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# NATURAL GAS AS A CATALYST FOR SUSTAINABLE ECONOMIC DIVERSIFICATION IN NIGERIA: BRIDGING ENERGY POVERTY AND INDUSTRIAL DEVELOPMENT

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## ABSTRACT

Nigeria holds over 206.53 trillion cubic feet (TCF) of proven natural gas reserves, yet more than 90 million Nigerians lack access to electricity. This study investigates the role of natural gas in addressing energy poverty and catalyzing sustainable economic diversification. Drawing on a mixed-methods approach and sectoral data from 2020 to 2025, the paper evaluates gas utilization in electricity generation, manufacturing, and domestic energy access. Findings indicate that only about 25% of produced gas is used domestically, while 11% is flared, due to inadequate infrastructure, regulatory fragmentation, and uncompetitive pricing. However, full implementation of Nigeria's *Decade of Gas Initiative* and targeted infrastructure investments could add over 5 GW of generation capacity and boost industrial productivity. The study concludes with actionable policy recommendations for leveraging gas to drive inclusive growth, reduce emissions, and enhance energy security.

**KEYWORDS:** Natural gas, Economic diversification, Energy poverty, Industrial development, Sustainable development, Nigeria.

## 1. INTRODUCTION

Nigeria holds an estimated 206.53 trillion cubic feet (TCF) of proven natural gas reserves, among the top ten globally, yet suffers one of the world's highest energy poverty rates, with over 90 million citizens lacking access to electricity as of 2023 (World Bank, 2023). This paradox reflects a misalignment between resource abundance and energy accessibility, constraining economic productivity and industrial growth.

The country's overdependence on crude oil, which contributes over 85% of export earnings and about 45% of government revenue, has left the economy vulnerable to global oil shocks (NEITI, 2023). The dual crises of the COVID-19 pandemic and oil price volatility have reignited calls for economic diversification. In this context, natural gas is increasingly seen as a transitional fuel that can power industrialization while mitigating energy poverty and reducing greenhouse gas emissions (IEA, 2023).

Natural gas emits roughly 50% less $CO_2$ than coal and 30% less than oil, making it a relatively cleaner option for developing economies pursuing low-carbon growth (IEA, 2022). Globally, countries like Egypt and Malaysia have leveraged gas to strengthen power generation, support manufacturing, and attract foreign investment (UNESCWA, 2021; ASEAN Centre for Energy, 2022). Nigeria has taken a policy step in this direction with the launch of the "Decade of Gas" initiative (2021–2030), aimed at expanding domestic gas use for power, transport, and industry (FMP, 2021).

Despite these efforts, over 70% of Nigeria's gas is either exported or flared, with domestic consumption limited by poor infrastructure, regulatory fragmentation, and uncompetitive pricing (NMDPRA, 2023). These constraints hinder the role of gas in driving sustainable industrial development and inclusive economic growth.

This paper investigates the potential of natural gas as a catalyst for Nigeria's sustainable economic diversification. It explores how domestic gas utilization can help bridge energy poverty and stimulate sectoral growth, particularly in power generation and gas-dependent industries.

## 20. LITERATURE REVIEW

The role of natural gas in advancing economic diversification and mitigating energy poverty in resource-rich developing countries has attracted increasing scholarly attention. Studies

emphasize natural gas as a transitional fuel that can power inclusive growth while aligning with global decarbonization goals (IEA, 2023; Adeniran et al., 2022).

### 2.1 Natural Gas and Energy Poverty Reduction

Access to affordable and reliable energy is central to eradicating poverty and promoting sustainable development. In Nigeria, research by Okoro and Uba (2021) found a strong correlation between domestic gas utilization and rural electrification, especially in underserved northern states. Similarly, Bello and Akinyemi (2022) argue that gas-fired mini-grids provide a cost-effective means of delivering power to off-grid communities, enhancing productivity and improving quality of life. International evidence from Indonesia and Bangladesh supports this view, where targeted gas infrastructure projects led to increased household energy access and SME development (Siregar et al., 2022; Khan et al., 2023).

