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## Rural Electrification and the Uptake of Renewable Energy in Nigeria: Lessons from Kenya

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### ABSTRACT

Recent technology advancements have brought to the fore the role renewable energy can play in providing timely access to clean and affordable energy in the rural areas. Although rural electrification programme in Nigeria aims at harnessing renewable energy resources for improved electricity access, the contribution of renewable energy has remained marginal till date. The aim of this paper is to identify barriers to the uptake of renewable energy for improved access to electricity in the rural areas. The paper finds that inadequate funding of rural electrification programme, high initial costs of renewable energy technology, absence of community participation coupled with the absence of a body with specific mandate to promote the use of renewable energy for rural electrification are major barriers to the rural application of renewable energy. Failure of Nigeria to address the issues will have implications for electricity access in the rural areas.

### INTRODUCTION

Nigeria, with over a population of 200 million and landmass covering about 923,773 km<sup>2</sup>, is the most populous country. Arguably, Nigeria has the largest economy in Africa (National Council on Power, 2016a; IMF, 2017; Ochayi, 2020). Energy supply in Nigeria is characterised by overdependence on fossil fuels and under-utilisation of renewable energy resources (National Council on Power, 2016b). For many years, electricity has remained a source of concern given that only about 57% of the Nigeria's population has access to grid electricity (World Bank, 2021). The rural areas of Nigeria are the most affected with barely 22% access to grid electricity (Nnodim, 2021). Many times, the people in rural areas, whose energy needs are often basic, have had to rely on the traditional energy (mostly biomass) as an alternative to electricity (Chete *et al.*, 2014; Bashir & Modu, 2018). The state of electricity access in the rural areas is of serious concern in view of the fact that majority of Nigerians resides in the rural areas (Federal Ministry of Power, 2015a; Johnson & Ifeoma, 2018). Insufficient generation, inefficient transmission system, non-coverage of the grid network and poor distribution system have been, and remain, ongoing challenges of electricity access in Nigeria, especially in the rural areas. The little megawatts of electricity generated by electricity generating companies have to be transmitted through old and outdated electricity infrastructures thereby resulting in wastages. The outdated electricity infrastructures have raised the questions about the reliability of grid electricity in providing access to every part of Nigeria (KPMG, 2016; Ohajiana *et al.*, 2014).

For many years, how to provide improved electricity access, especially in the rural areas, has remained a key policy programme of successive governments in Nigeria. An important programme in this regard is the rural

electrification programme (REP) which targets electricity access in the rural areas. Extending the electricity grid network to connect more rural areas to the national grid has been a key strategy of the programme since inception (Rural Electrification Agency, 2019a). However, the rate of electricity access shown that grid extension without more cannot address the challenges of electricity access in Nigeria. A major reason is that grid extension is not sustainable in Nigeria due to the high costs of extending the grid (Sanusi, 2015; AllAfrica, 2018). As a result of the high costs, the Federal Government of Nigeria (FGN) has embraced alternative strategies whereby the country will make use of abundant renewable energy as a key component of the REP (Rural Electrification Agency, 2019b; Olanrele, 2020a). The approach is based on the realisation of the role of renewable energy in providing timely access to clean electricity in rural areas (Cook, 2013). Nigeria is blessed with abundant renewable energy resources of varying potentials. The available solar energy resources in Nigeria, for instance, can supply not less than 36,000 MW of electricity from only about 1% of the country's land areas (Oyedepo *et al.*, 2018). The wind energy and small hydro resources are also a plus to the available renewable resources.

Despite the potentials of renewable energy in providing timely electricity access, and the existence of abundant renewable energy resources, the deployment of renewable energy for improved access to electricity in the rural areas of Nigeria is still constrained by a number of factors. The aim of this paper is to analyse factors that are constraining the uptake of renewable energy for rural electricity access in Nigeria. This paper is divided into seven parts. Part I, this introduction, sets the context for the challenges of rural electrification in Nigeria, while Part II explains the methodology employed in this paper. Part III discusses the historical evolution of electricity generation, rural

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electrification programme and, the policy and regulatory frameworks for the REP in Nigeria. Part IV focuses on the barriers to rural application of renewable energy in Nigeria. While the uptake of renewable energy is one of the planks of the energy policy in Nigeria, too many regulators without a specific mandate, lack of funding and failure to promote community participation in renewable energy projects have remained major impediments to the uptake of renewable energy as part of the REP. The rural electrification agency, the body that is saddled with the responsibility of rural electrification programme, does not have specific mandate to promote the uptake of renewable energy for improved electricity access. Powers over renewable energy development are shared by different agencies of the FGN such as the Ministry of Power and the Nigerian Electricity Regulatory Commission (NERC).

Moreover, the deployment of renewable energy technologies involves high initial costs while the rural electricity programme continue to be poorly funded by the FGN. Nigeria needs to address the barriers to the uptake of renewable energy if the country is desirous of achieving improved electricity access among the rural population. According to Worika (2016), developing countries (such as Nigeria) may not achieve sustainable development in the absence of rural applications of renewable energy (Worika, 2016).

This paper argues that Nigeria may not make any progress in the application of renewable energy for improved electricity access in the absence of a dedicated fund, community participation and, the establishment of a hybrid body with functions over rural electrification and renewable energy development. In proffering solutions to the identified problems, this article will draw lessons from the experience of Kenya in the application of renewable energy for rural electrification programme. In Part V this paper discusses rural electrification programme, electricity generation and the development of renewable energy through the law in Kenya. Part VI examines lessons which Nigeria can derive from the Kenya's experience, and makes a case for the rural application of renewable energy in Nigeria.

