

Assessing Nigeria's Compressed Natural Gas (CNG) Adoption Pathways for Accelerated Implementation — Evidence from a National Perception Survey

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Abstract

Nigeria is undergoing a major transition in its transportation and energy sectors, driven by fuel subsidy removal, rising costs, and the government's push for low-carbon mobility through the Presidential Compressed Natural Gas Initiative (PCNGI). This study assesses national readiness and pathways for accelerating the adoption of Compressed Natural Gas (CNG) as a viable bridge fuel toward Nigeria's Net-Zero 2060 targets. Anchored theoretically in the Technological Innovation Systems (TIS) framework, this study employed a cross-sectional perception survey design over a three-month period. Data was gathered from a purposively selected sample of 110 elite stakeholder group respondents across key operational sectors—including government, transport, and energy—spanning all six geopolitical zones, with a primary concentration in the South-West and North-Central regions. The findings demonstrate an extremely high level of CNG awareness (98%) and robust positive sentiment regarding its economic, environmental, and public-health benefits. However, actual adoption remains severely restricted by deep structural barriers. The primary constraints identified by respondents include insufficient refueling stations (74%), prohibitive vehicle conversion costs (68%), and a lack of flexible financing options. These challenges highlight critical systemic weaknesses in resource mobilization and market formation within the TIS framework. To convert strong latent demand into widespread uptake, a coordinated national strategy is required. The study recommends strategic imperatives including a Public-Private Partnership (PPP) model, robust investment in refueling infrastructure, targeted conversion subsidies, localized manufacturing of CNG components, and enhanced regulatory safety standards to establish a sustainable CNG market ecosystem.

Keywords: Compressed Natural Gas; PCNGI; Infrastructure Deficits; Conversion Costs; Financing Gaps; Policy Recommendations; Public-Private Partnership; Net-Zero 2060

1 Introduction

Nigeria currently stands at a decisive crossroads in the evolution of its energy and transportation sectors. This shift was primarily catalyzed by the 2023 removal of the petrol subsidy—a move that exerted profound "landscape-level" pressure within the Multi-Level Perspective (MLP) framework [1,2]. By reclaiming approximately \$7.5 billion in annual savings, the federal government launched the Presidential Compressed Natural Gas Initiative (PCNGI) as a strategic "niche innovation" to weaponize Nigeria's vast gas reserves and slash refueling costs by 60% [3,4]. By late 2024, the initiative had already secured over \$175 million in private investment, facilitating 100,000 vehicle conversions across

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140 nationwide centers [5,6]. However, for this momentum to endure, the refueling infrastructure must now scale rapidly to meet the burgeoning demand [7].

The nation's trajectory toward net-zero emissions by 2060 depends on the implementation of integrated "policy packages" rather than isolated interventions [8,9]. Global precedents from Brazil and India underscore that success requires robust regulation, explicit targets, and the development of local manufacturing capacity [10,11,12]. Theoretically, the MLP and Technological Innovation Systems (TIS) frameworks suggest that strong governance is the only way to resolve the friction between niche innovations like CNG and the entrenched petroleum-based regime [13,14]. Ultimately, successful adoption hinges on converting latent demand into durable socio-cultural acceptance [15].

Despite these strategic gains, significant hurdles threaten the viability of the rollout. Infrastructure deficits remain the primary bottleneck, with 74% of stakeholders citing a scarcity of refueling stations, which remain disproportionately clustered in urban hubs [16,17]. This geographic maldistribution, compounded by high upfront conversion costs and recent "subsidy shocks," has birthed deep-seated public skepticism [18,19]. Furthermore, safety concerns following high-profile incidents have intensified the call for accredited technicians and rigorous regulatory enforcement to restore public trust [20,21].

While CNG is technically safer than petrol, inconsistent access and varying maintenance standards continue to undermine its reputation [22,21]. This study utilizes original survey data to evaluate national perceptions of CNG, analyzing awareness, economic expectations, and perceived risks. By applying the TIS framework to Nigeria's unique landscape of massive reserves and subsidy reform, the research identifies structural bottlenecks and proposes actionable pathways for an accelerated, equitable energy transition.

2 Methodology

2.1 Research Design

This study utilized a cross-sectional survey design to evaluate national perceptions of Compressed Natural Gas (CNG) adoption in Nigeria. This approach is standard in energy-policy and public-perception research for capturing attitudes and intentions at a specific point in time [23,24]. Data were collected via an online questionnaire to reach a geographically diverse stakeholder base across the government, transport, and energy sectors [25]. The survey addressed seven domains, including awareness, safety, and infrastructure, aligning with the Diffusion of Innovations [26] and Technological Innovation Systems [27] frameworks.

2.2 Sampling and Participants

A mixed-methods non-probability sampling approach, combining convenience and snowball techniques, was employed to engage a diverse stakeholder base across key sectors. The study prioritized a purposive expert sample of 110 stakeholders from government (26%), academia (26%), and technical professions (17%). This intentional focus on actors involved in regulating and commercializing technology provides high informational value regarding the TIS governing CNG adoption [28]. While the sample size limits broad statistical generalizability, it captures the critical perspectives of key decision-makers and early adopters.

2.3 Instrumentation

Data collection relied on a structured online questionnaire featuring closed-ended and Likert-scale items to ensure reliability and comparability [29]. The instrument covered seven thematic areas, ranging from alignment with the Presidential CNG Initiative (PCNGI) to socio-economic impacts and local content development. The questionnaire was validated by subject-matter experts for clarity and face validity, with anonymity maintained throughout the process.

2.4 Data Analysis

Analysis integrated descriptive statistics and thematic interpretation. Frequencies and percentages were used to identify dominant patterns, such as policy preferences and barriers [30]. Qualitative data from open-ended responses were analyzed using Braun and Clarke's [31] thematic framework to identify recurrent issues like "infrastructure deficit" and "cost barriers." This mixed-methods approach provided comprehensive explanatory power [32]. Participation was voluntary and conducted under strict ethical standards.

