CENTRE FOR CLIMATE CHANGE & DEVELOPMENT

# ENERGY SCENARIOS FOR NIGERIAN'S NATIONALLY DETERMINED CONTRIBUTIONS (NDCs) REVISION


By

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**Promoting Critical Analysis of, and Public Engagement with Nigeria's Nationally Determined (NDC) Revision and Climate Action**

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## Promoting Critical Analysis of, and Public Engagement with Nigeria’s NDC Revision and Climate Action Project

The Promoting Critical Analysis of, and Public Engagement with Nigeria’s NDC Revision and Climate Action Project is a project implemented by the Climate Change and Development Centre, Alex Ekwueme Federal University, Ndufu-Alike Ikwo, in partnership with the World Resources Institute with funding from the IKEA Foundation. The project is geared towards providing independent critical analysis and input into the revision process of Nigeria’s Nationally Determined Contribution (NDC) which is due for submission in November 2020. The project is also intended to increase public awareness of, and stakeholders’ engagement in the revision and subsequent implementation of the revised NDC. It is also expected that project will increase public awareness of climate change in Nigeria more broadly. The project aims to help widen the horizon of the discourse and strongly compliment the government-led NDC revision process with the support of the NDC Partnership through the Climate Action Enhancement Package (CAEP), by injecting academic analysis and more public debate into the process.

**Disclaimer**

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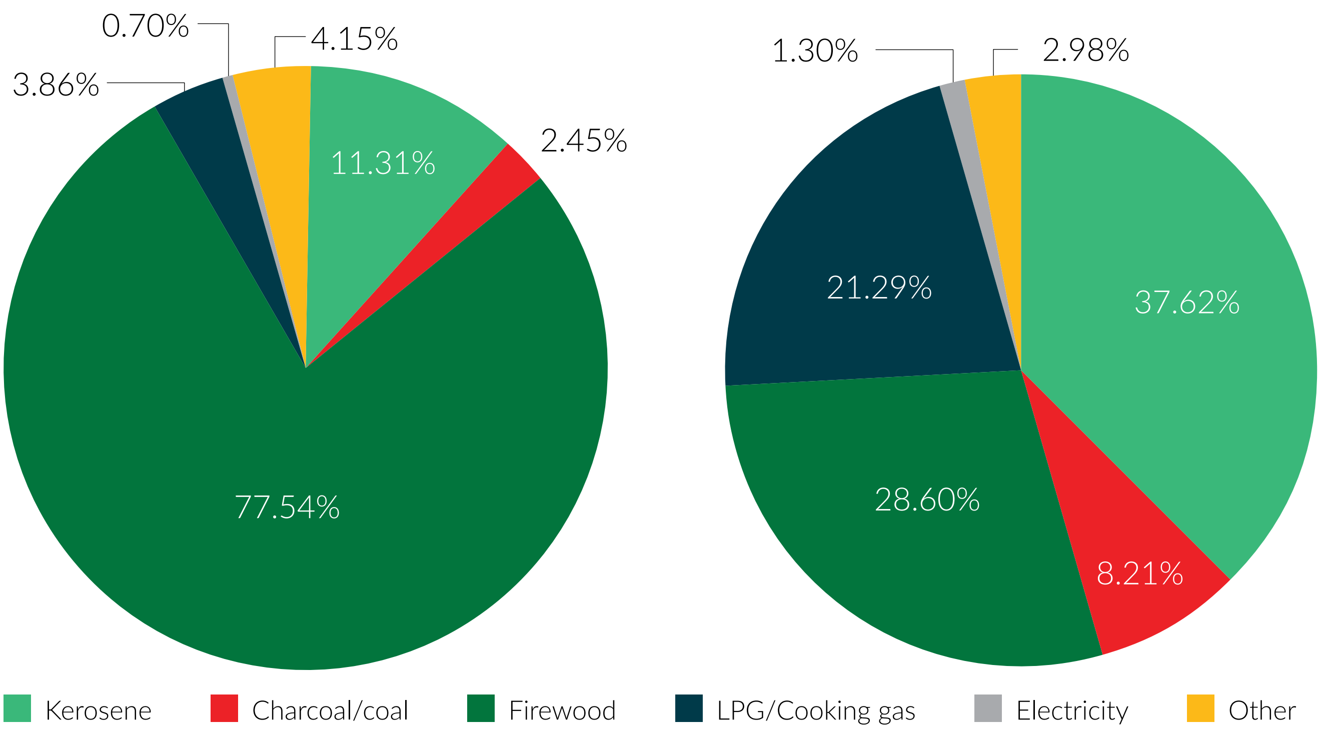
# 1.0 Introduction