The paper finds that Kenya is a leading African country in electricity generation from renewable energy (particularly geothermal and wind), and therefore a country from which Nigeria can derive lessons from in the area of rural application of renewable energy (Fischer *et al.*, 2011). Kenya is also the only African country that has been benchmarked by the World Bank as a model for other African countries in renewable energy development (World Bank, 2018; Pueyo, 2018). Part VII concludes the discussions and makes recommendations for the promotion of renewable energy for improved electricity access in Nigeria.

## METHODOLOGY

This paper reviews the law and the policy framework for rural electrification programme, and the traditional legal

materials on the development of renewable energy in Nigeria. For the purposes of the policy framework, the paper will analyse the provisions of the 2001 National Electricity Power Policy, the 2003 National Energy Policy, the 2005 Renewable Electricity Policy Guideline, the 2015 National Renewable Energy and Energy Efficiency Policy and the 2016 Rural Electrification Strategy and Implementation Plan. The aim is to identify how the law and the policy framework have been influencing the uptake of renewable energy for electricity access in the rural areas of Nigeria. In this paper, reference to the uptake of renewable energy for rural electrification access has the same meaning as the rural application of alternative energy and vice versa.

## Electricity Generation and Rural Electrification in Nigeria

### Background to rural electrification in Nigeria

Although the first electricity generation plant was installed in 1896, it was in 1929 that Nigeria achieved a major milestone following the establishment of the Nigeria Electricity Supply Company (NESCO) as the first utility company in Nigeria (Federal Ministry of Power and Steel, 2006a; Aladejare, 2014). In 1946, Nigeria granted electricity generation licences to the Public Works Department (PWD) and the Native Authority (NA) for electricity generation for the Lagos colony and other parts of the country respectively. One noticeable thing is that the activities of the electricity companies were concentrated only in the urban parts of the country to the exclusion of the rural areas.

The exclusion of the rural areas resulted in a disparity in electricity access between urban and the rural areas (Okoro *et al.* 2007; Aladejare 2014). Later in 1950, following the scrapping of NESCO, PWD and the NA, Nigeria established the Electricity Corporation of Nigeria (ECN) as the new electricity body. The ECN went on to harmonise the electricity infrastructure in the country and integrate them into what is now known as the national grid (Awosope, 2014). The ECN, however, failed to address the disparity in the electricity access between urban and the rural areas when harmonising the electricity infrastructures.

The harmonisation created a centralised electricity distribution system with major electricity powers given to the FGN (Awosope, 2014). In a bid to improve the state of electricity generation and supply in the country, Nigeria set up the Niger Dam Authority (NDA), alongside the ECN, to oversee hydro-electricity generation. The NDA constructed the first electricity dam in Nigeria, the Kainji Dam, in the same it was created (Okoro *et al.* 2007; Aigbovo & Ogboka, 2016). Later, for efficiency reasons, Nigeria merged the NDA and the ECN to create the National Electric Power Authority (NEPA) to oversee core electricity functions (that is, generation, transmission and distribution) (Zarma, 2006). NEPA, like the previous bodies, failed to deliver the anticipated change in the power sector. There was no improvement in state of

electricity access in the country, especially in the rural areas (Uzoma *et al.*, 2021). The development prompted Nigeria to opt for a new approach to addressing the challenges of electricity access in the rural areas by launching the REP. Although the launch of the Nigerian Rural Electrification Programme (NREP) in 1981 marked the beginning of the REP in Nigeria, the programme started officially in 1989 (Federal Ministry of Power and Steel 2006b; Federal Ministry of Power, Works and Housing, 2016a). At the early stage of the programme, the focus was on grid extension to connect more areas. The attempt by the FGN to connect local government headquarters and selected villages to the national grid under the REP, however, failed to materialise.

The programme could not connect many villages to the grid due to high costs of grid construction and other connection costs (Federal Ministry of Power, Works and Housing 2016b; Akpojedje *et al.*, 2016; Amaza & Agbaegbu, 2018). In addition to the high construction costs, there were allegations of corruptions in the execution of the rural electrification projects, inadequate funding and the absence of reliable data (Ajibade, 2018). So, for many years after its creation the programme did not achieve any significant results. The FGN then began to consider a complementary approach to grid extension that had failed to achieve rapid electricity expansion (Federal Ministry of Power and Steel, 2006c; Okwori, 2016). In 2009, the FGN suspended the programme but re-packaged it in 2012 in line with the objectives of the power sector reform (Elusakin *et al.*, 2014; Madu, 2016).

## Policy and regulatory framework for rural electrification in Nigeria

### Policy Framework

The 2001 National Electric Power Policy (NEPP) is one of the principal policy documents in the Nigeria's electricity industry (ESMAP, 2005). In the NEPP, the principal objective of the rural electrification is the rapid expansion of cost-effective and affordable electricity access using a low-carbon energy source (that is, renewable energy). Despite the electricity objective in the NEPP, there was no significant change to the rate of electricity access in the rural areas. Majorly, there was no clear-cut policy framework to guide the development of renewable energy. In 2003, Nigeria achieved a major milestone on the development of renewable energy following the approval of the National Energy Policy (NEP) by the National Council on Power. The NEP is a sector-wide policy document for the Nigeria's energy/electricity sector.

