Natural Resource Governance Institute

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STRENGTHENING COORDINATION IN NIGERIA'S ENERY TRANSITION PLAN: GAS SECTOR ALIGNMENT WITH NIGERIA'S ENERGY TRANSITION PLAN

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LIST OF ABBREVIATIONS

AKK – Ajaokuta–Kaduna–Kano

CCS – Carbon Capture and Storage

DARES – Distributed Access through Renewable Energy Scale-Up

DER – Distributed Energy Resources

DGSO – Domestic Gas Supply Obligations

DisCos – Distribution Companies

ECN – Energy Commission of Nigeria

ETP – Energy Transition Plan

IEA – International Renewable Agency

GenCos – Generation Companies

IPF – International Public Finance

LPG – Liquefied Petroleum Gas

LT-LEDS – Long Term Low Emissions Development Strategy

IOCs – International Oil Companies

IRENA – International Renewable Energy Agency

NDCs – Nationally Determined Contributions

NERCs – Nigerian Electricity Regulatory Commissions

NEP – Nigeria Electrification Project

NGFCP – Nigerian Gas Flare Commercialization Programme

NGP – National Gas Policy

NLNG – Nigerian Liquified Natural Gas

NUPRC – Nigerian Upstream Petroleum Regulatory Commission

NREEEP – National Renewable Energy and Energy Efficiency Policy

NRGI – Natural Resource Governance Institute

RE – Renewable Energy

REFIT – Regulations on Feed-In Tariff (for Renewable Energy Sourced Electricity in Nigeria)

REMP – Renewable Energy Master Plan

RESIP – Rural Electrification Strategy and Implementation Plan

TREP – Transmission Rehabilitation and Expansion Program

1. BACKGROUND

The government of Nigeria has indicated and committed to achieving energy transition as articulated in its Energy Transition Plan. This plan is supported by different policies and regulations that govern the operations of the gas and renewable energy sectors. The focus on these sectors is informed by the fact the Nigerian government has indicated that its path to energy transition is multidimensional, adopting the use of natural gas as a transition fuel, while aiming to upscale its renewable energy capabilities. This brings into the energy transition conversation, the impact of the complex interplay of natural gas and renewable energy utilization in helping the country attain net-zero by 2060. Detailed investigation of the dynamics of gas and renewables reveals nuances at play that may hinder their integration to drive effective energy transition in Nigeria. For instance, continuous investment in gas infrastructure to upscale gas utilization as a transition fuel limits the availability of resources for renewables.

Under such circumstances, there is a possibility for such natural gas infrastructure to become locked-in assets, which would hinder Nigeria's transition towards of cleaner energy sources quickly. This dynamic interplay depicts the complexity inherent in achieving Nigeria's energy transition targets, which some energy transition and renewable energy-focused government institutions may not be aware of. This therefore informs the rationale for this project, where mechanisms of driving optimal integration of natural gas and renewables to achieving Nigeria's energy transition plans is made known to relevant government institutions. Hence, this report examines the complex interaction between the role of natural gas as a transition fuel and the evolving role that renewables will play in driving Nigeria's energy transition towards net-zero, thereby informing government agencies on the optimal pathways to achieving net-zero by 2060.

Drawing this rationale, the project aims to achieve the following objectives;

i. Facilitate discussion between relevant energy transition-related government institutions working in silos.
ii. To influence a comprehensive vision the energy transition that clarifies how gas and renewables are expected to work together and how those roles are expected to change over time.

At the end of the project, it is expected that;

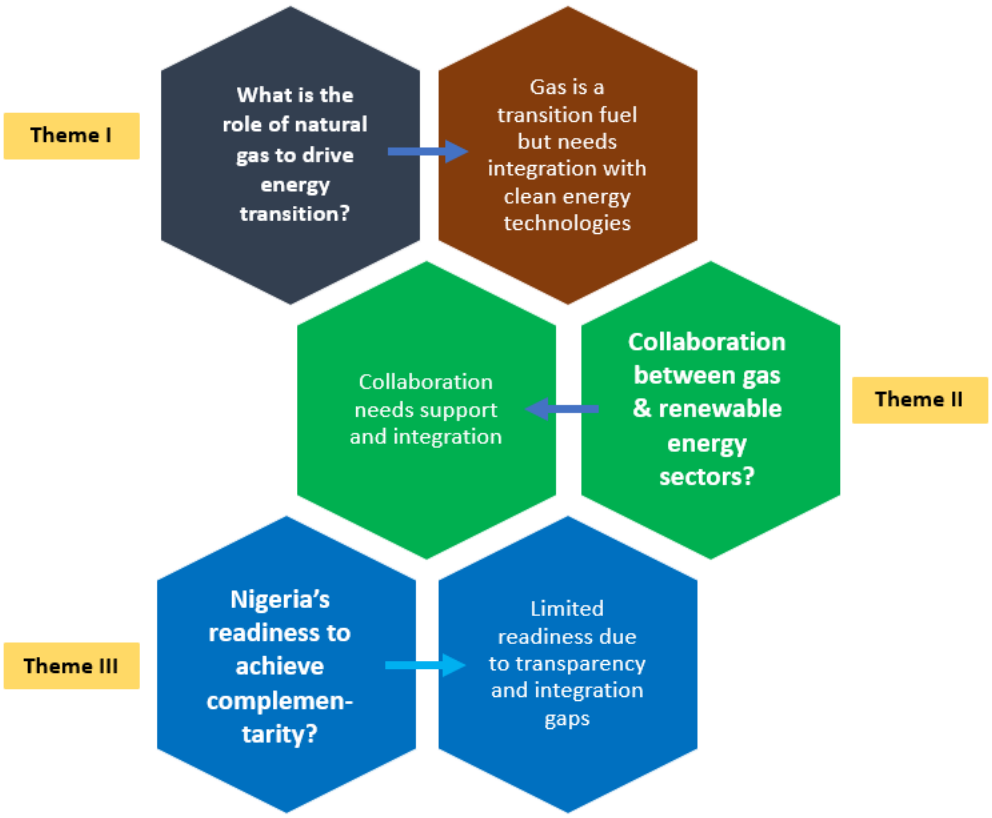
i. Energy transition-related government institutions more aware of how to integrate its gas and renewable energy plans.
ii. Greater commitment by government and other stakeholders on the need for integration of renewable and gas plans to achieve a sustainable energy transition.

It is important to note that the research evolved from the Natural Resource Governance Institute (NRGI)'s publication titled 'Guidebook on Nigeria's Energy Transition'. The Guidebook and engagements with energy transition stakeholders identified policy coherence and coordination gaps as a limitation to successful implementation of the energy transition. Further, this research seeks to evaluate how to balance gas and renewable energy through integration to accelerate Nigeria's plans to achieve net zero by 2060. Thereafter,

Policy Dialogue was organized on Nigeria's Energy Transition, with the goal of unravelling what is known about Nigeria's drive towards net zero in 2060 using gas as the transition energy, the changing role of renewables over time and the institutional responsibility to drive support for that change. The first phase of the research comprised of desk research evaluating NRGI's Gas to power framework and adapting it to the Nigerian context and Policy Dialogue on Nigeria's Energy Transition which was attended by stakeholders within the energy transition sector. This research report builds on that initial engagement and questionnaires administered to stakeholders. The second phase involved seeking clarifications of some responses with participants. While a third phase entailed in-depth review and analysis of published literature and videos relating to the balancing gas and renewable pathways to achieve a sustainable energy transition.