All over the world, energy is a central consideration in climate change policy. In Nigeria, the intersection between energy and climate is broad, multiple, and complex. First, given the high rate of energy poverty and a fast-growing population, there is huge pressure on Nigeria to vastly increase energy generation and distribution from its vast fossil fuel reserves. According to World Bank figures, only 40% of Nigeria's 200 million population is connected to the national grid and well over 70% of the rural population depend on traditional biomass for cooking (see **Figure 1**) (Nigerian Bureau of Statistics, 2019)

**Figure 1:** *Percentage distribution of energy sources for cooking (Nigerian Bureau of Statistics, 2019)*




The second major point of intersection is that the energy sector, which plays a critical role as the key enabler of other sectors such as agriculture, health, and water, is prone to climate change variabilities. At the grid level, the power generation capacity is dependent on both ambient conditions (temperature and humidity) and water level of which could be severely altered by climate change(Klimenko et al., 2018). For example, a rise in temperature (with corresponding humidity) will affect the performance of gas turbine power plants. Similarly, the performance of hydro-power plants can be impacted by the quantity and pattern of rainfall. As noted by Nigerian experts in the power sector, the grid power network in Nigeria is grossly limited leaving a large proportion of dwellers in both urban and rural communities to depend on off-grid energy sources (mostly firewood and agro-wastes) for their cooking and heating needs. In rural communities, energy access is also highly vulnerable to climate change given their dependence on biomass (firewood and agro-wastes). For the southern zones, energy access is vulnerable to flooding, windstorm, and erosion (Haider, 2019). In the northern zones, access to energy is more impacted by extreme heat, wind storms, drought, and desert encroachment (Haider, 2019). Thirdly, the activities in the oil and gas sector (especially gas flaring and oil spillage) have a significant impact on greenhouse gas emissions, climate vulnerability, ecological integrity, and the livelihood of a large population. For these reasons, a clever and strategic treatment of energy is vital in Nigeria's Nationally Determined Contributions and for any prospects of achieving a low carbon development.

# 2.0 Energy-Related Commitments in the Current NDC

The existing NDC acknowledges the important position of energy is occupying in the development of Nigeria's economy. In this perspective, the NDC identified the energy sector as critical to achieving the Paris Agreement through the pillars of decentralized renewable energy, improving power generation stations and the electricity grid, enforced energy efficiency, and shift from liquid fuels to natural gas usages. The NDC considers a range of energy-related measures as part of the plan to achieve a reduction of emissions, which are projected to grow by 114% by 2030 reaching about 900 $MtCO_2$ under a business as usual (BAU) scenario. The reduction would be achieved by actions in five sectors of the economy listed below:

- energy,
- oil and gas,
- agriculture and land use,
- industry,
- and transport.

Notably, for the energy sector, the NDC reduction actions consider linear improvement in energy efficiency by 2% per year to reach 30% by 2030; providing 13 GW off-grid solar PV electricity to rural communities that are currently off- or under-grid, improved electricity grid transmission and distribution efficiency to minimise transmission losses, and ending the flaring of gas by converting it to useful energy through appropriate gas-to-useful energy conversion technologies –natural gas generator, LPG cook stove, and natural gas engine bus for examples. The emissions reduction actions in all the sectors considered in the NDC would lead to a 20% reduction compared to BAU, which is the basis of the unconditional NDC. A commitment to higher emission reduction is made conditional to international support. The conditional pledge includes increasing energy efficiency and drastically reducing the use of fossil fuel-based generators. This would lead to a 45 % reduction of emissions in 2030 compared to BAU, or 18% increase from the 2015 emissions level.