In the area of rural electrification, the NEP emphasises renewable energy and off-grid electricity generation as key to providing electricity access in the rural areas (Federal Ministry of Power, Works and Housing, 2016c). The NEP provides for the setting up of a fund to be known as the Rural Electrification Fund (REF) to promote access to electricity among the rural population (Energy Commission of Nigeria, 2003). Apart from the REF and

the role of renewable energy in promoting sustainable energy, the NEP does not contain specific provisions on how to drive the REP. Specifically, NEP fails to provide for sources of funding the REF. Later in 2005, the FGN introduced the Renewable Electricity Policy Guidelines to drive renewable electricity generation in the country.

The rationale behind the REPG is that it will provide the necessary framework for the integration of renewable energy into the country's electricity mix (Federal Ministry of Power and Steel, 2006d). The REPG seeks to ensure sustainable electricity generation by focusing on diversification of electricity generation sources. In the area of funding, the REPG provides for the establishment of the Renewable Electricity Trust Fund (RETF) as a component of the REF. The RETF, a private-public sector fund, is meant to promote domestic utilisation of renewable energy and, for the construction of independent renewable electricity projects. Budgetary allocation by the National Assembly, surcharge by the NERC on electricity consumers and, gifts and donations are the main sources of funding the RETF (Federal Ministry of Power and Steel, 2006e). The provisions of the REPG on the RETF are, however, not captured in the Electric Power Sector Reform Act that was enacted in 2005. As a result, there is no legal backing for the RETF, which fund would have applied to promote the uptake of renewable energy for rural electrification.

The call for a new approach led to the making of the 2009 Rural Electrification Policy by the FGN. Rural Electrification Policy sets out new modalities for undertaking rural electrification in Nigeria. Under the new policy, the FGN plans to provide electricity to every household regardless of where they live. A key component of the policy is the use of renewable energy for improved electricity access.

The FGN is to facilitate private sector participation in the development renewable energy for off-grid and on-grid electricity (Olanrele, 2020b). Surprisingly, it was in the same year 2009 that the FGN suspended the operations of the REP on corruption allegations. In 2015, the National Council on Power approved the National Renewable Energy and Energy Efficiency (NREEEP) as a policy document on renewable energy and energy efficiency. The NREEEP differentiate the mode of electricity supply between urban and the rural areas, and enjoins the FGN to develop a strategy for undertaking rural electrification (Federal Ministry of Power (2015b). Electricity supply to urban areas will be through the grid, while the rural areas will benefit from off-grid electricity through the utilisation of renewable energy resources.

The new approach to electricity supply between urban and the rural area is important as it shows a clear understanding of a fundamental challenge of grid electricity in Nigeria (Federal Ministry of Power (2015c). Specifically, NREEEP emphasises the use of solar photovoltaic in expanding access to electricity among the rural population (Federal Ministry of Power, 2015d). NREEEP directs the Rural Electrification Agency (REA)

to carry out a feasibility study of the rural areas for the purposes of ascertaining the possibility of deploying renewable-sourced electricity (Federal Ministry of Power, 2015e). In furtherance of the provisions of the NREEEP on rural electrification strategy, the Federal Ministry of Power, Works and Housing in 2016 approved the Rural Electrification Strategy and Implementation Plan (RESIP).

The RESIP embodies the strategies for undertaking the REP in Nigeria. According to the RESIP, electricity access in the rural areas will be achieved by employing strategies that combine the deployment of on-grid and off-grid electricity generation from thermal and renewable energy (Federal Ministry of Power, Works and Housing, 2016d). The RESIP targets sustainable realisation of rural electrification goals and objectives. The REF will serve as a major source of funding rural electrification projects in accordance with the modalities established by the REA for allocating the fund. As an additional requirement, REA is required to demand the deployment of low-costs but high quality technologies from suppliers who apply for subsidies under the REF (Federal Ministry of Power, Works and Housing, 2016e). Based on the projections in the RESIP, Nigeria targets 90% electricity access in the rural areas by the 2030, and universal access by 2040. Nigeria plans to actualise the 90% access target by connecting 80% to grid-connected electricity and using off-grid renewable energy for the remaining 10% (Federal Ministry of Power, Works and Housing, 2016e). The RESIP underscores the importance of community and private-owned mini-grids to the realisation of the rural electrification goals (IEA, 2018).

### Regulatory Framework

In Nigeria, the 1999 Constitution (as amended) is the foundation of electricity regulation (Oni, 2014). The Constitution divides powers over electricity generation, transmission and distribution between the FGn and the state governments (Federal Ministry of Power and Steel, 2006f; Akinleye, 2020). The FGn exercises power with respect to electricity generation, transmission and distribution over the national grid, while the powers of the state governments are limited to electricity generation which are not covered by the grid (Federal Republic of Nigeria, 1999a). By the Constitution, where there is a conflict between a federal law and a law made by a state with respect to electricity, the federal law will prevail (Federal Republic of Nigeria, 1999b; Agbede, 1973; A. G. Lagos State, 2017). Given that the bulk of electricity generation is through the grid, the activities of the state governments in relation to electricity generation and distribution are, therefore, limited (Oke, 2017). The FGn is the primary driver of electricity law and policy in Nigeria. It is in the exercise of the constitutional powers that the National Assembly enacted the Electric Power Sector Reform Act ("EPSR Act") in 2005.

Part IX of the EPSR Act deals with matters relating to rural electrification in Nigeria. The EPSR Act establishes

the Nigerian Electricity Regulatory Commission (NERC) as the electricity regulator, and the rural electrification agency (REA) as the coordinator for the REP. The EPSR Act provides for the setting up of a fund, the rural electrification fund (REF), for the REP. Based on the EPSR Act, contributions from eligible electricity consumers and licensees and allocation by the National Assembly constitute a major source of funding the REF (Electric Power Sector Reform Act 2005a). The REA is required to apply the REF towards the stimulation of innovative approaches to rural electrification and, for grid and off-grid electrification expansion (Electric Power Sector Reform Act 2005b).