2. METHODOLOGY

This report was developed using qualitative data obtained from primary and secondary sources. The primary data sources were questionnaires administered by Dr. Opia Oji Bonnyfaceof African Initiative for Transparency Accountability & Leadership (AfriTAL) to stakeholders during the engagement phase of the project. The stakeholders that participated include experts from Federal Minister of Power, Nigerian Upstream Petroleum Regulatory Commission (NUPRC), Nigerian Liquified Natural Gas (NLNG) company, Akwa Ibom State Ministry of Environment, Renewables experts and other relevant civil society organizations. As regards feedback from the renewable energy experts, their feedback was still being expected as the time of writing this report. Their valuable perspectives would be presented in subsequent reports that would be developed. As for the secondary data sources, extensive literature review of relevant gas and renewable policy documents was conducted to identify critical information, which were used for critical analysis in this report. It is important to note that research items in the questionnaires were culled from the "Framework for Countries Evaluating Gas-to-Power Pathways" and "Guidebook on Nigeria's Energy Transition" from NRGI. These questions were categorized into three themes depicted in the question framework below. The feedback from the stakeholders is summarized and presented in the framework.



Stakeholder survey feedback

3. BALANCING NATURAL GAS UTILIZATION WITH RENEWABLE ENERGY GOALS TO ACHIEVE A SUSTAINABLE ENERGY TRANSITION

3.1 Theme I: Strategic Intentions for Leveraging Natural Gas as a Transition Fuel

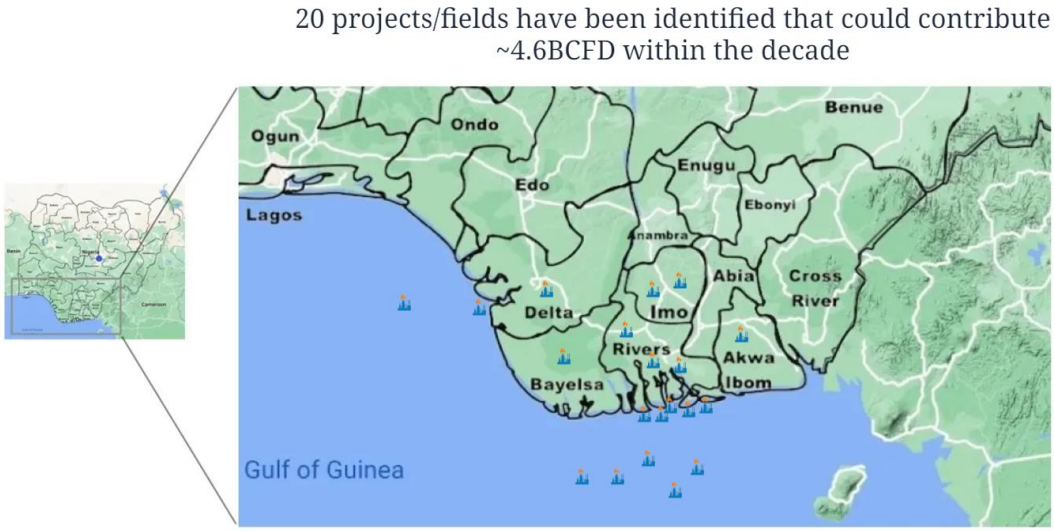
3.1.1 Are the Nigerian government's supply and demand projections for gas credible?

According to the Decade of Gas Initiative[1], development of critical gas infrastructure in 20 project/fields would increase Nigeria's current gas production capacity, estimated at 8 billion cubic feet per day (BCFD) by ~4 BCFD (amounting to ~12 BCFD). This is expected to provide the needed energy to drive a gas-powered economy by 2030. According to the government, this contributes to energy access and security. The government and private sector, which are implementing partners of the initiative have demonstrated commitment to actualize this plan. Amongst other gas projects, the government recently commissioned expanded AHL Gas Processing Plant, the ANOH to Obiafu-Obrikom-Oben (OB3) custody transfer metering station gas pipeline projects and the ANOH Gas Processing Plant, located in Imo and Delta states, which are reported to drive up the country's gas production by 25%[2]. This "driving up gas supply" targets are based

[1] Decade of Gas Initiative, 15 December 2024, https://decadeofgas.com.ng/#decadeofgas
[2] Tinubu to tackle power outages with two gas plants, 15 December 2024, https://punchng.com/tinubu-to-tackle-power-outages-with-two-gas-plants/

on projections that gas demand would either uptake supplied gas or probably surpass. Data from the Decade of Gas Initiative shows that the government expects that gas demand would be 16.6% per annum between 2020 and 2030 (amounting to ~22.6 BCFD by 2030), which is a 503.03% increase from the increment of ~3.3% per annum, recorded between 2010 and 2020.

This projected gas demand exceeds supply, painting an impressive future for Nigeria's gas sector, although it is anticipated that gas utilization will gradually drop as the net-zero target of 2060 draws closer. While the gas supply targets are commendable, the finance needed for actualization is largely lacking, coupled with market risks, political uncertainties and insecurity amongst others facing oil and gas operations in Nigeria. In fact, with an investment of USD 20 billion needed for gas infrastructure (such as Nigeria/Morrocco gas pipeline, AKK pipeline and NLNG Train 8 amongst others)[3], coupled with dwindling global investment in gas (dropping to USD 4 billion for lower income earning countries, mostly going to Mozambique)[4], the needed gas projects might likely come on stream by 2030, distorting the ambitious gas supply targets set to take off before 2030.



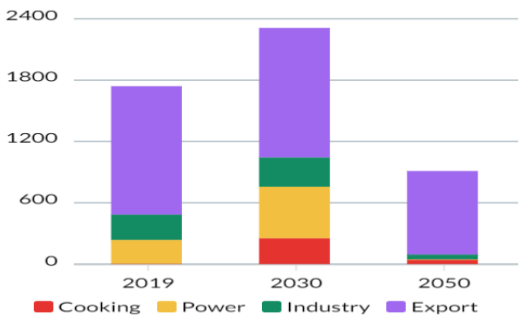
**adapted from Decade of Gas Initiative, https://decadeofgas.com.ng/#decadeofgas

It is important to note that these projections for gas demand are based on a thriving market for domestic gas demand [prompted by the Domestic Gas Supply Obligation (DGSO)] and for export. By inference, this means that power and non-power uses of gas would increase in Nigeria, with projections indicating ~60% for domestic utilization while export infrastructure would uptake the remaining ~40%. A critical probe of this ambitious target reveals that there is a complex interplay of forces that indicate that the projections do not reflect realities on the ground. Firstly, increased gas demand in the gas-to-power sector is tied to different mechanisms such as market regulations (that impacts investor confidence), limited finance for infrastructure (induced by aversion to carbon-based power projects from the private sector, except for

[3] Nigeria requires $20 billion gas infrastructure to unlock potential, 15 December 2024, https://guardian.ng/energy/nigeria-requires-20-billion-gas-infrastructure-to-unlock-potential/

[4] International Institute for Sustainable Development, 15 December 2024, https://www.iisd.org/publications/natural-gas-finance-clean-alternatives-global-south\

multilateral development agencies), limited ability of extant gas transmission and distribution lines to uptake increased power generation amongst others. Secondly, the non-power uses of gas also show variability that needs to be unbundled. For instance, the government has posited that petrochemicals remain a viable *uptaker* of gas in Nigeria, but the question is, "how much gas can the petrochemical sector take?".



Evolution of gas demand across different sector due to transition[5]

A report by Carbon Tracker[6] pointed out that emerging economies need to be wary of perceived ability of petrochemicals to shore up oil and gas demand, as most of these projections assume a 3.9% year-on-year growth till 2035, a figure that is at the top range of expectations of industry experts, highlighting over-ambition. This does not in any way negates the efforts of the government in upscaling petrochemical driven gas-demand, as the government signed a USD 3.5 billion deal with IOCs to supply gas to Brass Fertilizer and Petrochemical Plant in Bayelsa[7]. The question however is, with the dwindling investment in oil and gas projects globally, how many of such deals can the Nigerian government broker, to ensure the petrochemical sector meets the projected gas demand? While there is no deterministic answer to this, the probability that it would happen often is low, further casting doubts on the credibility of the domestic gas demand projections.

