A roadmap for energy transition strategic planning and governance: a case study of Nigeria's grid-based renewable electricity sector.

ADEDOKUN, R.F.

2024

A Roadmap for Energy Transition Strategic Planning and Governance

A Case Study of Nigeria's Grid-Based Renewable Electricity Sector

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A thesis submitted in partial fulfilment of the requirements of the Robert Gordon University for the Degree of Doctor of Philosophy

Aberdeen Business School
The Robert Gordon University, Aberdeen
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January, 2024

Declaration of Authorship

I declare that this thesis, to my knowledge, is solely the work of the named author and all sources have been cited and acknowledged in the reference list. This thesis is submitted in partial fulfilment of a Doctor of Philosophy at the Aberdeen Business School, Robert Gordon University. This thesis or a part can be used for academic or non-commercial research purposes.

Dedication

I dedicate this thesis to God almighty for His undying love and preservation throughout my research. Also, to my amazing family for their support during my study, my encouraging husband, Oluwasegun Adedokun, and my delightful daughter, Beverly Adedokun, whose unwavering support led to the completion of this thesis.

Acknowledgements

I thank God almighty, who has made this possible. I thank him for his graciousness, strength, wisdom, knowledge and guidance throughout my PhD journey.

Words cannot express my gratitude to my supervisors, Prof. Peter Strachan and Dr. Anita Singh, for their patience, support and feedback. Special gratitude goes to Aberdeen Business School Robert Gordon University for sponsoring the last phase of my doctoral research. I am immensely grateful to Prof. Elizabeth Gammie and Dr. Omaima Hassan for believing in me and making this possible.

I appreciate the support of the graduate school, Nick Anderson, Martin Simpson, Paula Sledzinska, Prof. Andrew Lamb, and the research degree coordinator, Dr. Omaima Hassan, who have positively impacted my success. I would also like to thank Alison Orellana for her continuous welfare and support throughout the process.

Special thanks to my darling Husband and delightful Daughter. This endeavour would not have been possible without their understanding and unwavering support, additionally to my family, especially my parents, Deacon and Deaconess Ojo, and siblings Elizabeth Amao, David Ojo, Samuel Ojo and Kehinde Ojo, whose belief in me and continuous prayers and encouragements kept me going during the journey.

I would also like to thank my colleagues at Robert Gordon University who had encouraged, inspired and impacted me positively; special thanks to Prof. Rhona, Prof. Zoe Morrison, Prof. Heather Fulford, Dr Ama Lawani, Dr Adekunle Oke, Jane Innes, Dr Moira Bailey, Dr Imaobong James, Dr Ayodele Asekomeh, Dr Stephen Isa, Dr Ian Broadbent, and Dr Ebuka Ibeke.

My appreciation goes to my friends Saidu and Melody Mamman, Lolade and Kunle Okunrinboye, Nouman Naseem and Mrs Crown. Thank you for your continuous support. I am also grateful to my friends and colleagues at Robert Gordon University: Diana Byonge, Ahsan Jawad, April Cuffy, Edith Dinkpa, Joseph Ogunyemi, and Benita Ize-Iyamu.

I also appreciate all of the research interview participants. The research was only successful with your input.

I cannot mention all who have contributed positively to my research and led to successful completion, but I thank you.

Abstract

The global drive for energy transition has resulted in Nigeria formulating energy policies to incorporate about 30% of new renewable energy sources into the planned 30GW of electricity generation by 2030. This is principally because deploying renewable energy on the national grid provides succour to the complex dual energy issues of access and poverty currently experienced in Nigeria, promoting the reduction of greenhouse gas emissions and enabling Nigeria to fulfil the Paris Agreement's commitments. However, from the literature, there has not been new grid-based renewable energy development in the country despite the Renewable Energy Master Plan, which initiated the pursuit of novel renewable energy (solar and wind) development, including other policies and policy mechanisms formulated to encourage the grid-based transition. Moreover, the ineffectiveness of the governance and the decision-making frameworks for addressing the challenges of the electricity sector, especially the stakeholders' involvement, is a debate in the literature and topical among experts and the academia. Transition theories have been widely applied to navigate these challenges which was developed not in the context of developing countries with energy challenges and institutions that are not matured. This study contributes to transition studies by fusing accountability and transparency concepts and applying these to the context of a developing country which is identified in the literature as limited. Therefore, this research aims to assess the renewable energy planning process and governance for sustainable development and recommend a roadmap model for implementing strategies on grid-based renewable energy electricity generation in Nigeria.

The study adopts a socio-technical transition perspective underpinned by the Multi-Level Perspective and the Transition Management Framework supported by the accountability and transparency concepts to resolve these issues. An interpretivist paradigm and a case study strategy were employed with a qualitative approach, which was analysed inductively. Thirty-one (31) semi-structured interviews of energy and non-energy actors and experts and a review of the extant academic literature from the energy industry and other sources of information were carried out. Additionally, thematic analysis through NVivo Software was used for data analysis. The findings from the study have implications for policymakers and planners in developing a governance framework to promote the transformation of energy systems to cleaner technologies in developing nations.

This study argues that there is a need to protect renewable energy niche innovation by providing an enabling environment for the growth and maturity of the technology. Also, the findings show that socio-technical landscape pressures from electricity demand on the existing regime and the grid system's multifaceted challenges have created niche development opportunities. However, the strong incumbent socio-technical regime, the system's inefficiency, conflicting multiple actors' interests and the government's petroleum subsidies and policies reinforce the incumbent regime (technology lock-in). Furthermore, the transition needs to be adequately managed by a designated agency to foster transition, transparency and accountability, which was found to be sub-optimal, as there is no dedicated agency handling grid-based renewable energy implementation. A conceptual framework was developed from the study’s findings and roadmap model was created for implementing strategies for grid-based renewable energy electricity generation as guide for planners and policymakers. This study also provides a sound basis for other nations with similar technological, economic, cultural, socio-technical and political concerns to Nigeria.

Key words: Renewable energy; Electricity; Strategic planning; Energy transition governance; Socio-technical transition; Transition management; Multi-level perspective; Accountability and transparency; Developing countries; Nigeria.

Table of Contents

List of Figures

List of Tables

CHAPTER ONE: RESEARCH BACKGROUND AND OVERVIEW

1.1 Introduction

This chapter presents the background and rationale for the study. The research problem is discussed with a clear aim, objectives and scope of study defined. Furthermore, the set of objectives is presented as research questions, which this study addresses. A summary of the research method and the methodology is presented, including the theoretical underpinning of the study. Finally, the chapter concludes by describing the structure of the thesis.

1.2 Background of Study

Energy security has been of concern globally, generating more focus in recent studies, especially on the supply side of energy (Axon and Darton 2021; Mara et al. 2022). Energy security definition has been more dynamic and evolving in recent times (Azzuni and Breyer 2018). Kuzemko et al. (2020) defined energy security as low susceptibility to essential energy systems. However, there have been increased energy insecurity challenges in different forms in several countries and regions. According to the IEA World Energy Outlook, about 754 million people were without electricity in 2021 (IEA 2022a), accounting for 10% of the world's population without energy access (IEA 2022a) and 75% of the sub-Saharan African population without electricity access with a slow decline. However, Covid-19 has set the trajectory of energy access in sub-Saharan Africa in the opposite direction. Thus, in Nigeria, despite being the 'giant of Africa', energy insecurity is prevalent as a result of low energy access and energy poverty in the rural and urban areas, insufficient electricity supply and electricity outages, impeding socio-economic progress in the country (Nwozor et al. 2021).

Several studies have highlighted the impact of global warming and climate change in revolutionising energy transition to meet the growing energy demand exacerbated by increased population. According to the United Nations (UN) (2022), the world's population is projected to be about 9.7 billion by 2050, which will require energy for survival. Moreover, there is a need to tackle environmental health risks impacting humans due to air pollution, which the United Nations Environmental Programme (UNEP) estimates kills about 7 million people yearly, with significant effects in developing nations (UN 2019). Existing studies argue that energy transition should address these issues (Bogdanov et al. 2019; Jacobson et al. 2019).

A review of scientific papers shows that more than 99% of scientists agree that global warming is caused by anthropogenic climate change (Lynas, Houlton and Perry 2021). Oreskes (2019) and O'Brien (2019) argue that climate change denial in society is influenced by individuals' ideology and political concerns and aver that there is a need for collaboration within the political and scientific community to accelerate tackling climate change issues. Against this backdrop, the Paris Agreement treaty was signed by 196 countries with their Nationally Determined Contribution (NDC) targeted at reducing greenhouse gas emissions to "keep global warming below a 2°C increase by the end of the 21st Century and pursue efforts to limit the temperature rise to 1.5°C" (IPCC 2021). Climate-change-induced events have taken various forms globally, such as melting glaciers, wildfires and flooding, which create a climate emergency (UN 2022). The energy sector has been identified as the primary emitter of greenhouse gas

(GHG) (OECD/IEA 2015), accounting for 90% of global carbon dioxide (CO_2) (IEA 2019a), resulting in the drive to fulfil the Paris Agreement by decarbonising existing energy systems which is largely dependent on conventional oil and gas sources (Ruggiero, Varho and Rikkonen 2015; Rocholl and Bolton 2016; Rogge, Kern and Howlett 2017).

Nigeria is a signatory of the Paris Agreement, though the country is a crude oil-producing and exporting country, and the energy system is dominated by oil and gas sources (Elum and Momodu 2017; Adeniyi 2019; Ojo, Awogbemi and Ojo 2020). Although Nigeria's current GHG emissions account for 0.27% of world emissions (Knoema Corporation 2019), it is pertinent for the country to consider cleaner energy sources for sustainable development. There are projections that the existing population will double by 2050 (Cookson 2019; IEA 2019b); therefore, energy demand and consumption will increase as CO_2 emissions, especially if unsustainable means are adopted to satisfy this demand. Nigeria is faced with energy security issues and the need to address climate change. Therefore, tackling these two challenges has been central to Nigeria's electricity sector for the past two decades (Ovwigho 2020; Nwozor et al. 2021).

To set the context of this study, this research is centred on Nigeria, a country in West Africa with the largest GDP on the continent and has been an advocate for climate change mitigations (Ujumadu 2018). The country is a major fossil fuel exporter and has abundant other energy sources (renewable and non-renewable). However, it faces electricity challenges, low energy supply and access (Dada 2015; Monyei 2018). Concerning energy supply, the national grid supplies most electricity to the populace, mainly through gas and hydro sources. However, the country is plagued with energy poverty: the populace connected to the grid experience erratic electricity and blackouts owing to inadequate electricity generation, infrastructural dearth and so on (Butu 2017; Osu 2017; Ovwigho 2020). This has had a ripple effect on the socio-economic development of Nigeria. Hence, there are opportunities for the country to resolve the electricity challenges and develop economically by incorporating renewable energy technology into the energy mix (UNFCCC 2020). Also, regarding access, only about 40% of the populace has a direct connection to the national grid, leaving the remainder to satisfy their energy need by using generators powered by fossil fuel, resulting in pollution and health challenges (IEA 2019b). The electricity supply is currently unable to reach the country as the population growth rate is faster than the reach of electricity access (Dada 2015; Ovwigho 2020; IEA 2022a).

Moreover, these issues are more concentrated in rural areas, which have had to seek alternative solutions that are harmful and constitute a health and environmental hazard (Butu 2017). Similarly, 35% of the urban area has no access to electricity, despite proximity to the national grid, and this constitutes residential and industrial estates, thereby relying totally on fossil-based generators for electricity, resulting in higher electricity consumption costs (NINDC 2015; Elo 2018; IEA 2020a). This earned the country the tag as a top importer of generators in Africa (Adesina 2012; Rosel 2014; Omojola 2015; IEA 2020b). Hence, this research primarily focuses on increasing electricity generation in Nigeria by introducing renewable energy (solar and wind) to the grid.

As part of the effort to reduce GHG emissions, the Nigerian government embarked on renewable energy development, which is also an element of the

NDC. The agreement document maintained that Nigeria would achieve the aims to reduce emissions by 20% and progress to 45% by 2030 with financial aid and support promised to developing nations to mitigate climate change impacts (NINDC 2015). Furthermore, the document covered other aspects of optimising energy efficiency by 20% and installing 13GW of decentralised energy systems to reach the unserved rural community. Others include upgrading the national grid, encouraging green agriculture and expanding mass transit (NINDC 2015). However, the obligation did not clearly articulate the plans for electricity generation relating to the grid, but the progress of the national grid is pivotal to demonstrating the achievement of the unconditional obligations, which will have a ripple effect in unlocking the conditional support. Hence, to achieve the requirements of the conditional obligations, grid-based electricity is required.

Accordingly, it is essential to note that policies were created to include renewable energy technologies (solar and wind) to tackle the electricity generation challenge in Nigeria as stated in the National Strategic Development Plan (Vision 20:2020), which was created in 2006 and superseded by the Vision 30:30:30 in 2016 and incorporated into the National Renewable Energy and Energy Efficiency Policy (NREEEP). Importantly, accelerating and achieving the milestones of renewable energy policies on the national grid will encourage the release of external funds for the country to achieve the promise of reducing emissions by up to 45% by 2030, provided all other terms of the agreement are met (NINDC 2015; NREEEP 2015).

Over the last two decades, initiatives and policy activities have been targeted at maturing the on-grid and off-grid renewable electricity generation (REA 2020). Table 1 captures these various elements.

Table 1: Current strategies, policies, programmes and regulation on renewable energy (Author).

S/N	Document Title	Year	Due
1	National Electric Power Policy (NEPP)	2001	
2	National Energy Policy (NEP)	2003	2043
3	National Economic Empowerment and Development Strategy (NEEDS)	2004	2007
4	National Power Sector Reform Act (EPSRA)	2005	2020
5	Renewable Electricity Policy Guidelines (REPG)	2006	2010
6	Renewable Electricity Action Programmes (REAP)	2006	
7	National Biofuel Policy and Incentives	2007	2020
8	Vision 20:2020	2010	2020
9	Roadmap for Power Sector Reform, 2010, 2013 (Update)	2012	2030
10	National Adaptation Strategy and Plan of Action on Climate Change for Nigeria (NASPA-CCN)	2012	2050
11	Renewable Energy Master Plan, 2005, 2012 (Update)	2013	2030
12	National Renewable Energy and Energy Efficiency Policy NREEP	2015	2030
13	Draft Rural Electrification Strategy and Plan (RESP)	2015	2040
14	Intended Nationally Determined Contribution (INDC)	2015	2030
15	Vision 30:30:30	2016	2030

The National Renewable Energy and Energy Efficiency Policy (NREEEP) is Nigeria's current overriding policy for renewable energy development, incorporating elements from previous policies but with later target dates. Notwithstanding all these policies, strategies and plans, it has not been able to trigger and accelerate the necessary transition on the grid as there are no new grid renewable energy technologies (solar and wind) installations to date (Ohunakin et al. 2014; Ozoegwu Mgbemene and Ozor 2017; Adeniyi 2019). Also, most policies were not achieved and replaced with new ones.

The literature has documented various challenges to transition in Nigeria, including inefficient renewable energy planning process, governance and accountability challenges. Others include technological challenges, unaligned policies, lack of political will, insufficient investment, stakeholder misalignments, market-related concerns and issues relating to research (Edomah, Foulds and Jones 2016; Adeniyi 2019; Gungah, Emodi and Dioha 2019).

Existing studies have investigated and addressed these issues comprehensively, from techno-economical, policy and energy systems; however, there is a dearth of literature investigating governance and strategic planning (Edomah, Foulds and Jones 2017; Adesola and Brennan 2019; Idowu, Ibietan and Olutokun 2019; Nwozor et al. 2021). Some research in the deployment of renewable energy was reviewed under the policymaking and governance viewpoint (Edomah, Foulds and Jones 2016; Gungah, Emodi and Dioha 2019), renewable energy-based communities (Butu 2017), related to transitioning to a lower carbon system and evaluating the NDC impacts (Dioha and Kumar 2020), relating to solar thermal sources (Akinyele et al. 2019) and providing a solution for the off-grid electricity system and resolving governance concerns (Sheba and Bello 2020). There is extensive literature on Nigeria's national grid and electricity generation challenges. However, there has yet to be any empirical investigation found specifically focused solely on investigating grid-based renewable energy planning processes and governance. Also, no research has been found that expressly incorporated accountability and transparency in renewable energy planning and governance processes at the national level.

Hence, to address the challenges of developing renewable energy on the Nigerian national grid, this study seeks to assess the renewable energy planning process and governance for sustainable development in Nigeria and propose a roadmap for implementing the grid renewable energy strategy. The Multi-Level Framework (MLP), Transition Management Framework (TMF), and the accountability and transparency concepts underpinned this research. A qualitative research method is employed using semi-structured interviews administered to the electricity sector actors and non-actors.

The remainder of this chapter is structured as follows: first, the research problem is stated, followed by the research rationale; the research aim and research objectives with the research questions are presented and, subsequently, a summary of the research method and methodology and scope of the research are discussed. Additionally, MLP, TMF and accountability and transparency concepts are introduced as the theoretical underpinning of the research. Moreover, the justification for the research is elucidated. Finally, the chapter concludes by describing the structure of the thesis.

