



# Unpacking the realities of Nigeria's Energy Transition: A view through the Lens of Energy Trilemma

April 2024

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## Key Highlights

- The critical actions of the nation's Energy Transition Plan are up lifting persons out of poverty, ensuring energy security and facilitating sustainability.
- Considering these action points within the scope of the evolving Nigerian macroeconomic performance, the optimal energy resource that can drive energy transition is different from the ones deployed in the Global North, whose macroeconomic trends are different.
- While renewable energy offers a popular solution that can drive successful energy transition, its deployment in Nigeria is faced with limited financing (especially from private investors) and low customer purchasing power that can the growth its infant market.
- Currently, renewable energy cannot ensure massive energy access across Nigeria which makes it less suitable as the go-to energy resource to drive the country's energy transition.
- Natural gas is integrated into existing systems of energy production and utilization in Nigeria which means less capital investment for its production and utilization. This offers an energy resource that is affordable within the context of limited purchasing power as induced by recent macroeconomic trends.
- Putting these peculiarities in mind in line with the stipulations of the energy trilemma, it is proposed that the most favourable option to drive energy access is natural gas, the most favourable option to drive energy security is natural gas while the most favourable option to drive sustainability is renewable energy.

## Introduction

The global impact of climate change induced by greenhouse gas emissions, from the use of fossil fuels as an energy resource and feedstock in industrial processes necessitates the need to adopt clean and sustainable alternatives. This need is hinged on the fact that fossil fuels contribute significantly to emission with about [three-quarter of global greenhouse gas emitted from the fossil dependent energy sector](#). It is on this note that “[energy transition](#)”, an action point that focuses on the massive adoption of clean and sustainable energy alternatives and technologies for emission mitigation and attainment of net-zero globally, is being adopted as an evidence-based solution that can mitigate climate risks.

While energy transition offers a viable solution to limit greenhouse gas (particularly CO<sub>2</sub>) emissions, it requires massive investment to ensure its implementation. [Report](#) from International Renewable Energy Agency shows that about USD 35 trillion cumulative investment is needed by 2030 to drive successful energy transition globally. This goes to show that energy transition has huge macroeconomic implications which each country has to address and align with. In fact, [it is argued that the extensive macroeconomic implications \(such as high initial cost, infrastructural challenges, overdependency on imports and job displacement amongst others\) which aggressive energy transition can induce for countries \(especially emerging economies and developing](#) [www.ecodatatrend.com](http://www.ecodatatrend.com)

[countries\) has capacity to limit their ability to attain just transition](#).

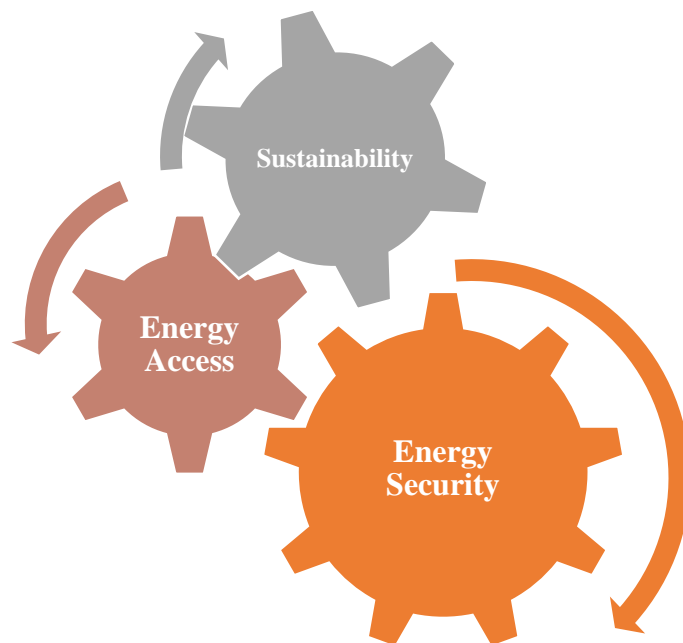
On this note, it is important for each country to understand the complex dynamics driving its energy transition landscape. According to research carried out by [Liu et al. \(2022\)](#), the key points on which the concept of a country's energy transition is rooted are energy access, energy security and sustainability implications. Hence, these three factors are used as yardsticks to assess the realities of energy transition in Nigeria in this report.