Further, other non-power uses of gas are its use as compressed natural gas (CNG) for transportation, which is being implemented by the Presidential CNG Initiative (PCNGi)[8] and as liquefied petroleum gas (LPG), which is at the heart of clean cooking initiatives currently being implemented across the country. The latter has gained popularity in the wake of fuel subsidy removal by President Bola Ahmed Tinubu. This can be attributed to the fact that reports show that CNG is able to reduce fuel costs by 70%, as CNG and petrol currently sells at ₦230 and ₦1000 per litre respectively[9]. However, it needs to be highlighted that the massive adoption of CNG in Nigeria for transportation faces challenges cultural limitations, safety considerations

[5] ETP, https://www.energytransition.gov.ng/natural-gas/
[6] Petrochemical Imbalance: Why chemicals are unlikely to prop up oil demand, 15 December 2024 https://carbontracker.org/reports/petrochemical-imbalance/
[7] Nigeria signs deal to supply gas to proposed $3.5 billion petrochemical plant, 15 December 2024, https://www.reuters.com/business/energy/nigeria-signs-deal-supply-gas-proposed-35-billion-petrochemical-plant-2024-10-11/
[8] Presidential Compressed Natural Gas Initiative, https://pci.gov.ng/
[9] Nigeria CNG initiative faces hurdles amid conversion challenge, 15 December 2024, https://www.theafricareport.com/364501/nigeria-cng-initiative-faces-hurdles-amid-conversion-challenge/

and cost implications needed for conversion processes. The accurate outcome of this interplay of challenges would be difficult to determine, highlighting uncertainty in domestic gas demand. As regards LPG consumption, the government targets a 5 million metric per annum consumption by 2030[10], to drive domestic gas consumption. Of course, this is an impressive target but also it needs to be stated that NLNG (which is the biggest player in domestic LPG supply, controlling ~40% market size) supplied a total of 3 million metric ton to the domestic market between 2007 and 2024[11]. Also, the country recently crossed the 1 million metric ton per annum of LPG consumption in 2022[12]. Upscaling this significant LPG demand would not be an easy task, especially considering the current economic realities of the country where customer purchasing parity seems to be dropping, meaning that the increased market demand might not increase as expected.

This is further complicated by the fact that renewables can become energy sources in applications of non-power use of gas within the coming years. While CNG and LPG are projected to be main drivers of gas demand in the transportation and clean cooking sectors respectively, it is important to note that electric vehicles (EVs) and other clean cooking options such as solar stoves and clean electrification might strongly distort gas demand from these sectors. There is also the role of petrochemicals being used in the production of renewable energy technologies (such as solar panels, wind turbines, battery storage systems e.g. lithium-ion batteries and hydrogen fuel cells and advanced plastics used in EVs) in the country. In this case, as the RE value chain expands in line with the goals of the ET, consumption of petrochemicals across its value chain is expected to increase, leading to increase in petrochemicals and by inference, an increase in gas supply and demand. Putting these into perspective, it can be presented that the credibility of Nigeria's gas supply and demand is debatable.

3.1.2 How well will producing and burning more gas to generate electricity serve Nigeria's goals for its domestic energy sector?

Feedback from the stakeholders put forward that gas utilization would result in increased electricity production in Nigeria. This consensus can be attributed to the government's disposition to a causal relationship that assumes that more gas would translate to more fuel for gas-fired power plants. Considering that natural gas accounts for ~75% of electricity production in Nigeria[13], it is not out of place to assume this. Most gas-fired power plants provide baseload power, meaning that country's electricity production is strongly tied to the functionality of these power plants. Along this line, it can be assumed that increased gas utilization would improve the country's electricity operational grid capacity, estimated at ~6

[10] NLNG's Domestic LPG Supply Hits 3m Metric Tons in 17 Years as FG Targets 5m MT, 15 December 2024, https://www.thisdaylive.com/index.php/2024/10/15/nlngs-domestic-lpg-supply-hits-3m-metric-tons-in-17-years-as-fg-targets-5m-mt/

[11] NLNG pledges more local cooking gas supply, 15 December 2024, https://punchng.com/nlng-pledges-more-local-cooking-gas-supply/

[12] Nigeria's LPG consumption hits 1m metric tonnes — PPPRA, 15 December 2024, https://www.premiumtimesng.com/business/business-news/437398-nigerias-lpg-consumption-hits-1m-metric-tonnes-pppra.html?tztc=1

[13] International Renewable Energy, https://www.iea.org/countries/nigeria/electricity

GW[14] out of an installed capacity of13 GW[15]. It is also worth noting that the national grid is failing to meet significant electricity demand currently arguably due to limited gas supply, indicating available electricity uptake capacity in the sector. Further, data shows that this unmet demand by the national grid (which is estimated at ~80% of installed national grid capacity) is currently being met by diesel and petrol generators[16], further substantiating that there is extant demand for more electricity supplied by gas-fired power plants. This is also the perspective where increased gas utilization would address the intermittency problem faced by renewables, when they are increasingly integrated into Nigeria's electricity mix, highlighting the continuously role that gas-fired power plants would play into the coming decades.

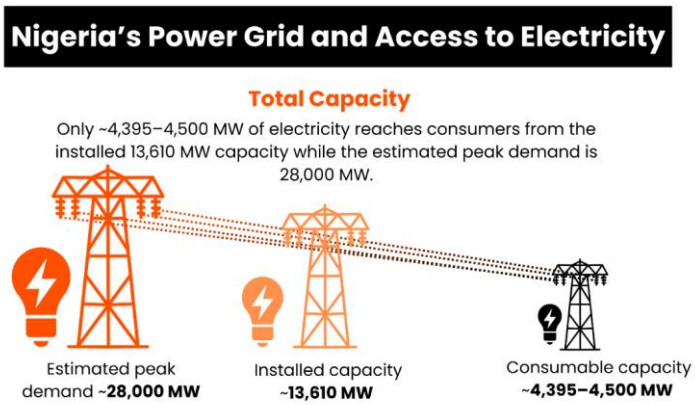
In 2022, Nigeria's electricity demand profile was mainly dominated by the domestic sector (~50%) while the commercial and industrial sector accounts for ~25% each, with the demand from each of these sectors projected to increase over time[17]. This is hinged on projections from Nigerian Electricity Regulatory Commissions (NERCs) that state Nigeria's electricity demand would get to ~ 46 000 MW by 2050[18]. This highlights that the market is viable enough to prompt GenCos to uptake more gas and transmit to DisCos for these end-users This coupled with the government steps to implement National Mass Metering Program[19], the "willing seller, willing buyer" electricity distribution policy and Nigeria electrification project that put plans in place to sell "unutilized" stranded electricity to other west African countries via the North core Power Transmission Line project.

While these assumptions are relatable and government's actions commendable, it is important to note that translating gas to electricity for end-users faces complexities that are usually not evident to these stakeholders. This is because the value chain that exists between transporting gas to GenCos and transmitting electricity to the end user faces different challenges, that negate the position of these stakeholders., the market remains unattractive. For instance, there are huge legacy debts in Nigeria's electricity owed to GenCos, amounting to ~ USD 1.6 trillion[20], that makes the sector unattractive for investment. If these debts are not resolved in the nearest future, gas utilization might not result in electricity access in line with expectations as electricity might become stranded, because investment in infrastructure needed for its transmission may become scarce. There is also the challenge of huge losses recorded during transmission and distribution of electricity, with data showing that ~46% of electricity transmitted is lost through the country's interconnected transmission network and 11 distribution lines[21].