1.3 Research Problems

Globally, about 754 million people have no access to electricity as of 2019 (IEA 2022a). However, there are about 580 million people without access to electricity in the African continent (IEA 2022b). According to the IEA World Energy Outlook, this figure has increased due to the COVID-19 pandemic's impact on the continent (IEA 2022b). For instance, 74% of the sub-Saharan African populace without access to electricity has increased to 77% of the global population (IEA 2022b), with Nigeria having a 10% share of the global population (IEA 2020). With this in mind, the first installation of electricity in Nigeria started in 1896 in Lagos colony, currently Lagos State (Awosope 2014). However, electricity connection through grid transmission commenced in 1951, integrating Ijora and Ibadan power stations before extending to other parts of the country (Awosope 2014). However, since 2000, the country has experienced unstable electricity from the transmission lines and a vast amount of Nigerians are not connected to the grid, especially in the rural communities (Dada 2015; Ovwigho 2020). Therefore, the government engaged in various reforms to deal with these issues. Monyei et al. (2018) postulate that a huge step taken to tackle these challenges was the privatisation of the National Electric Power Authority (NEPA), wholly owned and controlled by the government, to include private companies in the electricity value chain except transmission. Nevertheless, the country remains challenged infrastructurally, with an unreliable grid, loss in the electricity value chain and lack of funding and financing (Edomah Foulds and Jones 2016; Monyei et al. 2018; Leke and Sibanda 2019).

The IEA report in 2020 shows that, although the country has a large energy capacity, electricity generation remains low. The report further indicated that the current generation capacity in Nigeria is 12.5 GW, but the actual generation is about 4 GW, which cannot meet the 6 GW demand for electricity. This can be compared to the average power generated of 28.8 GW in South Africa, 22.1 GW in Egypt and 23.3 GW in the UK, despite having lower population sizes. For instance, the estimated population in 2022 were about 59.9 million in South Africa, 111 million in Egypt and 67 million in the UK, comparable to Nigeria's estimated population of 218.5 million. Similarly, Nigeria's per capita electricity consumption remained low at 0.2 TWh/capita compared to 4.0 TWh/capita for South Africa, 1.6 TWh/capita for Egypt and 4.8 TWh/capita for the UK. Furthermore, Nigeria's energy access is 60%, which is comparatively lower than 89% for South Africa and 100% for Egypt and the UK (IEA 2020).

Conversely, Nigeria's population has increased by about 78% since 2000 to aggravate the country's electricity generation deficiency. According to the Financial Times, the population is projected to double by 2050 (Cookson 2019), with a population growth rate of 2.62% per year (Worldometer 2020). Also, there is significant pressure on the need to increase the existing electricity generation capacity, as Woodmac (2019) projects that energy demand will rise by 64% from 2020 to 2040. The existing electricity issues have impacted Nigeria's economy and advancement (Leke and Sibanda 2019; Ovwigho 2020). Hence, Nigeria's citizens have resorted to fossil-fuel generator usage, which has enormous disadvantages, including CO_2 emissions (Adesina 2016). Figure 1 depicts that the electricity supplied has remained relatively the same over the years, with the Figure showing that changes in supply from 2005 to 2019 are insignificant. For instance, the highest electricity generated was about 9,000 MW in 2015; however, this state was not maintained due to vandalism of gas pipelines (CEIC 2020). Furthermore, even with the improvement seen in recent years, as shown in Figure 2, the maximum generation is about 9,500 MW, which is low compared to the increased population and demand in that same period.

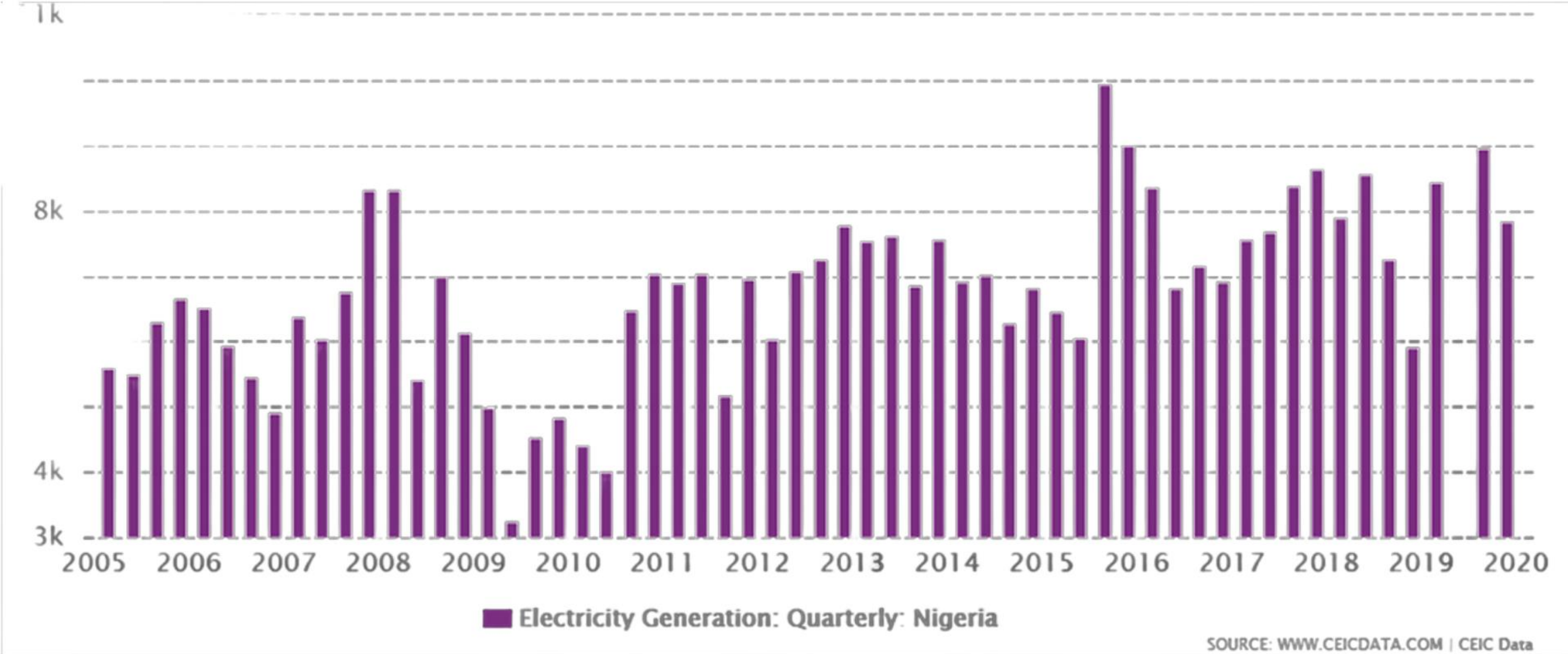


Figure 1: Nigeria electricity generation from March 2005 to December 2019 in MW (adapted from CEIC 2020)

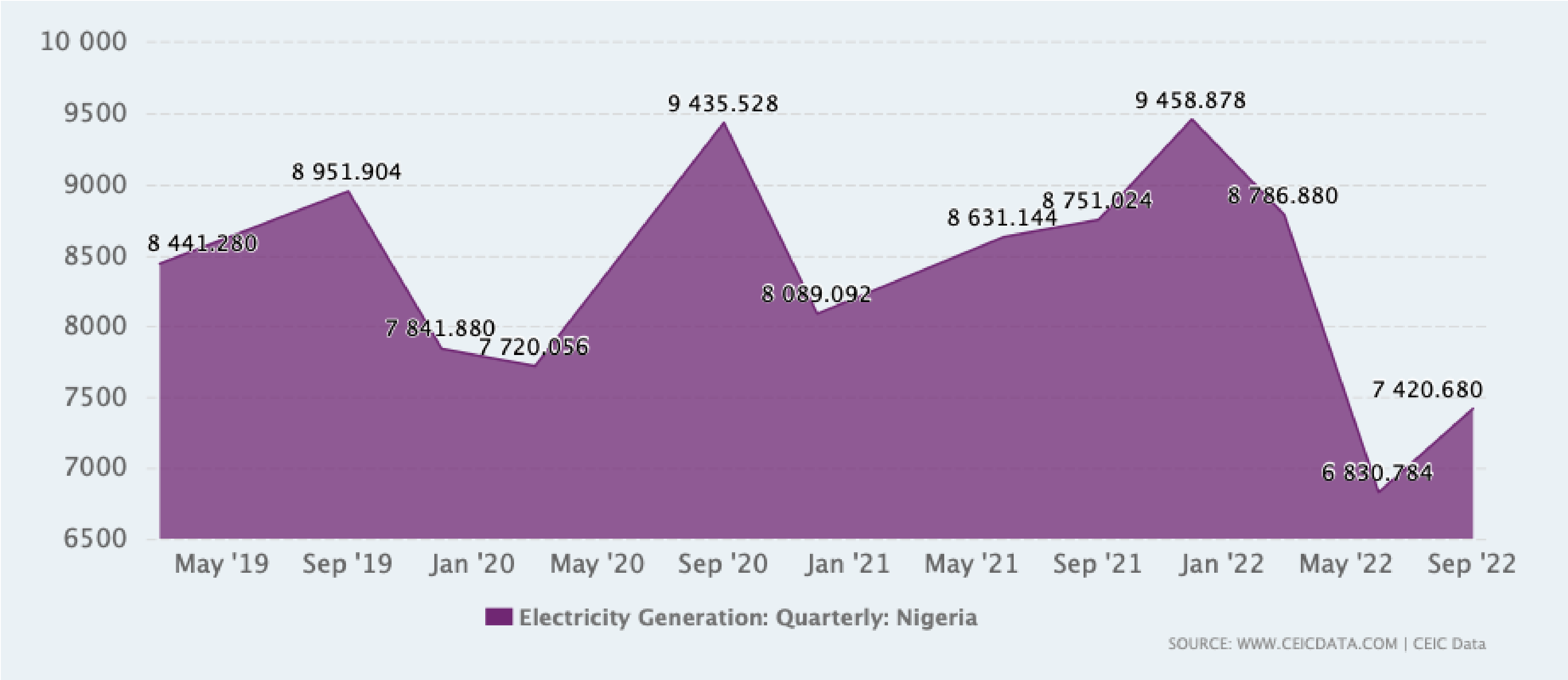


Figure 2: Nigeria electricity generation from March 2019 to September 2022 in MW (adapted from CEIC 2023)

From the literature, the Nigerian government's involvement in the Transmission Company breeds challenges in the company's running. Other issues are the lack of political continuity, control and transparency resulting in reworking and remodelling of policy systems, which impacts the grid-based electricity planning process. Research has highlighted that corruption is deeply rooted in Nigeria even so that it is now apparent to everyone, both government and individuals, especially its consequence on the economy (Awojobi 2014; Agbo 2015).

Renewable energy was embraced in Nigeria to salvage infrastructural dearth and inadequate electricity generation (Butu 2017; Osu 2017) and ensure sustainable development. Hence, renewable energy policies were developed to encourage RE development on the national grid (NREEEP 2015). Specific plans, strategies and policies that encourage grid renewable energy development are captured in Table 2. The documents are mainly developed by the Energy Commission of Nigeria (ECN) responsible for energy strategic planning and management. ECN has created the Power Sector Recovery Programme (PSRP), enforced with the other documents below. Vision 30:30:30 and the NREEEP target 30% inclusion of renewable energy sources on the national grid by 2030 (Vision 30:30:30 2020; NREEEP 2015) to diversify the electricity mix, which is currently made up of 85% from thermal plants and 14% from large hydro plants (Gungah, Emodi and Dioha 2019).

Table 2: Strategic plans for Nigeria's renewable electricity generation sector (Author).

S/N	Strategic Plans	Descriptions
1	Vision 30:30:30	To contribute about 30% renewable energy in the available electricity mix
2	National Renewable Energy and Energy efficiency Policy (NREEP)	To improve energy security and increase power output at least 2,000 MW of electricity
3	Rural Electrification Strategy and Implementation Plan (RESIP)	To expand access to electricity as rapidly as possible in a cost-effective manner; use of both grid and off-grid approaches
4	Nationally Determined Contribution (NDC)	To reduce greenhouse gas emission by 20% unconditionally and 45% with international support
5	National Adaptation Strategy and Plan of Action on Climate Change for Nigeria (NASPA-CCN)	To take action to adapt to climate change by reducing vulnerability to climate change impacts and increasing the resilience and sustainable wellbeing of all Nigerians

Furthermore, to address the grid electricity concerns, the new policies and policy mechanisms introduced, such as regulations for meter provisions, decentralisation of electricity generation by allowing direct flow from generating companies to some consumers and a feed-in tariff system. However, the fourteen Solar PV companies who signed Power Purchase Agreements (PPA) in 2016 are yet to commence work due to challenges from not being able to conclude the Put-Call Option Agreement (PCOA) (see Glossary) and receive the Partial Risk Guarantee (PRG) (see Glossary) (NESP 2015; Adeniyi 2019). This justifies the call for upgrading current RE policies' governance and planning process by incorporating accountability and transparency to solve the hitherto complex challenges hampering the development of the grid-based electricity sector and aid transition. Therefore, this study focuses on assessing the renewable energy planning process and governance for sustainable development to determine the barriers, drivers and enablers for developing grid-based renewable electricity generation in Nigeria and developing a roadmap model to facilitate the transition.

1.4 Rationale for the Study

This research focuses on Nigeria due to the persistent electricity supply challenges experienced in the country and the urgent need to resolve this issue by introducing renewable energy on the national grid. Additionally, this research aims to meet the present and growing demand from population growth, modernisation and industrialisation, energy security and climate change considerations. A case study approach is adopted, with the grid-based electricity sector selected as the case reference due to the persistent and peculiar challenges in the sector for renewable energy development. Also, despite the continuous effort to introduce renewable energy on the national grid, there has not been any success. Furthermore, several reforms are currently being carried out to actualise the country's goal of constant electricity.

However, the transition to renewable energy technology has become difficult because of the complex nature and structure of the grid and the various levels of bureaucracy involved in governance and management. Therefore, it requires a different level of thinking to resolve. Including the government as a stakeholder complicates the system; it is still difficult to steer the transition toward RE development in Nigeria, even with other private entities. Thus far, the planning process and governance approach are considered futile in addressing actors' varying roles and objectives and maintaining transparency (Akuru and Okoro 2014; Edomah, Foulds and Jones 2016). Additionally, RE policies have not been effective at triggering the required transition; hence, the rationale for assessing the renewable energy planning approach and governance for sustainable deployment is to determine the enablers and inhibitors for grid-based renewable electricity generation in Nigeria and develop a model that can facilitate the successful implementation of strategies for RE development on the national grid. This will involve assessing a more suitable approach to managing and coordinating such externalities and wider stakeholders of the RE grid-based transition in Nigeria.

The transition theory and accountability and transparency concepts underpin this research. The research employs the Multi-Level Perspective (MLP) and Transition Management Framework (TMF), extensively utilised to assess transition process and governance. The transition to renewable energy involves overhauling the infrastructural systems to accommodate the new energy systems and their complexities (Geels 2018). This has been studied using different lenses and categories, such as socio-technical systems (Kern and Smith 2008; Geels 2018; Batinge, Musango and Brent 2019). Furthermore, several authors have assessed this socio-technical system: Wesseling, Bidmon and Bohnsack (2020) considered it from vehicular changes from petrol/diesel to battery-powered engines. It was also studied by Ansari and Garud (2009) in the telecommunication sector, while El Bilali and Allahyari (2018) evaluated transition in the food systems.

From the literature, the energy industry focused primarily on the changes in energy systems for sustainable growth and development (Bogdanov et al. 2019). Child et al. (2019) and Hansen, Breyer and Lund (2019) reviewed the possibility of having 100% renewable energy-powered cities by 2050. Also, Markard, Sutter and Ingold (2016) studied the relationship that must occur for the successful implementation of renewable energy development within the socio-technical and political systems.

Similarly, Doukas et al. (2008) reviewed the critical elements of policymaking in the energy sector. They attested to its importance for the sector's expansion, highlighting the importance of including all stakeholder preferences. Also, Li and Strachan (2019) elaborated that a lower carbon system can be achieved through government directives or market forces acting together or singularly. Likewise, the renewable energy transition in the United Kingdom on a community level was reviewed by Strachan et al. (2015). This was done to understand the importance of community-level energy for electricity supply in the UK.

Most literature reviewed, published in the West, evaluated energy transition using transition theory (Kern and Smith 2008; Rogge, Kern and Howlett 2017; Geels 2018; Batinge, Musango and Brent 2019). Furthermore, most countries, especially in Europe, are working out strategies for a full-scale transition of their energy infrastructure, including making the environment suitable for such transitions (Bogdanov et al. 2019). Hence, the transition theory is adopted to assess Nigeria's RE planning process and governance. The transition from the dominant electricity sources (hydro and gas) requires transforming the existing energy system, which requires the interaction of society and RE technology, which has inherent complexity. Thus, transition theory directs how this RE transition can be navigated.