3 Results and Discussion

3.1 Demographic Profile of Respondents

The demographic profile (refer to Figures 1a and b) provides important context for interpreting national perceptions of CNG adoption. The sample was predominantly male (91%), reflecting Nigeria's gender imbalance in technical sectors such as energy, engineering, and transport [33,34]. Respondents were largely mid-career professionals (26–55 years), a cohort actively engaged in policymaking, engineering practice, and transport-sector management.



Figure 1 Gender (a) and age group (b) distribution of survey respondents.

From Figure 2, educational attainment was high, with 87% holding tertiary or postgraduate qualifications. This aligns with global evidence that technically literate stakeholders exhibit greater awareness and more nuanced understanding of energy transitions [35].

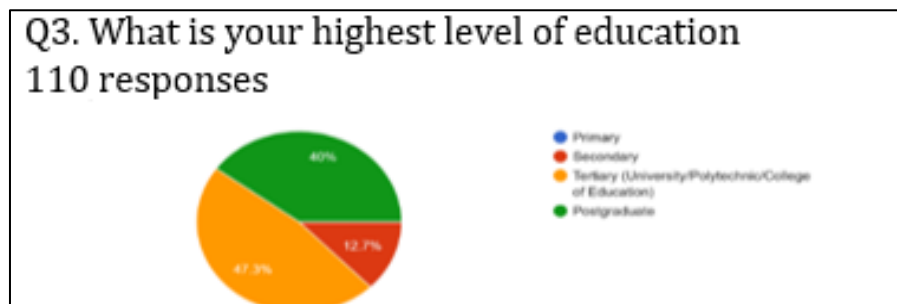


Figure 2 Highest level of education attained by respondents.

Respondents were drawn from all six geopolitical zones (Figure 3), though participation was higher in the South-West and North-Central, reflecting the concentration of pilot projects, research institutions, and industrial activity in these regions. This spatial pattern is typical of early-stage transitions where innovation clusters emerge around economic and administrative hubs [36]. Although the sample size ($n=110$) limits statistical generalization, its expert composition enhances internal validity. As Steg et al. [37] argue,

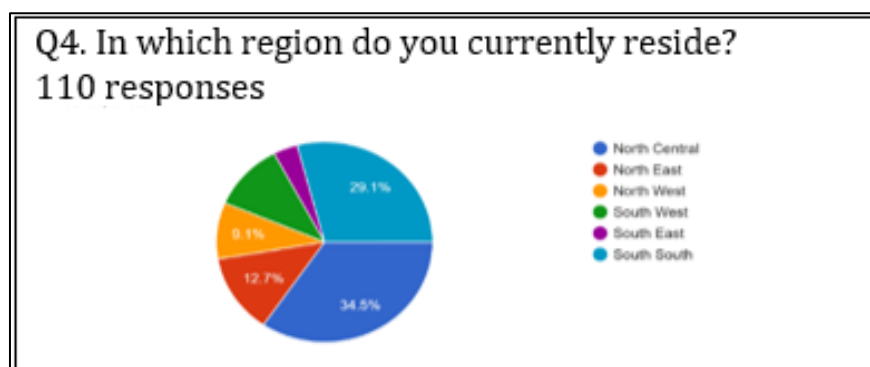


Figure 3 Geopolitical regional distribution of survey respondents.

informed stakeholders play a decisive role in shaping energy-transition trajectories, particularly regarding infrastructure, safety, and investment priorities.

3.2 Awareness and Alignment with National Priorities

3.2.1 3.2.1 Awareness of CNG and PCNGI

Awareness of CNG technology was nearly universal (98%), reflecting heightened visibility following the 2023 fuel-subsidy removal (refer to Figure 4). Similar awareness surges were observed in India and Pakistan after fuel-price shocks accelerated alternative-fuel policies [38,39]. Respondents broadly agreed that CNG aligns with efforts to reduce dependence on petrol and diesel (Pi-CNG, 2025), consistent with studies identifying CNG as a viable transitional fuel for reducing energy poverty [40].

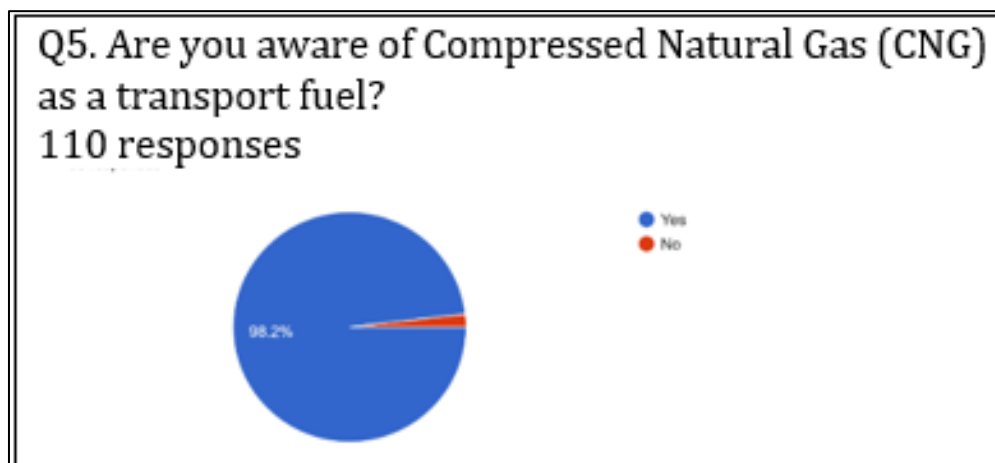


Figure 4 Stakeholder awareness of Compressed Natural Gas (CNG) as a transport fuel.

However, awareness of the Presidential CNG Initiative (PCNGI) was moderate. Respondents cited limited information on timelines, conversion procedures, and infrastructure expansion. This communication gap mirrors findings that weak policy messaging undermines trust and slows adoption even when public awareness of the technology is high [41,42,43]. Media reports further confirm that transport operators remain hesitant due to high conversion costs and insufficient refueling infrastructure [42,44].