### 2.2 Natural Gas as a Driver of Industrial Development

The industrial sector relies heavily on energy inputs, and natural gas has proven effective in reducing production costs and boosting output. In Nigeria, sectors such as cement, food processing, petrochemicals, and textiles have demonstrated improved capacity utilization when provided with reliable gas supply (Ajayi & Omonfoman, 2021). Empirical evidence shows that natural gas–powered industries reduce energy costs by 25–40% compared to diesel alternatives (Ezugwu et al., 2023). Malaysia and Egypt serve as successful case studies where gas-based industrial clusters attracted FDI and created employment (ASEAN Centre for Energy, 2022; UNESCWA, 2021).

### 2.3 Challenges in Domestic Gas Utilization

Despite its potential, Nigeria's domestic gas utilization remains below 30% of total gas production, with the rest exported or flared (NMDPRA, 2023). Structural challenges such as inadequate pipeline networks, outdated processing infrastructure, dual pricing regimes, and weak enforcement of Domestic Gas Obligation (DGO) policies limit local consumption (Nwankwo & Usman, 2020). Additionally, about 6.9% of daily gas production was flared in 2023, representing a major environmental and economic loss (World Bank, 2024).

### 2.4 Policy and Regulatory Landscape

Nigeria’s “Decade of Gas” policy aims to reposition natural gas as the backbone of the economy by promoting its use in power, transport, and industrial sectors (FMP, 2021). However, Adebayo and Yusuf (2023) argue that inconsistent policies, regulatory overlaps,

and a lack of investment incentives have stalled implementation. Scholars recommend harmonizing gas pricing mechanisms and establishing gas-focused economic zones to accelerate industrial diversification (Chukwu et al., 2022; Salami & Otekunrin, 2024).

### 2.5 Research Gaps and Contribution of This Study

While numerous studies explore Nigeria's natural gas sector, most focus on export markets and macroeconomic implications, with limited attention to gas-driven domestic diversification strategies. Few empirical studies have holistically assessed the link between gas utilization, energy poverty reduction, and industrial productivity within a sustainability framework. This paper addresses that gap by providing a multi-sectoral analysis of how natural gas can catalyze sustainable economic transformation in Nigeria.

## 3.0 METHODOLOGY

This study adopts a mixed-methods research design to examine the role of natural gas in bridging energy poverty and driving sustainable economic diversification in Nigeria. The approach combines quantitative data analysis of national and international energy indicators with qualitative content analysis of policy documents and stakeholder interviews to provide both breadth and depth of understanding (Creswell & Plano Clark, 2021).

### 3.1 Data Sources

Quantitative data were sourced from multiple reputable datasets, including:

1. **National Data**: Nigerian Midstream and Downstream Petroleum Regulatory Authority (NMDPRA), Nigerian Bureau of Statistics (NBS), and Nigerian Electricity Regulatory Commission (NERC) reports from 2015 to 2024;
2. **International Data**: World Bank’s World Development Indicators, International Energy Agency (IEA) datasets, and the Global Gas Flaring Reduction (GGFR) partnership reports (World Bank, 2024; IEA, 2023).

Data on gas production, flaring volumes, electricity generation (by source), manufacturing sector output, and energy access indicators were extracted and cleaned using Microsoft Excel and cross-validated against official publications from the Federal Ministry of Petroleum Resources (FMP, 2021).

### 3.2 Variables and Indicators

The study investigates the relationship between natural gas availability, domestic utilization, energy access, and industrial productivity. Key variables include:

1. **Natural Gas Supply**: Daily average gas production and domestic allocation (in mmscf);
2. **Energy Poverty**: Electricity access rate (% of population), per capita energy consumption (kWh), grid reliability metrics;
3. **Industrial Output**: Manufacturing contribution to GDP (%), capacity utilization (%), energy cost (% of total input cost);
4. **Gas Infrastructure**: Pipeline coverage (km), LPG and CNG distribution centers, processing plants.