Recently, transition studies experts have been targeting achieving a sustainable energy system (Kern and Smith 2008; Geels 2018). Lachman (2013) concluded that this transition is unique because of its complex nature; extrinsic factors do not fix or impact the pathway. This implies that its control is distinct but can only be steered or accelerated (Kemp and Loorbach 2003). In the same vein, Smil (2010) and Sovacool (2016) argued that transitions of large-scale socio-technical systems like the electricity system could be slow or rapid in transition. Several studies utilised socio-technical concepts to understand the complex relationships between society and technology, such as renewable energy (Geels 2002, 2004 and 2018). Books that depict this kind of visible impact for the type of relationship that occurs in the energy sector for societal, technical and framework changes are typically published in Western countries like the Netherlands, United Kingdom and the USA (Kern and Smith 2008; Strachan et al. 2015; Batinge, Musango and Brent 2019). The structure of the planning process is critical to energy transition (Li and Pye 2018). Markard, Suter and Ingold (2016) established that strategic and sustainable objectives are critical to displacing socio-technical transitions (Rogge, Kern and Howlett 2017). The socio-technical transition pattern can be slow and not as fast as expected, which leads to ensuring that governance and planning processes are not jeopardised (Geels 2002, 2004, 2018). This is to ensure that the transition is flexible, durable and viable (Batinge, Musango and Brent 2019), similar to what is obtainable in the Nigeria energy sector.

Existing literature has explored various approaches to navigating uncertainties and overcoming energy systems transformation inhibitors. Li and Pye (2018) argue that social and political uncertainties and dimensions influence decisions on the transformation of energy systems. However, Oyewo et al. (2019), Child et al. (2019) and Castrejon-Campos, Aye and Hui (2020) aver that other dimensions of uncertainties should be incorporated into decision-making analysis beyond technology and economic drivers. Ruggiero, Varho and Rikkonen (2015) also emphasised the need for institutional reforms, stakeholder participation and overcoming the impediments to accelerate transitions. These are elements that Castrejon-Campos, Aye and Hui (2020) addressed in the study focused on adaptive policy for transition. However, the qualitative and quantitative approaches made the model complex for policymakers to understand.

Conversely, Rogge, Kern and Howlett (2017) advocate for policy mechanisms to drive transitions to be diverse and argue that a quantitative approach to policy mixes literature needs to be incorporated. However, societal interactions with technologies, stakeholders' role, and their beliefs are pivotal in the energy transition policy domain (Markard, Suter and Ingold 2016). Markard et al. (2020) posit that accelerating sustainable transition experiences coordination issues relating to governance and policy. Sawulski, Gałczyński and Zajdler (2019) argue that knowledge transfer across countries depends on the identity as followers or pioneers and the capacity to accommodate new learnings. Since most countries are behind in meeting targets for emission reduction, Andersen et al. (2023) aver that future research could focus on exploring tipping points for transition, multi-system relationships, and the system variance, including policy failures focussed on the role of policy bubbles and smokescreens to accelerate the transformation of incumbent systems to achieve net zero. Therefore, optimisation of the energy mix must be accompanied by good governance and policies for a successful transition.

There are only a few studies on the governance of grid-based renewable electricity generation in developing countries compared to advanced countries (Rocholl and Bolton 2016; Gaspari and Lorenzoni 2018; Karanasios and Parker 2018) with excess electricity generation, societal advancement and matured institutions dissimilar to Nigeria. Much research has reviewed the transition governance in African energy systems. For example, Dagnachew et al. (2020) considered the impediments and elements of the devolved energy system governance, which are fairly the same throughout sub-Saharan Africa and are apathetic due to the hierarchical structure. However, Nigeria includes the private sector in electricity generation, especially on the grid and existing literature with a view on the Nigeria energy system are for policies geared toward sustainable transition (Ajayi and Ajayi 2013; Ohimain 2013; Adesola and Brennan 2019; Gungah, Emodi and Dioha 2019), opportunities for renewable energy deployment (Mas'ud et al. 2015), and community-focused renewable energy (Butu 2017; Gungah, Emodi and Dioha 2019). However, none of the studies assessed grid-based RE's planning process and governance. Hence, this research makes a novel contribution to the RE transition planning process and governance to successfully implement RE on the national grid.

Accountability and transparency support this research's theoretical underpinning and are essential for government initiatives (Osho and Afolabi 2014; Gberevbie et al. 2015). Accountability measures the "responsiveness and answerability" of authority figures to society (den Boer 2002; Mulgan 2003; Mulgan 2000; Bovens 2010), which ensures the institutions do not act outside of written agreed statutes (Chandler and Plano 1988; Odugbemi 2008; Gberevbie et al. 2015). Therefore, a community without accountability is prone to corruption and public funds mismanagement, resulting in underdevelopment (Adenugba and Sa 2010; Osho and Afolabi 2014). Sareen (2020) identified that energy transition could be used to solve the issues regarding accountability. A case study of Portugal's energy transition was provided using solar energy, where accountability between stakeholders in the energy sector has aided the sector's improvement. Bowen et al. (2017) also explain the Sustainable Development Goals (SDG) 7, with many actors with different interests and stakes to achieve the goal. Hence, the energy transition process is suitable for resolving the complex issues among government, companies, communities and other stakeholders.

Thus, the research seeks to assess the RE planning process and governance using MLP, TMF and accountability and transparency concepts. The MLP was selected because it is useful for understanding transition dynamics. In addition, it provides the lens to understand transition problems and barriers through the interaction along three analytical lenses. It takes into cognisance actors, niche innovation and the context specific (Geels and Schot 2007; Geels 2011; Ruggiero, Varho and Rikkonen 2015; Geels 2019; Frank and Ayoub 2023). Similarly, the rationale for selecting TMF is that the TM framework is a prescriptive and operational governance and management framework applied in the coordination and management of sustainable transitions, which involves a reflective approach to transition problem structuring, transition arena formulation, forming a joint image and transition agenda, coordinating stakeholders, implementing the transition vision, monitoring and evaluating (Loorbach and Rotmans 2010; Roorda and Wittmayer 2014). On the other hand, the study adopts the accountability concept described by Mulgan (2000), Behn (2001), Pollitt (2003), Bovens (2007), Dubnick (2007), Bovens (2010), and Osho and Afolabi (2014). It aims to ensure transparency in decision-making, commitment to the course of action, responsibility and answerability of processes to foster good governance. Hence, incorporating the accounting and transparency concepts is appropriate for this study for the effective planning process and governance approach of grid-based RE in Nigeria.

This study seeks to add to the debates in the energy transition, governance and socio-technical literature for deploying grid-based renewable energy for electricity generation and provide respite to the challenges enumerated in the sector. Several of the current work on energy transition in Nigeria is predominantly focused on the decentralised energy systems, niche regime management, and the governance of community-focus electricity systems; however, this work approaches governance from the renewable energy deployment on the national grid for electricity generation using the Multi-Level Perspective (MLP) and Transition Management (TM) framework and accountability and transparency concepts. The use of the MLP for contextualising Nigeria's energy system is familiar and will be used as a basis for the TMF; these have been utilised widely in developed societies and are finding usage in the less developed parts of the world. Furthermore, integrating the accountability and transparency concepts into the TMF is a novel strategy. It provides solutions to the pitfalls of the framework in a sub-Saharan African country, thereby demonstrating the uniqueness of this study.

1.5 Aim

This research aims to assess the renewable energy planning process and governance for sustainable development and propose a roadmap model for the implementation of strategies for grid-based RE electricity generation in Nigeria.

1.6 Research Objectives and Questions

This research seeks to achieve the research aim by dividing the aim into five (5) achievable objectives. The research objectives, questions and methods (which are explained in Section 5.2) are summarised in Table 3 below:

Table 3: Research objectives and questions

Research Objectives		Research Questions	Research Methods
1	To critically assess Nigeria's electricity generation sector and the development of renewable energy.	What are the challenges of Nigeria's electricity sector and the role of renewable electricity generation to address them?	Critical review of literature.
2	To design a conceptual framework for the successful transition planning process of grid-based renewable electricity generation in Nigeria using MLP, TMF and Accountability and transparency concepts.	What are the determining factors for successful planning process of grid-based renewable electricity generation in Nigeria?	Qualitative approach- *Semi-structured interview and analysis of data.*
3	To critically assess the renewable energy planning process and governance incorporating accountability and transparency for sustainable development in Nigeria using the developed framework.	What are the renewable energy planning process and governance for sustainable development in Nigeria? And how accountable and transparent are the processes?	Qualitative approach- *Semi-structured interview and analysis of data.*
4	To critically investigate and analyse, using the developed framework, the key elements of the roadmap for the implementation of grid-based renewable electricity strategies in Nigeria.	What are the key elements of the roadmap for the implementation of grid-based renewable electricity generation strategies in Nigeria?	Qualitative approach- *Semi-structured interview and analysis of data.*
5	To propose recommendations that policymakers and other stakeholders can adopt to steer the renewable electricity generation growth and development in Nigeria.		

1.7 Scope of the Study

This research focuses on renewable energy development in the electricity sector. It is restricted to wind and solar energy sources, which are the principal novel renewable energy technologies introduced into the Nigerian national grid and a focal target to reduce GHG emissions and increase electricity supply in the country, as contained in Nigeria's strategy and policy documents (NREEEP and Vision 30:30:30).

1.8 Structure of the thesis

The study is structured as follows: Chapter One presents the global and national context of the research. This briefly iterates the challenges of the electricity sector and the role of renewable energy on Nigeria's national grid. Moreover, the chapter stated the research aim, objectives, questions and justification of the study. To guide the reader of this thesis, a synopsis of the remainder of this thesis's chapters is given in the next paragraphs.

Chapter Two gives a general overview of global energy and electricity discussions. Furthermore, the Nigerian electricity sector was reviewed. Lastly, RE development and governance relating to the national grid are critically reviewed by examining grid-based RE strategies, policies and policy support mechanisms. Finally, the chapter is summarised.

Chapter Three provides a comprehensive and critical review of the transition theory, Multi-Level Perspective (MLP), Transition Management Framework (TMF), and accountability and transparency concepts. The TMF and MLP serve as a theoretical underpinning of the research. They are supported by accountability and transparency concepts to assess the renewable energy planning process and governance for sustainable development to determine the enablers and inhibitors for developing grid-based renewable electricity generation in Nigeria and to formulate a model to facilitate the transition. Thus, the chapter reviewed transition studies, socio-technical transition perspective and lens, and transition theories (MLP and TMF) were critically discussed. Moreover, the rationale for adopting TMF, MLP and accountability and transparency concepts is discussed. Finally, modules for the successful transition of grid-based renewable energy generation in Nigeria are developed, providing direction for research questions, and the chapter is summarised.

Chapter Four presents the research philosophy, methodology and data analysis. Thus, the chapter commences by introducing the research method's interpretivism philosophical stance, the research method employed, the data collection technique and the procedure. Also, research recounts how the data obtained is managed and analysed. Lastly, the credibility and validity of the research are presented, including any ethical considerations. Finally, the chapter is summarised.

Chapters Five and Six present the results and findings of the semi-structured interviews for grid-based RE generation planning process and implementation of strategies in Nigeria. After that, the chapter is summarised.

Chapter Seven discusses pertinent literature on grid-based RE and findings from data analysed, and this is synthesised with the developed modules for the successful transition of grid-based renewable energy generation in Nigeria. Thus, a refined planning process and governance model for successfully implementing grid-based RE generation is presented.

Finally, Chapter Eight summarises the key findings and contributions of the research. Additionally, recommendations and research limitations are discussed. Conclusively, areas for further research are stated.

CHAPTER TWO: RENEWABLE ENERGY DEVELOPMENT AND GOVERNANCE FOR GRID-BASED ELECTRIFICATION IN NIGERIA

2.1 Introduction

This chapter identifies relevant literature to achieve the aim and objectives of the study, which centres on assessing the RE planning process and governance approach for sustainable development to determine the barriers, drivers and enablers of grid-based RE generation in Nigeria for formulating a roadmap to accelerate the transition. To contextualise the research, critical global discussions on RE development for electricity were discussed under the following themes: the roles of the energy industry for sustainable development and energy transition as a pathway to tackle climate change. Furthermore, the journey to the current Nigerian electricity sector profile was critically examined by first identifying key facts and figures of Nigeria. Subsequently, the evolution of the Nigerian electricity sector and the challenges of the grid system were assessed. Additionally, RE governance's evolution was reviewed concerning strategies, policies, roadmaps, guidelines, programs and support mechanisms. Finally, the chapter is summarised.

2.2 Global Energy/Electricity Discussions on Renewable Energy Development

2.2.1 The Roles of the Energy Industry for Sustainable Development (SD)

In recent times, the energy industry has moved the emphasis from fossil-fuel-centred energy to a more sustainable one, i.e., countries and energy companies are devoting significant investments into research and development to provide the energy the world needs. The energy demand of the world is growing rapidly. In 2018, the global energy demand rose by an astounding 2.3%, the highest in almost ten years (IEA 2019a), but grew by about 2% in 2022, despite the Ukraine-Russia crisis (IEA 2023).

Fossil fuel contributes to most of these energy needs. Natural gas led the way with about a 45% rise in energy consumption from the United States and China (IEA 2019a). Even though cleaner and sustainable energy sources are also increasing in demand, with solar and wind energy growing by double digits (IEA 2019a; IEA 2023), this pace is too slow to meet the required electricity demand as almost a billion people around the world are still without electricity (IEA 2019b; IEA 2020; IEA 2023).

In the same period, global energy-related carbon dioxide (CO_2) emissions rose by 1.7% between 2018 and 2019 (IEA 2019b) and by 1.3% between 2021 and 2022 (IEA 2023), mostly from coal-power plants from China and India. In Figure 3, the Environmental Protection Agency (EPA 2022) showed that the 2021 CO_2 gas emission was about 79% of the global greenhouse gases (GHG) and have contributed to the drastic climate change impacts in the society. Hence, it has become a tall order for the energy industry to continue to sustainably meet the global energy production requirement with a lower carbon emission focus.

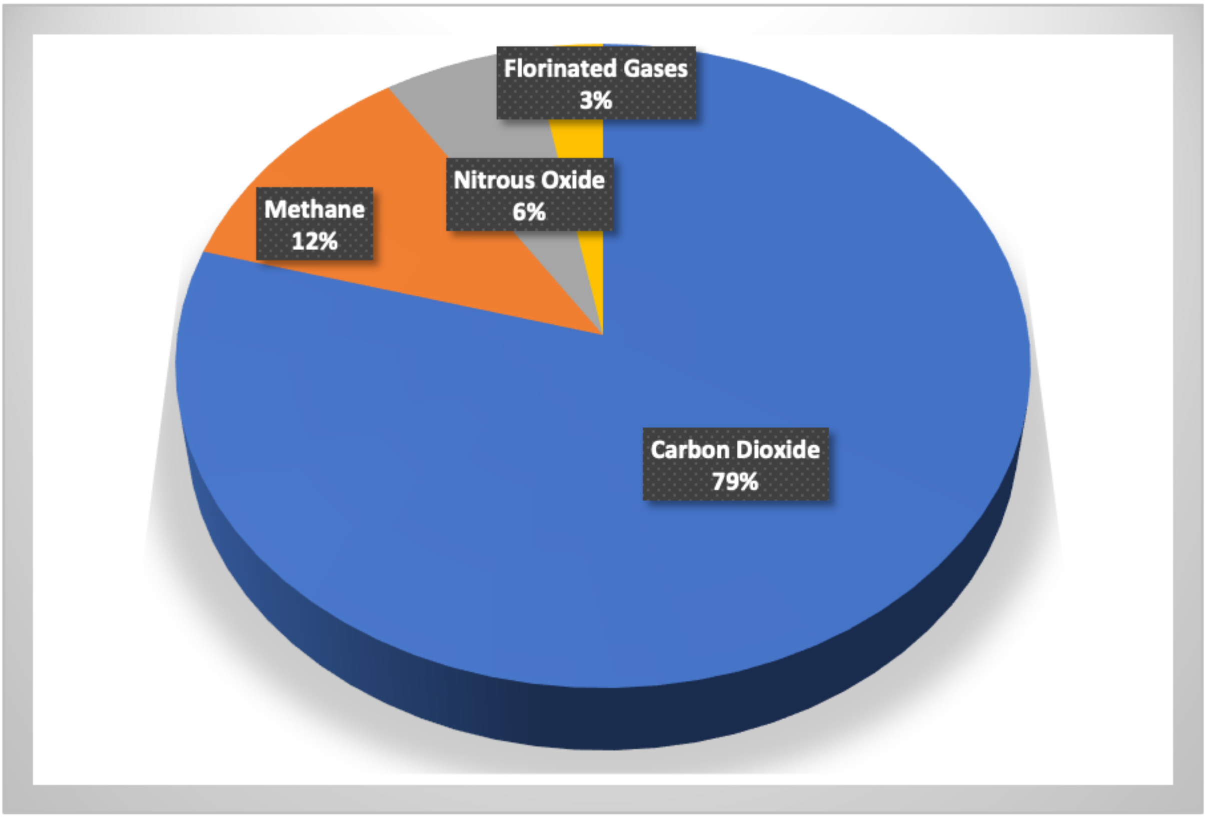


Figure 3: Greenhouse Gas Emission in 2021 (Environmental Protection Agency (EPA) 2022)

The proportion of emissions associated with the African continent is 2.9% of the global total (Statista 2022), and Nigeria only accounts for about 0.4% of the global CO_2 emissions in 2021 (Ritchie and Roser 2022). These volumes are negligible compared to what a nation like China emits, contributing 30.9%, the highest CO_2 emitter (Ritchie and Roser 2022). However, Nganga (2016) states that "only 24% of sub-Saharan Africans have access to electricity". Currently, there is deficient energy access and consumption in most African countries and "those connected to power grid experience an average of 54 days of power outages in a year – that is darkness for 15% of the year" (Nganga 2016). Therefore, the increased African population and further rural-urban migrations will lead to an upsurge in energy requirements with the inherent challenge of additional CO_2 emissions if the continent meets this demand using fossil-fuel-based energy systems (Nganga 2016; Gungah, Emodi and Dioha 2019).