3.2.2 Alignment with National Priorities

Strong alignment with national priorities was evident in Figure 5, with 90–95% agreeing that CNG supports affordability, industrialization, emissions reduction, and job creation. This reflects broader Nigerian and international studies positioning CNG as a pragmatic transitional fuel that leverages domestic gas resources while addressing energy poverty [45, 46,47].

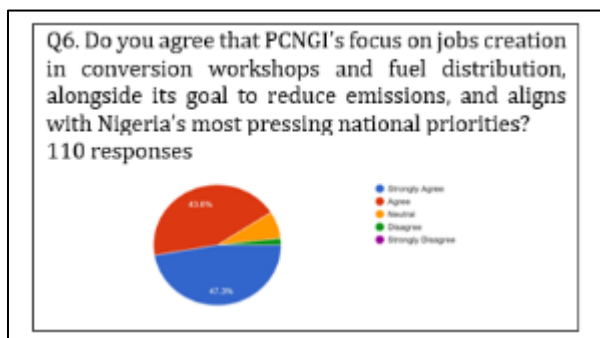


Figure 5 Respondent agreement with PCNGI's focus on job creation, emissions reduction, and national priorities.

Despite this alignment, Diffusion of Innovations theory emphasizes that adoption depends not only on perceived benefits but also on effective communication channels [27]. The moderate awareness of PCNGI therefore represents a

critical disconnect between policy ambition and public clarity, underscoring the need for improved outreach and education.

3.3 Adoption, Performance, and Safety Perceptions

An evident intention–action gap characterizes Nigeria’s CNG transition (refer to Figure 6). While 41% of respondents intend to convert, only 33% have done so, a pattern typical of early-stage transitions constrained by infrastructure and perceived risks [36,15]. As observed in India, adoption accelerates only after station density increases and financial incentives are introduced [11,17].



Figure 6 Status of vehicle conversion to CNG among respondents and their organizations.

It can be seen from Figure 7, that respondents identified four dominant barriers: insufficient refueling stations (74%), high conversion costs (68%), limited financing—requiring 74% of adopters to self-fund—and safety concerns among a minority (27%). These findings align with market assessments identifying infrastructure scarcity as the foremost constraint and financial barriers as key deterrents without subsidies or concessional financing [17,45,48].

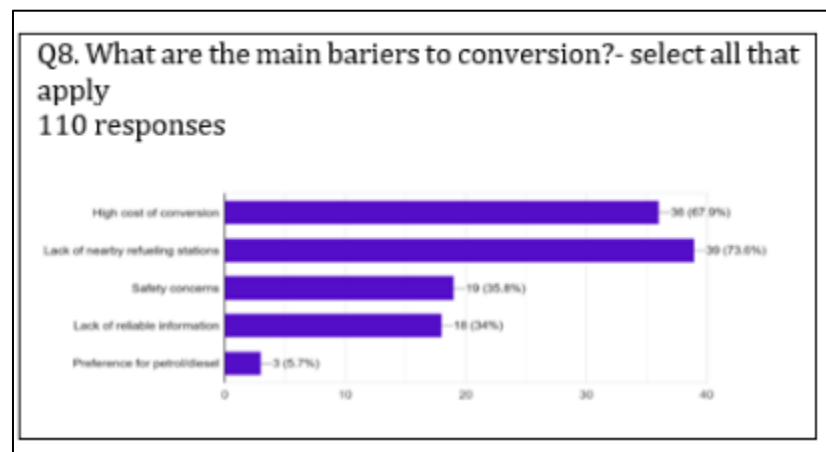


Figure 7 Primary barriers to CNG vehicle conversion cited by respondents.

Despite these barriers, operational perceptions were positive (Figures 8 a-c). Respondents reported performance comparable to petrol or diesel (65%), improved fuel efficiency (73%), and lower maintenance costs (64%), consistent with empirical studies on CNG vehicle economics [45,49].

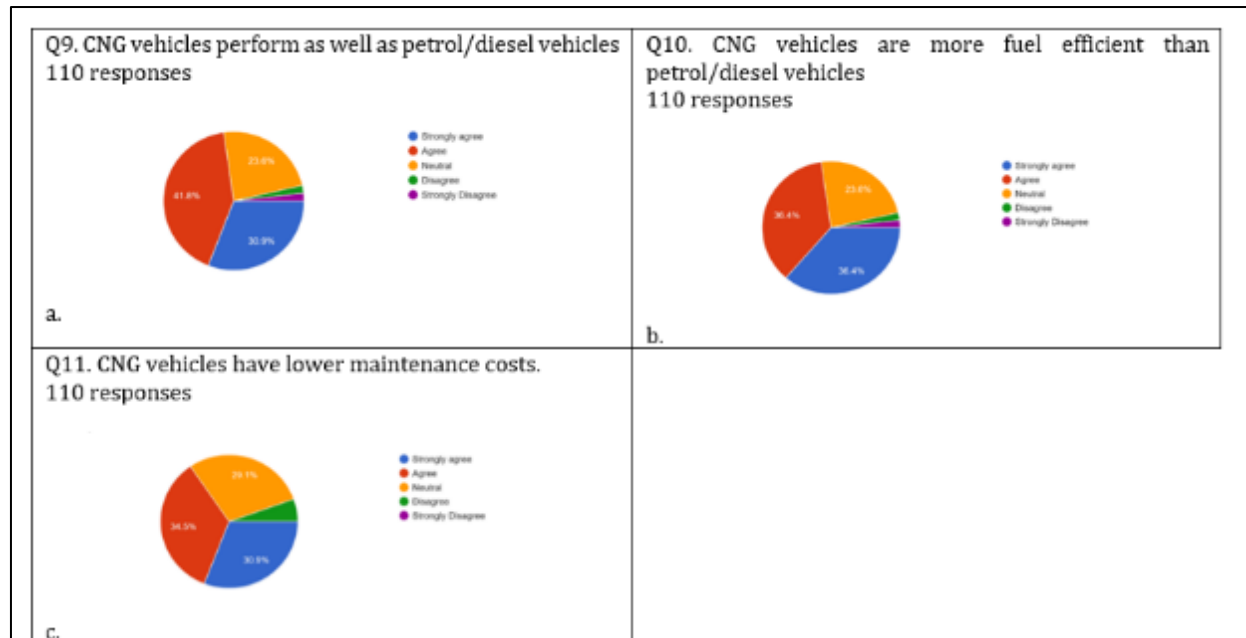


Figure 8 Stakeholder perceptions of CNG performance (a), fuel efficiency (b), and maintenance costs (c).