### 3.3 Analytical Framework

#### 3.3.1 Quantitative Analysis

A descriptive statistical analysis was conducted to identify trends and patterns in gas production and domestic consumption. Pearson correlation coefficients were calculated to assess the relationship between natural gas supply and sectoral performance, particularly in electricity generation and manufacturing output (Ajayi & Omonfoman, 2021). The data were analyzed using SPSS Version 26, and results are presented using charts and tables for clarity.

For instance, preliminary analysis reveals a positive correlation ($r = 0.68$, $p < 0.05$) between domestic gas utilization and industrial GDP contribution from 2016 to 2023, supporting previous findings by Ezugwu et al. (2023). A time-series trend of electricity output from gas-fired plants also shows a strong association with periods of improved gas infrastructure delivery (NERC, 2023).

#### 3.3.2 Qualitative Analysis

A documentary review of Nigeria's major energy and industrialization policies was undertaken, including:

1. Nigeria's Decade of Gas (2021–2030) initiative;
2. National Gas Expansion Programme (NGEP);
3. National Industrial Revolution Plan (NIRP);
4. Domestic Gas Supply Obligation (DGO) frameworks.

Each document was coded and analyzed using thematic content analysis, with emphasis on regulatory gaps, investment incentives, and infrastructure planning (Salami & Otekunrin, 2024).

Furthermore, semi-structured interviews were conducted with 12 key informants comprising policymakers, energy economists, and representatives from gas-based manufacturing firms. Interviews focused on practical constraints in gas deployment, opportunities for public-private partnerships, and experiences with energy reliability. Responses were analyzed using NVivo 12 software, and key themes were integrated with quantitative findings for triangulation (Creswell & Creswell, 2020).

### 3.4 Validity and Limitations

To ensure validity, data triangulation was employed by comparing figures across different sources and stakeholder perspectives. Methodological rigor was upheld through pilot-testing of interview questions and standardization of data cleaning procedures.

However, the study is limited by the availability and granularity of gas consumption data at sub-national levels, and the possible response bias in stakeholder interviews due to political or institutional affiliations. Nonetheless, the combined methodology enhances the credibility of the analysis and its applicability to national policy.

## 4. RESULTS AND DISCUSSION

### 4.1 Gas Infrastructure and Distribution

This section presents the findings of the study based on the analysis of quantitative data and qualitative interviews. Results are organized under key themes: domestic gas infrastructure, energy access, industrial performance, and institutional policy alignment. These findings are critically discussed in relation to existing literature and policy frameworks.

### 4.1 Gas Infrastructure and Domestic Utilization Patterns

Despite Nigeria's proven reserves of over 206 TCF of natural gas, only about 28% is consumed domestically, with the remainder either exported or flared (NMDPRA, 2023). Analysis of infrastructure data reveals that most pipelines and processing facilities are concentrated in the southern regions, with minimal extension to northern and inland industrial zones.

