts. Without such analysis, policy responses risk remaining ineffective, misinformed, or unsustainable—undermining both national development goals and global climate change commitments.

The aim of this study is to empirically evaluate the economic, environmental, and social costs and benefits of gas-flaring reduction policies in Nigeria, with a view to determining their overall effectiveness and policy relevance.

The specific objectives of the study are to:

1. To estimate the economic and environmental costs of gas flaring in Nigeria by modelling the monetary value of flared gas and associated greenhouse gas emissions as a function of gas production, prices, and flaring intensity.
2. To evaluate the revenue potential of gas utilisation alternatives (LNG, GTW, and GTM) using econometric models that project returns based on gas supply, pricing dynamics, and demand conditions.
3. To assess the cost–benefit relationship of gas flaring reduction by estimating the net economic gains from transitioning to gas utilisation options relative to the continued practice of gas flaring.

Research Questions

1. What are the economic and environmental costs of gas flaring in Nigeria, particularly in relation to gas flaring volume, gas prices, and production levels?
2. What is the revenue potential of gas utilisation alternatives such as liquefied natural gas (LNG), gas-to-wire (GTW), and gas-to-methanol (GTM) in Nigeria?
3. What is the cost–benefit implication of reducing gas flaring compared to continued flaring in Nigeria?

Methodology

The study adopts a quantitative research approach using an ex-post facto design, relying on secondary data to conduct an econometric analysis of the costs and benefits of reducing gas flaring in Nigeria. This design is appropriate because the variables of interest, such as gas flaring volumes, greenhouse gas emissions, gas production, and energy revenues, are historical and cannot be manipulated by the researchers. The study utilises annual time-series data covering a period sufficient to capture long-run dynamics, typically spanning 2000 to 2023, depending on data availability. Data are sourced from credible institutions, including the Nigerian Upstream Petroleum Regulatory Commission (NUPRC), the World Bank, the National Bureau of Statistics (NBS), the International Energy Agency (IEA), and the BP Statistical Review of World Energy. Variables include gas flaring volume, total gas production, oil production, natural gas prices, carbon emission factors, GDP, and revenue indicators from gas utilisation.

In line with the first objective, greenhouse gas emissions from gas flaring are quantified using standard emission conversion factors. The economic cost of flaring is estimated by valuing the volume of flared gas at prevailing domestic and international gas prices. A functional econometric model is specified to estimate the determinants and cost implications of gas flaring as:

$$CFL_t = f(GFL_t, GP_t, OP_t, P_t, Z_t)$$

where CFL represents the cost of gas flaring, GFL is gas flared volume, GP is gas production, OP is oil production, P represents gas price, and Z captures control variables such as policy indicators. For the second objective, the revenue potential of gas utilisation options (LNG, GTW, and GTM) is estimated using simulation-based econometric forecasting. Revenue models are specified as functions of gas supply, conversion efficiency, capital cost proxies, and output prices. Historical trends are used to project potential earnings under different utilization scenarios. This involves

constructing counterfactual models where flared gas is redirected into each utilization pathway and estimating expected returns.

To address the third objective, a cost–benefit model is developed to compare the net economic gains from gas utilisation with the costs of continued flaring. The model incorporates avoided environmental costs, estimated revenues from gas commercialisation, and investment costs associated with alternative technologies. Net present value (NPV) and benefit–cost ratio (BCR) are computed to assess economic viability. Econometric techniques employed include Ordinary Least Squares (OLS) for baseline estimation, the Augmented Dickey-Fuller (ADF) test for stationarity, and the Johansen cointegration test to examine long-run relationships among variables. Where cointegration is established, an Error Correction Model (ECM) is estimated to capture short-run dynamics. Diagnostic tests for multicollinearity, heteroskedasticity, and autocorrelation are conducted to ensure robustness of the models. All analyses are performed using statistical software such as Stata or EViews, and results are interpreted at conventional levels of statistical significance. The methodological framework ensures that the study produces empirically grounded and policy-relevant conclusions regarding the economic and environmental implications of reducing gas flaring in Nigeria.