In applying the fund for rural electrification projects, the REA is further required to promote equitable electricity access among the rural population, and ensures that the programme delivers on its mandates of expanding electricity access (Electric Power Sector Reform Act 2005c). In line with the provisions of the EPSR Act, the FGn officially inaugurated the REA in 2007 as the coordinator for the REP, and this signalled a new beginning for the programme.

### Barriers to Rural Application of Renewable Energy in Nigeria

From the policy documents, the deployment of technologies that rely on renewable energy for rural electrification is firmly established (REA, 2019c; Federal Ministry of Power & Steel, 2006g; Amaza & Agbaegbu). However, the uptake of renewable energy for improved rural electricity access has remained marginal. The challenges of renewable energy in Nigeria are a combination of factors - challenges which are peculiar to renewable energy development generally (such as high initial costs, absence of a renewable energy regulator/agency, challenges of new technology, etc.) and challenges which are peculiar to rural electrification (poor funding, absence of community participation, absence of reliable data and corruption in the execution of projects) (Ajibade, 2018; Ojo & Orue, 2009). The impact of the challenges can be seen in the number of rural household that has so far been provided with electricity access under the programme (REA, 2019d). Some of the factors will be examined.

### Complex regulatory framework

First, the regulatory framework for renewable electricity in Nigeria is unnecessarily complex, and this has affected the pace of development of renewable energy in the rural areas. Globally, the uptake of renewable requires the creation of a special regime to overcome the dominance of fossil-based electricity (Wiseman *et al.*, 2011). In theory, REA operates as an independent body within the Presidency. However, in reality REA is subject to the control and supervision by the NERC. The NERC, the sole electricity regulator, is responsible for regulating electricity sector, and for approving renewable electricity projects such as mini-grids. In Nigeria, the deployment

of mini-grids is a key strategy of the rural electrification programme. However, the construction of mini-grids is within the exclusive preserve of the NERC, and requires an approval. While there are plans to deploy off-grid renewable energy for electricity in the rural areas using mini-grids, REA is required to first obtain approvals from the NERC before it can deploy the mini-grids (NERC, 2016).

What this means is that REA can only undertake any projects in accordance with the regulation put in place by NERC, and after obtaining necessary approvals. REA does not have specific mandates to prioritise electricity from renewable energy over the conventional energy. The absence of an obligation on REA to promote the use of renewable has affected the pace of development of renewable energy for electricity access in the rural areas. In addition to the NERC, there is also the Ministry of Power with supervisory powers over the REA. For renewable energy and rural electrification, both the NERC and the Ministry of Power have come up with policy documents.

While NERC has prepared the renewable energy feed-in tariff regulation for renewable electricity generation, the FMPWH prepared the RESIP. Each of these documents seeks to establish a framework for the regulation and development of renewable energy in Nigeria without proper coordination. The failure of the FGN to streamline the powers of the regulators has constraint the implementation of rural electricity projects (Okedu *et al.*, 2015). The result is long and complex approval processes for renewable energy projects the rural electrification. The administrative bottleneck in the approval processes has affected the pace at which REA undertakes renewable energy projects in Nigeria (Eleri *et al.*, 2012).

### High initial technology costs

Renewable energy technologies are not readily available in Nigeria, and as such have to be imported into the country at huge costs (Olawuyi, 2013; Ohunakin, 2014). Given the poor exchange value of the Naira to other major currencies in the international market (most especially the United States' dollar), the procurement and deployment of these smart technologies involves high initial costs (Federal Ministry of Power, Works and Housing, 2016f). As a result of the high costs, Nigeria has not been able to undertake massive deployment of renewable energy technologies in the rural areas (Monyei *et al.*, 2018). Connected to the issue of high costs of renewable energy technologies is the scarcity of qualified personnel that can work on faulty and/or malfunctioned technologies. The fear of not able to get qualified personnel that can repair faulty technologies has affected the acceptance rate, and as a consequence, the diffusion rate of renewable energy in the rural areas (Federal Ministry of Power, Works and Housing, 2016f).

### Inadequate funding of rural electrification programme

Inadequate funding is another barrier to the uptake of

renewable energy for rural electrification in Nigeria. For many years now, the yearly budgetary allocation by the National Assembly including funding from international donors has been the principal source of funding rural electrification projects in Nigeria (Anuforo, 2016; Olanrele, 2020c).

However, the budgetary allocation for the REP has been very poor, and as such not a reflection of the percentage of the population that currently lives in the rural areas of Nigeria. Between 1999 and 2010, for instance, out of about 1.5 trillion Naira budgetary allocation to the power sector rural electrification got only 191 billion Naira (that is, about 13.27% of the allocated money) (Eleri *et al.* 2012b). The REP is not well funded so as to be able to undertake mass projects. In most cases, REA has little or no fund to execute electrification projects which involve the uptake of renewable energy such as the installation of solar PV and batteries (Anuforo, 2016; Okedu *et al.*, 2015b). The poor funding has hindered the ability of the programme to undertake projects that can accelerate rural electricity access.