Meanwhile, the advancement of technology and further development of digital and technology-based businesses in Africa has resulted in an upsurge in energy demand (Leke and Sibanda 2019). From the literature, Africa can produce the energy required on the continent through a holistic structural plan to exploit its abundant renewable energy sources (Mas'ud 2015, Butu 2017, Osu 2017, Bamisile et al. 2020; World Economic Forum (WEF) 2022), e.g., solar, hydro, wind and geothermal, enumerated in Table 4 below.

Table 4: Potential energy generation capacity in Africa (World Economic Forum 2022)

Energy Type	**Potential Capacity**	**Main Countries**
Solar	> 10 terawatts	All
Gas-generated power	400 gigawatts	Mozambique, Nigeria, Tanzania
Hydropower	350 gigawatts	DRC
Coal	300 gigawatts	Botswana, Mozambique, South Africa
Wind	109 gigawatts	N/A
Geothermal	15 gigawatts	Ethiopia, Kenya

From Table 4, the potential generation capacity of the African continent is over 11TW, where 95% is from renewable energy sources (10.5 TW) and of this, 10.1 TW is from solar and wind. There is a projection from experts that "by 2040, more than 25% of Africa's total energy will come from a variety of clean sources – geothermal, hydro, solar and wind" (Nganga 2016). Thus, the opportunity abounds for power generation in Africa, but infrastructure and significant structural provisions are needed to ensure these potentials' fulfilment (Ajayi and Ajayi 2013; Mas'ud 2015). Hence, African governments' policies will need to be tailored in such a way to properly transition to sustainable energy sources through partnerships and collaborations to tackle energy transition challenges (DBEIS and Perry 2018; ECN 2012; SE4A 2020).

2.2.2 Energy Transition as a Pathway to Tackle Climate Change

The transformation of energy sources from predominantly fossil-based to a more sustainable energy form has become a widely used appellation. Climate change enthusiasts and activists are adopting more creative strategies to ensure governments worldwide commence constructive work to address the issues related to greenhouse gas emissions. According to IEA (2019a) and IRENA (2020), the potential for transitioning to renewable energy will lead to about 90% reduction in global carbon dioxide (CO_2) that the industry currently emits.

Therefore, several factors need to align to create an effective energy system: improved production from renewable sources to replace current energy systems, ensuring a broad reach all across the world reliably and affordably, lowering carbon intensity and other pollutants from the production of energy and having in place the infrastructural and technological framework to make for a sustainable energy system (Mas'ud 2015; Carafa, Frisari and Vidican 2016; Butu 2017; Osu 2017; Batinge, Musango and Brent 2019; WEF 2022).

The Paris Agreement, signed in 2016 by the United Nations countries, aimed to tackle climate change, especially greenhouse gas emissions mitigations, adaptation and finance. It aims to "keep global warming below a 2°C increase by the end of the 21st Century and pursue efforts to limit the temperature rise to 1.5°C" (United Nations (UN) 2020).

As of 22 April 2016, when the Paris Agreement was signed, sub-Saharan African countries such as Angola, Burundi, Cameroon, Djibouti, Equatorial Guinea, Ghana, Kenya, Lesotho, Madagascar, Niger, Rwanda, South Africa, Uganda and Zimbabwe, among others, were early signatories (UN 2020).

The Nigerian government, led by President Mohammadu Buhari, signed the agreement on 22 September 2016, demonstrating "Nigeria's commitment to a global effort to reverse the effects of the negative trend" (Vanguard 2016; UN 2020). The Paris Agreement is geared towards countries who are signatories to the agreement tending towards sustainable energy. Over the years, Nigeria has aimed to have energy systems in place to cater to its growing population and set up several legislations and policies to transition from one dominant form of energy to another with no evident breakthrough.

Nigeria's energy need is an open secret. The energy crisis, which has engulfed the country for over forty years, has been massive and mainly contributed to the country's poverty rate by destroying industrial and commercial activities (Oyedepo 2012; Awosope 2014; Gungah, Emodi and Dioha 2019). The Council for Renewable Energy of Nigeria (CREN) "estimates that power outages brought about a loss of 126 billion Naira (US$ 948.38 million) annually" (CREN 2009; Oyedepo 2012).

The main form of energy in Nigeria currently is oil and gas-based. According to the Organisation of the Petroleum Exporting Countries (OPEC 2022), Nigeria's petroleum consumption in 2021 was about 495,000 barrels per day. The Department for Petroleum Resources (DPR 2007) reported a quantity of petroleum above 78% of Nigeria's total energy consumption. This singular form of energy has its inherent effects on climate change, and for the country to achieve the Paris Agreement's aim of reducing greenhouse gas emissions, energy diversification is imperative. Renewable forms of energy, such as solar, hydro and wind, will need to be developed.

2.3 Journey to the Current Nigerian Electricity Sector Profile

2.3.1 Facts and Figures of Nigeria

Nigeria is located on 10 00 N, 8 00 E in West Africa, bordered by Niger and the Republic of Chad to the North, the Republic of Benin to the West and Cameroon to the East, with the Gulf of Guinea at the coastline, as shown on the map in Figure 4 (World Atlas 2020). The country has a population of 220,440,000 million (2.64% of the world population) and is ranked seventh globally (Worldometer 2023), with a total area of 923,768 sq. km and approximately 98.5% accounting for the land area (IEA 2020). According to the Financial Times, Nigeria's population will more than double by 2050 (Cookson 2019), with a population growth rate of 2.62% (Worldometer 2020). Nigeria has 36 states, as shown in Figure 4, and 51.2% of its population resides in urban settlements (Worldometer 2020), with the largest urban area population of 15,287,876 in Lagos State (PopulationStat 2023). The map (Figure 4) indicates the capital's location (Abuja) located at the north-central and the commercial state (Lagos) located at the southwest of the country.

Figure 4: Map of Nigeria (Source: WorldAtlas)

According to the International Energy Agency (IEA) (2013), Nigeria accounted for about 50% of the total electricity demand between 2000 and 2012 in the West African region. The demand is expected to grow by 2040 to 33 GW. Approximately 10% of the rural houses and only 60% of the population are connected to the grid. Nigeria is endowed with abundant renewable and non-renewable energy sources. However, the country experiences energy poverty and is among the world's poorest in energy consumption. Recent studies have shown that the country is still confronted with electricity supply challenges, low connection to the grid, recurrent blackouts, and power outages (Oyewo et al. 2019; Idowu, Ibietan and Olutokun 2019; Aluko et al. 2020; Bamisile et al. 2020), despite the country's attempts to address the prevailing issues through the introduction of electricity sector reform (Power Reform Act 2005) and strategy (Vision 30:30:30). Due to the unmet electricity demand, Nigerians utilise fossil fuel-based generators to supplement the inadequate electricity supply (IEA 2020). The country relies predominantly on hydro and gas power plants.

Table 5 is a historical electricity profile for Nigeria's electricity sector from 2000 to 2022. The data depicts the Nigerian population, electricity capacity, generated, distributed and demand, electricity consumption per capita and access to power yearly. Nigeria's population is currently estimated at 218.5 million, about a 78% increase from 2000, as shown in Table 5. The Table shows that over the same period (2000 to 2022), the installed capacity for electricity generation has increased from about 5,000 MW to 12,500 MW (about a 150% increase). However, the average power generated is about 4,000 MW (a third of installed capacity.

Table 5: Nigeria's population and electricity data from 2000 to 2020 (Source: IEA 2023 and World Bank 2023)

Year	Population (million)	Electricity capacity (MW)	Electricity Generated (MW)	Electricity Distributed (MW)	Energy demand (MW)	Electricity Consumption per capita (MWh/capita)	Access to power (%)
2000	122.9	4,918	1,677	1,343	-	0.120	43
2001	126.2	5,098	1,765	1,416	-	0.123	44
2002	129.6	5,098	2,459	1,963	-	0.166	45
2003	133.1	5,098	2,304	1,849	-	0.152	52
2004	136.8	5,098	2,764	2,209	-	0.178	46
2005	140.5	6,443	2,687	2,146	-	0.168	47
2006	144.3	6,443	2,638	2,112	-	0.160	48
2007	148.3	7,642	2,623	2,226	-	0.155	50
2008	152.4	7,642	2,403	2,038	-	0.139	50
2009	156.6	8,653	2,258	1,918	-	0.126	50
2010	161.0	8,803	2,982	2,534	3,881	0.162	48
2011	165.5	8,803	3,086	2,626	4,224	0.163	56
2012	170.1	10,947	3,270	2,778	4,668	0.169	53
2013	174.7	11,508	3,300	2,808	4,680	0.165	56
2014	179.4	11,508	3,682	3,128	5,137	0.180	54
2015	184.0	12,228	3,703	3,151	5,365	0.176	53
2016	188.7	12,228	3,824	3,256	5,351	0.178	59
2017	193.5	12,228	3,932	3,345	5,594	0.178	54
2018	198.4	12,500	4,141	3,516	5,936	0.183	57
2019	203.3	12,500	3,818	3,619	6,164	0.165	55
2020	208.3	12,500	4,066	3,381	6,489	0.171	55
2021	213.4	12,500	4,155	3,596	6,621	0.171	60
2022	218.5	12,500		3,664	6,963		

Although the installed capacity and electricity generated and distributed have increased, there still needs to be a significant increase in the per capita electricity consumption, principally attributed to the population increase and the massive gap between the installed capacity and the actual electricity generated and distributed (Table 5).

2.3.2 Evolution of the Nigerian Electricity Sector

2.3.2.1 History of the Nigerian electricity sector: 19th century (1801-1900)

Since 1896, Nigeria began generating electricity through two power plants located at the former Lagos colony, now known as Lagos State, with the first having a capacity of 60 KW (Sambo et al. 2010; Oseni 2011). This was almost a century after Italian physicist Alessandro Volta discovered the possibility of generating a steady flow of electrical current (Bowers 2001) and over a decade after the advent of steam power and hydropower stations in the United Kingdom (Rutter and Keirstead 2012).

2.3.2.2 History of the Nigerian electricity sector: 20th century (1901-2000)

The electricity generated was initially available to serve the elites. However, by 1928, other towns (now major cities) began generating electricity individually, with Port Harcourt being the first (Awosope 2014), followed by Kaduna, Enugu and other cities, as shown in Figure 5 below.

Subsequently, the Nigeria Electricity Supply Company (NESCO) and the Public Works Department (PWD) were instituted in 1929 to superintend the operations of the installed power plants, including the distribution of power and building of electric power plants across the amalgamated protectorate (southern and northern), now Nigeria (Awosope 2014; Mas'ud et al. 2015; Monyei et al. 2018).

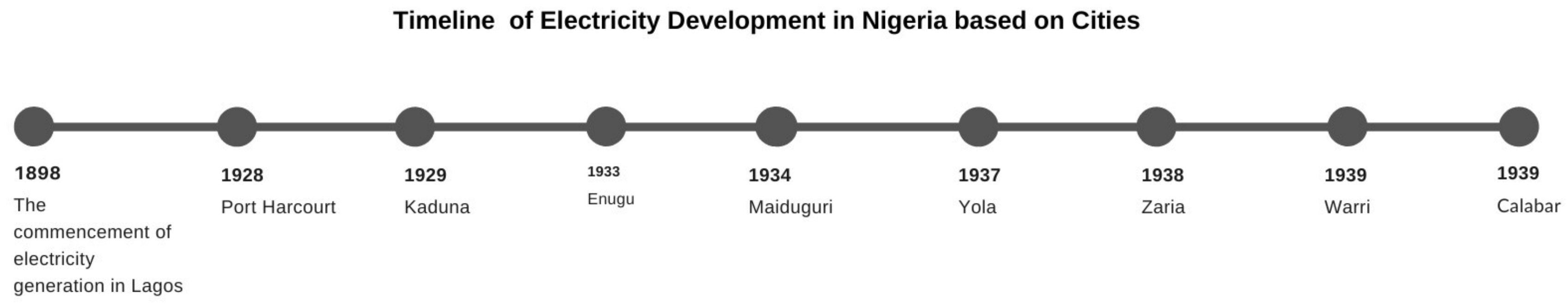


Figure 5: Timeline for electricity development in Nigeria (Source: Awosope 2014. Adapted and modified)

In 1946, the PWD's control and management of the Lagos colony's power generation and distribution system was transferred to the Nigerian Government Electricity Undertaking (NGEU), an offshoot of the PWD (Mas'ud et al. 2015). Subsequently, the Electricity Corporation of Nigeria (ECN) was instituted by a new regulation formulated from an Act of Parliament under Ordinance No.15 of 1950 (Awosope 2014). The ECN functioned as a central authority to control and coordinate all electrification operations in the country, except the Native Authority (NA)-owned systems, which included all other cities except Lagos colony. Afterwards, the control was extended to include NA systems in 1951, and electricity was provided to all Nigerians with purchasing power (Media Nigeria 2018), thus commencing grid connections and power transmission in Nigeria. Accordingly, the first connection of power plants was a 132 KV line construction linking Ijora and Ibadan Power Stations, resulting in economic development in Western Nigeria (Awosope 2014).

It is essential to add that the discovery of hydro-electric power potentials in Kainji (now in Niger State) led to the commencement and completion of the building of the first dam and reservoir in 1962 and 1968, respectively, and therefore the establishment of the Niger Dams Authority (NDA) to preside over the affairs of generation, transmission and distribution (Britannica 2020). After four years of establishment, the NDA, in partnership with ECN, connected Kainji to Lagos, and later to the North-Central: Kaduna and Zaria, North-West: Kano, and then to the South: Oshogbo, Benin, Ughelli, Onitsha, and Afam.

In 1972, the NDA and ECN merged to become the Nigeria Electric Power Authority (NEPA) (Monyei et al. 2018). The NEPA became a monopoly, maintaining a "vertical integrated" structure and exercising absolute authority and control over the entire value chain of the electricity market, from power generation to sales, as illustrated in Figure 6. By the 1980s, electricity demand had grown significantly, including from unconnected rural communities, encouraging discussion on restructuring and privatisation of the NEPA.

2.3.2.3 History of the Nigerian electricity sector: 21st century (2001-2020)

Moreover, by 2000, the NEPA experienced many inadequacies, resulting in insufficient and unreliable power supply and rising demand for electricity from non-connected rural communities (Monyei et al. 2018). Power supply fell significantly to 1,680 MW from a previous generation of 1,840 MW in 1997 (IEA 2020), which led to the privatisation and restructuring of the sector to reinvigorate the power system through the Electric Power Sector Reform Act (EPSRA) 2005, governed by the National Electricity Power Policy (NEPP) and Presidential Action Committee on Power (PACP) under the President Obasanjo government (Media Nigeria 2018). Consequently, the new establishment ceased to operate with the name NEPA and acquired the Power Holding Company of Nigeria (PHCN) as the new name of the operation in 2001 (Awosope 2014; Monyei et al. 2018). Hence, as shown in Figure 6, the sector's structure evolved from a vertically integrated setup and illustrated the sector's various divisions. Additionally, the Nigeria Electricity Regulatory Commission (NERC) was formed as a regulatory agency of the power sector, which constitutes PHCN and private involvement through the National Integrated Power Projects (NIPP), aimed at accelerating the improvement of the electricity supply system, encouraging private sector funding and expansion of the national grid. The Niger Delta Power

Holding Company (NDPHC) was also incorporated to manage the NIPP (NDPHC 2020).

Figure 6 shows the former bundled power supply model used by NEPA, and the restructured NEPA, now PHCN, unbundled power supply model consists of eighteen (18) Business Units tasked with resolving the lack of efficiency of the sector. The certificate of ownership was issued to private entities (NIPPs) in 2013 (PHCN 2020). These constitute six (6) independent generation companies (GENCOs), one (1) transmission company (TRANSCO), and eleven (11) private distribution companies (DISCOs).

Notably, the transmission company was owned and controlled by the government, with the Federal Ministry of Power charged with management's responsibility (Mas'ud et al. 2015). However, the management has now been outsourced to a management contractor, Manitoba Hydro International, which oversees all the divisions of TCN, transmission service provider, system operator and market operator (NESO 2020). This created the pathway to reducing government dominance and monopoly of the electricity sector; thus, the emergence of liberalisation through joint ownership and a monopsony market structure was created. Table 6 reveals the existing ownership structure and management of the sector. The government owns 20%, 100% and 40% of the GenCos, TransCo and DisCos, respectively. At the same time, private investors control the rest of the stake, which implies that the government has the controlling power in the electricity sector as a whole. Also, the electricity DisCos currently in operation is owned by the government, which implies that private sector control distribution companies are not yet operational owing to the various challenges confronting the private sector in the electricity industry (Monyei et al. 2018).