[14] Energy Transition Plan, https://www.energytransition.gov.ng/power/
[15] Electricity. Power Systems and Renewable Energy, 15 December 2024, https://www.trade.gov/country-commercial-guides/electricity-power-systems-and-renewable-energy
[16] Nigeria relies on generators for 75% electricity – report, 11 January 2025, https://punchng.com/nigeria-relies-on-generators-for-75-electricity-report/
[17] Amount of electricity consumed in Nigeria as of 2022, by sector, 11 January 2025, https://www.statista.com/statistics/1307456/electricity-consumption-in-nigeria-by-sector/
[18] FG estimates electricity demand to hit 45,662MW by 2030, 15 December 2024, https://punchng.com/fg-estimates-electricity-demand-to-hit-45662mw-by-2030/
[19] Meter Asset Provider and National Mass Metering Regulations, 11 January 2025, https://nerc.gov.ng/wp-content/uploads/2021/08/NERC%20Meter%20Asset%20Provider%20and%20National%20Mass%20Metering%20Regulations%20-%20August%202021.pdf
[20] Senate to intervene in N1.6trn legacy debt to Egbin, 15 December 2024, https://businessday.ng/news/article/senate-to-intervene-in-n1-6trn-legacy-debt-to-egbin/
[21] German Cooperation, https://www.german-energy-solutions.de/GES/Redaktion/DE/Publikationen/Praesentationen/2019/190725-gr-nigeria-08.pdf?__blob=publicationFile&v=1

For better perspective, the severity of these losses would result in the country needing ~USD 100 billion within the next 20 years to maintain its current service[22].

However, the government has made some progress in this aspect, by securing funding to upgrade the country's existing electricity transmission infrastructure. Some of these fundings are the World Bank's USD 486 million International Development Association credit for the Nigerian Electricity Transmission Access Project (NETAP) obtained in 2018[23], as part of the Transmission Rehabilitation and Expansion Program (TREP), a planned investment of USD 800 million to upgrade the capacity of DISCOs through the Presidential Power Initiative[24] and a USD 500 million loan from the African Development Bank Group to support clean energy access both in 2024[25]. It is worth noting that amongst the highlighted funding mechanisms, only AFDB's loan highlighted that the funding is aimed to improved clean energy access, hence its commitment to upscaling renewables. The former funding options did not categorically outline commitment to renewables, hence can be inferred to commit to gas expansion. With the increasing disposition of international funding organizations towards clean energy globally and reducing funding towards gas-fire power projects, it is probable that securing needed investment to continuously upscale the country's transition and distribution infrastructure (that is focused on transmitting gas-powered electricity) might be increasingly difficult, even though currently, the government seems to be making some progress in getting these fundings. Under such circumstances in the future, comprehensively addressing the transmission losses might be difficult, limiting the ability of gas to drive to electricity supply to consumers.



**adapted from Quintessence Environmental Consult, https://consultqe.com/2024/11/17/transforming-nigerias-power-grid-pathways-to-sustainable-and-reliable-transmission-and-distribution-infrastructure/

[22] Electricity. Power Systems and Renewable Energy, 15 December 2024, https://www.trade.gov/country-commercial-guides/electricity-power-systems-and-renewable-energy#:~:text=Nigeria%20generates%20most%20of%20its,capacity%20of%20about%2012%2C522%20MW.
[23] Nigeria: World Bank Approves $486 Million to Improve Nigeria Electricity Transmission Network and Infrastructure, 11 January 2025, https://www.worldbank.org/en/news/press-release/2018/02/15/nigeria-world-bank-approves-486-million-to-improve-nigeria-electricity-transmission-network-and-infrastructure
[24] Nigeria To Release $800m For Power Infrastructure Upgrades Under Siemens Project, 11 January 2025, https://www.arise.tv/nigeria-to-release-800m-for-power-infrastructure-upgrades-under-siemens-project/
[25] African Development Bank Group approves $500 million loan to boost electricity access in Nigeria, 11 January 2025, https://www.afdb.org/en/news-and-events/press-releases/african-development-bank-group-approves-500-million-loan-boost-electricity-access-nigeria-73123

Putting this perspective into the evolving dynamics of implementing Nigeria's ETP where renewables are being gradually introduced into Nigeria's electricity mix, it is evident that the role of gas utilization in driving electricity access to customer remains uncertain. This is especially as regards the fact that Nigeria's gas supply and demand projections are arguably not credible as presented in 3.1.1, meaning that designing an integration plan where both energy sources deterministically play key roles becomes challenging. For instance, Nigeria's Renewable Energy Master Plan posits that the share of renewables would increase to at least 13% by 2015, 23% by 2025, and 36% by 2030[26], depicting a situation where the role of gas-fired power plants would drop within the decade, to accommodate the growth in renewables. Within this context, it is important to note that currently, Nigeria is not a go-to location for the renewable energy investments in Africa, even though the continent gets ~2% of global renewable energy investment[27]. This limited investment in the country is due to different factors such as unstable macroeconomic indices that makes investment in Nigeria unattractive, perceived political and regulatory risks, limited institutional capacity, inefficient policy support amongst others. While there are possibilities of addressing these challenges by standardizing RE Power Purchase Agreements with favorable terms for investors, establishment of a RE stabilization fund that addresses currency risks, providing legislation that guarantees the right of investments in RE project (in spite of changes to the policy dynamics) and reduction of bottlenecks in the licensing and permitting systems within the country's RE sector, actualizing this solutions would prove challenging.

With these factors interplaying into the near future, it is possible that investment in Nigeria's RE market might not be achieved as expected, meaning that there is a possibility that these RE targets in the country's electricity sector might not be met. If this is the case, can existing gas-fired power plants be retooled to respond to variabilities and intermittencies of RE derived electricity, whose production capacity is not certain? This question is considering that most of Nigeria's gas-fired power plants are baseload which are rigid in their functionality. Such rigidity can lead to cases of stranded electricity where while more gas is produced and burnt, the electricity does not get to the end-users, because these gas-fired power plants are not able to respond to the intermittency of RE electricity. Within this context, energy access and security in the country become less guaranteed. However, within the context of short to medium planning when RE takes a baseload power role in line with government's net-zero ambition, it becomes important to integrate energy storage mechanisms that would store energy during peak periods and release it during periods of peak demand.

[26] Africa accounts for ~2% of global funding on clean energy investment despite continuous advocacy for more funding, 15 December 2024, https://ecodatatrend.com/africa-accounts-for-2-of-global-funding-on-clean-energy-investment-despite-continuous-advocacy-for-more-funding/

[27] Financing Clean Energy in Africa, 11 January 2025, https://iea.blob.core.windows.net/assets/f76594a5-8a9f-4820-ba3e-2908e03b02a9/FinancingCleanEnergyinAfrica.pdf

3.1.3 If the Gas-To-Power project operates beyond 2050, does it plan to include clean energy technologies such as CCS to limit its emissions?

From all indications, Nigeria's gas-to-power projects would exceed 2050 as the country's target is to become net-zero by 2060 and not to become carbon negative. However, the country also has NDCs that aim to reduce emissions by 20% by 2030 compared to a business-as-usual scenario or up to 47% contingent on international support[28]. This presents a scenario where even though gas-to-power projects could be upscaled, the government recognizes the need to achieve this sustainably. In the government's recently launched NDC Implementation Framework that provides actionable steps towards limiting the country's carbon emissions and methane emissions, the government's identifies reducing carbon emissions from its energy sector. Within this context, it can be assumed that the government is committed to upscaling clean energy technologies to reduce emissions from the sector. But well, these are assumptions and remain so until there are clear cut indications from the government; this is especially applicable to gas-to-power plants. The adoption of carbon capture and storage (CCS) technologies in Nigeria has been mentioned by several stakeholders within the energy sector, identifying it as a solution that should be explored. There are reports from the International Finance Corporation (the private investment arm of the World Bank) on its readiness to work with the Nigerian government to identify promising sectors for CCS[29]. However, these indications are yet to materialized into tangible plans with financial commitments. Similarly, the Chief Executive of Nigerian Upstream Petroleum Regulatory has identified CCS as a viable decarbonization technology for Nigeria[30] but as earlier mentioned, there are no commitments to it.