The NDC demonstrates its determination to contribute to the success of the Paris climate through the unconditional and conditional pledges. The NDC indicates a commitment to contribute to the sustainable growth of Nigeria's economy. However, the Nigerian economy is heavily dependent on income from oil and gas production – 90% of the exports and 15 % of GDP. Therefore, energy has an important impact to influence the climate policy in the country; where the demand for oil and gas is reduced. In this regard, the energy sector should be systematically dissected for possible opportunities that will positively impact the environment in the revision of Nigeria's Nationally Determined Contributions (NDC).

# 3.0 Energy Policies in Nigeria that are Relevant to the NDC

There is evidence that in setting the energy-related goals in the current NDC, the government attempted to create a link with the relevant existing policy in the country. The Nigerian government has long prioritised energy access for all judging from the plethora of energy policies and regulatory frameworks in the energy sector. For example, the 2005 Renewable Energy Master Plan (REMP) pertains to the support for the development of renewable energy sources for both small- and large-scale applications pledged to generate at least 10% of the total energy consumption from renewable energy by 2025.The 2006 National Policy and Guidelines on Renewable Electricity aimed at generating 5% of the total electricity from renewable sources by 2016. The National Energy Master Plan (NEMP) targeted to facilitate decarbonisation of the country's development pathway through renewable energy technologies application; and the 2015 National Renewable Energy and Energy Efficiency Policy (NREEEP), which was published a few months before the conclusion of the NDC, plans to vigorously pursue the deployment of renewables in its electricity generation, and embark on efficient energy management, which is targeted at 40 % energy efficiency by 2030 at 2.5 % yearly improvement.

Particularly, REMP and NREEEP have a significant role in decarbonising the energy sector of Nigeria. The REMP targeted to increase the renewable energy share in the total energy consumption of the country to at least 10% by 2025. The pathway to achieving the target is by increasing renewable electricity from 13% of the country's total electricity generation in 2015 to 23 % in 2025, which will progress to 36 % by 2030. It can, therefore, be argued that this target was more diverse than the NDC narrow target of solar PV electricity generation.

In what follows, the electrification rate will be improved from 42 % to 75 % in 2025. The NREEEP was designed to respond to both the modern energy supply crisis in Nigeria and Nigeria's commitment to the Paris Agreement by increasing the utilisation of renewable energy and the application of energy-efficient systems and appliances. The NREEEP identified renewable energy resources, at an economic potential assessment, that could produce68 GW of both on-grid and off-grid electricity (about 17 times the current electricity generation capacity in the country). However, the NDC has entrapped on only off-grid solar PV electricity generation at a generation capacity of 13 GW, which is over ambitious compared to the relevant policy targets. It is possible to achieve a significant proportion of the targeted potential 68 GW of electricity generation to bridge the huge gap between supply and demand to reduce the proliferation of inefficient and polluting liquid fuel generators. It is obvious that the NDC did not consider the potential of renewable energy to support diverse energy mix for both on-grid and off-grid energy access.