### Absence of community participation

The absence of community participation in renewable energy projects is also affecting the deployment of renewable energy projects in the rural areas. Research has shown that communities play important roles in the diffusion of renewable energy (Yamamoto, 2016). European countries have experienced innovative developments courtesy of community participation in renewable energy projects (OECD, 2012). In countries like Germany and Denmark, for instance, communities have facilitated electricity access through the application of decentralised renewable energy system (Bomberg & McEwen, 2012; Nolden, 2013). Furthermore, associations have emerged for the promotion of renewable energy technologies in rural areas through community participation in renewable energy (Greenius *et al.* 2010; OECD, 2012). As a result of the inherent benefits, developing countries have been enjoined to promote community participation in different forms for improved access to energy (Kitenge & Siring, (2019).

In Nigeria, the platform to facilitate collaboration between the government and the rural communities is almost non-existent.

The energy policy though recognises the importance of community participation to the uptake of renewable energy, there is no specific guidance on the modalities for community engagements (Federal Ministry of Power, 2015f). The absence of community participation has denied Nigeria of the contribution of rural communities to the promotion of renewable energy. Although the FGN, in recognition of the role of community engagement in the execution of renewable energy projects, has been engaging key stakeholders, a lot still has to be done in this regard (Nweze, 2021).

### Rural Electrification and Renewable Energy in Kenya

## Background to rural electrification and renewable energy development

Energy has played an important role in the economic development of Kenya. There is a strong correlation between energy consumption and economic growth in Kenya (Esen & Bayrak, 2017). Regarded as the commercial hub of East Africa, energy supply in Kenya comes from different sources: petroleum, coals and electricity (Republic of Kenya, 2011a). Kenya generates electricity from fossil energy (coal, petroleum and large hydro) and renewable energy (solar, small hydro, geothermal and wind) (Kiplagat, Wanga & Li, 2011; Onuonga, 2012a). The choice of fossil and renewable energy sources for electricity generation can be traced to the economic plans for the Kenya's energy sector. In the 1980s, following an economic expansion drive by the Government of Kenya (GoK), Kenya recorded an unprecedented increase in the demand for electricity (Republic of Kenya, 2001b). At this time, the main source of electricity generation was large hydro with an insignificant contribution from coal and renewable energy (Kapika and Eberhard, 2013; Onuonga, 2012b). However, there were challenges with choice of large hydro as the principal source of electricity generation given that hydro was subject to frequent fluctuations in supply. The GoK made efforts to address not only the immediate electricity demands but also the future increase.

In a bid to ensure more access to electricity, Kenya made rural electrification programme one of the core pillars of sustainable development programme. With this approach, Kenya planned to undertake rural electrification as part of the comprehensive economic development policy whereby the programme will be used for measuring the economic performance of the country (Abdallah, Bressers & Clancy, 2015). Furthermore, the GoK embraced the promotion of renewable energy as part of the sustainable development strategies (Energy Act 2006a; Mabea, Macatangay & Mutua, 2018).

## Policy and regulatory framework for rural electrification in Kenya

In Kenya, the developments in law and the energy policy have played major roles on the uptake of renewable energy for rural electrification. Although the policy and the regulatory frameworks are historically biased in favour of fossil-fuel energy, the frameworks have nevertheless promoted rural electrification and renewable energy development. The Electric Power Act 1920 ("EPA") was the earliest legislation on electricity in Kenya. Based on the provisions of the EPA, Kenya established the Kenya Power and Lighting Company Limited (KPLC) as the first utility company in 1922 (Godinho & Eberhard, 2019). Structurally, the EPA created a vertically-integrated energy sector with KPLC performing core electricity functions (Kapika & Eberhard, 2013). The performance of electricity functions by the KPLC was, however, fraught with operational inefficiency. Grid connection and expansion projects were poorly executed, and this

contributed to the poor state of electricity access in the rural areas of Kenya (National Council for Law Reporting, 1982; Mwawughanga, 2005).

In 1973, the GoK launched the rural electrification programme (KREP) to address the challenges of electricity access in the rural areas (UNEP, 2017). The KREP aimed at providing subsidized electricity to the people in the rural areas, who were considered as not economically buoyant (Ministry of Energy, 2004a; Abdullah & Markandya, 2012). The programme though was under the supervision of the KPLC, there was no provision for the uptake of renewable energy in the EPA (Kareithi & Mutua, 2018). In 1986, the Kenyan parliament repealed the EPA and enacted a new law, the Revised Electric Power Act ("Revised EPA").

The Revised EPA did not introduce any significant changes to the operations of the KREP, and the development of renewable energy in particular. The operational inefficiency of the KPLC persisted thereby prompting a proposal for reforms. The proposed reforms of the electricity sector aimed at unbundling key electricity functions to make KPLC competitive. The Revised EPA was repealed in 1997 to pave the way for a law that would accommodate the proposed changes in the economic paper.

The enactment of the Electric Power Act 1997 ("EPA 1997") resulted in the separation of electricity regulatory functions from the policy functions (Onyango, 2013). Based on the provisions of the EPA 1997, the GoK established the Electricity Regulatory Board ("ERB") in 1998 as the electricity regulator. The ERB was responsible for setting electricity tariff, and for undertaking rural electrification (Electric Power Act, 1997; Onyango, 2013). The GoK introduced in 1998 a 5% levy on electricity consumptions to finance rural electrification projects (Ministry of Energy 2004b).

However, the KREP was a huge loss to the GoK given that about 80% of the revenue realised from the programme was being used to finance loss arising from the rural electrification programme (Ministry of Energy 2004c). For many years after the inauguration, the KREP barely achieved 4% electricity coverage and connectivity against 15% target for national coverage. The poor state of electricity access affected the commercial activities in the rural areas thereby aggravated the poverty rate among the rural population.