From Figure 9., it can be seen that safety confidence was moderate (64%), though concerns persist due to regulatory gaps and inconsistent enforcement [50,51]. Global evidence confirms that regulated CNG systems are safe when harmonized standards and certified technicians are in place [45,52,53,54,55].

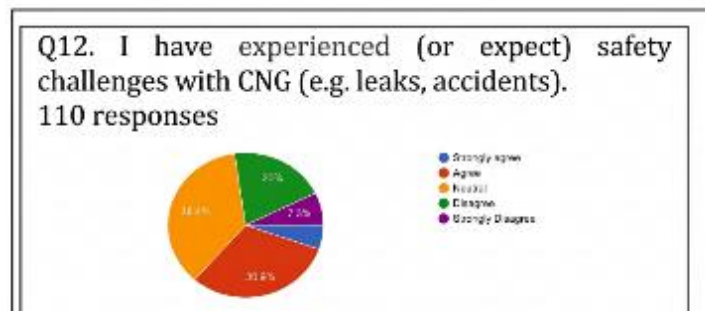


Figure 9 Personal or expected experience with safety challenges related to CNG.

Notably, 92% of respondents would recommend CNG, indicating strong potential for peer-driven diffusion (refer to Figure 10). According to Rogers [27] Diffusion of Innovations (DOI) theory, such social endorsement is critical for accelerating early adoption.

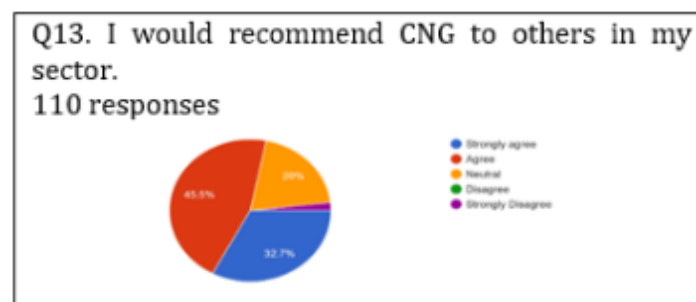


Figure 10 Likelihood of stakeholders recommending CNG within their respective sectors

From a Technological Innovation Systems (TIS) perspective, these results indicate weaknesses in resource mobilization and market formation (Hekkert et al., 2007). Addressing infrastructure gaps and financing constraints could therefore unlock rapid adoption.

3.4 Environmental and Climate Alignment

It could be observed from Figures 11(a, b, c, d), that environmental benefits were widely recognized: 89–95% agreed that CNG reduces emissions and air pollutants, and 95% associated it with public-health improvements. These perceptions align with scientific evidence showing lower particulate matter, NO_x , and CO_2 emissions compared to petrol and diesel [56,57].

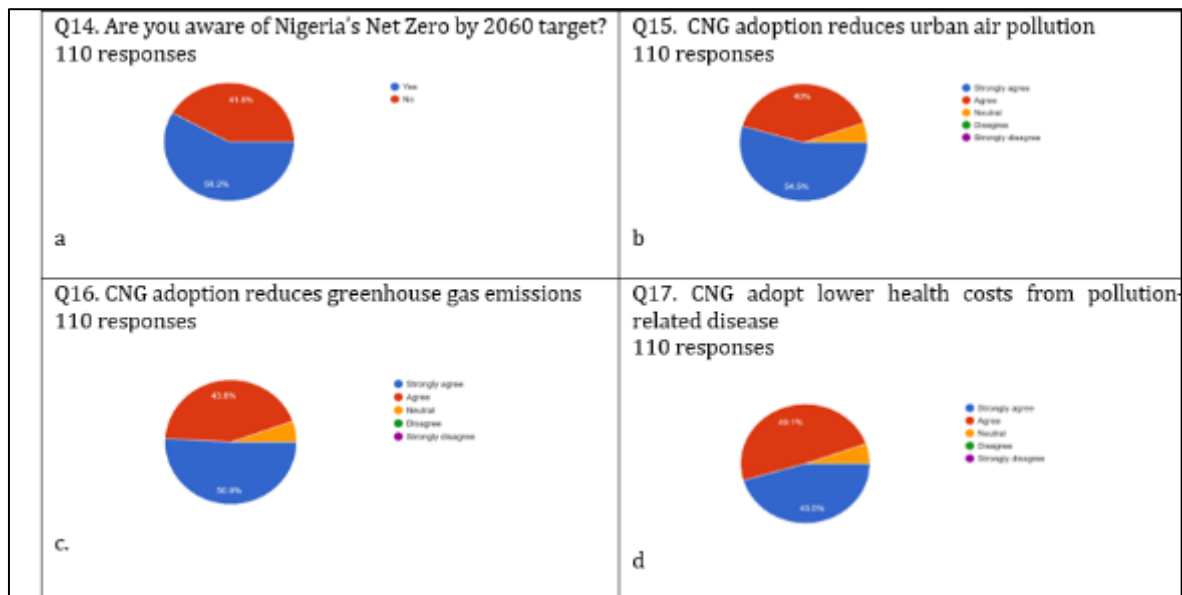


Figure 11 Perceptions of Net Zero 2060 awareness (a), urban air pollution reduction (b), greenhouse gas reduction (c), and health cost reductions (d).

However, 58% were unaware of Nigeria's Net-Zero 2060 and Paris Agreement commitments, revealing a climate-literacy gap consistent with findings across sub-Saharan Africa [58]. While, Figure 12 reveal that 62% viewed CNG as a transitional rather than terminal solution, this is consistent with global transition models [35]—its high environmental approval strengthens its legitimacy as a bridge fuel. From a Multi-Level Perspective, climate pressures act as a landscape-level driver destabilizing the petrol-based regime and creating opportunity for CNG adoption [36].