# 4.0 Energy-Based Analysis of the Existing NDC

## 4.1 The Ambition Gap

The central challenge for the NDC with regards to energy is that it has to walk a tight balance between the urgent need for more energy generation to improve access across the country and the need to keep energy-related emissions from increasing based on BAU scenario. The existing NDC as indicated commits to a significant reduction of emissions by improving some of the energy-related SDG indicators, namely access to electricity, access to clean energy, etc. However, the approach and data used in developing the NDC are largely opaque, which may have contributed to the poor performance of the country's energy-related SDG indicators, namely access to electricity (59.3% of the population), access to clean fuel for cooking (4.9 % of the population) and reduction of $CO_2$ emission from fuel combustion/electricity output ($MtCO_2$/TWh)(Sachs, et al 2019). It has been shown that improved energy-related SDG indicators induce the development of any nation. The Nigeria economy was on the rapid increase, with the standard of living tending to the higher side, before its downturn as a result of declining international oil prices coupled with the recent COVID-19 pandemic (Ozili 2020). Ultimately, energy is required to revive the economy and to sustain the growing population, which is expected to double over the next 25 years. However, there is a conflicting burden of widening energy access and reducing emissions to avoid average global temperature above 2 oC of the pre-industrial era. As indicated, the way the NDC attempts to address this tension is by committing to reduce emission through 2 % yearly energy efficiency (to reach 30 % by 2030), deployment of 13 GW off-grid solar PV, efficient gas generators, and the improved electricity grid to reduce transmission losses. However, the existing NDC ambition seems to be crafted on poor data, circumvention of subsisting energy policies, and ill-defined methodology.

## 4.2 The Neglect of the Demand-Side Energy Efficiency

The second gap is that the existing NDC focuses mainly on the supply-side of the energy chain– generation, transmission, and distribution – and neglects demand-side energy management, or at best these two have been lumped together in a way that does not help in policy design, implementation, and monitoring. In the supply-side, efficiency is expected to be driven by technology innovation response, namely upgrade gas-fired power plants (e.g combined heating and power plants), create more efficient transmission and distribution, and capturing waste heat.No doubt, these are all important and established approach for minimising energy consumption, emission and enhancing productivity(Bataille and Melton 2017; IEA 2017). However, they are often capital intensive and technology innovation-driven, which often makes it more difficult for developing countries with limited financial and technological capacity to implement. Whereas in the demand side (demand-side management), efficiency is driven more by technology and behavioural responses a big part of which could be more readily implemented by the government. It has been noted that the adoption of smart energy management systems (e.g. smart switches) in homes and offices could substantially reduce energy consumption vis-à-vis emission(Zipperer et al. 2013; Khan 2019).

The NREEEP identified the demand-side energy efficiency in the household and industry sectors as a fulcrum to achieve the40 % energy efficiency, at a 2.5 % yearly improvement, target. The policy identifies the use of efficient household appliances, in particular for lighting, cooking, refrigeration, and productive uses to significantly improve the energy efficiency landscape. The policy shows that good energy management (simple housekeeping measures) in the industry can save at least 25 % of energy. In this regard, the policy committed the Federal Government to promote and support the adoption of energy-saving appliances and devices in all sectors of the country. Certainly, there is a significant difference between the NREEEP 40 % energy efficiency target and the NDC 30 % energy efficiency target at the same 2030 time horizon. The implication is that energy scenarios should be designed in recognition of the appropriate weighting factors for the energy efficiency sides – the supply-side and the demand-side– and the adequate consideration of the subsisting energy policy energy efficiency target.

## 4.3 Over Concentration on Solar PV

Another important gap in the current NDC is the concentration on off-grid solar PV as the only means to achieve the 13 GW target of electricity generation from renewable sources. It is true that solar PV off-grid electrification has gained significant policy drives and research attention in recent decades, especially in this country. However, narrowing on only solar PV to meet the 13 GW of off-grid electrification seems to be too ambitious. The NREEEP is targeted to meet 1.343 GW and 6.831 GW of electricity generation from solar energy by 2020 and 2030, respectively, which is far below the 13 GW NDC target of only off-grid solar PV electrification. Certainly, the target of13 GW renewable energy penetration will not be met, as suggested by the NREEEP and Bamisileet al. (2020a), due to the local entrapment of only solar PV electrification. The NDC, to a large extent, circumvents subsisting energy policies; for example, the REMP, NREEEP, etc... The REMP and NREEEP are targeted to simultaneously consider all potentially viable renewable energy sources for on- and off-grid applications for household and productive uses, which is not reflected in the existing NDC.