As a result of the poor outing, the GoK considered a further reform of the electricity sector in 2004 for sustainable energy production (Kenya Miniwind Project, 2018). The GoK then outlined 'the policy framework upon which cost-effective, affordable and adequate quality energy services will be made available to the domestic economy on a sustainable basis' (Ministry of Energy, 2004d). For the first time, Kenya acknowledged the need to promote the uptake of renewable energy in electricity generation.

Kenya shifted from a system that is predominantly fossil-based to one that favoured renewable energy (Kimuyu,

Mutua & Wainaina, 2012). The country set three main agenda for rural electrification under the sustainable development agenda, that is: (a) creation of a new body for rural electrification programme; (b) use of renewable for rural electrification; and (c) large-scale deployment of renewable energy resources (Ministry of Energy, 2004; Abdallah *et al.* 2015).

Additionally, Kenya planned to deploy off-grid technologies such as mini-grids and standalone systems for rural electrification (Hameedi, 2019). In 2006, Kenya enacted a new law, the Energy Act and, repealed the EPA 1997 and the Petroleum Act (Energy Act, 2006b). Based on the 2006 Energy Act, the GoK re-organised the rural electrification programme and established the Rural Electrification Authority (“Authority”) as the coordinator for the KREP. The Energy Act imposed on the Authority the obligation to deploy renewable energy technologies for electricity access in the rural areas taking into consideration the peculiar needs of each area such as the possibility of using renewable electricity for irrigation (Energy Act, 2006c; Kirai & Shah, 2009). For the first time in Kenya, there was a law that mandatorily required the Authority to deploy technologies that rely on renewable energy. In the aspect of funding, the Act provided for the establishment of the Rural Electrification Programme Fund (REPF) under the supervision of the Authority. The Authority applied part of the fund to support the uptake of renewable energy for improved electricity access (Energy Act 2006d). Following its creation, the Authority commenced the expansion of grid coverage across Kenya, even though the expansion could not be carried out in every part of the rural areas due to geographical constraints (Lee, Miguel & Wolfram, 2017). Kenya recorded successes in the operation of rural electrification given that the number of connectivity of customers in the rural areas had increased (Republic of Kenya, 2011c).

Kenya made a further progress in renewable energy in 2008 following the GoK’s approval of a long-term economic development blueprint tagged “Vision 2030”. By the Vision 2030, Kenya plans a transformation to an industrialised country by 2030 generating at least 18,000 MW from fossil energy and renewable energy sources (Kitenge & Siring, 2019b). In 2009, the Authority, in the exercise of its mandates, developed a 3-phased Rural Electrification Master Plan (Phase I (2008-2012), Phase II (2013-2022) and Phase III (2022-2030) to enhance rural electrification (Institute of Economic Affairs, 2015). However, the energy and economic development objectives of the Vision 2030 on the development of renewable energy and electricity access in the rural areas were not captured in the 2006 Energy Act. Consequently, a bill was introduced to the Kenyan Parliament to address the changes in the energy sector, and this was passed as the 2019 Energy Act. The 2019 Energy Act consolidates all laws on the Kenya’s energy sector and, repeals the 2006 Energy Act, the Geothermal Resources Act and the Nuclear Electricity Board Order (Energy Act 2019a). The

2019 Energy Act contains explicit provisions on rural electrification and the development of renewable energy. Specifically, the Act establishes the Rural Electrification and Renewable Energy Corporation (“Corporation”) to oversee rural electrification and renewable energy development (Energy Act 2019b). The Corporation, a hybrid body, replaces the Authority as the coordinator for the KREP. The Corporation implements and executes rural electrification projects in Kenya (Energy Act 2019c). Kenya is now regarded as having one of the best-served off-grid populations in the world.

Through the application of the REPF, Kenya has recorded increased use of off-grid renewables such as solar PV mini-grids as well as substantial progress in grid expansion in rural areas. Kenya has connected not less than 5.8 million households under the KREP (Kuo, 2017; Castalia & Ecoligo, 2017).

There are many on-going off-grid projects which are specifically designed to expand electricity distribution networks in Kenya (Mokveld and von Eije, 2018a). One such project is the Kenya Off-Grid Solar Access Project (OGSAP) that is being funded under the World Bank projects. Through OGSAP, the GoK will deploy mini-grids to provide electricity for people in remote communities who cannot be connected to the grid. In furtherance of this project, the GoK has approved a mini-grid regulation to provide modalities for off-grid electricity (Mokveld and von Eije, 2018b). Furthermore, the largest solar plant in Africa, the 50 MW Garissa solar power plant, is underway courtesy of the Corporation (CMS Legal 2021). While Kenya sets a 100% electricity access target by 2030, the available evidence shows that the country may achieve universal access earlier than planned Banerjee *et al.*, 2017).

From the law and the policy, a number of factors have contributed to the successes of Kenya in the uptake of renewable energy for rural electrification. First, rural electrification in Kenya is under the control of a body with dual power, that is, powers over rural electrification and the development of renewable energy. Unlike the Authority, the Corporation is obligated to “provide sustainable energy solutions for all through rural electrification and renewable energy for social economic transformation” (REREC, 2019). The Corporation’s powers that explicitly cover rural electrification and, the development and use of renewable energy. The grant of hybrid powers has enabled the Corporation to consolidate on what has been achieved by the Authority in the area electricity access through the deployment of renewable energy.

The Corporation have embarked on a number of off-grid projects, which are designed to support the expansion of the electricity access in the rural areas (Mokveld and Eije, 2018c). Furthermore, the Corporation, in consultation with the county governments, develops the electrification master plans which serve as a template for aggregating the energy need of the rural areas. Kenya is able to achieve this feat because there is a framework for

sustainable utilisation of renewable energy whereby the law mandates the Corporation to ensure the uptake of renewable energy. The Corporation is required by law to apply the principle of equity when developing the framework for the uptake of renewable energy by local people (Energy Act 2019e).