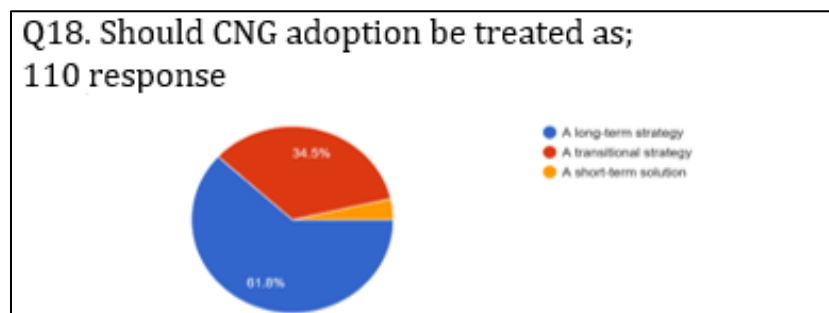


Figure 12 Stakeholder views on whether CNG adoption should be treated as a long-term, transitional, or short-term strategy.

3.5 Socio-Economic, Research, and Infrastructure Implications

Referring to Figures 13(a-f), it can be observed that respondents strongly linked CNG to socio-economic benefits, including job creation (89%), poverty reduction (80%), and local industrial development (85%). These perceptions align with evidence from Brazil and India showing that CNG transitions stimulate manufacturing, services, and skills

development [59]. Reduced transport costs were identified as a key driver, consistent with studies linking affordable mobility to higher disposable income and improved labor access in Nigerian cities [60,61].

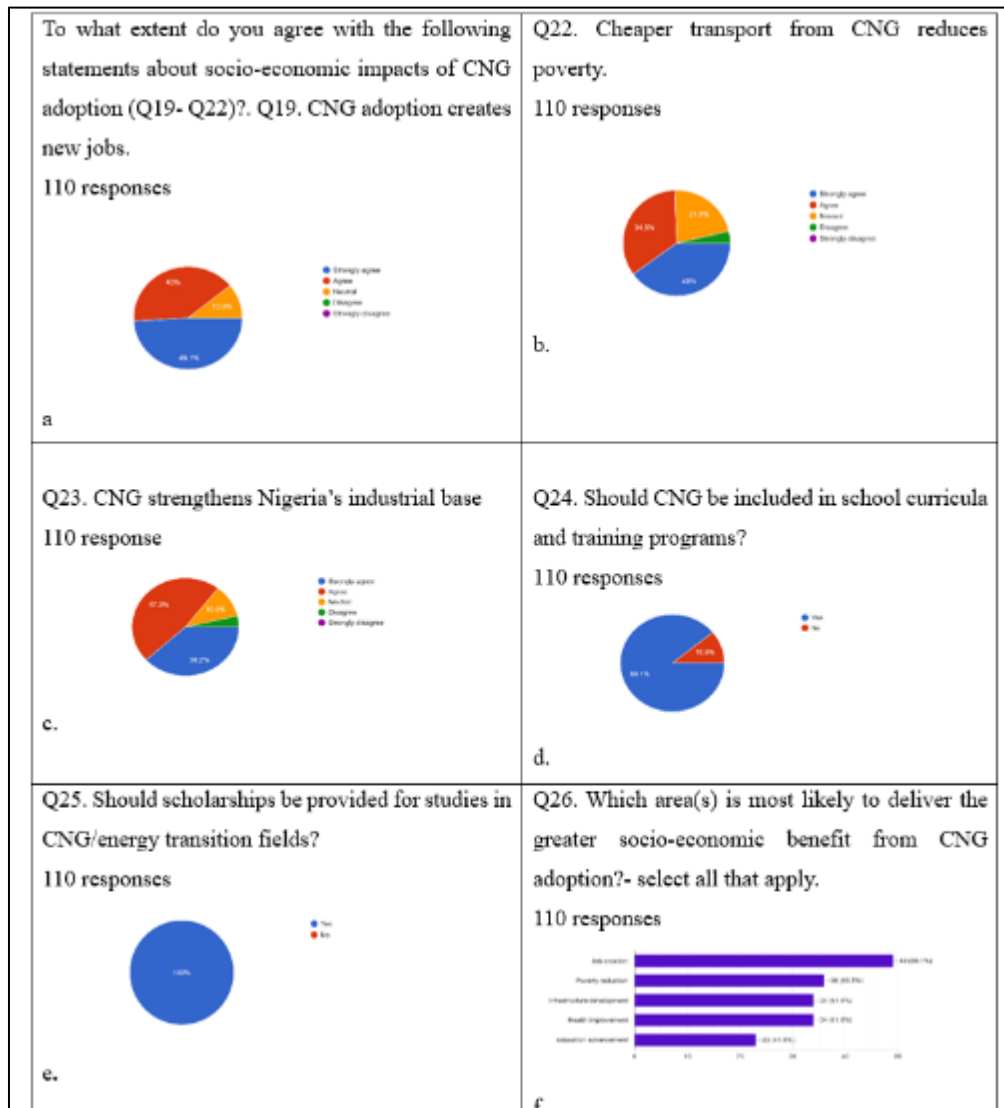


Figure 13 Perceived socio-economic impacts of CNG adoption regarding jobs (a), poverty reduction (b), industry strengthening (c), school curricula integration (d), study scholarships (e), and areas delivering the greatest benefit (f).

Support for training, research and local content development was overwhelming (refer to Figures 14 a,b,c,d,f). Respondents endorsed university-led R&D (98%), prioritizing safety, efficiency, and retrofitting, alongside strong local-content policies (75–100%) and international partnerships (96%). Funding constraints and weak policy frameworks were identified as major obstacles, echoing broader critiques of Nigeria's energy innovation system [41]. These findings underscore the need to strengthen TIS functions related to knowledge development, legitimization, and guidance of the search.