### What are the Three Pillars of Energy Trilemma?

The concept of [energy trilemma](#) which is common amongst energy policymakers highlights the seemingly conflicting goals of ensuring access to energy and affordability, facilitating energy security for countries and achieving all these without creating any negative impact on the environment. In other words, energy trilemma is rooted in the trade-offs and synergies between energy access, energy security and sustainability. Considering the specific socioeconomic dynamics that each country faces, the interaction of these three pillars of the energy trilemma differs and results in different outcomes.

Therefore, this creates a context where the pathway of energy transition of each country must incorporate the intricate and conflicting interaction of the three pillars (as shown in the

image below) in such manner that it ensures just transition.



#### An interaction of elements of the Energy Trilemma

Specifically, [energy access](#) pertains to the ability of a country to provide universal, fairly priced and abundant energy for its commercial and domestic use. Arguably, the determining factors of energy access are energy prices and socio-economic improvements recorded through energy use; this puts forward that energy access prioritizes affordability.

The aim of energy access in this case is to ensure social equity where there is adequate access to affordable for cooking, heating, transportation, electricity and industrial and commercial applications. On this note, energy access puts people at the centre of the energy transition discourse which is meant to be fair and inclusive.

It is however important to accentuate that centralization of energy access in the energy

trilemma may upturn the process of energy transition towards clean energy. This is especially important for developing countries where investment in clean energy infrastructure faces significant challenge through uneven investment distribution with [data showing that the bulk of USD 347.6 billion worth of energy investment in Africa between 2012 and 2021 went to fossil fuels-related projects](#).

As for [energy security](#), it pertains to the ability of a country to meet its current and future energy demand in a reliable and sustainable manner with minimal disruption, in the events of shocks, volatilities disruptions that occur within energy systems. In this case, this dimension focuses on the effective management of the internal and external sources of a country, while also

maintaining the resilience and reliability of its energy infrastructure.

It is important however to note that energy security extends beyond the availability of hydrocarbon or clean energy according to an [article](#) published in Forbes, to include containment of evolving energy security risks in the wake of low-carbon energies such as digitalization, application of sensors and artificial intelligence to the management of grids and the entire energy infrastructure. Hence, this dimension of the energy trilemma is one that is intertwined with the entire functionality of the energy infrastructure.

For the third dimension that pertains sustainability, it focuses on environmental impact of the energy production and utilization over a period of time as it is reported that [energy production and consumption produce about two-thirds of annual greenhouse emissions](#). This aspect of the energy trilemma therefore concerns the scaling up of decarbonization pathways that limit the carbon footprint of the energy complex of a nation, facilitating the strategic transition towards clean energy technologies. On this note, sustainability strongly interacts with climate change mitigation.

Some of these decarbonization pathways include improvement of energy efficiency, deployment of low-emission power generation, grid modernization, adoption of carbon capture and storage technologies at industrial source

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points, low-carbon hydrogen, up-scaling green hydrogen for energy production and as a feedstock amongst others. It is however important to note that there are complexities inherent in this dimension of energy trilemma, that makes its context subjective for each country.

There is also the complex nation-specific interaction between balancing policy, regulations and economies, which has led to a global stakeholder demand for accountability through increased attention on Environment, Social and Governance (ESG) guidelines. In essence, there is the pull and push relationship between the three dimensions of the energy trilemma, which are examined within the context of the Nigerian energy ecosystem.