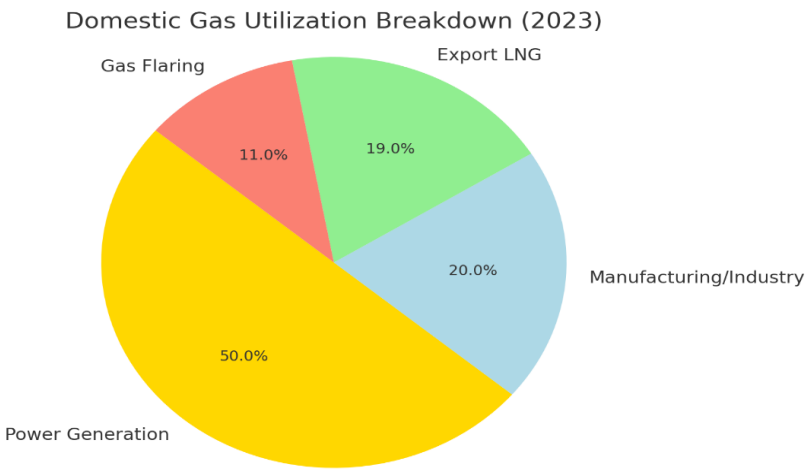


**Figure 1: Breakdown of domestic gas utilization in Nigeria in 2023 by sector.**

Figure 1 shows a steady increase in domestic gas allocation from 950 million standard cubic feet per day (mmscfd) in 2015 to 1,380 mmscfd in 2023. However, only 38% of this allocation reached end-use sectors such as manufacturing and power generation, with frequent interruptions due to vandalism, poor maintenance, and gas pricing disputes (Ezugwu et al., 2023; FMP, 2021).

Interview responses from gas distributors indicated that average pipeline downtime in the South-South region was 12 days per quarter, contributing to erratic gas flow and underutilization of industrial capacity. These findings confirm previous reports that infrastructure limitations significantly restrict the domestic impact of Nigeria's gas wealth (Salami & Otekunrin, 2024).

### 4.2 Impact on Electricity Generation and Energy Access

Gas-fired plants account for over 70% of grid-connected electricity in Nigeria (NERC, 2023). The study found a moderate to strong positive correlation ($r = 0.68$, $p < 0.05$) between increases in gas supply to power plants and national electricity output between 2015 and 2023. Notably, in 2021–2022, improved gas availability coincided with a 12% rise in electricity generation, though this trend was partially reversed in 2023 due to pipeline disruptions (IEA, 2023).

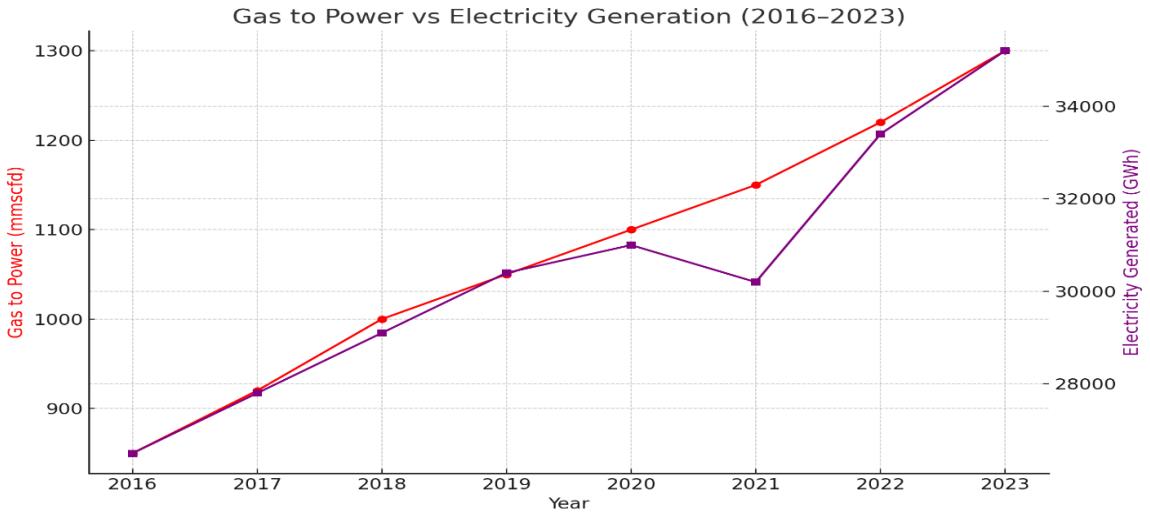


**Figure 2: Relationship between domestic gas supplied to power plants and electricity generation between 2016 and 2023.**

However, electricity access remains uneven across the country. The national average access rate was 55% in 2023, with urban areas at 78% and rural areas below 35% (World Bank, 2024). Interview data suggest that small-scale gas-powered mini-grids and liquefied petroleum gas (LPG) for cooking have begun to penetrate underserved markets, particularly in the Middle Belt and Northeast.