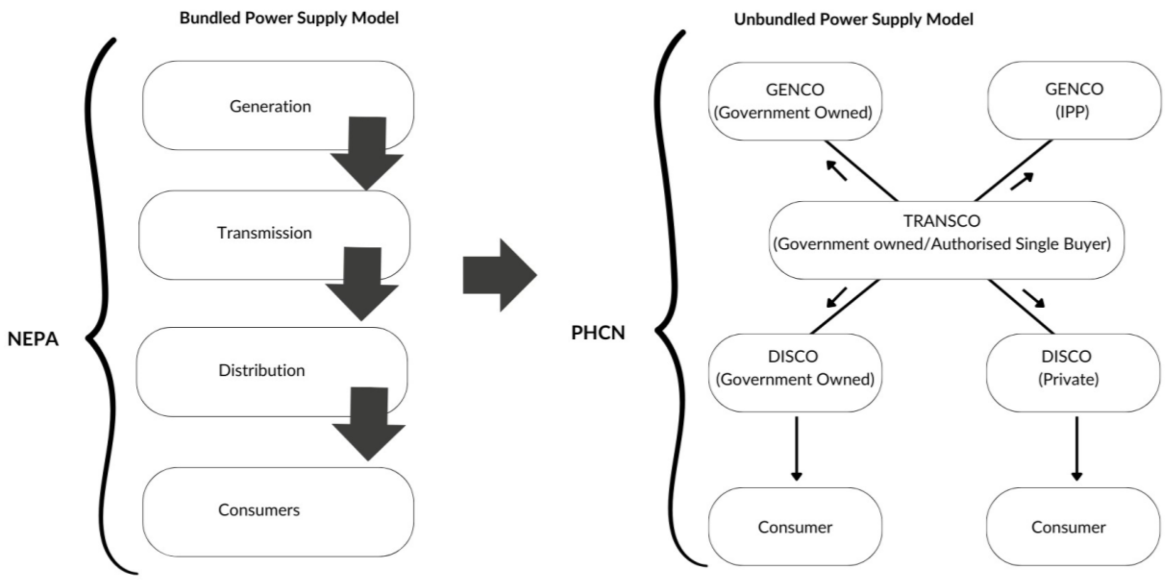


Figure 6: NEPA and PHCN Structures

Furthermore, in the subsequent stage of liberalisation and the Power Sector Reform (PSR), the Transitional Electricity Market (TEM) was established in 2015 to support the development of RE sources and produced 2,000 MW of electricity by 2020 (Offiong 2020). The arrangement required distributing companies to source 50% of electricity from RE companies while the other 50% of RE electricity will be purchased by the Nigerian Bulk Electricity Trading Plc (NBET) (Offiong 2020). Therefore, the NBET oversaw the transition to a free electricity market (Dada 2015). Ovwigho (2020) asserted that RE sources' encouragement through the PSR has created a platform for a competitive market where forces of demand and supply stimulate the outcome, making the industry more attractive for investors.

Table 6: Structure of ownership and management of PHCN. Source: Awosope 2014, Mas'ud et al. 2015; Monyei et al. 2018

Ownership	Generating Companies	Government owned 20%		Egbin Electricity Generating Company (EEGC)	Sapele	Ughelli	Afam	Shiroro	Kainji	Power Producers under the auspices of the Niger-Delta Power Holding Company (NDPHC)				
		Private Sector ownership 80%		There are also new Independent Power Plants										
	Transition companies	Government owned 100%	Transmission Company of Nigeria – Managed by Manitoba Hydro Company (Canadian company)											
	Distributing Companies	Government owned 40%		Abuja Electricity Distribution Company (AEDC)	Benin Electricity Distribution Company (BEDC)	Eko Electricity Distribution Company (EkEDC)	Enugu Electricity Distribution Company (EnEDC)	Ibadan Electricity Distribution Company (IbEDC)	Ikeja Electricity Distribution Company (IkEDC)	Jos Electricity Distribution Company (JEDC)	Kaduna Electricity Distribution Company (KdEDC)	Kano Electricity Distribution Company (KnEDC)	Port-Harcourt Electricity Distribution Company (PHEDC)	Yola Electricity Distribution Company (YEDC)
		Private Sector ownership 60%												

2.3.3 Challenges of the Grid-Based Electricity Sector

Twenty years into the sector's unprecedented global reform (Tinuoye 2017), the sector has experienced significant changes. However, the initiative is yet to fulfil its mandate, and the country is still one of the poorest in electricity access worldwide.

Energy Access

Access to electricity remains at 60% of the population (increased from 43% in 2000), below the 75% planned by 2020 (REA 2020); an additional 74 million people have had electricity between 2000 and 2021. Nigeria is the top African country with a GDP of $477 billion (Figure 7) and 31st in the world based on GDP as of year-end 2022 (World Bank 2023). However, Nigeria aims to be in the top 20 economies (Vision 20:2020). Globally, comparing Nigeria to the top five economies in the world, which include the United States of America, China, Japan, Germany, and the United Kingdom, based on the GDP (Figure 7), Nigeria is still behind. The energy access still needs to be improved compared to countries with 100% access to power for their population. To illustrate this, Figure 7 is a geographical representation of the top five economies globally, including the top five in Africa: Nigeria, South Africa, Egypt, Algeria and Morocco.

Nigeria has the lowest energy access in Africa compared to the top economies. Figure 8 is a graphical representation of the energy access progression of these countries from 2000 to 2021. This is the plot of access to power of the top five (5) African economies, i.e., Nigeria, South Africa, Egypt, Algeria and Morocco, from 2000 to 2021.

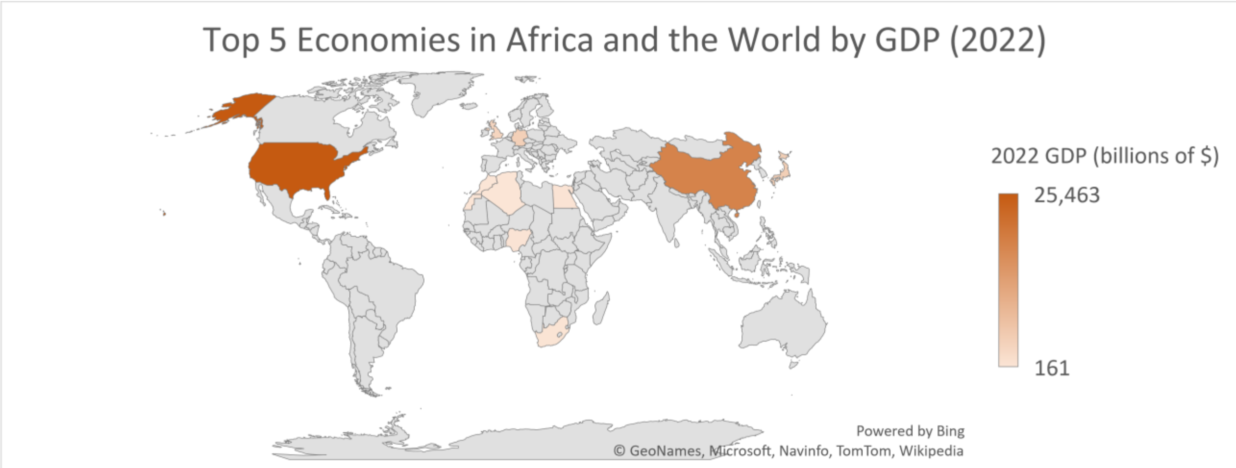


Figure 7: Top 5 Economies in Africa and the World by GDP (Source: World Bank 2023)

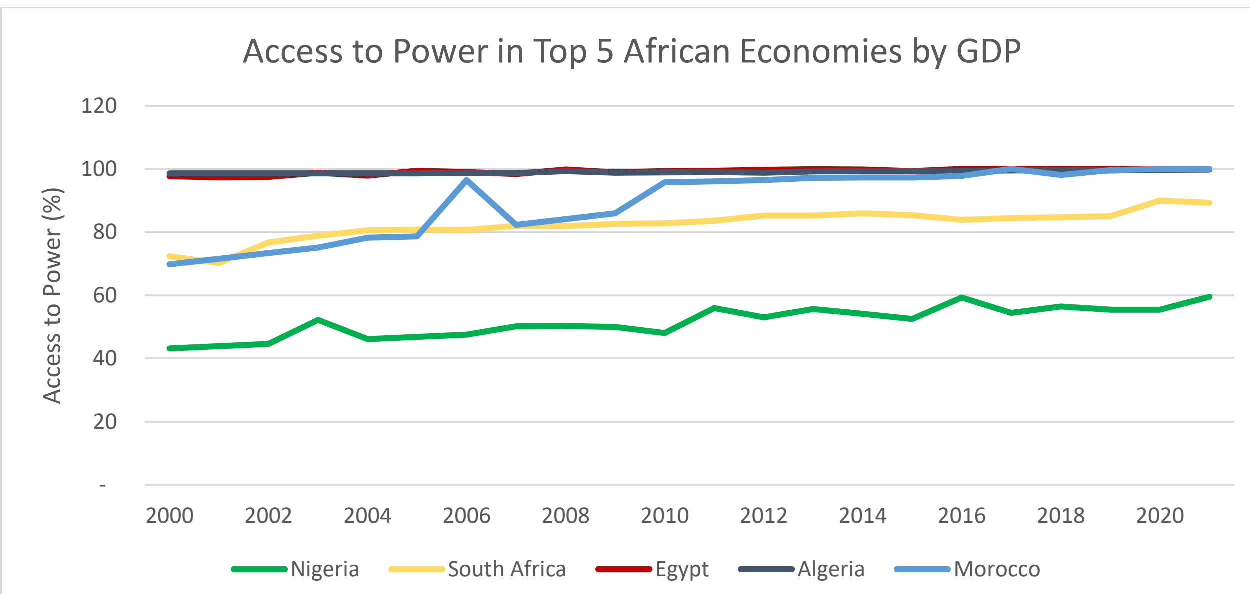


Figure 8: Access to Power for the Top 5 African Economies by GDP (Source: World Bank 2023)

Nigeria's energy access has moved from 43% to 60% of the population between 2000 and 2021; however, this is below the 75% access targeted by the Nigerian government (Vision 30:30:30 2000). Egypt, Morocco and Algeria achieved 100% access in the same period. At the same time, South Africa has achieved 89% from 72% (World Bank 2023).

Population Growth

As earlier iterated in this section, Nigeria's population has been a significant challenge for the electricity sector. Also, based on Table 7 below, the country experienced the highest increase (78%) in the 22 years under review, with other African countries like Egypt at 56%, Algeria at 46%, Morocco at 31%, and South Africa at 28% (World Bank 2023). The population growth has placed significant pressure on the existing infrastructure and demonstrates a further need to increase existing electricity generation capacity (Aladejare 2014; Awosope 2014; Mas'ud 2015; Cookson 2019). On the other hand, the top economies in the world had only experienced lower increases in population in the reviewed period, with the USA being the highest (18%), UK (14%), China (12%), and Germany (2%). Japan even had a negative growth of -1% (World Bank 2023).

Table 7: Populations (Millions) of top African and world economies from 2000 to 2022 (Source: World Bank 2023)

Years	Nigeria	South Africa	Egypt	Algeria	Morocco	USA	China	Japan	Germany	UK
2000	122.9	46.8	71.4	30.8	28.6	282.2	1,262.6	126.8	82.2	58.9
2001	126.2	47.2	72.9	31.2	28.9	285.0	1,271.9	127.1	82.3	59.1
2002	129.6	47.7	74.4	31.6	29.3	287.6	1,280.4	127.4	82.5	59.4
2003	133.1	48.1	76.0	32.1	29.7	290.1	1,288.4	127.7	82.5	59.6
2004	136.8	48.6	77.5	32.5	30.0	292.8	1,296.1	127.8	82.5	60.0
2005	140.5	49.0	79.1	33.0	30.4	295.5	1,303.7	127.8	82.5	60.4
2006	144.3	49.5	80.6	33.4	30.8	298.4	1,311.0	127.9	82.4	60.8
2007	148.3	50.0	82.2	34.0	31.2	301.2	1,317.9	128.0	82.3	61.3
2008	152.4	50.6	83.8	34.6	31.6	304.1	1,324.7	128.1	82.1	61.8
2009	156.6	51.2	85.5	35.2	32.0	306.8	1,331.3	128.0	81.9	62.3
2010	161.0	51.8	87.3	35.9	32.5	309.3	1,337.7	128.1	81.8	62.8
2011	165.5	52.4	89.2	36.5	32.9	311.6	1,345.0	127.8	80.3	63.3
2012	170.1	53.1	91.2	37.3	33.4	313.9	1,354.2	127.6	80.4	63.7
2013	174.7	53.9	93.4	38.0	33.8	316.1	1,363.2	127.4	80.6	64.1
2014	179.4	54.7	95.6	38.8	34.2	318.4	1,371.9	127.3	81.0	64.6
2015	184.0	55.9	97.7	39.5	34.7	320.7	1,379.9	127.1	81.7	65.1
2016	188.7	56.4	99.8	40.3	35.1	323.1	1,387.8	127.1	82.3	65.6
2017	193.5	56.6	101.8	41.1	35.5	325.1	1,396.2	127.0	82.7	66.1
2018	198.4	57.3	103.7	41.9	35.9	326.8	1,402.8	126.8	82.9	66.5
2019	203.3	58.1	105.6	42.7	36.3	328.3	1,407.7	126.6	83.1	66.8
2020	208.3	58.8	107.5	43.5	36.7	331.5	1,411.1	126.3	83.2	67.1
2021	213.4	59.4	109.3	44.2	37.1	332.0	1,412.4	125.7	83.2	67.0
2022	218.5	59.9	111.0	44.9	37.5	333.3	1,412.2	125.1	84.1	67.0

Low Energy Generation Capacity

Nigeria has increased the amount of energy generated by 146% from 1.7 GW in 2000 to 4.1 GW in 2021, as shown in Table 8 (IEA 2020). This is mainly from installing new gas power plants to supplement the hydropower plants. Eighteen gas power plants have been installed since 2000 to increase power generation (Ozoegwu, Mgbemene and Ozor 2017; Monyei et al. 2018; Adeniyi 2019). According to IEA (2020), there has been a significant increase in backup generator usage due to the grid's failures from 2010 to 2020, as shown in Figure 9. As the population increases, this phenomenon is expected to continue, thereby hampering the nation's target of reducing greenhouse gas emissions (Aluko et al. 2020).

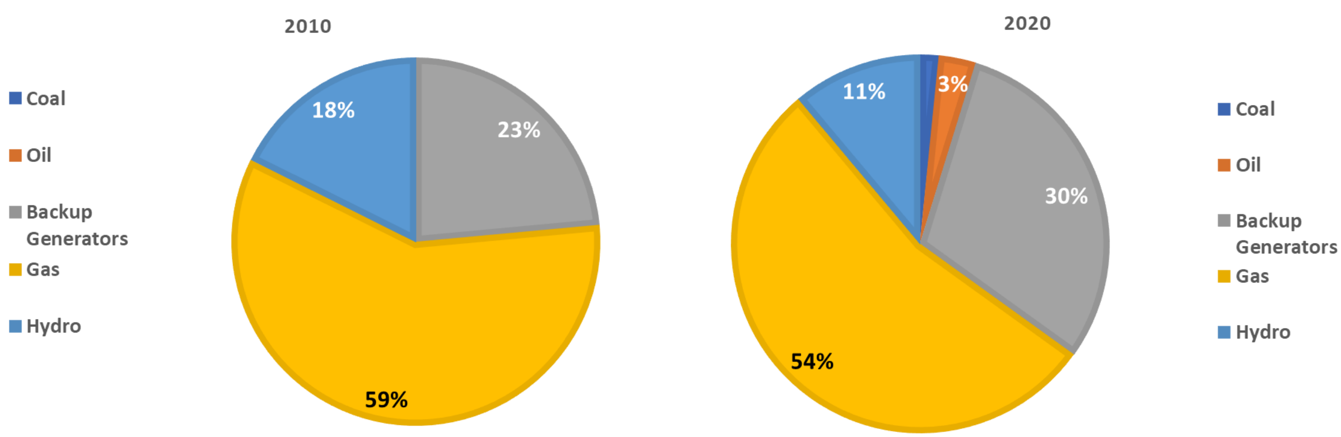


Figure 9: Nigeria’s electric generation sources (Data Source: IEA 2020)

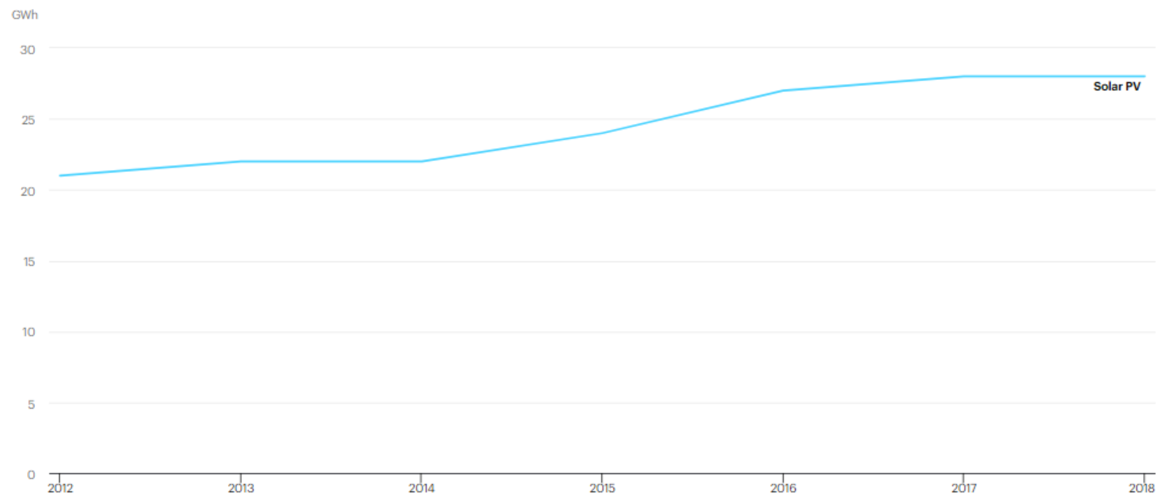


Figure 10: Solar PV development in Nigeria (Source: IEA 2020)

Nevertheless, renewable energy, especially Solar PV (off-grid), serving as an individual powerhouse station, has been added to the energy mix, as seen in Figure 10, which is expected to increase further to halt the need for increased utilisation of backup fossil-fuel-based generators.