### **What are the realities of Nigeria's Energy Transition using the lens of the Energy Trilemma?**

#### **A peep into Nigeria's energy landscape**

The energy landscape of the Nigerian state is one that is heavily dependent on fossil fuel resources across its various energy production and utilization sectors. These critical sectors (which include power, industry, oil and gas, cooking and transport) as outlined by Nigeria's Energy Transition Plan constitute ~65% of the country's emissions. For the power sector, it is largely driven by off-grid generation systems from petrol and diesel generators and on-grid natural gas power plants (with [~75% of the country's on-grid electricity supply driven by natural gas as at](#)

[2023, while the remaining is attributed to hydropower](#)).

Likewise, the energy demand of the country's transportation sector is heavily dependent on fossil fuel. Particularly, data shows that [98% of private and passenger vehicles run on gasoline, heavy vehicles run on diesel, rail transportation run on diesel and air transportation also run on fossil fuels](#). To further depict the fossil fuel dependent nature of the transportation sector, it is reported that [72% of emissions from the sector are attributed to passenger vehicles](#) which are heavily reliant on gasoline as already stated. It is important to note that with the projected growing population of Nigeria which is currently estimated at 213.4 million as at 2023, the transportation sector would further expand, producing more greenhouse gases.

As regards the country's industrial complex, there is huge reliance on fossil fuels both as an energy source and as a feedstock. For context, it is reported that across the industrial value chains of chemicals, ammonia, petrochemical production and also industrial heating, ~93% of energy-related emissions in Nigeria are emitted. Further, it is reported that fossil dependent energy demand in [Nigeria's industrial sector has significantly increased from 2.13 million tonne of oil equivalent \(Mtoe\) in 1990 to 7.51 Mtoe in 2018](#), with capacity to grow further based on the economic projects of the country as an emerging economy.

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Amongst residential and commercial energy users in Nigeria, where energy is used in different applications (such as cooking, refrigeration, air conditioning, lighting and powering of electrical appliances), the bulk of energy comes from fossil fuel sources such as kerosene, liquefied petroleum gas, fossil fuel derived electricity and biomass. These constitute the bulk of the increase in energy demand in the residential sector (from 50.92 Mtoe in 1990 to 105.59 Mtoe in 2018) and in the commercial sector (from 1.94 Mtoe in 1990 to 3.41 Mtoe in 2018).

With this overview, it is obvious that the energy ecosystem in Nigeria is extensively dependent on fossil fuels. On this note, weaning Nigeria's energy sector off fossil fuel dependency becomes a complex task that requires careful consideration and implementation, so as not to distort the delicate balance of the energy landscape.

### **The Complex Interaction of the elements of Energy Trilemma in Nigeria's Energy Landscape**

In Nigeria, there has been a growing conversation about energy transition which cumulated in the Nigerian Energy Transition Plan (ETP) that was launched on August 22nd, 2022. The [stipulations of the transition plan](#) are well rooted in the three elements of the energy access, security and sustainability. This pertains to ensuring energy access to all Nigerians, which would facilitate the uplifting of 100 million persons from poverty, energy security which

pertains to commercialization of the country's energy resources needed to drive sustainable economic development, and facilitating sustainability which pertains to reduction of greenhouse gases reduction by 45% and 90% by 2030 and 2050 respectively.

The disposition of the ETP tilts toward natural gas as the transition fuel, an outcome which environmentalists have frowned against. In line with global transition scenarios, natural gas does not offer a reliable energy source that can induce the dynamic shift towards sustainability in the long term. On this note, there are calls from different stakeholders from within and outside Nigeria that attention should be solely directed towards renewable energy as the driver of the nation's energy transition. This therefore presents two different schools of thought about the optimal pathway to ensure energy transition. Should Nigeria focus on renewables and totally phase out fossils as clamoured for or should the country continuously harness its abundant fossil fuel related energy solutions as indicated by ETP to drive its energy transition?