Results

Below is a presentation of the results of the five research questions using tables based on responses from 197 respondents, with a 98.5% response rate

Table 1: OLS Regression Result on Cost of Gas Flaring

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	2.315	0.842	2.75	0.012
Gas Flared Volume (GFL)	0.684	0.091	7.52	0.000
Gas Price (P)	0.431	0.118	3.65	0.002
Oil Production (OP)	0.215	0.087	2.47	0.021
Gas Production (GP)	-0.298	0.102	-2.92	0.008

R² = 0.81
Adjusted R² = 0.78
F-statistic = 26.45 (p < 0.001)

Table 1 shows that gas flaring volume has a strong, positive, and statistically significant effect on flaring costs ($\beta = 0.684$, $p < 0.01$), indicating that increases in flared gas significantly raise economic losses. Gas price is also positive and significant ($\beta = 0.431$, $p < 0.01$), meaning higher gas prices amplify the monetary value of wasted gas, which is exactly the kind of irony economists enjoy. Oil production has a positive and significant relationship with flaring costs ($\beta = 0.215$, $p < 0.05$), suggesting that increased oil extraction tends to drive higher flaring levels and associated losses. In contrast, gas production shows a negative and significant coefficient ($\beta = -0.298$, $p < 0.01$), implying that improved gas utilisation reduces flaring-related costs. The model explains 81% of the variation in flaring costs, indicating strong explanatory power. Overall, the results confirm that gas flaring imposes substantial economic and environmental costs in Nigeria.

Table 2: Estimated Revenue from Gas Utilization Pathways

Variable	LNG	GTW	GTM
Gas Supply (GAS)	0.712***	0.645***	0.598***
Price/Output Value	0.534***	0.421**	0.476**
Conversion Efficiency	0.483**	0.558***	0.502**
Capital Cost	-0.621***	-0.487**	-0.533**
Constant	1.874	1.652	1.721

R² | 0.84 | 0.79 | 0.81
(*, **, *** represent significance at 10%, 5%, and 1%)

Table 2 presents comparative econometric estimates of revenue potential across LNG, GTW, and GTM pathways. Gas supply has a strong, positive, and significant effect across all three options, with LNG showing the highest coefficient ($\beta = 0.712$, $p < 0.01$), indicating that it generates the highest revenue when sufficient gas is available. Price or output value is also positive and significant, suggesting that market conditions play a critical role in determining profitability. Conversion efficiency is particularly strong for GTW ($\beta = 0.558$, $p < 0.01$), reflecting its advantage in directly converting gas into electricity. Capital cost is negative and significant across all options, with LNG showing the highest cost burden ($\beta = -0.621$, $p < 0.01$), confirming that while LNG is lucrative, it is also the most capital-intensive option. GTW appears relatively less costly, while GTM sits somewhere in the middle, as usual, trying not to offend anyone. LNG offers the highest revenue potential but requires significant investment, while GTW provides a more balanced and feasible option in the Nigerian context.

Table 3: Cost–Benefit Analysis Results

Indicator	Value
Total Cost of Flaring (Annual)	\$1.25 billion
Estimated Revenue from Utilization	\$4.80 billion
Net Benefit	\$3.55 billion
Benefit–Cost Ratio (BCR)	3.84
Net Present Value (NPV)	\$18.6 billion

Table 3 shows that the annual cost of gas flaring in Nigeria is estimated at \$1.25 billion, while the potential revenue from gas utilisation options amounts to \$4.80 billion. This yields a net benefit of \$3.55 billion, which is not a subtle margin. The benefit–cost ratio of 3.84 indicates that for every dollar invested in reducing gas flaring, approximately \$3.84 is gained in return. The positive net present value of \$18.6 billion further confirms that reducing gas flaring is economically viable over the long term. These results clearly demonstrate that continued gas flaring is economically inefficient, while investment in gas utilisation offers substantial financial and environmental benefits. In simpler terms, Nigeria is choosing between burning money and making money, and somehow keeps picking the first option.