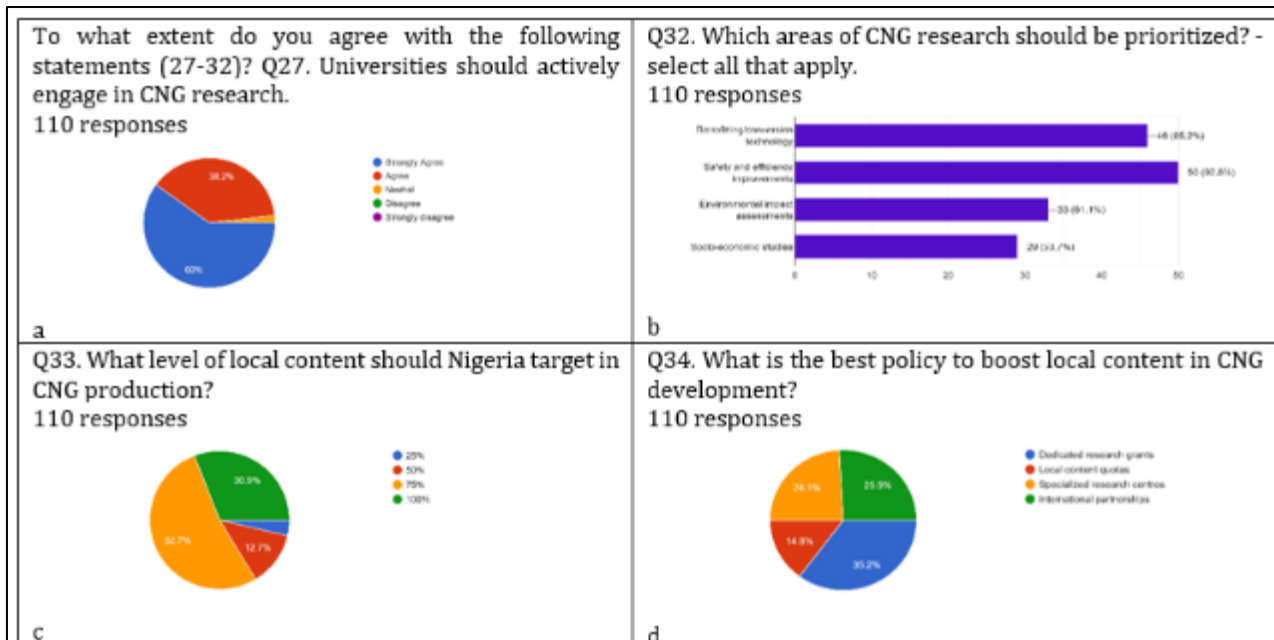


Figure 14 Stakeholder preferences regarding university research engagement (a), research priorities (b), local content targets (c), and local content development policies (d).

Infrastructure - distance, consistency of supply, and logistics emerged as the most critical bottlenecks to the success of the PCNGI (refer to Figures 15a-d). Most respondents lived over 20 km from a station (66%), 94% deemed coverage inadequate, and 44–56% reported unreliable supply. The emphasis on nationwide rollout, storage capacity, and hybrid delivery models—including mobile units and pipelines—aligns with IEA recommendations for flexible infrastructure deployment in emerging economies to overcome the high capital costs and long lead times of traditional pipeline networks [62,63].

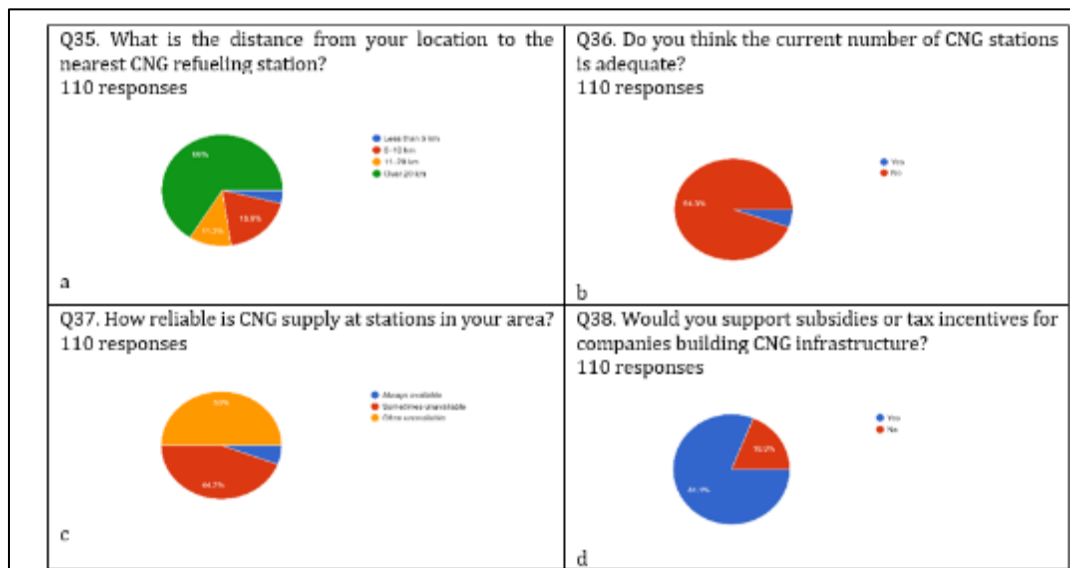


Figure 15 Key infrastructure bottlenecks, including distance to nearest station (a), station adequacy (b), supply reliability (c), and support for infrastructure subsidies or tax incentives (d).

Without rapid infrastructure expansion, the petroleum-dominated regime will continue to constrain CNG scale-up despite strong public support. These findings align closely with MLP and TIS frameworks: the socio-technical regime (existing petroleum-dominated infrastructure) remains a strong barrier preventing niche technologies like CNG from scaling. Without rapid expansion of stations, compression hubs, and pipeline distribution, adoption will remain limited regardless of public support or policy ambition.