On this note, there is huge uncertainty that the gas-fired power plants that would be in operation into 2050 and beyond would retrofit these decarbonization technologies. More so is the fact GenCos may not want to incur the huge upfront costs of CCS that are outlined by International Institute for Sustainable Development[31]; this hesitance can be attributed to different factors such as financial challenges facing the sector currently and uncertainties around market viabilities of investing in these clean energy projects. With these factors playing in, it can be opined that emissions from gas-fired power plants would not be mitigated, and if gas-fired power plants are increased in Nigeria, it means that emissions from the sector would increase, defeating the decarbonization goals of the government. In this scenario, integration of renewables into the electricity mix may not make significant impact as regards reducing carbon emissions. This is further complicated by the fact that emission savings from gas-fired power plants compared to coal-powered plants have been exaggerated, and data suggests that emissions from gas-fired plants are close

[28] World Bank announces support for CCUS in Nigeria despite criticisms it reinforces fossil fuel dependence, 15 December 2024, https://www.brettonwoodsproject.org/2022/04/world-bank-announces-support-for-ccus-in-nigeria-despite-criticisms-it-reinforces-fossil-fuel-dependence/

[29] Nigerian Upstream Petroleum Regulatory Commission, https://www.nuprc.gov.ng/nuprc-hosts-u-s-delegation-for-collaboration-on-methane-abatement-decarbonisation-and-emissions-management/

[30] Why the Cost of Carbon Capture and Storage Remains Persistently High, 16 December 2024, https://www.iisd.org/articles/deep-dive/why-carbon-capture-storage-cost-remains-high

[31] The Hidden Emissions from Gas-Fired Power, 16 December 2024, https://www.climatebonds.net/files/files/eu-gas-briefing-220221.pdf

to emissions from coal-fired powered plants, putting into consideration emission from its supply chain[32]. In other words, there is a huge possibility that the country's ambition to use natural gas as a transition fuel, while integrating renewables may not lead to net-zero by 2060.

3.2 Theme II: Facilitating Synergy between the Gas and Renewables Sector

3.2.1 What grid improvements are planned, and what is the associated model for future electricity generation?

There are indications, commitments, and initiatives from the Nigerian government on grid improvements, as there are huge power losses occurring in the nation's electricity grid. As earlier mentioned, Nigeria losses about ~40% of power transmitted, necessitating the need for rehabilitation of the existing grid. As mentioned by the stakeholders, the Presidential Power Initiative[33], is one of such initiatives targeted at increasing operational capacity by the end of its Phase I to 7 GW and ultimately attain a capacity of 25 GW by the end of the PPI. With investment targets running into billions of dollars, this initiative underscores the government's drive to have adequate energy access for Nigerians. However, the current grid improvement initiatives are still inadequate. The government's partnership with the private sector and public institutions (such as multilateral development agencies) that have access to finance required to mobilize these grid improvements have not yielded impressive funding outcomes, limiting widespread grid improvement capabilities. For context, it is reported that between 2016 – 2020, Nigeria received an average of USD 95 million per annum, highlighting limited funding opportunities[34].

It is vital to note that these grid improvements are vital to the effective integration of gas-fired powered electricity and renewables into the nation's grid. Nonetheless, it can be argued that most renewable projects currently operating in Nigeria (over 125 mini grids established under the NEP, and many planned to come on stream through the World Bank Distributed Access through Renewable Energy Scale-Up (DARES) Project) are off-grid in nature, without aim of supplying electricity to the national grid. However, it is vital to note that driving up RE capacity to 36% by 2030, would require development of utility-scale projects that will supply electricity to the national grid. These utility-scale projects include planned solar farms under the Nigerian electrification project. The need for the integration of utility scale projects is because a significant number of consumer demand is meet through the national grid, meaning that if these consumers are transitioning to clean energy, the national grid needs to be supplied with RE-sourced electricity. Therefore, these grid improvements are one of the base criteria to achieving complementarity needed to drive an energy system that integrates both gas-generated and renewable-generated electricity. Hence, the government is on the right track in this aspect, taking the right steps towards complementarity of the gas and renewable sector.

[32] FGN Power Company, https://fgnpowerco.ng/wp-content/uploads/PPI-Project-Book.v6.pdf
[33] International Renewable Agency, https://www.iea.org/policies/5974-nigeria-feed-in-tariff-for-renewable-energy-sourced-electricity
[34] BloombergNEF, 11 January 2025, https://www.global-climatescope.org/markets/ng/

As regards the future generation model, it is evident from the government's policies and initiatives that the government is adopting both hybrid energy systems and a decentralization model through distributed energy projects, even though the stakeholders did not give feedback on this question. However, assessment of most of the renewable energy policies such as Electric Power Sector Reform Act, RESIP 2016, NEP, Nigerian Off-Grid Electrification Strategy and Distribution Franchising Guidelines show that they align with decentralization of the energy system in the form of mini grids, showing disposition towards a decentralization model. Nonetheless, policies such as Electricity Act 2021 and REFIT tilt towards a hybrid system, highlighting how stakeholders can generate electricity and feed it into the national grid. The challenge with the hybrid system in Nigerian is that most of its gas-fired power plants act as baseload capacity, making it difficult to allow the feed-in in electricity for renewables that are intermittent. This therefore creates conflicts as regards the aims of the different renewable policies, highlighting the need for harmonization. In summary, the current disposition of the government tends towards a decentralized energy system, so if ratification of the policies is to be done, decentralization may be considered as the go-to model of future energy generation. However, this must be carefully done as it opens the opportunity of locking in gas-fired power plants.

3.2.2 Is there an intention to build most transmission and distribution lines around one a few large urban gas plants, or to connect small solar or wind farms in different areas to the grid?

From the stakeholders' feedback, there is a common knowledge that the Nigerian government is committed to building new transmission and distribution lines. This reflects the findings from secondary data obtained from government sources such as Power Sector Recovery Program, Transmission Rehabilitation and Expansion Program (TREP) and Nigeria Electricity Transmission Access Project amongst others. Having presented that gas-fired power plants would remain a vital part of Nigeria's energy transition goals, it is safe to assume that the new transmission and distribution lines would be built around them. This assumption is based on the fact improving the operating capacity of existing gas-fired power plants offers a low-hanging fruit in improving country's energy access, without incurring huge costs of constructing new gas-fired power plants. With this disposition that prioritizes existing gas-fired power plants, utility-scale renewable energy projects might face challenges in assessing the national grid and supplying electricity to it, further complicating the complementarity ideology that Nigeria's energy transition is based. However, there are also initiatives such as the DARES that tend to circumvent this challenge, by supplying electricity to localized electricity networks. By so doing, the prioritization of the national grid for gas-fired plants can be bypassed, ensuring electricity supply to consumers to localized regions.

Consequently, this means that renewables may not easily feed electricity into the national grid, veering off the REFIT policy, that proposes that the payment of a stable rate for electricity generated and supplied to the national grid, while obliging DisCos to source 50% of their electricity from renewable sources[35]. This creates another area of conflict in achieving complementarity in Nigeria's energy transition plans. The question in this case is, "how will renewables supply electricity to the national grid when electricity

[35] Expo Group, https://www.expogr.com/tanzania/powerenergy/detail_news.php?newsid=654&pageid=2

transmission and distribution lines are being built around gas-fired power plants located in urban areas?". Providing answer to this question is the decentralization focus of Nigeria's renewable energy projects – renewables are not expected to supply electricity to the national grid, at least from all indications. As a result, there is the possibility of locked-in assets that may not be applicable to a future of energy systems that is dominated by renewables, as indicated by the country's energy transition plans.

3.2.3 Do the government plans to address renewables intermittency allow for change over time to address evolving realities?

As already mentioned, gas-fired power plants operate functions in baseload capacities, limiting opportunities to ramp up or reduce their operating capacity to respond to demand variabilities. Most of Nigeria's gas-fired power plants act in this capacity except for Geregu II gas-turbine power plant in Ajaokuta, operating in peak load capacity[36]. This presents a scenario where Nigeria's electricity system will not be able to effectively integrate power from gas-fired power plants and energy from renewables simultaneously. With this mind, does the Nigerian government plan to address this challenge and if yes, how? Unfortunately, this is difficult to determine as a lot of efforts currently being geared towards grid improvement or building new gas-fired power plants do not clearly state that if operations would be in either peak load or ancillary service capacities. Nonetheless, the disposition of the Nigerian government towards using its vast gas resources for development throw insights into the possibilities of building gas-fired power plants that are maybe likely function in baseload capacities.