In other African countries, Morocco's average power generation increased by 224%, Algeria's increased by 202%, Egypt's by 148% and South Africa's by 20%. China had the highest increase of 455%, from about 155 GW in 2000 to 860 GW in 2019. Germany and the USA's power generation both increased by 7%. The UK and Japan had decreases of -14% and -6%, respectively, focusing more on renewable energy development and energy efficiency (IEA 2020). Therefore, despite Nigeria's notable increase in power supply, Nigeria is still lagging compared to other countries (Ozoegwu, Mgbemene and Ozor 2017; Monyei et al. 2018; Adeniyi 2019).

In terms of the country's consumption, Nigeria's electricity consumption per capita, as demonstrated by Table 9, has increased by 42% from 0.12 TWh/capita in 2000 to 0.17 TWh/capita in 2021. Even though this seems a massive increase, it is still lower than typical consumption per capita experienced elsewhere in Africa. For instance, in 2019, South Africa's electricity consumption per capita was 4.00 TWh/capita, and Egypt and Algeria had 1.60 TWh/capita. However, only Morocco, with 0.90 TWh/capita, has a rate lower than Nigeria among the top five economies in Africa, but with an increase of 80% from 2000 (0.50 TWh/capita). Furthermore, in the developed economies, the USA had an electricity consumption per capita of 12.80 TWh/capita in 2019. Japan, Germany, China and the UK had 7.60, 6.70, 4.90 and 4.80 TWh/capita, respectively.

Table 8: Average Power Generated (GW) for top African and world economies from 2000 to 2019 (Source: IEA 2020)

Years	**Nigeria**	**South Africa**	**Egypt**	**Algeria**	**Morocco**	**USA**	**China**	**Japan**	**Germany**	**UK**
2000	1.7	24.0	8.9	2.9	1.5	462.3	154.7	121.8	65.8	43.0
2001	1.8	24.0	9.5	3.0	1.7	440.9	168.9	119.8	66.9	43.9
2002	2.5	25.2	10.2	3.2	1.7	462.1	188.7	121.8	66.9	44.2
2003	2.3	26.7	10.9	3.4	1.9	465.6	218.0	120.8	69.5	45.4
2004	2.8	27.9	11.6	3.6	2.0	476.3	251.4	124.2	70.5	44.9
2005	2.7	27.9	12.4	3.9	2.3	490.4	285.2	126.5	69.9	45.4
2006	2.6	28.9	13.2	4.0	2.3	490.6	326.9	126.9	73.0	45.3
2007	2.6	30.1	14.3	4.2	2.3	496.2	374.4	130.3	73.2	45.3
2008	2.4	29.5	13.4	4.6	2.4	497.7	395.5	126.4	73.1	44.4
2009	2.3	28.5	14.3	4.4	2.5	477.8	423.8	124.4	68.0	43.0
2010	3.0	29.6	16.7	5.2	2.7	499.6	480.0	133.6	72.2	43.6
2011	3.1	29.9	16.4	5.8	2.9	377.1	538.0	126.7	69.9	42.0
2012	3.3	29.4	17.1	0.8	3.1	489.5	569.7	125.4	71.7	41.5
2013	3.3	29.2	17.5	6.8	3.2	491.3	621.4	126.0	72.9	40.9
2014	3.7	28.8	18.3	7.3	3.4	495.1	647.8	122.8	71.6	38.6
2015	3.7	28.5	19.7	7.8	3.6	492.5	668.4	120.8	74.0	38.7
2016	3.8	28.8	20.2	0.9	3.7	493.0	709.3	121.1	74.2	38.8
2017	3.9	29.1	21.1	8.7	3.8	489.0	757.0	122.2	74.6	38.6
2018	4.1	5.8	22.1	8.7	4.1	508.3	819.3	120.7	73.4	38.0
2019	3.8	28.8	22.1	8.7	4.8	497.0	857.8	114.1	70.5	23.3

Table 9: Electricity Consumption per capita (TWh/capita) for top African and world economies from 2000 to 2020 (Source: IEA 2020)

Years	**Nigeria**	**South Africa**	**Egypt**	**Algeria**	**Morocco**	**USA**	**China**	**Japan**	**Germany**	**UK**
2000	0.12	4.60	1.00	0.70	0.50	13.70	1.00	8.10	6.70	6.10
2001	0.12	4.30	1.00	0.70	0.50	13.00	1.10	7.90	6.80	6.10
2002	0.17	4.50	1.10	0.70	0.50	13.30	1.20	8.00	7.00	6.10
2003	0.15	4.60	1.20	0.80	0.60	13.30	1.40	7.90	7.10	6.20
2004	0.18	4.60	1.20	0.80	0.60	13.40	1.60	8.10	7.20	6.10
2005	0.17	4.60	1.30	0.90	0.60	13.70	1.80	8.30	7.20	6.30
2006	0.16	4.70	1.30	0.90	0.70	13.60	2.00	8.30	7.30	6.20
2007	0.15	4.90	1.40	0.90	0.70	13.60	2.30	8.50	7.40	6.10
2008	0.14	4.70	1.30	1.00	0.70	13.60	2.50	8.30	7.30	6.00
2009	0.13	4.40	1.40	0.90	0.80	12.90	2.60	8.10	7.00	5.70
2010	0.16	4.50	1.60	1.00	0.80	13.40	2.90	8.80	7.40	5.70
2011	0.16	4.60	1.50	1.10	0.80	13.20	3.30	8.30	7.30	5.50
2012	0.17	4.40	1.50	1.20	0.90	13.00	3.50	8.30	7.30	5.50
2013	0.17	4.30	1.50	1.30	0.90	13.00	3.80	8.30	7.20	5.40
2014	0.18	4.20	1.50	1.40	0.90	13.00	3.90	8.10	7.00	5.10
2015	0.18	4.10	1.60	1.50	0.90	12.90	4.10	8.00	7.00	5.10
2016	0.18	4.00	1.50	1.50	0.90	12.90	4.30	8.00	7.00	5.10
2017	0.18	4.00	1.60	1.60	0.90	12.70	4.60	8.10	7.00	5.00
2018	0.18	4.00	1.60	1.60	0.90	13.10	4.90	8.00	6.90	4.90
2019	0.16	4.00	1.60	1.60	0.90	12.80	4.90	7.60	6.70	4.80

Various scholarly work postulates that inadequate power supply has contributed significantly to the country's slow industrial and economic development as the industry usage of power is low; hence, they have to run on fossil-based generators, which are more expensive (Adesina 2016). In support, Ovwigho (2020) found a correlation between low productivity and human empowerment in the industrial sector due to inadequate power supply. Similarly, Onayemi (2020) examined the relationship between the electric power supply, Foreign Direct Investment (FDI) and economic growth using a 1986-2017 data set. The econometric result showed that a constant electricity supply would encourage FDI by 30% and boost economic growth by 6%. This correlates with the earlier findings of Nkalo and Agwu (2019). Their studies showed that Nigeria's economy is expected to grow by 3.94% for every 1% increase in electricity supply. This implies that an increase in electricity consumption in Nigeria will accelerate industrial and economic development. Table 10 shows Nigeria's per capita electricity consumption is 0.2 TWh/capita and GDP of $477 billion. However, countries with higher per capita electricity consumption have higher GDP per capita. Hence, increased electricity generation and consumption in Nigeria will lead to economic and industrial development.

Table 10: Summary of GDP and Electricity Consumption (Source: World Bank 2022)

Countries	2022 GDP (billions of $)	GDP/capita ($/capita)	per capita electricity Consumption (TWh/capita)
Nigeria	477.4	2,184.5	0.2
South Africa	405.9	6,698.0	4.0
Egypt	476.7	4,843.5	1.6
Algeria	219.1	4,879.7	1.6
Morocco	160.5	4,454.6	0.9
USA	25,463.0	77,940.0	12.8
China	17,963.0	12,895.2	4.9
Japan	4,231.0	33,446.6	7.6
Germany	4,072.0	49,113.5	6.7
UK	3,071.0	46,208.2	4.8

However, the present challenges of the grid-based electricity sector cut across all facets of the power system. Ayamolowo et al. (2019) opine that, despite the deregulation, the sector still suffers setbacks such as erratic and inefficient electricity supply, high tariffs and poor services. This is also evident in the low power generated to meet the growing demand from the growing populace (Table 10).

Uncompleted Liberalisation of the Power Sector and Lack of Cost-reflective Electricity Tariff.

Additionally, the privatisation transition process remains uncompleted due to the unmet pre-transitional market conditions: lack of cost-reflective electricity tariff and reset of the distribution companies' baseline losses, among others (Adeniyi 2019). The inclusion of RES on the national grid through the TEM had not advanced due to an "Interim Order" introduced before the RE development commenced in 2015. This had hampered the performance of the reorganisation

(Adeniyi 2019). The "Interim Order" entailed the government providing a capped compensation for the shortage of proceeds to GenCos and DisCos. The arrangement was such that the NBET buys power from the generating companies, and the distributing companies remit payments to the Market Operator (MO) and NBET in the interim before TEM is initiated (Adeniyi 2019; NBET 2020). Unfortunately, the lack of cost-reflective electricity tariff and the inability of DisCos to effectively collect money from consumers created a liquidity crisis resulting in a ripple effect on the DisCos' ability to make full remittance to NBET and, subsequently, NBET to GenCos (including Gas IPPs) and gas suppliers, as the GenCos are unable to service their loans, thereby accumulating debt (Oyeleke 2020). Therefore, TEM has not been successful thus far.

Transmission and Distribution Challenges

The transmission and distribution systems face several persistent challenges, notwithstanding the drive to address them. These challenges range from ineffective policies (Nkalo and Agwu 2019), corruption in electricity management (Idowu, Ibietan and Olutokun 2019), conflict among stakeholders, lack of synergy in the whole value chain, infrastructural dearth, limited transmission line, ineffective implementation planning, and inadequate metering systems (Idowu et al. 2019). Nkalo and Agwu (2019) assert that while improving the transmission and distribution systems is ongoing, there is a necessity for policies on alternative electricity sources to reduce reliance on current energy sources (thermal and hydro).

Transparency and Accountability

Accountability and transparency challenges in Nigeria have proven difficult to surmount, even with the immense human, capital and material resources imbued in the country (Kwanashie 2007; Gberevbie et al., 2015). Aliyu, Ramli and Saleh (2013) posit that accountability and transparency challenges are present in the electricity sector and have cost the sector the confidence from potential investors about the government's commitment to deliver on the mandate as contained in Vision 30:30:30. To support this, SERAP's (2018) assessment of the sector indicated that political interference has hampered the successful liberalisation of the sector and has led to disregard for existing rules and regulation in governance and mismanagement and circumventing the process of bidding. The report clearly stated evidence of politics and mismanagement of the electricity sector reforms. Hence, Idowu, Ibietan and Olutokun (2019) postulated that the unstable business and political climate have become critical investor concerns.

Insecurity of Network

The electricity grid network is unsecured and prone to vandalism. Therefore, the government and the private sector are expending funds to keep the network safe from vandals. However, despite these efforts, vandalism is still prevalent due to the large expanse of land covered by the network and more difficulty in ensuring a stable electricity supply (Tinuoye 2017), leading to a loss of about 50% of electricity generated (Adesina 2016). Furthermore, the pipelines that supply gas to the gas plants regularly get vandalised by vandals, cultists and smugglers who intend to tap into the oil pipeline but inadvertently rupture the gas pipeline (Tinuoye 2017).

2.4 Renewable Energy Governance in Nigeria

2.4.1 Evolution of Renewable Energy Strategies, Policies, Roadmaps, Guidelines and Programs

The Federal government in Nigeria has developed several policies and initiatives to resolve the challenges in the electricity sector and include renewable energy in the energy mix for sustainable development (NEP 2003). However, all the efforts are futile and have had to be recycled or upgraded in newer policies, especially after missing milestone dates. Therefore, it is imperative to review these policies, strategies, plans and guidelines to understand the governance of Nigeria's grid-based renewable electricity system. These include the National Electric Power Policy (NEPP), National Energy Policy (NEP), Renewable Electricity Policy Guidelines (REPG), Renewable Electricity Action Program (REAP), Vision 20:2020, Roadmap for Power Sector Reform 2010 and 2013, National Adaptation Strategy and Plan of Action on Climate Change for Nigeria (NASPA-CCN), Renewable Energy Master Plan (REMP), National Renewable Energy and Energy Efficiency Policy (NREEEP), Rural Electrification Strategy and Implementation Plan (RESIP), Nationally Determined Contribution (NDC), and Vision 30:30:30.

2.4.1.1 Outdated strategies, policies, roadmap, guidelines and program review

A. NEPP 2001

The National Electric Power Policy (NEPP) was initiated in 2001 to govern the power sector's holistic reform and address the inefficiencies present in the sector. Arowolo (2005) averred that reducing government control and participation in the sector to encourage private investments was a fundamental guideline for reforming the sector. In achieving the aim of the NEPP, the process was influenced by the Electrical Power Implementation Committee (EPIC), charged with the responsibility of facilitating and coordinating the reform. Firstly, these processes involved unbundling the vertically integrated setup of the power sector to encourage Independent Power Producers (IPP) (see Figure 6), secondly, removing the government's interventions (subsidies and incentives) to enhance competition among players and liberalise the sector by having a cost-reflective tariff to foster social equity in the electricity market (NEPP 2001). Aladejare (2014) postulated that while significant progress has been made in reducing government involvement and encouraging investors, some challenges still hinder potential investors' active participation, limiting free competition in the sector. Nevertheless, it is essential to note that the NEPP was focused on introducing Gas IPPs, not hydro or other renewable sources; hence, this has also affected achieving free-market competition. Additionally, being the sole buyer from GenCos implies that the government has a significant influence on price control, hindering market forces' control (Oyeleke 2020).

B. NEP 2003, 2006 and 2013

The Energy Commission of Nigeria (ECN) developed the National Energy Policy (NEP) in 2003, a comprehensive policy document to optimise the country's vast resources to boost energy security for sustainable and economic development. Therefore, renewable energy sources, solar, wind and biomass, were introduced into the hydro and gas-dominated sector. The policy was subsequently revised in 2006 and 2013 (NEP 2003).

An essential aspect of the NEP was to lower greenhouse gas emissions from the energy sector by fifteen per cent on or before 2025 (NEP 2003). However, the observation is that the policy plan is silent on renewable energy's detailed role in reducing this emission (Oyeleke 2020).

C. Electric Power Sector Reform (EPSR) Act 2005

The Federal Government of Nigeria enacted the Electric Power Sector Reform Act (EPSRA) to improve electricity access and fully involve private participation in the energy industry. The EPSRA was a backdrop from the NEPP and was the legal and regulatory basis for restructuring the power sector (Aigbovo and Ogboka 2016). According to Ikeme and Ebohon (2005), the enactment of EPSRA annulled NEPA and the Electricity Act, liberalising the Federal Government's operational and regulatory control sector. Therefore, this led to the institution of the National Electricity Regulatory Commission (NERC) and other bodies (Rural Electrification Fund (REF) and the Consumer Assistance Fund (CAF)), with the NERC acting as the essential regulatory body. Moreover, REF was set up to optimise rural electrification subsidies and benefits and facilitate rural electrification through private and public involvement. On the other hand, the CAF was created to protect and provide funds for underprivileged electricity consumers (Oke 2015).

The EPSRA aimed "*to provide for the formation of companies to take over the functions, assets, liabilities and staff of the National Electric Power Authority (NEPA), to develop competitive electricity markets, to establish the Nigeria Electricity Regulatory Commission (NERC); to provide for the licensing and regulation of the generation, transmission, distribution and supply of electricity*"

(EPSRA 2005). The EPSRA is divided into several parts, which are represented in Table 11 below:

Table 11: The EPSRA parts and division (Source: EPSRA 2020)

ESPRA Parts	Comments
Part 1	Formation of initial and successor companies and the transfer of assets and liability of the NEPA.
Part 2	Development of a competitive electricity market.
Part 3	Establishment, functions and powers of the NERC
Part 4	Licenses and tariffs
Part 5	Acquisition of land and access rights
Part 6	Consumer protection and licensee performance standards
Part 7	Competition and market power
Part 8	The power consumer assistance fund
Part 9	Rural electrification fund
Part 10	Offences
Part 11	General
Part 12	Consequential and transition provisions

Table 11 shows the subdivision of the EPSRA, which was adequately and comprehensibly captured to aid the power sector reforms. These parts were created to ensure a smooth transition from a totally national company to one that involves public-private partnership for the development of the electricity sector and the prosperity of the nation; this is essential to create an economic environment that encourages the private firm to invest in the sector with little or no interference from the government. The parts also dictate the roles of individual stakeholders in the new industry.