The NDC mainly touted the electrical form of energy, without the due considerations of other forms of energy, thermal energy for example – it could be because electricity is the most demanded form of energy. In doing so the NDC fails to seriously consider the need to promote a robust and diverse energy mix which several experts have held as being important for climate resilience and energy security.

Other commercially proven renewable energy conversion technologies in the market support climate change mitigation, namely solar thermal, wind turbine, small hydropower, and bioenergy, see **Table 1** for NREEP targets, which support decentralised off-grid power generation. There are substantial potentials for the utilisation of solar thermal, wind turbine, small hydropower, and bioenergy technology in the country judging from a plethora of literature in the open domain(Nyeche and Diemuodeke 2020; Bamisile et al. 2020b). For example, UNIDO commissioned an off-grid 0.4 MW small hydropower plant in the Northern part of the country in 2014, and many of such projects are expected to follow soon. There is a high potential of bioenergy in the country and it has seen growing interest in recent times (Oyedepo et al. 2019). The application of bioenergy in electricity generation is a mature technology globally, for example, agro-waste-to-energy power plant. The implication is that other viable technologies could be used to drive the off-grid energy access in Nigeria that did not feature in the NDC.

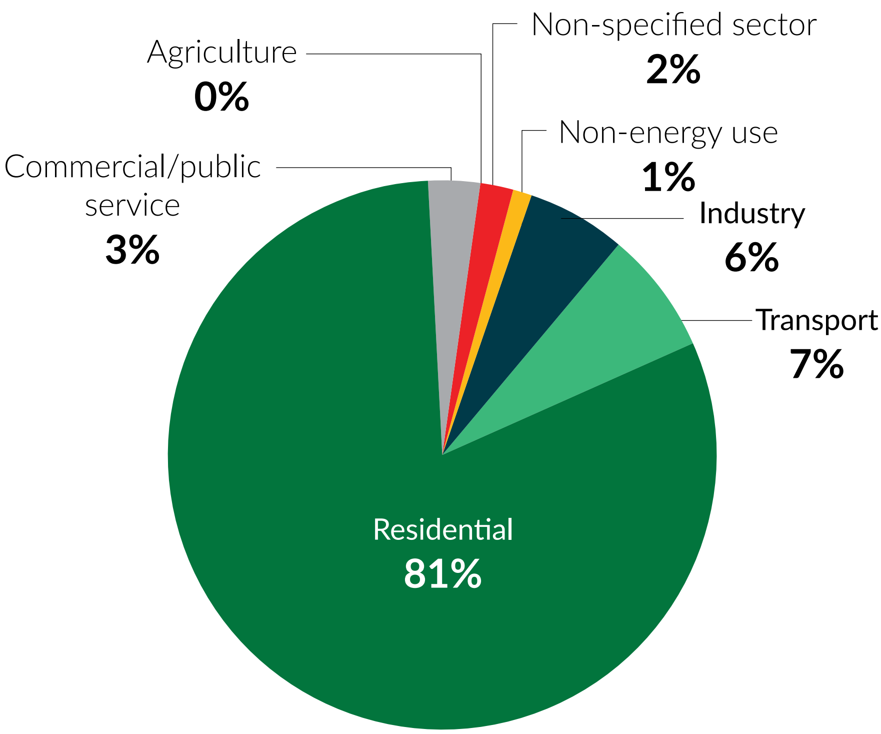
**Table 1:** *Nigeria's Energy Potentials (Source: Federal Ministry of Power 2015)*

| S/N | Energy Source | Timeline | | |
|---|---|---|---|---|
| | | 2015 | 2020 | 2030 |
| 1. | Hydropower (large and small) –MW | 2,261 | 6,156 | 12,801 |
| 2. | Biomass electricity –MW | 5 | 57 | 292 |
| 3. | Biofuel -ML/day | 7.3 | 13.1 | 35.9 |
| 4. | Solar –MW | 117 | 1,343 | 6,831 |
| 5. | Wind –MW | 55 | 631 | 3,211 |

## 4.4 Neglect of the Residential Sector

Another significant gap in the NDC is that it fails to seriously consider the need for energy supply to the residential sector. Given that the residential sector currently consumes a significant proportion of the country's primary energy as shown in **Figure2**, it is not possible to imagine a meaningful or effective socioeconomic development and climate change action that does not have residential energy transition as a key thrust (Selvakkumaranand Ahlgren 2019).