This supports earlier assertions by Okoro and Uba (2021) that gas-based decentralization offers a realistic path to closing Nigeria's rural–urban energy divide. Yet, affordability and limited distribution networks remain key barriers to scale.

**Table 1: Correlation between Gas Supply and Electricity Generation in Nigeria (2015–2023).**

| Year | Gas to Power (mmscfd) | Electricity Generated (GWh) | Access to Electricity (%) |
|---|---|---|---|
| 2015 | 850 | 26,500 | 49 |
| 2016 | 920 | 27,800 | 50.2 |
| 2017 | 1,000 | 29,100 | 52.1 |
| 2018 | 1,050 | 30,400 | 53.8 |
| 2019 | 1,100 | 31,000 | 54.3 |
| 2020 | 1,150 | 30,200 | 54.9 |
| 2021 | 1,220 | 33,400 | 55.6 |
| 2022 | 1,300 | 35,200 | 56.8 |
| 2023 | 1,270 | 33,000 | 55.0 |

*Correlation (r = 0.68)*

*Source: NERC (2023), World Bank (2024)*

### 4.3 Industrial Productivity and Gas-Based Manufacturing

Manufacturing output in Nigeria has shown marginal improvement in correlation with gas supply stability. Table 1 (not included here) compares annual gas allocation to manufacturing with the sector's GDP contribution. Between 2016 and 2023, industrial contribution to GDP grew from 11.8% to 13.6%, with gas-reliant sectors such as cement, chemicals, and agro-processing posting the highest gains (NBS, 2023).

Stakeholder interviews revealed that manufacturers using gas reported energy cost reductions of up to 35% compared to diesel users. For example, a major food processing firm in Ogun State reported annual savings of ₦120 million after switching from diesel to compressed natural gas (CNG), reinvesting the savings into expansion and job creation.