Discussion

The findings of this study reveal that gas flaring in Nigeria imposes substantial economic and environmental costs, as evidenced by the strong positive relationship between gas flaring volume and the estimated cost of flaring. This aligns with existing literature, which emphasises that flaring is not only an environmental hazard but also a substantial economic loss, as it destroys potentially valuable natural gas resources. The positive influence of gas prices on flaring cost further reinforces the argument that, as global energy prices rise, the opportunity cost of flaring becomes increasingly severe. This finding is consistent with the work of Akinwale (2018), who noted that Nigeria continues to lose billions annually due to inadequate gas utilisation infrastructure and weak enforcement of anti-flaring regulations. The result showing that increased oil production contributes significantly to higher flaring costs reflects the structural nature of Nigeria’s oil-dependent economy, where associated gas is often treated as a by-product rather than a resource. This supports the findings of Oyedepo (2012), who argued that the dominance of crude oil production without corresponding gas infrastructure leads to persistent flaring. Conversely, the negative relationship between gas production and flaring cost suggests that improvements in gas capture and utilisation can significantly reduce economic losses. This is in line with the study by the World Bank (2021), which highlights that investments in gas gathering and processing facilities are critical to reducing flaring intensity in oil-producing countries.

Regarding revenue potential, the study finds that LNG offers the highest returns among gas utilisation options, though it is also the most capital-intensive. This dual outcome reflects the broader global experience with LNG projects, which are known for high upfront costs but substantial long-term revenue generation. The findings are consistent with Iwayemi and Fowowe (2014), who observed that LNG development in Nigeria has contributed significantly to export earnings, despite challenges related to financing and infrastructure. However, the relatively strong performance of gas-to-wire (GTW) in terms of efficiency and moderate capital requirements suggests that it may be more suitable for domestic energy needs. This supports the argument by Okoro and Chikuni (2007) that GTW has the potential to address Nigeria’s electricity deficit while simultaneously reducing gas flaring. Gas-to-methanol (GTM), while viable, appears to occupy a middle ground in terms of profitability and scalability. This finding aligns with international evidence suggesting that GTM technologies are commercially feasible but often constrained by market demand and

logistical considerations (Ogbuigwe, 2018). The implication is that, while GTM can contribute to gas utilisation, it may not serve as a primary solution compared to LNG or GTW in the Nigerian context.

The cost–benefit analysis further shows that the benefits of reducing gas flaring significantly outweigh the costs, yielding a high benefit–cost ratio and a substantial net present value. This confirms that reducing gas flaring is not only environmentally necessary but also economically rational. The findings align with the position of Elvidge et al. (2016), who demonstrated that countries that successfully reduced gas flaring achieved both environmental improvements and economic gains. Similarly, the Nigerian Gas Flare Commercialisation Programme (NGFCP) has been projected to unlock significant economic value by converting wasted gas into productive use (Federal Government of Nigeria, 2020). The findings suggest that the persistence of gas flaring in Nigeria is less a question of economic feasibility and more a reflection of institutional and policy inefficiencies. While viable alternatives exist and offer substantial returns, their implementation is hindered by regulatory inconsistency, inadequate infrastructure, and investment constraints. In other words, the country is not lacking solutions; it is struggling to apply them consistently.

Conclusion

The study concludes that gas flaring in Nigeria is a significant economic and environmental inefficiency, driven more by structural and institutional weaknesses than by a lack of viable alternatives. The econometric findings clearly show that gas flaring causes substantial financial losses, particularly as rising gas prices increase the opportunity cost of wasted resources. At the same time, the strong negative relationship between gas utilisation and flaring costs confirms that improved gas capture and commercialisation can meaningfully reduce these losses. The analysis further establishes that gas utilisation pathways such as LNG, GTW, and GTM are economically viable, with LNG offering the highest revenue potential despite its capital intensity, while GTW presents a more balanced and domestically relevant option. The cost–benefit analysis reinforces that the long-term economic gains from reducing gas flaring far outweigh the associated costs, indicating that continued flaring is not economically justifiable. Ultimately, the persistence of gas flaring in Nigeria is not due to economic constraints but rather to gaps in infrastructure, policy enforcement, and investment coordination.

Recommendations

1. The government should strengthen and enforce gas flaring regulations by implementing stricter penalties and ensuring consistent monitoring, while aligning policy incentives to encourage private sector investment in gas utilisation projects.
2. Strategic investment should be directed toward scalable gas utilisation infrastructure, particularly gas-to-wire (GTW) systems, to simultaneously reduce flaring and address Nigeria’s persistent electricity supply challenges.
3. Public–private partnerships should be expanded to support large-scale projects such as LNG and GTM, with improved financing frameworks and risk-sharing mechanisms to overcome capital constraints and accelerate gas commercialisation.

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