**Figure 2:** *Sectoral primary energy consumption in 2015 (source: Edomah 2019)*

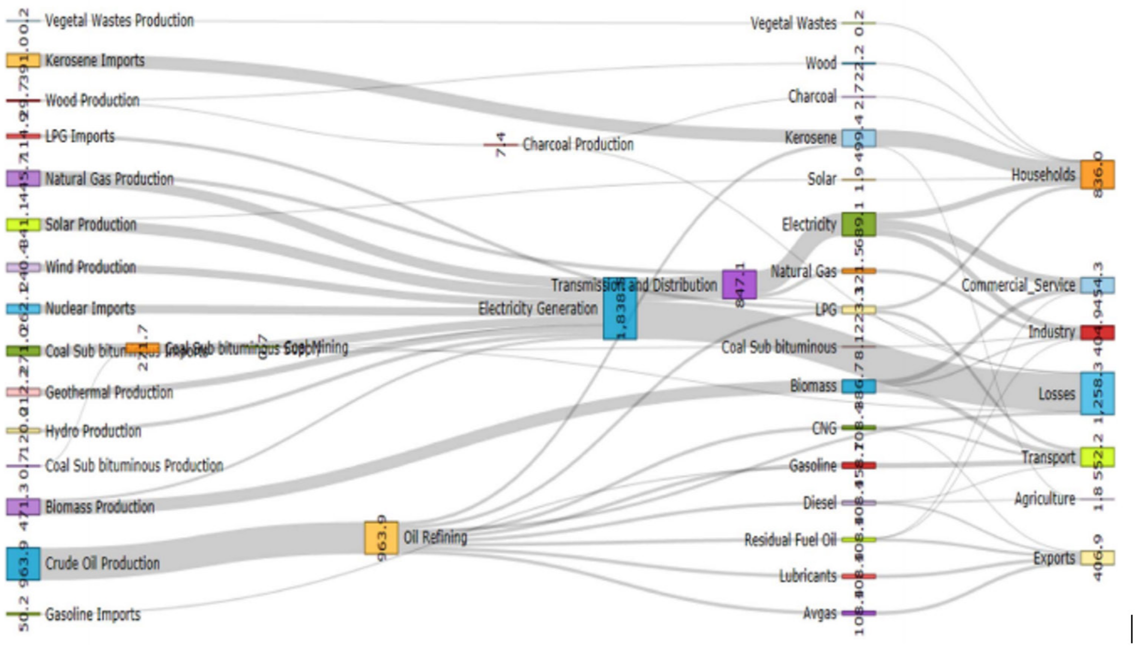


In many of the residential sectors, energy demand for cooking and heating is dominated by non-clean energy technology, with only 10 % access to clean cooking (IEA 2019). The rural communities, which constitute about 50 % of the population, depend on inefficient fossils, firewood, charcoal, and agro-wastes cookstoves to meet their cooking and heating energy needs. The implication is that off-grid clean energy solutions towards cook stoves would play a vital role in the decarbonisation of the residential sector. It is, therefore, a big gap that the NDC did not seriously consider how to close the energy access gap for the rural population. It is desirous for the future NDC should fashion energy scenario for the adoption of clean cooking technology in line with the National Gas Policy and the adoption of other clean cooking technologies – e.g. improved biomass cook stove (Moses, Pakravan, and MacCarty 2019).