4 Discussion on Theoretical Framework Suitability for CNG Policy Development.

The findings of this study, when analyzed through the Multi-Level Perspective (MLP), Diffusion of Innovation (DOI), and Technological Innovation Systems (TIS) frameworks, underscore that Nigeria's CNG transition has moved beyond a "niche innovation" phase into an active institutionalization stage. While the MLP contextualizes the external crisis driving this shift and DOI highlights the readiness of the adopter's mindset, the TIS framework provides the most critical diagnostic utility for Nigeria's current landscape. The survey metrics—specifically the 74% self-financing rate and 94% infrastructure deficit—reveal that the transition is stalling due to systemic coordination issues rather than a lack of public interest. Consequently, the TIS framework is uniquely suited for current policy development as it quantifies these structural weaknesses.

A significant marker of this transition's maturation is the recent evolution of the Presidential Compressed Natural Gas Initiative (Pi-CNG). The initiative now reflects a sophisticated bifurcation of roles: the Pi-CNG continues to spearhead the Presidential Steering Efforts regarding the program's incentive components, while the commercial aspects have been transitioned to a government-owned company managed through the Ministry of Finance Incorporated (MOFI). This structural shift aligns with the TIS functions of resource mobilization and market formation. However, it also indicates that earlier recommendations for a "National CNG Steering Committee" have been effectively overtaken by events. To ensure long-term sustainability and resolve the friction between this emerging gas regime and the entrenched petroleum landscape, the policy framework must now focus on elevating the initiative. This requires widening stakeholder participation in policy formulation and implementation, ensuring the transition evolves from a government-led directive into a socially embedded and systemic movement.

Table 1 Theoretical Framework Interpretation of Nigeria's CNG Transition

Framework	Perspective on Nigeria's CNG Transition	Core Diagnostic Contribution & Utility	Key Survey Metrics & Systemic Constraints	Suitability for Policy Development
Multi-Level Perspective (MLP)	Views the transition as a landscape-level shock (subsidy removal) creating a window of opportunity for the CNG niche to challenge the established petroleum regime.	Landscape Dynamics: Explains the 2023 subsidy removal as the external "shock" that destabilized the entrenched petrol regime.	98% Awareness: Contextualizes high awareness as a response to regime instability, yet notes that "regime resistance" (existing petrol infrastructure) hinders a total shift.	Moderate: Excellent for contextualizing the "why" but offers fewer specific operational mandates for industrial scaling.
Diffusion of Innovations (DOI)	Focuses on the adopter's mindset, specifically the "Relative Advantage," "Complexity," and "Triability" of CNG technology.	Behavioral Barriers: Explains why high awareness does not automatically lead to uptake; identifies the shift from early adopters to the majority.	41% Conversion Intention: Shows high adoption potential is canceled out by perceived complexity and the inability to "test" the technology due to high costs.	Moderate: Highly useful for communication and public education strategies but overlooks broader industrial and supply-side logic.
Technological Innovation Systems (TIS)	Evaluates the functional performance of the entire ecosystem, specifically focusing on market formation, resource mobilization, and legitimization.	Functional Failure Analysis: Identifies exactly which systemic "gears" are stuck (e.g., lack of coordination). It converts "bottlenecks" into specific mandates.	Resource Mobilization: 68% high conversion costs & 74% self-financing. Market Formation: 94% infrastructure deficit. Legitimation: 27% safety concerns.	High: The most comprehensive tool. It provides a direct roadmap for regulatory, financial, and structural policy intervention.

5 Policy and Strategic Recommendations

The survey results highlight a landscape of robust public enthusiasm for Compressed Natural Gas (CNG) adoption, contrasted sharply by structural deficits that impede a comprehensive national transition. While earlier frameworks suggested a National CNG Steering Committee, the evolution of the Presidential CNG Initiative (PiCNG) as the primary incentive vehicle and the Ministry of Finance Incorporated (MOFI) as the commercial lead indicates that institutional progress has already begun. To convert this latent demand into a permanent energy paradigm, Nigeria must transition from fragmented, reactive measures toward a centralized, statutory system. Grounded in the Technological Innovation Systems (TIS) framework [28] and successful global precedents from India, Brazil, and Pakistan, the following ten strategic imperatives are proposed to harmonize the transition.

5.1 Strategic Governance: The National CNG Promotion Council

To overcome administrative silos and the current transition stalemate, it is essential to elevate the initiative through broader stakeholder participation. Establishing a National CNG Promotion Council as a statutory body—modeled after the National Hydrocarbons or Sugar Councils—would provide the necessary oversight to unify disjointed ministerial efforts. This body would ensure high-level policy continuity and significantly strengthen the "legitimation" function within the TIS framework [14, 50, 81].

5.2 Expansion of National CNG Infrastructure

Infrastructure remains the primary bottleneck, with 94% of stakeholders reporting inadequate station coverage and 66% living more than 20 km from refueling points. To address this weak market formation, Nigeria should adopt India's city gas distribution model [64, 65] and deploy mobile dispensing units as seen in Pakistan [66]. A critical strategy for cost-effective scaling is the co-location of CNG infrastructure within existing petrol and diesel retail outlets [81, 82]. Furthermore, developing pipeline-fed regional depots and securing federal-state cooperation for land access will reduce supply inconsistencies—currently reported at 44–56%—and siting delays [67].

5.3 Reduction of Conversion Costs and Enhanced Financing

High conversion costs (68%) and a lack of formal financing—which forces 74% of adopters to self-fund—demand a robust Public-Private Partnership (PPP) financing strategy [7]. Essential measures include targeted subsidies covering 30–50% of upfront costs, low-interest loans for small operators, and grants for commercial fleets [9, 45, 68]. Additionally, fostering the local manufacturing of kits and components could reduce costs by 20–40%, mirroring Brazil's success in resource mobilization [17, 68].

5.4 Harmonization of Safety Standards and Public Trust

While only 27% of respondents cited safety concerns, rigorous regulation is vital to prevent incidents that could shatter public confidence [21, 49]. Nigeria must establish harmonized national safety codes for cylinders, workshops, and mobile units, complemented by mandatory technician certification. Implementing a national safety audit and incident-reporting system, drawing on lessons from Pakistan where weak regulation eroded trust, will align the country with global best practices and reinforce TIS legitimation [22, 54, 70, 73].