Secondly, in addition to the Corporation, there is an inter-ministerial advisory committee, that is, the Renewable Energy Resources Advisory Committee (Committee), which advises the Cabinet Minister on the use of renewable energy (Energy Act, 2019f). The Committee's advice covers the following areas: (a) determination of criteria for allocating renewable energy resources; (b) granting of licensing for renewable energy areas; (c) development of multipurpose projects; and (d) management of water and catchment areas; and (e) management of renewable resources (Energy Act 2019g). The idea is to ensure that the GoK and the county governments get the best advice on the optimal allocation and utilisation of renewable energy resources in Kenya.

Thirdly, the source of funding the KREP and renewable energy has expanded over the years. In Kenya, there are now two main sources of funding: the REPF and the CEF. Unlike the funding sources in the previous laws, the source of contribution to the REPF has gone beyond the conventional 5% rural electrification levy. Electricity levy imposed by the cabinet secretary, interest from bank deposits, money appropriated by the Kenyan Parliament and revenue from other sources (e.g. donations) now form part of sources for the REPF (Energy Act 2019h). The Corporation applies the REPF, and the new fund, the Consolidated Energy Fund (CEF), for the implementation of rural electrification projects.

The CEF specifically targets the promotion of renewable energy initiatives and, for the construction of energy infrastructures in Kenya (Energy Act 2019i). Of particular importance among the sources of funds for the CEF is money recovered as proceeds of crimes in the energy sector. What this means is that there are more funds for the execution of the rural electrification projects including renewable energy projects. In addition to the REPF and the CEF, the law empowers the Corporation to source for additional funds for the KREP and renewable energy development (Energy Act 2019j). So, Kenya maintains a strong link with multinational development institutions such as the World Bank, the African Development Bank, etc. to raise funds for rural electrification projects (Eberhard & Gratwick, 2007). Through the collaboration, Kenya has consistently mobilised funds for the expansion of the country's power system, particularly hydro and geothermal developments, in a bid to meeting the rising electricity demands. The International Finance Corporation, under the PV Market Transformation Initiative, for instance, invested not less than 5 million US dollars in the Kenya's solar PV between 1998 and 2008 (International Finance Corporation, 2021). Lastly, community participation is a major factor in the success or otherwise of a renewable energy projects in

Kenya (Equitable Origin, 2016). The practice has given the rural community the opportunity to have a say in any project to be executed in the rural areas, thereby minimising hostilities towards renewable energy projects (Kitenge & Siring, 2019c). Furthermore, the participation has served as a platform through which the GoK is addressing the inequality in electricity supply caused by centralised distribution system (Kitenge & Siring (2019d). Rural electrification projects in Kenya have benefitted from community engagement in the execution of renewable energy. In the past, some renewable energy projects failed in Kenya on account of hostilities from the community. The GoK at some point could not successfully complete the 90 MW Barahini Electric Wind Farm because of the hostilities from the host community (Sanga, 2016). The situation, however, later changed following community engagement on renewable energy projects undertaken by the GoK. The GoK has set up energy centres across the country, a practice that has helped in deepening community engagement in renewable energy in Kenya.

## Lessons for Nigeria From Kenya's Experience

### Lessons for Nigeria

Kenya appears to have a better approach to rural electrification and renewable energy development. Compared to the REP in Nigeria, KREP in Kenya has recorded progress in the uptake of renewable energy. Presently, Kenya is on the verge of actualising universal access earlier than the set date (Banerjee *et al.*, 2017). Some aspects of the KREP, which can serve as lessons for Nigeria regarding rural application of renewable energy, are discussed below.

### Creation of a hybrid agency

Nigeria can gain some experience from Kenya on how the creation of a hybrid body can aid rural application of renewable energy. In Kenya, the creation of the Corporation has ensured that the body that is saddled with supervision of rural electrification also has power to develop renewable energy resources. Setting up such a hybrid body in Nigeria will ensure that the body that coordinates rural electrification can also develop renewable energy for rural electrification projects. This practice is going to be a welcome development given that it will help to address the bureaucratic bottleneck associated with REA in obtaining approvals for renewable energy projects from the NERC and the Ministry of Power. In other words, it will minimise the delay whereby the REA will have to first seek and obtain approvals from NERC before executing renewable energy projects (e.g. approvals for the operation of mini-grids). Ultimately, this will make the coordination of rural electrification and renewable energy development less cumbersome.

In addition to a hybrid body, the establishment of a renewable energy advisory committee, similar to the Renewable Energy Resources Advisory Committee in Kenya, can also serve as a lesson for Nigeria. The proposed advisory body will advise the GoN on matters

relating to the allocation, management and licensing of renewable energy resources in various parts of Nigeria as it is being practised in Kenya. This will give Nigeria the opportunity to make use of the expertise of people who are versed in matters relating the development of renewable energy.

### Expanded funding sources

Given the poor state of electricity access coupled with what need to be done in the area of funding, Nigeria should consider making provisions for the expansion of funding for rural electrification. Nigeria should specify a portion of the funds which should be set aside for the uptake of renewable energy. Having a specific fund for renewable energy will go a long way in boosting the application of renewable energy for rural electrification in Nigeria. The addition of another funding source, similar to the CEF in Kenya, will further aid the development of renewable energy. Corruption has been an endemic problem of the Nigeria's energy sector. At some point in the past, the FGN has had to suspend the REP on account of corruption.