While the objectives of the ETP are commendable and the clamour for phase out of fossil fuel is valid along sustainability lines, the current and evolving macroeconomic realities of the Nigerian society induce the complex interaction of the energy trilemma in a distinct manner. Firstly, it is important to note that Nigeria is experiencing record inflationary figures in recent times with [data showing that the country's inflation stands at 33.20% as at www.ecodatatrend.com](#)

[March 2024](#). This distortion has limited customer purchasing power, that is further exacerbated by the country's minimum wage of about USD 26 per month (at an exchange rate of ₦1,180 per dollar as at 16-04-2024). On this note, extensive energy access amongst the entire population (especially amongst low-income earners without targeted support and suitable financing mechanisms) becomes hindered.

In addition, the 230.8% increase of electricity tariff increase recently approved by Nigerian Electricity Regulatory Commission, further puts more strain on customers' ability to purchase on-grid electricity. This creates a scenario where even if on-grid electricity is supplied by clean energy resources, reliable customer purchasing power is not readily available, making the energy market unattractive. By inference, energy access is limited on a significant scale. Therefore, it becomes important to deploy energy solutions that can enable universal energy access across different income brackets in the face of limited customer purchasing power.

One of such solutions is arguably renewable energy with the cost of its infrastructure significantly dropping in recent times globally ([with cost of large photovoltaics dropping by 89% between 2009 and 2019](#)). However, considering the peculiarities of the macroeconomic performance of the Nigerian society in recent times, its adoption in Nigeria to enable decentralized electricity generation faces the challenge of financing (considering the



cost implications of installation of renewable energy infrastructure for domestic and commercial applications across Nigeria), limited widespread adoption due to low customer purchasing parity to pay for premium electricity and also intermittency. This creates roadblocks for its adoption even though infrastructure cost has dropped globally.

Further, the possibility of limited renewable energy adoption can be attributed to the high initial cost of capital investment needed to address extant dilapidated infrastructure required to support its massive installation, coupled with existing systemic and project-related risks, which collectively makes the country's renewable energy sector unattractive. For better context, it is reported that while Nigeria needs about USD 6 billion per year of investment in the clean energy sector, [it got about USD 101.53 million per year between 2017 – 2022](#)), presenting a scenario where private participation in the country's renewable energy faces significant limitation due to market unattractiveness.

With these challenges that limit the ability of renewable energy to enable extensive access to energy, there is need to deploy energy solutions that are affordable and well integrated into extant systems of energy utilization, with consequent limited capital investment. Within the Nigerian context where value chains of industries and energy utilization systems are hugely integrated with fossil fuels, it becomes attractive to deploy fossil-fuel related low-

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hanging fruit solutions that would require minimum capital expenditures.

Also, such solutions are ones that are readily accessible using available technologies with limited financial investments, while also being available in huge quantities. It is however, important to note that these fossil fuel related energy solutions are being arguably subsidized in Nigeria, benefiting the wealthier segment of the society. On this note, the low-income earning population are disadvantaged, leading to income inequality. In such scenario, the purchasing power of the customers are further limited across different dimensions such as reduced funding that could be used for different types of social programs, that can augment their purchasing power.

Nonetheless, the provision of fossil fuel dependent solutions (particularly natural gas) is in tune with the element of energy security where countries tend to deploy readily available energy solutions whose availability are least susceptible to distortion from the global energy ecosystem. In this regard, data shows that [Nigeria has capacity to increase its natural gas reserves to 600 trillion cubic feet](#), highlighting an energy resource that is accessible and explorable using existing technologies. Also, there is adequate manpower to harness this energy resource, limiting manpower-related risks that affect energy security of a nation.

In addition, there is a dynamic shift in the nation's oil and gas industry, where indigenous

oil and gas companies are increasing their influence through improved local content participation in the sector, further enhancing the nation's energy security within this context. There is also the [fossil-fuel focused African Energy Bank with a projected financing capacity of USD 5 billion projected to start later in the year](#), which can finance oil and gas exploration across Africa, of which Nigeria is a key stakeholder. With such financial muscle, Nigeria's oil and gas sector can provide fossil fuel related energy solutions that can ensure the needed energy security.