5.5 Promotion of Local Content and Industrialization

There is overwhelming support (75–100%) for domestic production, which aligns with national industrial goals and global clean-energy trends [74]. A phased local-content strategy—progressing from basic assembly to full component manufacturing—should be anchored by R&D partnerships with global leaders like Brazil, India, and China [75, 76, 77, 78]. Creating manufacturing clusters that integrate suppliers and training centers will enhance competitiveness and market stability.

5.6 Strengthening Public Awareness and Education

Despite a 98% general awareness rate, specific knowledge regarding PiCNG functions is lacking, indicating a need for a national multimedia campaign [69, 70]. Following models in South Korea and the UAE, integrating CNG technology into school and tertiary curricula will foster long-term energy literacy [71, 72]. Regional training centers and targeted scholarships can further bridge the skills gap and mitigate the perceived risks that influence adoption.

5.7 Integration with National Climate Strategy

CNG should be formally positioned as a cornerstone transition fuel within Nigeria's Net-Zero 2060 strategy [52, 53]. Although 89–95% of the public recognizes the environmental benefits, 58% are unaware of national climate commitments. Operationalizing these goals requires carbon-reduction incentives, such as tax credits and fleet-based carbon credits, alongside innovative hybrid infrastructure like solar-assisted refueling stations.

5.8 Strengthening Public-Private Partnerships (PPPs)

PPPs are the essential engine for scaling infrastructure and manufacturing. India's success in expanding from 738 stations in 2014 to over 8,150 by 2025 serves as a primary benchmark [79]. Nigeria should implement a standardized national PPP framework characterized by tax incentives, reduced import duties, and fast-track approvals to accelerate ecosystem growth, as evidenced by Brazil's rapid infrastructure delivery [12, 80].

5.9 Improvement of Logistics and Supply Chain Reliability

Supply unreliability highlights significant gaps in compression hubs and gas transport. To enhance the "knowledge development" function of the TIS, the government should mandate minimum storage capacities at stations and deploy a national digital dashboard for real-time data on station availability and pricing [13]. Expanding pipeline-fed depots will further ensure transparency and stabilize the supply chain.

5.10 Ensuring an Equitable and Socio-Economic Transition

The transition must maximize socio-economic returns, specifically regarding job creation (89%) and poverty reduction (80%). The National CNG Promotion Council should prioritize infrastructure in underserved and rural regions to prevent innovation clustering in urban centers [15, 36]. By establishing a national jobs and skills program focused on fabrication and maintenance, Nigeria can maintain equity as a core pillar of this new energy paradigm.

6 Conclusion

This study examined national perceptions of CNG adoption in Nigeria, focusing on awareness, perceived benefits, constraints, and scaling opportunities. The predominantly highly educated, mid-career respondents from government, academia, and technical fields provided expert-informed insights into Nigeria's emerging CNG ecosystem. Findings reveal near-universal awareness of CNG (98%) and strong alignment with national priorities such as affordability, industrialization, emissions reduction, and job creation—patterns consistent with other emerging economies transitioning to alternative fuels.

Despite this support, significant structural barriers remain. Inadequate infrastructure (94%), high conversion costs, limited financing, and moderate safety concerns persist, reflecting weaknesses in key Technological Innovation Systems (TIS) functions, including infrastructure provision, resource mobilization, market formation, and legitimation. These challenges mirror broader socio-technical lock-ins associated with petroleum-dominated transport regimes. Nonetheless, operational perceptions were positive, with respondents citing fuel efficiency, lower maintenance costs, and reliability, alongside strong agreement on socio-economic co-benefits such as job creation, poverty reduction, industrial growth, and public-health improvements.

Governance and communication gaps were also evident. While CNG awareness is high, awareness of Nigeria's climate commitments remains limited (58%), underscoring the need for targeted climate-literacy initiatives. Overall, the findings confirm that Nigeria possesses strong public support for CNG adoption but must urgently address infrastructure, financing, regulatory, and capacity gaps. The TIS framework is validated as a robust analytical lens for guiding Nigeria's clean-mobility transition.

6.1 Future Research Directions

Future research should address the dynamic and multi-dimensional nature of CNG adoption in Nigeria. Longitudinal studies are needed to track changes in public perception and adoption behavior as infrastructure and financing mechanisms evolve, assessing whether latent demand translates into sustained uptake. Detailed cost-benefit and lifecycle environmental analyses are essential to quantify long-term economic, emissions, and public-health impacts relative to petrol, diesel, and electric mobility.

Comparative sub-national studies across Nigeria's federal states could identify best practices in fiscal incentives, regulatory design, and political leadership, drawing lessons from India's state-driven gas programs. Further research

should examine gender, social inclusion, and geographic equity, as benefits and access may vary across socio-economic groups. Industrial capability studies are also critical, particularly regarding local manufacturing potential, workforce readiness, and R&D capacity. Finally, governance, risk, and regulatory compliance research—alongside studies on hybrid renewable–CNG and electric-mobility integration—would inform long-term investment sequencing and Net-Zero strategies.

6.2 Final Reflection

Nigeria's CNG transition stands at a pivotal moment. The survey confirms strong public willingness and favorable perceptions but also exposes systemic weaknesses requiring coordinated intervention. Addressing these challenges demands integrated policy action across infrastructure development, financing, regulation, industrialization, and research. Crucially, adopting a systemic, innovation-oriented approach—consistent with the Technological Innovation Systems framework—will enable CNG to serve not merely as a cost-saving fuel alternative but as a catalyst for broader economic transformation and sustainable mobility. This study contributes a clear, evidence-based roadmap for translating public support into accelerated, system-wide adoption within Nigeria's energy transition agenda.

Compliance with ethical standards

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Disclosure of conflict of interest

All authors declared that there are no competing interests to disclose.

Disclosure of Artificial Intelligence (AI) Use

The authors acknowledge the use of the Gemini 3 Flash AI system as a collaborative drafting assistant. However, it did not conduct the primary research or the survey (which are the original works of the authors).

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