## 4.5 Reducing Emission from Fossil Fuel–fired Energy Systems

Another gap in the current NDC is that it does not sufficiently consider options for greening emissions from the main sources of production which are fossil fuel-fired power plants. Currently, about 75% of the total on-grid generation in Nigeria comes from gas-fired power stations. Looking in the future some analyses have suggested that the energy mix in the country will continue to be dominated by fossil fuel (see **Figure 3**). Given the vast amount of gas reserves in the country and the current sunk cost in the gas-fired power generation, which currently accounts for the power generation in the country, it is difficult to see how the energy portfolio can shift significantly away from natural gas in the near future. Therefore, a key aspect of the low carbon development policy should be to figure out ways to reduce the carbon emission implications of gas-fired power generation through the application of downstream technology, carbon capture and sequestration (CCS) for example (Ugwuishiwu et al., 2019).The CCSis a proven global technology that is used to make fossil fuel-fired conventional power plants environmentally friendly.

**Figure 3:** *Nigeria Energy mix in 2040 (source: Emodi et al. 2017)*



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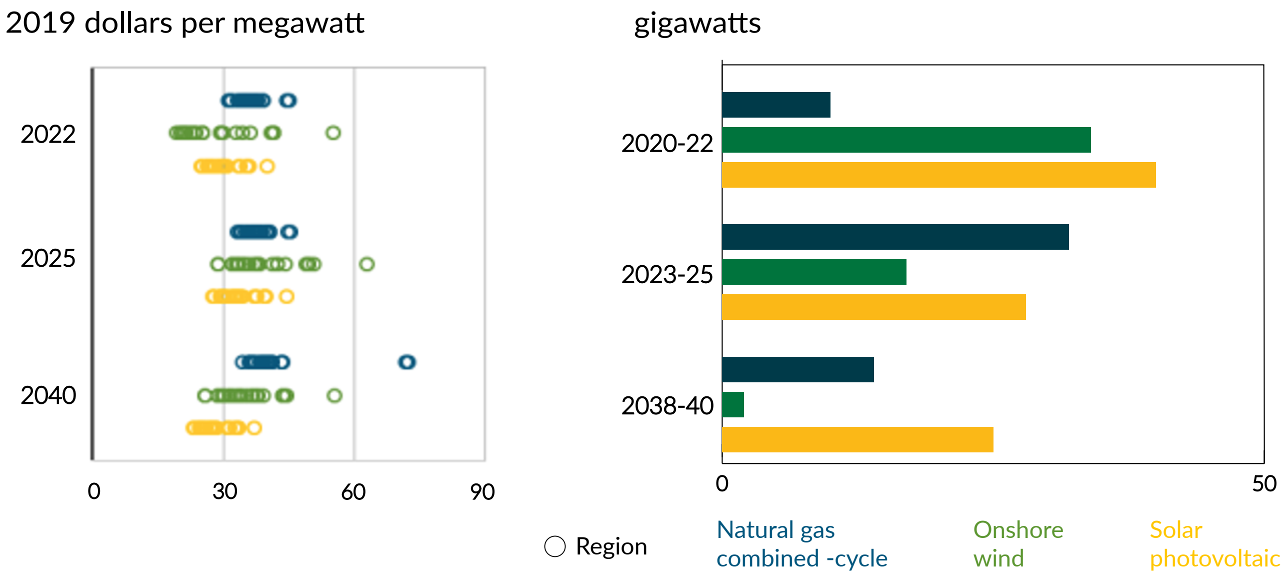
## 4.6 Muted on On-grid Renewable Energy Application

Policy-wise, Nigeria could be on the right track to compete favourably in the on-grid and mini-grid renewable energy revolution. However, institutional capacity and implementation challenges may impose turbulence on renewable energy innovation progress in Nigeria. Unfortunately, the current NDC does not mention on-grid let alone delve into the policy and institutional framework that is critical to catalyzing the scale and direction of innovation in the mini-grid area.