State governments are stepping up to the challenge, leveraging the powers of the Electricity Act 2021, to seek for investment that would enable construction of gas-fired power plants that would function in suitable capacities. This is evident in the recent efforts of the Lagos state government seeking investors to construct a 4000 MW gas-fired power plant in the state, that would provide additional power in times of limited power supply from the national grid, indicating a disposition towards peak load functionality[37]. There is also an ongoing construction of 1350 MW gas-fired power plant in Abuja but there is limited information on whether these plants would function in rigid or flexible capacity. Further, a recent report by Rocky Mountain Institute[38] reveals that the private sector (especially DisCos) has shown interest in addressing the intermittency problem of renewables within the context of complementarity. Particularly, the adoption of Distributed Energy Resources (DER) (in this case batteries) can limit the variability of renewables, allowing baseload gas-fired power plants to be integrated with renewables. However, how soon these DER would be adopted by DisCos remains unknown, keeping the conversation open. Nonetheless, there is possibility that DER technologies would increase revenue of DisCos by ~ USD 50 million per annum within the next decade, making them desirable.

[36] Nigeria's Lagos seeks investors for 4,000 MW gas-fired power plants, 16 December 2024, https://www.reuters.com/business/energy/nigerias-lagos-seeks-investors-4000-mw-gas-fired-power-plants-2024-11-07/
[37] Nigeria's Tinubu hails significant new gas-fired power plant, 16 December 2024, https://www.reuters.com/business/energy/nigerias-tinubu-hails-significant-new-gas-fired-power-plant-2023-08-04/
[38] Scaling Utility Enabled Distributed Energy Resources in Nigeria, https://energyalliance.org/wp-content/uploads/2024/06/GEAPP-RMI_Utility_Enabled_DER_Roadmap_2024.pdf

3.2.4 Are the gas and renewable energy government institutions collaborating?

In accordance with the feedback from the stakeholders, there is no concrete evidence suggesting extensive collaboration between gas and renewable energy government institutions. Evaluation of the *modus operandi* of institutions of these two sectors show that they are more disposed to working as silos rather than as partners. Specifically, the Ministry of Petroleum Resources (Gas) is responsible for implementing gas related policies and regulations such as National Gas Policy (2017), Nigeria Gas Expansion Plan and DGSO (2008) amongst others. This can be attributed to the Petroleum Act 1969 and Petroleum Industry Act 2021 that allows little or no disposition towards the role of renewables in Nigeria's energy systems. This is evident in the fossil-fuel centric nature of these legislations that clearly define the mandates of petroleum and gas institutions, excluding renewable integration, limiting possibility of collaborating with the RE sector. Under these laws, Nigeria's gas institutions are held back from venturing into emerging areas of RE utilization that the sector can benefit from. Similar trend is found in the operations of the Ministry of Power where power-related projects and programs are domiciled in line with the Electric Power Sector Reform Act (EPSRA) Act 2005 and now the Electricity Act 2021. Under this law, renewable energy institutions such as Rural Electrification Agency, National Energy Commission of Nigeria and Energy Commission of Nigeria amongst others are limited from designing programs where players from the gas sector can co-create solutions, that would enhance implementation of Nigeria's energy transition, which is based on the principle of complementarity between the two sectors.

Despite these legal limitations, these two government institutions have shown willingness to work together to drive energy access and security in Nigeria. For instance, the Nigerian Content Development and Monitoring Board have participated in conversations where renewables have been identified as a driver of the country's energy access[39]. Also, there are several workshops, seminars, and conferences where key players from these two sectors have shared have had extensive conversations around areas of possible collaborations, which show willingness to collaborate. Further, the Energy Transition Plan identifies both sectors-Power and Oil & Gas-as being vital to driving decarbonization in the country. From this perspective, there is an expectation from the government that requires both institutions to work together to actualize the goals of the transition plan. In this case, while there is an expectation for these sectors to collaborate, there is yet to be detailed outline on how this should be implemented. Hence, developing such outline should be one of the key action points in the energy transition conversation going forward.

[39] Develop Funding Interventions For Renewable Energy, Total Energies Urges NCDMB, 16 December 2024, https://leadership.ng/develop-funding-interventions-for-renewable-energy-totalenergies-urges-ncdmb/

3.3 Theme III: Assessing Nigeria's Readiness to achieve Complementarity between Gas and Renewables

3.3.1 Has the Nigerian government outlined a strategy that clearly addresses the dynamic utilization of natural gas and renewables as the country approaches its 2060 decarbonization target?

As already presented, Nigeria has outlined the critical role that natural gas would play in its energy transition plans, as evident in the Decade of Gas initiative. In a similar manner, the government has also outlined its intention to upscale renewable energy utilization into the future, according to Nigeria's REMP. Hence, the government has outlined the key role that these energy sources would play in its energy transition plan. The point of deliberation is however how these energy sources would be utilized optimally to ensure decarbonization and attainment of net-zero by 2060. As expected, if net-zero is to be achieved, the use of natural gas must be gradually reduced while renewables should be upscaled. The projected increase in renewables mean that natural gas supply and demand would drop over time. But is this the case based on the disposition of the government towards upscaling natural gas production and utilization in recent times? The government has made it clear that it intends to commit to more oil and gas exploration, this is evident in its commitment towards the establishment of the African Energy Bank (to finance oil and gas projects in Africa)[40] and even more recently, the USD 5 billion investment of Shell in Bonga North deep-water project[41], which are long-term projects that would increase the production of associated gas. Hence, it can be assumed that the Nigeria government is not committed to limiting gas utilization to attain net-zero by 2060, even though in the government's Long Term Low Emissions Development Strategy (LT-LEDS), there is a goal to limit emissions by 50% by 2050[42]. Notably, the LT-LEDS was referenced by stakeholders as they stated that Nigeria has a strategy to limit gas utilization into the future, although it does not outline the reduction of gas as one its goals. From the submissions, it can be assumed that the disposition of the government does not support this assertion from the stakeholders.

As regards strategy to increase renewables, government has shown commitment to upscale its utilization. In line with what has been discussed, the government has forged partnerships with the private sector and different multilateral development agencies to secure innovative financing mechanisms, that would aid development of distributed RE projects across Nigeria. In addition, the country is adopting the right policy and regulatory frameworks such as the Renewable Energy Master Plan, NREEEP 2015 and RESIP 2016 amongst others, that create enabling environment for such partnerships, incentives and financing mechanisms to thrive. Also, Vision 30:30:30, Renewable Energy Roadmap[43] and LT-LEDS offer actionable pathways that would guide the activities of stakeholders to upscale RE utilization and limit emissions within the nation's energy system. There is another dimension of the strategy that is gaining momentum amongst

[40] Nigeria sets date for take-off of $5 billion Africa Energy Bank, 16 December 2024, https://fmino.gov.ng/nigeria-sets-date-for-take-off-of-5-billion-africa-energy-bank/
[41] Shell invests in Bonga North deep-water project, Nigeria, 16 December 2024, https://www.shell.com/news-and-insights/newsroom/news-and-media-releases/2024/shell-invests-in-bonga-north-deep-water-project-nigeria.html
[42] Department of Climate Change, Federal Ministry of Environment, Nigeria, 2050 Long-Term Vision
[43] European Union & German Cooperation, https://www.giz.de/en/downloads/NESP%20II_Factsheet.pdf

stakeholders – which is capacity building and empowerment. Within the tenets of just transition, there are conversations to train and retrain personnel (with particular interest in employees from the oil and gas sector), so that they can adapt and become employable in the evolving RE industry in Nigeria. Although this has not bought significant government participation, it is expected within the nearest future the buy-in would be secured, as private sector continues to lead this strategy.

3.3.2 What power projects are listed as planned or commissioned?

Nigeria has made gradual progress in improving the number of its power plants (both gas-fired and renewables) over the years as shown in Table 1. This is a testament to the government's commitment towards leveraging both energy sources to drive energy access, security and sustainability and by inference, energy transition. It must however be mentioned that the number of these power plants highlighted is far below the government's target as there are several power projects that are in limbo without any funding allocations.