Gungah, Emodi and Dioha (2019) stated that the EPSRA was meant to encourage renewable energy investment opportunities in the electricity sector. Notably, the Act set up a structure for small, medium and large-scale renewable energy development connected to the national grid, specifically in suburban areas. Moreover, it provided for 1,000 KW to be generated and 100 KW to be distributed by individuals. Hence, solar PV modules were utilised due to the ease of installation and connection for household usage (Gungah, Emodi and Dioha 2019). However, support schemes were lacking to promote renewable energy investments. Similarly, Aigbovo and Ogboka (2016) argue that the absence of an explicit legal framework in the EPSRA to harness the country's ample RES contributed to the limitation of achieving the projected success of the reform.

D. Nigeria Vision 20:2020 – 2010 and 2013

Vision 20:2020 was established in 2010 and comprised three implementation plan processes to be executed between 2010 and 2020. The plan's main objective was to increase the country's GDP to US$ 900 billion to improve the citizens' quality of living and place the country among the top 20 economies in the world (Vision 20:2020 2020). The objectives were to resolve the epileptic power supply and increase electricity generation capacity from 4,000 MW to 35,000 MW by 2020 (Gungah, Emodi and Dioha 2019; Vision 20:2020 2020).

Notably, the document contained fundamental strategies for renewable energy development in the country. The strategy highlighted renewable energy sources, hydro, solar, wind, and biomass are crucial to achieving the energy mix projected at the installed capacity, as depicted in Table 12. Table 12 shows that the projected renewable energy sources accounted for about 22% of the grid-based electricity supply, with solar and wind constituting a smaller portion of 1% each.

Table 12: Nigeria's Vision 20:2020 (Vision 20:2020 2020)

Year	Renewable Energy
2015	Increase hydro share to 15%.
2020	Increase hydro share to 20%.
	Increase solar and wind energy share to 1% each.
	Replace 50% of fuelwood for cooking with biomass energy.
	Install 1 GW biomass power generation plant.
	Transport fuels will include 10% of biofuel blend.

Eneh (2011) argued that Nigeria's vision, policies and reform plan are robust and all-encompassing. However, they are confronted with execution challenges owing to inefficient implementation drive and corruption (Audu, Paul and Ameh 2017). Similar past policies and reform programmes created could not achieve the intended objectives (Ebigbo 2008).

E. Roadmap For Power Sector Reform 2010 and 2013

In 2010, the Federal government of Nigeria created the Roadmap for Power Sector Reform (RPSR) to fully implement the EPSRA, which included the adoption of the NEPP to achieve the full changes in ownership, control and regulation of the electricity sector. The roadmap outlines the plan to accelerate the pace of activities already mandated under the EPSRA. After the liberalisation of the PHCN, the roadmap was set up to achieve a corporate, commercial and private company. This was to be achieved, as shown in Table 13 below:

Table 13: Strategies of the RPSR (Source: RPSR 2013)

• Removing obstacles to private sector investment by the creating a bulk buyer, providing credit opportunities, forming a competent workforce, establishing the management of the Transmission Company of Nigeria (TCN), sorting out and resolving issues with licensing and strengthening NERC.
• Explaining the reasons and purposes of the privatisation of PHCN.
• Resolving the fuel-to-power industry.

The roadmap concerns the Hydro Power Plants and the Thermal Power Plants explicitly. Other objectives which are to be pursued are (RSPR 2013):

- a targeted increase in evacuation capacity,
- grid integrity and reliability,
- power quality and system stability, and
- specifying the undertakings of TCN.

F. Renewable Electricity Policy Guidelines (REPG) – 2006 to 2010

The REPG was the overarching policy for electricity from renewable energy sources. The guidelines were derived from the Nigerian Constitution (1999), the National Energy Policy (2003), the National Electric Power Policy (2001), the Electric Power Sector Reform Act (2005), the Renewable Energy Master Plan (2005), the Rural Electrification Policy (REP) and the National Economic Empowerment and Development Strategy (NEEDS). The guideline included the following strategies and sources, as illustrated in Table 14 (Federal Ministry of Power (FMOP) 2006; International Centre for Energy, Environment and Development (ICEED) 2006):

Table 14: Strategies and sources of the REPG (Source: ICEED 2006)

Strategies	Sources
• Grid-based extension for proximate areas. • Independent mini-grids for remote areas with concentrated loads where grid service is not economical or will take many years to come; and • Standalone renewable electricity systems for remote areas with scattered small loads.	• Small, Mini and Micro Hydro-power. • Biomass electricity. • Solar energy. • Wind energy.

The main objectives of the REPG included are captured in Table 15 below:

Table 15: The main objectives of the REPG (Source: ICEED 2006)

S/N	Objectives
1	encourage the diversification of sources of electricity supply through renewable energy, and as such, improve the country's energy security.
2	increase access to electricity services nationwide, especially in rural areas.
3	stimulate growth in employment generation through an expanded renewable electricity industry.
4	enhance technological development through increased domestic manufacturing of renewable electricity components.
5	stimulate competition in the delivery of renewable electricity.
6	promote rapid expansion of renewable-based electricity market through cost-reducing supply-side and demand-side incentives.
7	develop regulatory procedures sensitive to the peculiarities of renewable energy-based power supply.
8	create a stable and predictable investment climate in the renewable electricity market.
9	provide adequate protection for electricity consumers through effective regulation.
10	reduce household and outdoor air pollution, and contribute to the abatement of greenhouse gas emissions, thus contributing to improved health and overall social development.

Table 15 expatiates the main objectives of the REPG, which aimed to develop the renewable energy component of the electricity sector.

G. Renewable Electricity Action Program (REAP) – 2006 to 2016

The REAP is a ten-year strategy to provide "access to electricity services to achieve economic and social development objectives of the National Economic

Empowerment and Development Strategy (NEEDS) and the Millennium Development Goals (MDGs)" (REAP 2006). The strategies of the REAP includes "Grid-based extension for proximate areas. Independent mini-grids for remote areas with concentrated loads where grid service is not economical or will take many years to come. Solar Photovoltaic (PV) systems for remote areas with scattered small loads" (ICEED 2006).

The focus of the REAP, like the REPG, included sources such as:

- Small, mini and micro hydropower.
- Biomass electricity.
- Solar energy.
- Wind energy.

The REAP's objectives included covering aspects of renewable energy development and planning, targets, strategies, management, financing and monitoring and evaluation of the initiatives (ICEED 2006).

H. Discussion of the Outdated Policies, Roadmaps, Guidelines and Programs (NEPP, NEP, EPSRA, Vision 20:2020, RPSR)

The Federal government's initial policies to encourage RE development did not achieve their purposes (Gungah, Emodi and Dioha 2019; Musbaudeen and Bamgbopa 2019; Ogbonnaya et al., 2019). The NEP, NEPP, EPSRA, RPSR and Vision 20:2020 focused on non-renewable resource development to resolve the country's energy challenges (Emodi and Ebele 2016; Gungah, Emodi and Dioha 2019). Although the policies were formulated to translate into practical developments, actions and programmes (ECN-UNDP, 2005), they do not contain suitable mechanisms to entice investments, such as tax incentives, loans, grants, FIT and so on (Ajayi 2010; Ajayi et al., 2012). Furthermore, the presence of multiple taxations (federal, state and local governments), absence of customs and excise duty to stimulate RE development, unsuitable fiscal incentives, non-existent tax relief for research and development, low capital allowances and investments in infrastructure were also identified for the failure of the policies, programmes and agendas (Ajayi and Ajayi 2013).

The approaches adopted by NEP included international technology exchange and trade agreements for funding; however, the non-renewable resource development attracted more investments (Musbaudeen and Bamgbopa 2019). Despite the government's willingness to encourage partnerships for renewable energy development, as contained in the policies, this plan collapsed as it contained inherent challenges that were not resolved (Gungah, Emodi and Dioha 2019). Consequently, there needs to be a legal framework to resolve these challenges to ensure the effectiveness of the policies. Thus, numerous scholars agreed that the absence of a concerted effort to complete all "abandoned" projects in the power sector, insecurity along with the transmission network, grid instability, lack of leadership and transparency from regulatory organisations, mainly since they were not immune from political interference (and significantly impacted by a change in government), also constituted to the collapse of these policies (Bada 2011; Musbaudeen and Bamgbopa 2019; Ogbonnaya et al. 2019).

Therefore, the lessons learnt from the failure of the outdated policies, roadmaps, guidelines and programs will serve as a framework for the current strategies to achieve the objectives.

2.4.1.2 Current strategies, policies, roadmaps, guidelines and program review

A. National Adaptation Strategy and Plan of Action on Climate Change for Nigeria (NASPA-CCN) – 2012 to 2050

Nigeria identified climate change to have the ability to impact the development targets of the country, especially those contained in her strategic Vision 20:2020 (which has evolved into Vision 30:30:30) and the Millennium Development Goals (MDGs), now Sustainable Development Goals (SDGs). The identified impacts included: impeding the efforts towards poverty alleviation, retarding the efforts at an equitable distribution of development benefits, and affect all efforts at encouraging sustainable livelihoods, aside from the expected impacts to the environment and the ecosystem. To plan and act in response to the impact of climate change, the government, together with civil society organisations, embarked on the development of the National Adaptation Strategy and Plan of Action on Climate Change for Nigeria (NASPA-CCN 2011) to:

- reduce risks,
- expand local and nationwide adaptability and resilience,
- leverage new prospects,
- and accelerate alliance with the international community.

These are meant to minimise the country's susceptibility to the adverse effects of climate change.

Table 16: The objectives and sectors affected by the NASPA-CCN (Source: NASPA-CCN 2011)

Objectives	Sectors
• Improve awareness and preparedness for climate change impacts. • Mobilize communities for climate change adaptation actions. • Reduce the impacts of climate change on key sectors and vulnerable communities. • Integrate climate change adaptation into national, sectoral, State and Local Government planning and into the plans of universities, research and educational organisations, civil society organisations, the private sector and the media.	• Agriculture (Crops and Livestock) • Freshwater Resources, Coastal Water Resources and Fisheries • Forests • Biodiversity • Health and Sanitation • Human Settlements and Housing • Transportation and Communications • Industry and Commerce • Disaster, Migration and Security • Livelihoods • Vulnerable Groups • Education • Energy

The objectives and sectors affected by the NASPA-CCN are captured in Table 16 above.

The identified impacts of climate change and the strategies of NASPA-CCN in the energy sector are captured in Table 17 below:

Table 17: The impacts of climate change and the strategies of NASPA-CCN in the energy sector (NASPA-CCN 2011)

Impacts of Climate Change	Strategy of NASPA-CCN
• impacts on hydro-electric and thermal generation, • service interruption from damage to transmission lines and substation equipment by sea-level rise, flash floods, and other extreme weather events, • increased fuel-wood scarcity will increase pressure on the remaining forest resources, • further degradation of the environment and negative impacts on rural livelihoods.	• Increased protective margins in constructing and placing energy infrastructure (i.e., higher standards and specifications). • Undertake risk assessment and risk reduction measures to increase the energy sector's resilience. • Strengthen existing energy infrastructure through early efforts to identify and implement all possible 'no regrets' actions. • Develop and diversify secure energy backup systems to ensure civil society and security forces have access to emergency energy supply. • Expand sustainable energy sources and decentralize transmission to reduce the vulnerability of energy infrastructure to climate impacts.

Table 17 is a simple illustration of the identified impacts of climate change in the Nigerian energy sector. Additionally, the strategies of the NASPA-CCN were captured to address these potential impacts.

B. Renewable Energy Master Plan (REMP) – 2005 to 2030

The REMP was instituted in 2005 to increase renewable electricity supply from 13% of total generated electricity in 2015 to 23% in 2025 and 36% by 2030 (REMP 2005). According to the plan, the primary goal of the REMP was to provide a blueprint for the inclusion and utilisation of renewable energy technologies in the country's energy mix to reduce reliance on fossil fuels (REMP 2005). The plan includes installing 550 MW of solar PV and 61MW of wind renewable technologies by 2025, as shown in Table 18 below; these renewable energy sources account for both off-grid and grid-based renewable energy. Conversely, the forecast for fossil fuel-based power plants is expected to increase as renewable energy deployment increases. Hence, the driver of the REMP is increased energy access to supplement the current sources and not a shift to total RE utilisation (IEA 2013; Elum and Mjimba 2020). However, it is essential to note that the policies took cognisance of Sustainable Development Goals (Elum and Mjimba 2020).

Table 18: Targets for Electricity Generation (MW) (Source: REMP, 2005)

SOURCES/TERMS	**SHORT**	**MEDIUM**	**LONG**	
	2005-2007	**2008-2015**	**2016-2025**	**2030**
Small hydro	50	600	2000	See Vision 30:30:30
Solar Thermal	-	1	5	
Solar PV	5	120	500	
Wind	1	20	40	
Biomass	-	50	40	
Total	56	841	3345	

REMP is a consolidation of Vision 20:2020 and NASPA-CCN's objectives. Monyei et al.'s (2018) examination of the policy identified key hurdles to RE's development in Nigeria, including lack of technology, unskilled workforce, incentives, private sector partnership, and financing. However, the absence of a legal framework to resolve these challenges hampered the effectiveness of the policy. For instance, the Land Use Act, which conferred the ownership of state lands to governors, negates the spirit of the REMP, especially for wind energy development (Ajayi and Ajayi 2013). Therefore, the policy has missed all the milestones so far (Elum and Mjimba 2020).

C. National Renewable Energy and Energy Efficiency Policy (NREEEP) – 2015 to 2030

The NREEEP was instituted ten years after the EPSRA (NREEEP 2015) to encourage the development of grid-based and off-grid renewable energy in rural and urban areas to increase electricity access and improve the efficiency of power utilisation in the country (NREEEP 2015). The NREEEP can be considered a "de facto working document" as it has attracted investors and policymakers to renewable resources' potential and opportunities (Gungah, Emodi and Dioha 2019). The objectives and energy sources targeted by the NREEEP are captured in Table 19 below:

Table 19: The objectives and energy sources carried by the NREEEP (Source: NREEEP 2015)

Objectives	Sources
• Ensure the development of the nation's energy resources, with diversified energy resources option. • guarantee adequate, reliable, affordable, equitable and sustainable supply of RE at cost-reflective and environmentally friendly manner. • accelerate the process of acquisition and diffusion of technology, managerial expertise and indigenous participation in the RE and energy efficiency sector, for stability and self-reliance. • guarantee efficient, location-specific, and cost-effective consumption pattern of RES and improved energy efficiency. • promote increased investments and development of the RE and energy efficiency sector, with substantial private sector participation. • ensure a comprehensive, integrated, and well-informed RE and energy efficiency sector, with plans and programmes for effective development. • foster international cooperation in trade and project development, in the ECOWAS, Africa and the world. • successfully use the nation's abundant energy resources to promote international cooperation. • bring abundant electricity access to almost half of the Nigerian population that is currently electricity abstinent. • develop the nation’s RE and energy efficiency resources by establishing an appropriate financing mechanism that supports private investment in the sub-sectors. • ensure effective coordination and collaboration among all players in Nigeria’s RE and energy efficiency activities in Nigeria.	• Hydropower. • Biomass electricity. • Solar energy. • Wind energy. • Geothermal, wave and tidal energy.

The NREEEP aims to build and conclude the present hydropower projects and develop large-scale renewable energy projects such as major hydro, extensive wind, a significant PV solar power plant, a biomass electricity generating plant and a Concentrated Solar Power (CSP) grid-based development. It will also intensify the expansion of the off-grid electricity supply for rural development (NREEEP 2015).

Table 20: Summary of Renewable Electricity Targets (Source: NREEEP 2015)

S/N	Activity/Item	2012	Short-Term (2015)	Medium-Term (2020)	Long-Term (2030)
1	Hydro (LHP)	1,938.00	2,121.00	4,549.00	4,626.96
2	Hydro (SHP)	60.18	140.00	1,607.22	8,173.81
3	Solar	15.00	117.00	1,343.17	6,830.97
4	Wind	-	55.00	631.41	3,211.14
5	Biomass	10.00	5.00	57.40	291.92
	All Renewables plus LHP	1,985.18	2,438.00	8,188.20	23,134.80
	All Energy Resources (On-grid power plus 12,500MW of self-generated power)	21,200.00	24,380.00	45,490.00	115,674.00
	% of Renewables plus LHP	23.00	10.00	18.00	20.00
	% RE Less LHP	0.80	1.30	8.00	16.00

Gungah, Emodi and Dioha's (2019) review of RE policies concluded that the "Nigerian RE policies are not effective and lack elements of a good policy design". Conversely, Gungah, Emodi and Dioha's (2019) concluded that the NREEEP is robust enough, if implemented, to meet the country's energy needs and achieve the policies' targets on RE development. However, the government must provide the political backing to fight corruption, hindering the sector's development.