The Rural Electrification Agency of Nigeria (REAN)has identified renewable energy-powered mini-grids as a cost-effective option for rural electrification, which has created an exciting opportunity to rapidly adopt renewable electrification. The country's large population and large economy make it attractive to investors in the energy access sector; the mini-grid market has a revenue potential of US$8 billion annually according to a publication of Nigerian Economic Summit Group(Yakubu et al, 2018). The mini-grid energy access market of the country is robust and rapidly growing with emerging best practices in energy generation and utilisation (Yakubu et al, 2018). The mini-grid sector of the country is rapidly shifting away from grant and seed funding towards private debt and equity capital to support the market potential of over 9 million households according to the International Energy Association market potential criterion (Scott and Miller, 2016). The stakeholders across the renewable energy utilisation value chain in the country can enable and accelerate this growth through a few key actions, e.g proper policy implementation and evaluation. These key actions are expected to present an exciting investment opportunity in the mini-grid that is destined to significantly increase energy access across Nigeria (Yakubu et al, 2018).

The off-grid electrification, no doubt, has the potential to support the rapidly growing economy and emission reduction (Nyeche and Diemuodeke, 2019). However, heavy reliance on the off-grid supply-side energy solutions by the NDC seems to counter common logic that increases in energy demand will be substantial in on-grid due to increase in economic activities in urban and peri-urban that are on-grid. The improved on-grid electricity that is captured in the NDC could be driven simultaneously by smart grid facilities and an increase in on-grid renewable energy sources. For example, the Katsina wind farm has the capacity to generate 10 MW on-grid electricity and many of these projects are expected to come on board in no distance time. The implication is that an energy scenario that explores both on-grid and off-grid renewable energy technology is desirous especially as the cost of renewable energy technologies is coming down(see **Figure4**).

**Figure 4:** *Levelised cost of energy technologies entering service in 2022, 2025 and 2040 (source:EIA 2020)*



# 5.0 Conclusion and Recommendations

The current NDC makes important commitments in the energy sector, which could help limit GHG emissions while promoting increased access to green energy. However, there are many gaps such as circumvention of subsisting energy-related policies, lumped energy efficiency pathways, over concentration on solar PV, neglect of the residential sector, neglect of advanced emissions control technology, and neglect off-grid renewable energy utilisation. It is, therefore, critical and pertinent that the NDC revision should consider all the aspects of energy supply and demand sides in a transparent and equitable process. In what follow, the NDC revision should judiciously and equitably consider;

- Expanding the energy efficiency debate from both the supply-side and demand-side with clear accounting and monitoring pathways for supply-side energy efficiency and demand-side energy efficiency,
- A diverse energy mix from both on-grid and off-grid commercially proven renewable energy conversion technologies and applications,
- A critical review of bioenergy potentials in view of energy-environment-food nexus,
- The potential of clean and efficient energy utilisation in the residential sector by closing the energy access gap especially for the rural dwellers through policy and institutional framework that catalyse the scale and direction of innovation in the mini-grid energy access sector,
- A broad-based discussion on the potentials of modern cooking services especially for the off-grid communities,
- The application of advanced technologies for greening downstream of fossil fuel-fired energy systems, namely commercially proven carbon capture and sequestration and waste-to-energy technologies,
- Holistically anchoring the NDC on all relevant subsisting energy-related policies through a transparent and replicable methodology by coupling information from the research community and public policy and
- Designing a holistic implementation mechanism (finance, strategy, capacity building, and institutional development) that is specific to the energy sector, with friendly implementation process – adequate monitoring and evaluation plan.

To achieve the above, the new NDC should give attention to all the economic sectors of the country by exploring plausible emission avoidance opportunities, with energy taking the appropriate priority as the key enabler of the other sectors. The NDC revision would be enhanced by considering the above in the major energy-dependent sectors, namely residential, commercial, public service, industrial, and agricultural, for plausible means of reducing energy-induced emissions.

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