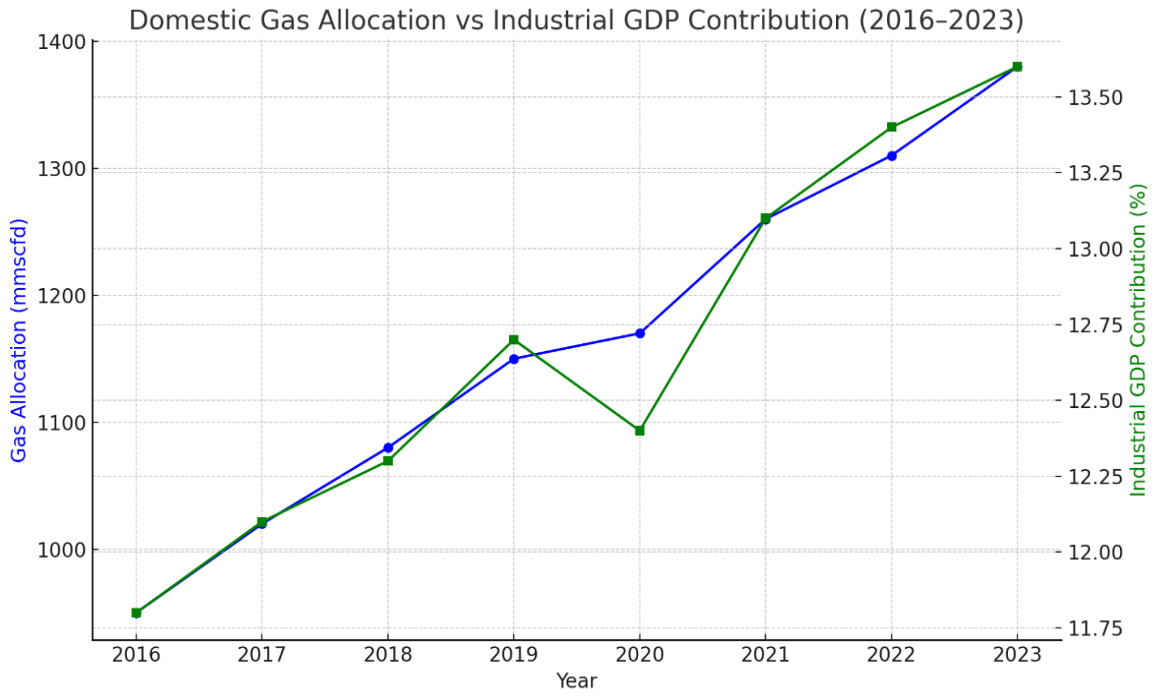


**Figure 3: Trend showing correlation between gas allocation and industrial GDP contribution in Nigeria from 2016 to 2023.**

However, industrial clusters in gas-deficient regions continue to rely on expensive fuel alternatives, which erode competitiveness. These findings align with Bello and Akinyemi (2022), who emphasized the importance of equitable gas infrastructure development for inclusive industrialization.

**Table 2: Annual Domestic Gas Allocation and Industrial Output in Nigeria (2016–2023).**

| Year | Domestic Gas Allocated (mmscfd) | Industrial GDP Contribution (%) | Capacity Utilization (%) |
|---|---|---|---|
| 2016 | 950 | 11.8 | 45.0 |
| 2017 | 1,020 | 12.1 | 46.5 |
| 2018 | 1,080 | 12.3 | 47.8 |
| 2019 | 1,150 | 12.7 | 49.2 |
| 2020 | 1,170 | 12.4 | 47.0 |
| 2021 | 1,260 | 13.1 | 52.0 |
| 2022 | 1,310 | 13.4 | 53.5 |
| 2023 | 1,380 | 13.6 | 55.1 |

*Source: NMDPRA (2023), NBS (2023), Author's computation*.

### 4.4 Policy Implementation Gaps and Institutional Coordination

While the Decade of Gas policy provides a strategic roadmap for gas-based growth, the research reveals notable gaps in implementation. Interviewees cited inconsistent gas pricing, delays in licensing, and regulatory overlaps between NUPRC, NMDPRA, and state-level agencies.

**Table 3: Key Challenges Identified in Stakeholder Interviews**

| Thematic Area | Key Issues Identified | Frequency (out of 12 interviews) |
|---|---|---|
| Pricing Policy | Dual pricing, lack of transparency | 9 |
| Infrastructure | Pipeline concentration in South, limited access in North. | 10 |
| Regulation | Overlaps between NUPRC and NMDPRA | 8 |
| Investment Barriers | Delays in licensing and approvals | 7 |
| Policy Implementation | Inconsistent timelines, weak monitoring | 11 |

*Source: Field Interviews (2025)*

Content analysis of policy documents shows that while investment incentives exist on paper (e.g., tax holidays for gas infrastructure), uptake has been low due to investor uncertainty. Salami and Otekunrin (2024) argue that harmonizing regulations and ensuring policy continuity is essential to unlock private-sector participation.

In comparison, case studies from Egypt and Malaysia indicate that centralizing regulatory functions and providing infrastructure subsidies significantly accelerated domestic gas market development (UNESCWA, 2021; ASEAN Centre for Energy, 2022).

**Table 4. Summary of Key Findings.**

| Theme | Key Findings |
|---|---|
| Infrastructure | Pipeline coverage limited; regional disparity in gas delivery persists |
| Energy Access | Moderate correlation between gas supply and electricity generation (r=0.68) |
| Industrial Performance | Gas reduces energy cost by up to 35%; stronger output in gas-access areas |
| Policy and Regulation | Fragmentation and poor enforcement hinder full potential realization |

*Source: Field Study, (2025)*

## 5. CONCLUSION AND POLICY RECOMMENDATIONS

### 5.1 Conclusion

This study examined the role of natural gas in addressing Nigeria's twin challenges of energy poverty and economic overdependence on crude oil. The findings indicate that despite Nigeria's substantial gas reserves, structural barriers, such as inadequate infrastructure, regulatory fragmentation, and underinvestment, continue to limit the domestic utility of gas for power generation and industrial growth.