Table 1: Selected gas-fired and renewable energy power plants in Nigeria

S/N	Gas-fired Power Plants				Renewable Energy Power Projects			
	Name	**Capacity (MW)**	**Location**	**Status**	**Name**	**Capacity (MW)**	**Location**	**Status**
1	Egbin Power Plant	1320	Lagos	Commissioned	Zungeru hydroelectric plant	700	Niger	Commissioned
2	Geregu I Power Plant	414	Kogi	Commissioned	Katsina wind farm	10	Katsina	Commissioned
3	Geregu II Power Plant	434	Kogi	Commissioned	Mambilla hydroelectric plant	3050	Taraba	Planned
4	Afam IV Power Plant	650	Rivers	Commissioned	Onna solar mini grid	0.1	Akwa-Ibom	Commissioned
5	Okpai Power Plant	450	Delta	Commissioned	Gurara II hydroelectric plant	360	Niger	Planned
6	Gwagwalada Power Plant	1350	Abuja	Planned	Jigawa solar park	1000	Jigawa	Planned
7	Ajaokuta-Kaduna-Kano Plant	3600	Abuja/Kaduna/Kano	Planned	Lagos solar project	1000	Lagos	Planned
8	Lagos Power Plant	4000	Lagos	Planned	Shiroro hydroelectric plant	600	Niger	Commissioned
9	Zungeru Gas Hybrid Plant	700	Niger	Planned	Kainji hydroelectric plant	760	Niger	Commissioned
					Jebba hydroelectric plant	578	Niger	Commissioned

**green color – commissioned plants, **brown color – still in planning or construction (in the case Gwagwalada Power Plant)

3.3.3 Do different gas and renewables policies share the same vision?

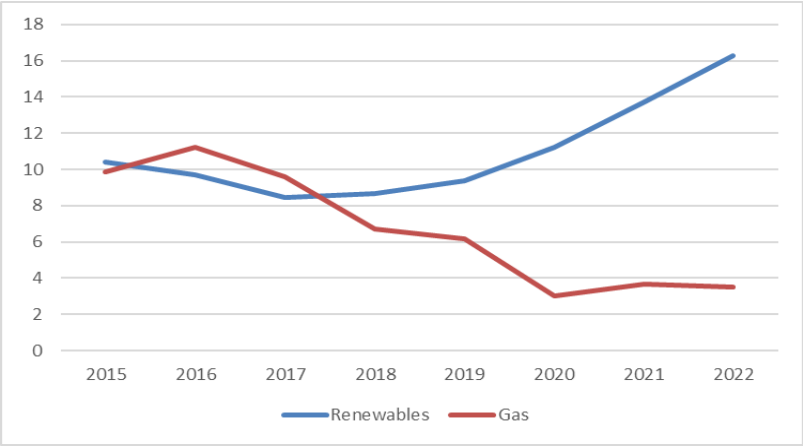
Within the context of complementarity and conflict, selected gas and RE policies have similar goals in certain areas. There are also areas where their goals do not align, therefore highlighting areas of conflict. The areas of focus are (i) energy security and diversity, (ii) infrastructure development, (iii) economic growth (iv) emissions reduction, (v) policy and resource allocation, (vi) market liberalization and (vii) energy transition alignment. In Table 2 below, the interaction of these policies is highlighted, and areas of complementarity and conflict are identified. In summary, for Nigeria's gas and RE policies, there is complementarity in the aspect of energy security & diversity, infrastructure development, economic growth and energy transition alignment. However, there are conflicts in the aspect of emission reduction (by inference attainment of net-zero by 2060) and policy and resource allocation.

A core component of the vision of gas and renewables to contribute to Nigeria's energy transition is finance availability. While the government has indicated its interest in upscaling natural gas infrastructure and supply to the domestic market, the needed funding to achieve this is lacking. Data from IEA[44] shows that investment in Africa's gas sector has significantly reduced within the previous decade, indicating that the government's aspirations towards getting funding for its Decade of Gas projects may not come to fruition. For context, while Nigeria's ETP states that the country needs ~ USD 10 billion annual worth of investment for its oil and gas sector to transition, an average of the annual investment in Africa has remained at ~USD 30 billion between 2019 and 2022 with most of these investments not coming to Nigeria. Most of the IOCs that have the capacity to raise the needed capital are divesting, coupled with the fact that most international public lenders (such as multilateral development agencies and development finance institutions) are hesitant to invest in the fossil fuel projects (especially for gas export projects, that form bulk of the projects that would provide the needed domestic gas supply). This is due to issues of climate change concerns and lack commercial viability of gas projects. This is further complicated by issues of lack of financial due diligence of Nigerian gas companies that make it difficult to raise capital.

Investment in Africa's oil and gas sector

[44] IEA, World Energy Investment 2023, https://iea.blob.core.windows.net/assets/8834d3af-af60-4df0-9643-72e2684f7221/WorldEnergyInvestment2023.pdf

More so is the reducing appetite of international public finance (IPF) for African gas power plants. Findings from NRGI reveal that sub-Saharan Africa got ~ USD 408 million/year investment of IPF (in loans and guarantees) for gas power plants between 2014 – 2023, which is an equivalent of for the construction of 1 or 2 plants. Unfortunately, Nigeria was not also a prime destination for these investments. This creates a gloomy picture for the country's gas-to-power aspirations. In summary, this shows that natural gas may not be a "low-hanging fruit" solution for Nigeria's energy transition ambitions. As regards renewables, there is an incremental trend in investment (with RE overtaking investments in gas in 2021), which is in line with the goals of the ETP. It is worthy of note that this is a common trend across Africa, with investments in solar and wind accounting for one-fifth of power investments in Africa[45] in recent years. Although out of ~ USD 6 billion investment needed for RE in Nigeria that is in line with the ETP, only ~ USD 95/year[46] has been secured, highlighting a huge funding gap.



Investments in RE and gas in Africa between 2015 – 2021 (USD bn, 2022)

This is however not peculiar to Nigeria as it is a common trend in Africa's clean energy investment, with the continent getting only ~2% of global clean energy finance over the years. This limited funding can be attributed to company risks, data gaps in customer demand, issues of affordability and unproven business models. It needs to be noted that there is a huge preference for off-grid RE projects amongst these investments, with the 14 solar projects (utility-scale on-grid) still in limbo with no funding. Under this scenario, the possibility of feed-in tariffs into the national grids become limited. Hence, there seems to conflict in the allocations of scarce funding to gas and renewable energy sectors. In this case, if Nigeria fails to take advantage of funding availability for RE and reposition itself as a viable destination for investment, while carefully navigating the country's goal of using gas as a transition fuel, the country might not meet its ETP's goal.

[45] Scaling Up Renewable Energy in Africa, https://assets.bbhub.io/professional/sites/24/BNEF-Scaling-Up-Renewable-Energy-in-Africa-A-NetZero-Pathfinders-report_FINAL.pdf
[46] https://www.global-climatescope.org/markets/ng/

Table 2: Interaction of Gas and Renewable Energy Policies – areas of complementarity and conflict?