The FGN had to institute criminal actions against some individuals for the purposes of recovering money which has stolen from the energy sector (Sanni, 2021). So, having a funding source similar to the CEF will ensure that any recovered fund looted from the energy sector gets back to the sector. Doing this will go a long way in minimising the impact of corruption on the Nigeria's energy sector especially the rural electrification.

Another important issue that needs to be addressed in relation to funding is the allocation of funds for research. The FGN should ensure that a portion of the fund is applied towards research and development of renewable energy initiatives in Nigeria. This will address the challenges of shortage of qualified personnel.

### Setting up of an advisory committee

The operation of rural electrification in Kenya owes its success to the establishment of an inter-ministerial advisory committee whose works cover criteria for allocation and development of renewable energy resources. Nigeria should also consider establishing a body with similar functions. Given the fact that the body is an inter-ministerial body, this will help in bringing together experienced people from different departments of government for the purposes of proffering solutions to the challenges electricity access in the rural areas.

### Energy centres and community engagement

Another important lesson for Nigeria from the Kenya's experience is the promotion of community participation in the execution of renewable energy projects. Trying to connect more areas to grid electricity has been a major hindrance to electricity access in the rural areas in Nigeria. With community participation in Kenya, many rural areas have benefitted from the deployment of renewable energy resources in their respective areas for electricity

generation. Interestingly, community participation in renewable energy projects is now gaining increased awareness Nigeria (Butu & Strachan, 2022). This is good news as there will be more community initiatives such as community solar-powered street light, etc. Ultimately, the initiative will help to reduce reliance on grid electricity for access in the rural areas of Nigeria. Community participation will also enable the FGN to ascertain and cater for energy needs of rural areas in the national energy policy. Nigeria should set up energy centres in different parts of the country and use the centres as a platform for community engagement.

### A case for rural application of renewable energy

There is need for Nigeria to address the challenges of rural application of renewable energy in order to realise the goals of improving electricity access in the rural areas. Apart from improved electricity access, uptake of renewable energy in the rural areas will benefit Nigeria in many other areas. First, the introduction of renewable energy technologies in the rural areas can help to create dynamic rural communities. Renewable technologies offer new learning skills, which in turn require new learning capacity. The accumulation of the new skills is a necessary innovation for the transformation of the rural areas. The presence of different actors in the renewable energy chain is an opportunity for dynamism since there are many new things the communities can learn and apply (Hache, 2018). In some rural communities, solar power has been erected to generate electricity for use of the communities as an alternative to the regular electricity service provider. The involvement of the communities in this context does not necessarily mean that the communities will own the projects (Seyfang *et al.*, 2013). Rather, it provides additional platforms through which a number of organisational structures such as cooperative organisations, charities and trusts can partake in renewable energy projects.

Secondly, rural application of renewable energy will serve as an opportunity for Nigeria to explore decentralised energy system. Through decentralised energy system, Nigeria can significantly minimise the challenges of the centralised energy distribution system which has denied rural areas access to electricity. Moreover, the rural application of renewable energy will aid the application of local knowledge in proffering solutions to the challenges of community-owned renewable energy projects. This way, there will be opportunities for better energy solutions among the rural areas population. Community-owned renewable energy projects, in this context, refer to all activities relating to electricity generation using renewable energy technologies in a local setting rather than ownership by the community.

Thirdly, the promotion of rural application of renewable energy can lead to more investments in energy infrastructure and, as a consequent, more job opportunities for the people in the rural areas (OECD, 2012). Many unemployed people can learn and take up

employment in operation and maintenance of renewable energy equipment. Doing this will enhance the capacity of the rural areas for development including opportunities for human capital developments in the local context (Hick & Ison, 2018).

Lastly, the rural application of renewable can serve as an opportunity to earn additional revenue by people in the rural areas (OECD, 2012). Renewable energy infrastructures are predominantly land-based activities that require acquisition of land on a long-term basis. For these activities, renewable energy investors will have to pay rents to landowners to acquire land (UKA, 2021). Landowners, who have parcel of land that suits renewable energy projects, will be able take this as opportunities to earn extra revenue incomes.

## CONCLUSION

There are prospects for the uptake of renewable energy for rural electrification in Nigeria. Nigeria should, therefore, take steps to address the identified barriers to the rural application of renewable energy. Nigeria can do this by taking a cue from Kenya in some aspect of rural electrification. Nigeria should consider the establishment of a single body for rural electrification and renewable energy development. Such a hybrid body will be better placed to undertake renewable energy projects alongside rural electrification projects. The law should specify the minimum renewable energy component in the rural electrification projects.

The experience of Kenya regarding funds for renewable electricity is an important lesson for Nigeria. Nigeria should consider expanding the sources of funding for the REF to include money recovered from corruption cases in the energy sector. In addition, Nigeria should consider setting up of a dedicated fund that is similar to the CEF in Kenya. This will help to ensure that looted fund finds its way back to the energy sector through rural electrification. Community participation is another areas that Nigeria needs to consider. This is of particular importance in view of the level of mistrust between local communities and the FGN on ground of marginalisation (Aderinoye-Abdulwahab & Adefalu, 2012). The promotion of community participation can also serve as a platform for educating the people of the rural areas on the benefits of off-grid electricity projects. Above all, the FGN should ensure that the recommendations are adapted in a way that the peculiar situation of Nigeria will be carefully addressed. At a minimum, Nigeria can amend the EPSR Act to capture the recommendations of this paper (Lawal, 2021).

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