However, within the context of energy security, renewable energy (particularly solar, wind and hydropower) offers diversification, by reducing the dependence of Nigeria on fossil fuels and imported fuels for energy consumption. Even with the commencement of the operation of the Dangote Refinery (one of the largest refineries in the world with production capacity of 650, 000 barrels per day) that is projected to refine a large amount of Nigeria's oil and gas production, it is still unclear if it can meet the entirety of the nation's needs, considering the possibility of the refinery focusing its products on the export market.

With such uncertainty, renewable energy offers a reliable opportunity for diversification from imported fuel which the country has solely depended on. As a result, it becomes possible to achieve resilience in the nation's energy sector as vulnerability to the geopolitics of the oil and gas industry becomes minimized. Interestingly,

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renewable energy is gaining popularity for providing energy in off-grid applications (especially in rural areas in Africa and by inference Nigeria), with data showing that [it accounted for ~16.4% of total electricity produced in Nigeria in 2022](#).

As concerning sustainability, there is overwhelming evidence that renewable energy ensures sustainability by releasing reduced amount of greenhouse gases into the atmosphere from its supply chain of production and utilization. In this case, renewable energy becomes a highly desirable energy resource that addresses the existing problem of carbon footprint of fossil fuel related solutions. It is within this capacity that environmentalists advocate for total transition towards renewable energy in Nigeria. Meanwhile, there are also arguments that natural gas can be considered a clean energy resource, considering it is less polluting than crude oil, with [1 barrel of oil equivalent of natural gas and crude oil emitting an estimated 360kg of CO<sub>2</sub> and 440k of CO<sub>2</sub> respectively](#).

While the status of natural gas as a clean energy is highly contestable, there are conversations and arguments that try to cast it as a go-to fuel and preferable transition fuel that can successfully drive Nigeria's energy transition. According to this school of thought, natural gas offers a less polluting energy resource compared to crude oil. Hence, its "limited" emission reduction signifies progress within the context of sustainability. Further, it is argued that Nigeria

constitutes an insignificant amount of global CO<sub>2</sub> emissions with data showing in that in [2022, Nigeria contributed 0.35% of global CO<sub>2</sub> emissions](#). Hence, significant emission reduction gains through outright removal of fossil fuel-related energy solutions would have minimal impact on limiting global warming and consequent climate change.

Considering this intricate interaction that occurs within the web of the energy trilemma, an outlay is generated that identifies the most suitable energy resources that induce optimal outcome for each of the elements of the energy trilemma. This is presented in Table of Interaction below.

Table of Interaction: A representation of current complex Nigeria’s Energy Ecosystem from author’s subjective inclinations

Elements of Energy Trilemma	Most Favourable	Moderately favourable	Least favourable
Energy Access	Natural gas [CNG, LPG, LNG]	Imported refined oil and diesel	Renewable Energy [solar, wind and hydropower]
Energy Security	Natural Gas [CNG, LPG, LNG]	Renewable Energy [solar, wind and hydropower]	Imported refined oil and diesel
Environmental quality	Renewable Energy [solar, wind and hydropower]	Natural gas [CNG, LPG, LNG]	Imported refined oil and Diesel

\*LNG – Liquefied Natural Gas, CNG – Compressed Natural Gas, LPG – Liquefied Natural Gas

**Conclusion**

Considering the peculiarities of the Nigerian energy ecosystem, the popular opinion of renewable energy being the frontline energy resource to drive energy transition does not

seem to reflect the realities within the country right now. This does in anyway negate the fact the renewable energy lacks the capacity to drive the transition in Nigeria. On the contrary, it does however, currently, it faces limitation that are

induced by macroeconomic vulnerabilities. On this note, it is therefore important for the Nigerian government to ensure that the Nigerian macroeconomic performance is improved to enable massive renewable energy production and utilization at commercial levels, while also ensuring that natural gas is produced and utilized in the most environmentally friendly manner. In summary, the Nigerian energy ecosystem is evolving hence, the suitability of different energy resource that can ensure optimal interaction of the elements of the energy trilemma is dynamic. Therefore, continuous evaluation needs to be carried out to know which energy option is most suitable to drive just energy transition.