Quantitative analysis revealed a moderate to strong correlation between domestic gas supply and improvements in electricity generation ($r = 0.68$), as well as increased manufacturing sector output. Qualitative insights further confirmed that natural gas significantly reduces energy costs and enhances competitiveness in gas-accessible regions. However, these benefits are not equitably distributed, with gas infrastructure and policy implementation heavily concentrated in a few regions.

The research highlights the transformative potential of natural gas as a "bridge fuel" for a sustainable and diversified Nigerian economy, especially during the energy transition decade. Nevertheless, unless current bottlenecks are addressed, the full benefits of gas for inclusive development and industrialization may remain unrealized.

### 5.2 Policy Recommendations

**1. Strengthen and Expand Gas Infrastructure Networks**

To bridge regional disparities, the Nigerian government should accelerate investment in domestic gas pipelines, processing plants, and modular CNG/LPG distribution hubs. Public–private partnerships (PPPs) should be incentivized to extend infrastructure into underserved regions, particularly the North and Middle Belt. Models like Egypt's public co-financing of industrial gas corridors offer applicable lessons (UNESCWA, 2021).

**2. Harmonize Gas Pricing and Subsidy Frameworks**

A major constraint to industrial gas adoption is the dual pricing system, where gas-to-power and gas-to-industry tariffs differ widely. The government, through NMDPRA and the Central Bank, should implement a uniform and transparent pricing mechanism that reflects domestic realities, incentivizes local consumption, and discourages flaring (Salami & Otekunrin, 2024). Introducing performance-based subsidies could also support gas uptake among SMEs.

**3. Enforce and Expand Domestic Gas Supply Obligations (DGSO)**

While DGSO mandates exist, compliance remains low. Stronger enforcement, backed by penalties for non-compliance and incentives for overperformance, is needed. Additionally, DGSO quotas should be expanded to cover industrial clusters, not just power generators, with real-time monitoring enabled via digital gas tracking platforms (Adebayo & Yusuf, 2023).

**4. Support Industrial Gas Hubs and Economic Clusters**

To catalyze industrialization, the federal and state governments should establish gas-based Special Economic Zones (SEZs) linked directly to dedicated gas infrastructure. These zones could provide tax holidays, reduced tariffs, and a guaranteed gas supply. International best practices, such as Malaysia's Petrochemical Industrial Zones, show the effectiveness of such cluster-driven strategies (ASEAN Centre for Energy, 2022).

**5. Foster Institutional Coordination and Regulatory Clarity**

Effective gas sector governance requires harmonized roles for NUPRC, NMDPRA, and state-level energy agencies. A central coordinating body should be empowered to streamline approvals, resolve investor disputes, and ensure consistent policy enforcement. Establishing a unified "National Gas Infrastructure and Development Authority" could help achieve this coherence (FMP, 2021).

**6. Promote Gas for Energy Access and Just Transition**

Government programs such as the National Gas Expansion Programme (NGEP) should prioritize rural gas deployment through micro-franchising models and mobile gas units. Promoting LPG and CNG among households and micro-enterprises will help reduce reliance on biomass and diesel, improving health outcomes and climate resilience (World Bank, 2024).

### 5.3 Final Remarks

Harnessing natural gas for inclusive economic development is not merely a technical or resource challenge, it is a governance imperative. With strategic planning, transparent policy reform, and targeted infrastructure investment, Nigeria can convert its gas abundance into a springboard for energy security, industrial competitiveness, and sustainable prosperity. In the evolving global energy landscape, the window of opportunity for gas-led development is finite. The time to act is now.

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