S/N	Aspect	Gas policies	Renewable energy policies	Complementarity or Conflict?
1	Energy security and diversity	National Gas Policy (2017) and Gas Expansion highlight the use of gas a transition fuel and to facilitate energy security	NREEEP (2015) and REMP prioritize solar, wind and hydro for long-term energy diversification	**Complementarity:** Expanding both gas and renewables enhances energy security and mitigates the challenge of intermittency facing renewables. However, it must be noted that existing technology must be retooled to ensure effective complementarity
2	Infrastructure development	Gas Infrastructure Blueprint Policy (2015) supports pipelines and centralized gas facilities	NEP and RESIP (2016) promote decentralized renewable systems such as solar mini grids	**Complementarity:** Gas pipelines can support hybrid systems; however, differing approaches (such as centralized or decentralized) can clash and influence outcome
3	Economic growth	DGSO (2008) and Gas Network Code (2020) create opportunities for private investment and industrial applications	REFIT and NREEEP encourage private investment in renewable energy generation and off-grid solutions	**Complementarity:** Both foster local economic growth, job creation and technology transfer in different segments of the economy
4	Emissions reduction	NGFCP and Gas Flare Prohibition Regulations (2018) aim to curb emissions by utilizing flared gas and CCS	NREAP and other renewable policies promote direct emission reductions through clean energy	**Conflict:** CCS investments may divert resources from renewables, delaying emissions-free energy deployment
5	Policy and Resource allocation	Gas policies dominate funding as in the Decade of Gas initiative, leaving less for renewable energy projects	Renewables rely on limited funding and face delays despite ambitious goals under the Vision 30:30:30 and other relevant policies	**Conflict:** Over prioritization of gas risks underfunding renewable energy projects that are critical for long-term sustainability and attainment of the country's net-zero target by 2060
6	Market liberalization	The NGP, NGFCP and similar policies seek to create liberalized market for private sector participation. However, DGSO tends to limit market flexibility for players in the sector	Policies such as CBN Solar Power and REFIT incentivizes private sector investment in solar solutions	Policies from both sector point towards market liberalization although there are some grey areas in the policies that tend to distort the principle of market liberality
7	Energy transition alignment	Gas Flare Commercialization Program	The ETP with an aim of attaining 30 GW renewable	Complementarity: Both contribute to energy transition,

		supports Nigeria's net-zero by reducing gas flaring in the country, limiting carbon emissions	capacity by 2030 focuses on limiting carbon emissions for the long-term	but it must be highlighted that gas policies may delay renewable dominance if the influence of both energy sources are not carefully balanced

**green color – policies complement, **red color – policies conflict

3.3.4 Do existing gas to-power plans use modeling or scenario-based analysis to show how the role of gas in the electricity mix will change over time?

From most of the official documents of relevant government agencies that predict data on gas supply & demand projections and RE production forecasting, it is not clearly outlined what type of forecasting or projection method that is used. This is in tandem with the feedback from stakeholders who also shared similar assertion. An exception to this is the "Renewable Energy Roadmap Nigeria"[47] which was developed by IRENA in conjunction with the ECN, where scenario-based modelling was used in determining renewable energy utilization projections. It is assumed that this exception is because the report was prepared by the IRENA, an organization that is accustomed to using scenario-based analysis for its projections. As for the other Nigerian government institution reports, there were no clarifications on the method of analysis. This makes it difficult for stakeholders to interrogate the mechanisms adopted to arrive at the projections. The reason for such interrogation is because it is important for assumptions made during the projections to reflect realities on the ground, to ensure that stakeholders can work with actionable projections. On the contrary, if the mechanisms and assumptions do not reflect the realities and evolving possibilities within the energy transition space, projections might out wrong, leading to stakeholders planning with wrong data, a situation that would lead to the failure of the country achieving its ETP.

For context, modeling analysis pertains to the development of a mathematical, physical or computational representation of a real-world system. In this case, it studies the behavior of the system using inputs to predict outcomes; in other words, it identifies relationships between variables. As for scenario modelling, it pertains to the evaluation of multiple plausible situations by examining a set of pre-determined conditions. Scenario modelling explores the uncertainties about occurrences, highlighting their impact on decision-making. Within this context, scenario-based analysis is highly suitable for strategic planning and long-term development. Therefore, it should be expected that the gas supply & demand projections and renewable energy production forecast should be based on scenario-based analysis.

[47] "Renewable Energy Roadmap Nigeria", https://energy.gov.ng/reports/IRENA_REMap_Nigeria_2023.pdf

4. PROPOSED RECOMMENDATIONS THAT FACILITATE COMPLEMENTARITY BETWEEN THE GAS AND RENEWABLE ENERGY SECTOR

Considering the intricate balance that exists between gas and renewable utilization in Nigeria for energy transition, it is vital to ensure that there is a common ground, which allows complementarity and limits conflicts. These following points of action are recommended.

i. **Creation of a Unified Policy Framework:** One of the main points of action that would be recommended is the developing of a unified framework that would substantiate the role of natural gas as a transition fuel, while establishing clear and measurable pathways for renewable energy expansion. Existing regulations such as Gas Flare Prohibition Regulations and the National Renewable Energy Action Plan (NREAP) already highlight Nigeria's commitment to emission reduction, hence a unified framework would facilitate a result-oriented approach. Under such framework, fiscal incentives can be developed to channel profits gas projects into renewable energy investments, particularly for underserved rural areas. This can be applied to fund off-grid renewable energy solutions which is in line with the Rural Electrification Strategy. This cohesive policy approach ensures gas supports immediate energy needs while enabling a structured shift to long-term renewable solutions.

ii. **Development of a Renewable Energy Fund:** Another point of action is the institutionalization of a renewable energy fund that would ensure consistent financial support for renewables. This would address the risks of significant gas investments overshadowing renewable energy initiatives such as CBN Solar Power Naija. Along this line, an energy investment roadmap can be developed in conjunction between stakeholders from both the gas and renewable energy sectors. By doing so, issues of resource parity that skews funding to gas projects can be avoided.

iii. **Fostering institutional synergy:** It is recommended that there should be cross-collaboration between the key institutions of the gas sector (Ministry of Petroleum Resources and Ministry of Gas Resources) and renewable energy sector (Ministry of Power). The collaboration should be strongly in tune with Energy Transition Office to ensure that there is clarity on the role of natural gas as a bridging fuel with strategic focus on scale-up of renewables. This collaboration would be vial for institutional efficiency, providing a clear transition pathway for stakeholders.

iv. **Incorporation of Advanced Emissions Management systems:** Due to the multidimensional nature of Nigeria's ETP, environmental trade-offs are inevitable hence a clear understanding of these trade-off is pertinent. Along this line, life-cycle assessments of gas and renewable energy projects that show the environmental impact of the entire supply chain of these projects should be carried out to determine how they impact Nigeria's emission targets, thereby avoiding any case of gas utilization derailing the country's ETP. With this knowledge, it becomes possible to design and commit to projects to would help achievement of net-zero by 2060. This information would aid the adoption of clean energy technologies such as CCS especially for gas-to-power projects, where it is posited that its emissions might be like coal-powered power plants.

v. **Exploration of Innovative Hybrid solutions:** Nigeria can enhance complementarity between natural gas and renewable energy by advancing innovative hybrid solutions that optimize resources and reduce emissions. Examples of such solutions gas-supported renewable microgrids that pair natural gas generators with solar panels and batteries for rural and industrial areas. Gas-assisted hydrogen production combines blue hydrogen from natural gas with green hydrogen powered by solar or wind, leveraging existing gas infrastructure. Other innovative solutions renewable-powered gas compression stations and co-located solar and gas power plants, maximizing efficiency and reducing operational carbon footprints. To fund these projects, public-private partnerships and international climate finance could be mobilized for these hybrid solutions. In this case, these hybrid models, with dual benefits of energy security and emissions reduction, position Nigeria as a leader in sustainable energy transition, driving balanced development across both sectors.

vi. **Extensive Engagement with the Renewable Energy sector:** While the adoption of renewable energy is gradually gaining momentum across Nigeria, the renewable energy sector and oil and gas sector still seems to be working as silos, despite the government's intention to leverage both sectors to achieve energy transition. As a crucial step to minimizing this, it is pertinent to create a platform where professionals from the renewable and oil and gas sector (both private and public) to have a conversation and deliberate on actionable areas of collaboration, in terms of policies, market systems and funding mechanisms. By doing so, it is expected that actionable areas of collaboration can be identified, drawing from the resources and expertise of these two sectors. Further, with the support of such government, such dialogue could result in the creation of a hybrid team would work in tandem with both sectors, continuously developing areas of synergy and collaboration, that are needed to drive Nigeria's multidimensional energy transition.