D. Nationally Determined Contribution (NDC) – 2015 to 2030

Nigeria became a signatory of the Paris Agreement in September 2016 to support climate change and ratified its Intended Nationally Determined Contributions, INDC, in May 2017 (which became the NDC) (UN 2020). The country aims to "under a business-as-usual (BAU) growth scenario" reduce emissions by up to 45% by 2030 conditionally (with financial aid and support from developed countries) and 20% reduction unconditionally (NINDC 2015), as shown in Figure 11 below.

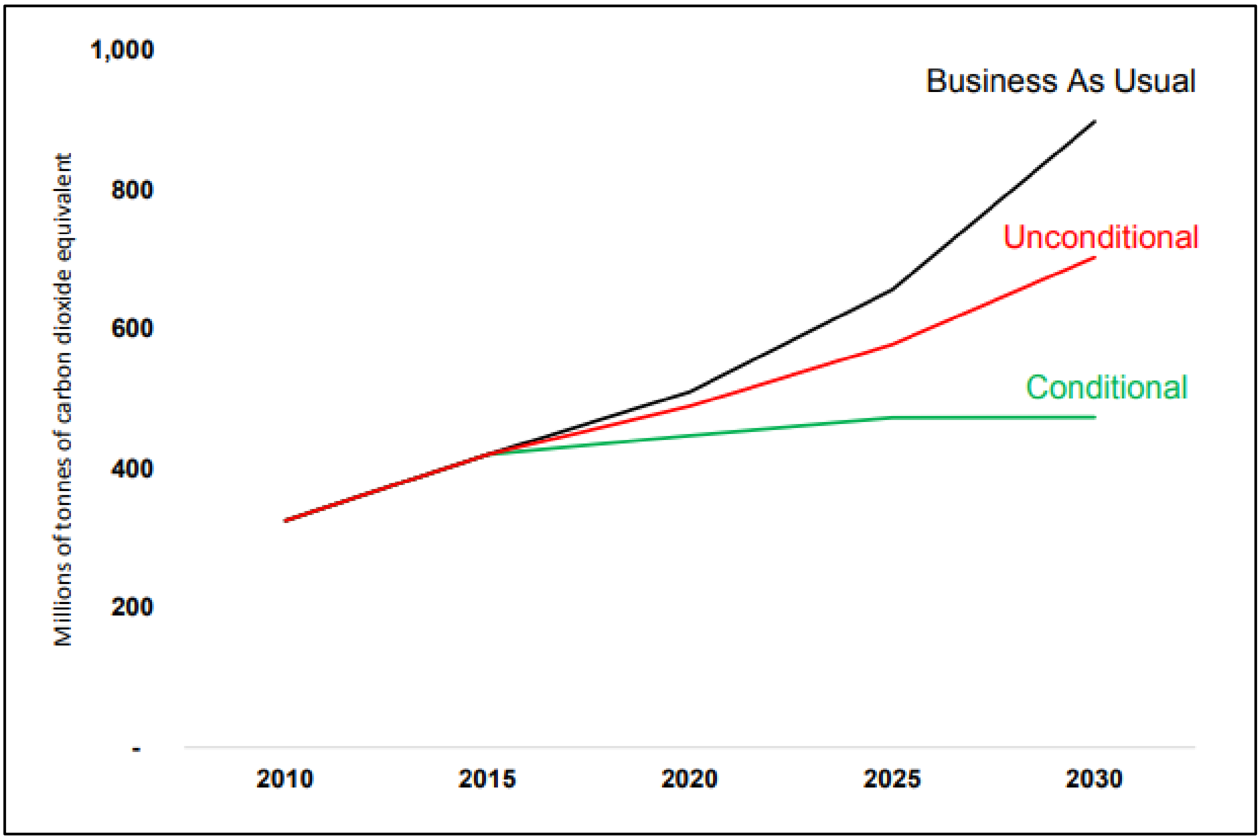


Figure 11: Mitigation contributions. Source: NINDC 2015

This will be achieved by stopping gas flaring by 2030, installing off-grid solar PV of 13 GW, utilising efficient gas-powered generators, reaching 2% yearly energy efficiency and 30% by 2030, moving from car to bus transport, improving the national grid and implementing climate-smart agriculture and reforestation.

The major sectors for emission reduction are captured in Figure 12 below:

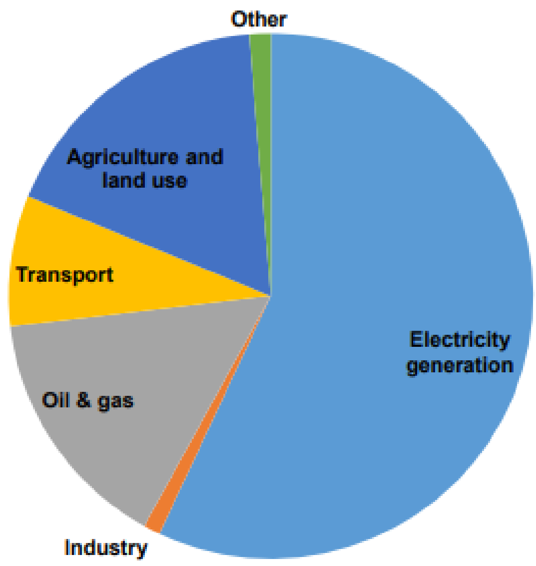


Figure 12: Major sectors for emission reduction (Source: NINDC 2015)

Sadiq et al. (2018) posit that complexities surround Nigeria's NDC: the need for environmental protection and economic development. They highlighted various constraints resulting in the lack of implementation of the NDC, including energy poverty, biomass economy, dependence on biomass and fossil fuel, price of RE, water and food insecurity, political support, policy inconsistencies and governance deficiency. Dioha and Kumar (2020) postulate that there are no carbon taxes in Nigeria's policies and that introducing a carbon tax will aid the achievement of the NDC.

E. Vision 30:30:30 – 2016 to 2030

Vision 30:30:30 is comprised of energy access (to extend electricity supply to a larger population), energy efficiency (to ensure most of the electricity generated is consumed) and renewable energy (to include renewable energy in the electricity mix at a higher percentage than currently). The following is a brief description of energy access, efficiency, and renewable energy components of Vision 30:30:30:

Energy Access: According to the SE4All (2016) document, the Nigeria government aims "To increase electricity access from the current aggregate level of 40% (urban= 65%, and rural=28%) in 2015 to 75% (urban= 90%, and rural= 60%) by 2020. By 2030, the population share living without electricity will drop from the current 60% in 2015 of the total population to about 10%. The electricity generation will increase from the present grid supply of 5,000 MW in 2015 to at least 32,000 MW by 2030".

Energy Efficiency: According to the SE4All (2016) document, the Nigeria government aims to "By the end of 2015, efficient lighting (at least five times more efficient than incandescent lamps) will be used by 20% of the households, 40% by 2020, and almost 100% by 2030. By 2016, energy audits will be compulsory for all high-energy consuming sectors and public buildings".

Renewable Energy: According to the SE4All (2016) document, the Nigerian government aims to "By 2030, have renewable energy contributing about 30% share in the available electricity mix. To achieve a 27% and 20% contribution of hydroelectricity (both large and small hydro) to the nation's electricity generation mix by 2020 and 2030 respectively. To achieve a 2.5% contribution of wind energy to the nation's electricity generation mix by 2030. To achieve a 20% and 19% contribution of solar energy (PV and solar thermal) to the nation's electricity generation mix by 2020 and 2030 respectively".

The Nigerian energy policies, especially those relating to renewable energy development, have evolved over the years; the fundamental difference in most policies is that a new administration oversaw its creation (Gungah, Emodi and Dioha 2019). When new governments are installed, new policies are created with no significant difference from the defunct ones. One of the major concerns in implementing policies in Nigeria is the lack of continuity in the various government agendas (Sadiq et al. 2018). Furthermore, Avila (2018) suggests that Vision 30:30:30 still relies heavily on natural gas, with an enormous underestimation of solar energy's role in future RE development. However, a more straightforward pathway can be found with no coal and nuclear energy to achieve this strategic vision (Avila 2018).

F. Rural Electrification Strategy and Implementation Plan (RESIP) – 2015 to 2040

The primary purpose of the RESIP is to increase access to electricity quickly and cost-effectively by utilising grid and off-grid methods. This is to meet the government's targets for increased access to electricity to 75%, 90% and 100% by 2020, 2030 and 2040, respectively, and at least 10% renewable energy in the mix by 2025 (RESIP 2015; REA 2020).

The strategies of RESIP include to:

- promote a full menu of rural electrification options – grid and off-grid (mini-grid & stand-alone) from thermal & renewable, etc.
- ensure close coordination of rural electrification expansion with economic development objectives.
- encourage states, local communities, and businesses to develop and contribute financially to rural electrification.

- facilitate the entry of new market participants and continued development of local rural electrification (RE) ventures whose activities may include the production, installation, operation, maintenance, and distribution/sales of equipment, systems, and services related to the power supply in rural areas.

However, Butu (2017) concluded that rural electrification concerns go beyond the installation of the technology but include social, economic, institutional and political concerns. Therefore, more attention should be paid to these concerns to achieve the policy's purpose. Furthermore, incentives should be provided to fund rural electrification projects with all stakeholders' involvement as the project progresses (Butu 2017).

G. Nigeria Energy Transition Plan (ETP) (Sets the plan to achieve carbon neutrality by 2060).

The Nigerian Energy Transition Plan is a strategy that sets out the plan to achieve carbon neutrality by 2060. The plan was established in 2022 with SE4ALL and the Global Energy Alliance for People and Planet (GEAPP) and approved by the Federal Executive Council (FEC). The plan articulates that the country aims to decarbonise the energy systems in 5 key sectors: Power, Cooking, Transport, industry and Oil and Gas. It stated that $1.9 trillion is required to reach net zero by 2060 (ETP 2022).

2.4.1.3 Discussion of the current policies, roadmaps, guidelines and program (NASPA-CCN, REMP, NREEEP, NDC, RESIP)

The current policies, roadmaps, guidelines and programs, such as NASPA-CCN, REMP, NREEEP, NDC, and RESIP, are updated and well-constructed compared to the previous ones, especially including achievable targets (Musbaudeen and

Bamgbopa 2019; Gungah, Emodi and Dioha 2019). Nevertheless, like the previous ones, many targets were missed because of a lack of implementation strategy (Emodi and Ebele 2016; Gungah, Emodi and Dioha 2019). For instance, the NREEEP's 2015 and 2020 targets for the short and medium term were not achieved, that is, the increased energy access nor the inclusion of renewable sources in the energy mix (Gungah, Emodi and Dioha 2019).

However, installation of 10 MW and 100 MW wind farms in Katsina and Plateau have commenced, respectively (Gungah, Emodi and Dioha 2019). Also, solar PV installations and commissioning have been carried out in the rural areas but are short of the 30% RE planned by 2030 (Gungah, Emodi and Dioha 2019; NREEEP 2015).

Moreover, experts believe that if the government work with the private sector, there are still opportunities to course-correct and meet the long-term target (Musbaudeen and Bamgbopa 2019). They also believe a better structure should be included in the policies and provide more ammunition to the regulatory bodies for execution (Ladan 2009; Gungah, Emodi and Dioha 2019). Also, adequate funding of the established research centres (ECN 2012) is necessary to develop feasible, practicable technologies and provide human resources development (Gungah, Emodi and Dioha 2019).

Also, the overseeing agencies for electricity development, such as the ECN, NERC and Federal Ministry of Power, need a better structure for independence and stability, especially to attract foreign direct investments in the sector through the confidence that ensues from this (Edomah, Foulds and Jones 2016; Agu and Ogbeide-Osaretin 2017). Likewise, the ECN should develop a better framework to track RE policies and occasionally review them as appropriately required.

2.4.2 Renewable Energy Development Policy Support Mechanism in Nigeria

The primary means policies and government initiatives are achieved are through support mechanisms, which have also been included in Nigeria's renewable energy policies (Adib 2015; Emodi and Ebele 2016; Ozoegwu, Mgbemene and Ozor 2017); these include feed-in tariff/premium payment, capital subsidy or rebate, tax incentives, and public investment, loans or grants.

Feed-in tariffs (FIT)/Premium payments: These payments serve the purpose of reducing risks of investments for RE producers, thus making provision for the higher Levelized Cost of Energy (LCOE), especially for solar PV development in Nigeria (Couture and Gagnon 2010; Baldwin et al. 2017; Ozoegwu, Mgbemene and Ozor 2017; Gungah, Emodi and Dioha 2019). However, having the FIT considered too high has scared away investments, making it difficult for the government to finance the projects (Adeniyi 2019; Gungah, Emodi and Dioha 2019). For instance, Aldersey-Williams, Strachan and Broadbent's (2020) research on the UK's offshore wind farm projects using audited accounts indicated that the cost of LCOE is reducing. However, the cost is much higher than the bidding for UK government financial support via the Contract for Difference (CfDs). Figure 13 shows the breakdown for FIT in Nigeria since 2012, reducing over the years, but investors still have concerns that these are considered too high (NESP 2015; Adeniyi 2019).

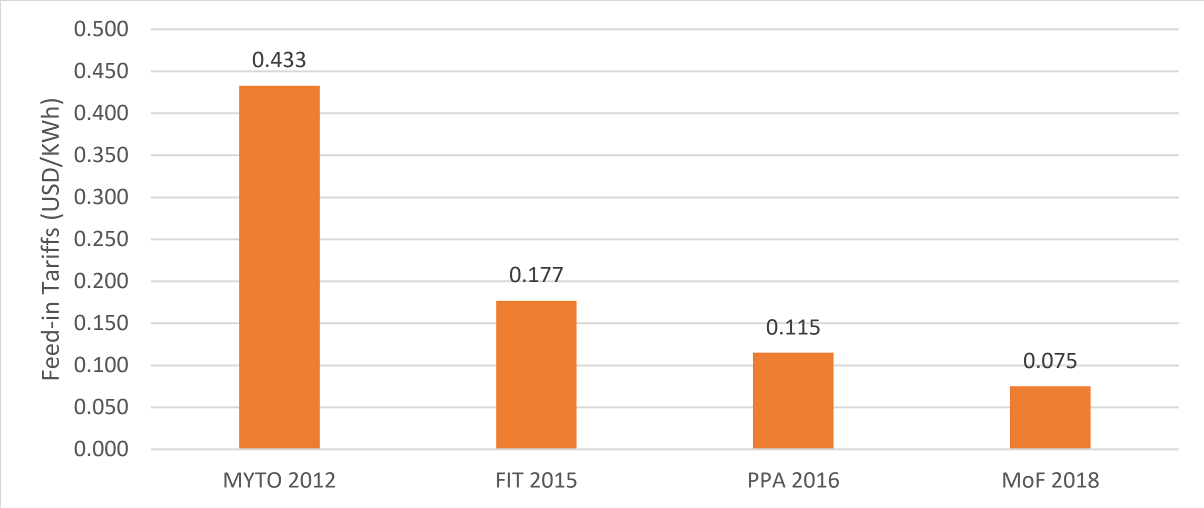


Figure 13: Breakdown of Feed-in Tariffs from 2012 (Source: Adeniyi 2019)

Furthermore, economies of scale would serve as a disadvantage to the smaller companies who will be expected to pay higher FIT and need to be considered in any final agreement; hence, the government may be required to provide subsidies for RE development (Couture and Gagnon 2010; Ozoegwu, Mgbemene and Ozor 2017). Nevertheless, the key determinant for a successful FIT would be secured grid access, long-term agreements and cost-based purchase prices (Miguel 2007). Notably, FITs have worked perfectly in the EU, especially Germany and Italy, for RE development (Timilsina et al. 2011).

Capital subsidy, grant, or rebate: The Federal government of Nigeria aims to supplement the funds required for RE development for electricity and work to attract more capital investment from foreign companies, organisations and partners (Emodi and Ebele 2016; Ozoegwu, Mgbemene and Ozor 2017; Ogbonnaya 2019). Subsequently, the NREEEP contains a complete description of the government's plan for subsidies, grants and rebates (NREEEP 2015). However, no specific figures are quoted, but the funds are available in the Power

Sector Development Fund for RE production and energy efficiency ventures (NREEEP 2015; Ozoegwu, Mgbemene and Ozor 2017).

Tax incentives: The NREEEP also offers tax holidays and exemptions for RE development projects, Power Production Tax Credit (PTC) to renewable electricity generation companies, tax credits for energy-efficient appliance productions, exemptions of tax and duty for new players in the RE space, availability of tax-deductible expenditure for research and development in RE and income tax exemption for revenues accrued from carbon credit trades (NREEEP 2015; Emodi and Ebele 2016; Ozoegwu, Mgbemene and Ozor 2017; Gungah, Emodi and Dioha 2019). The following are the provisions for the advancement of renewable energy and energy efficiency in the NREEEP: a five-year tax break for manufacturing, five-year tax break on dividend incomes from funds on local renewable energy sources, and exclusion of excise tax and transactions tax for imports of energy-efficient equipment and lighting.

Nevertheless, the absence of tax credit would negate the specifications in duration; hence, a need to further provide adequate and quantified details of the tax credit proposed.

Public investment, loans, or grants: NESP (2015) describes the continuous drive for the complete privatisation of Nigeria's electricity industry. Consequently, the NREEEP specifically encourages rural electrification through private or public-private partnerships. Moreover, the private sector alone, without any public investments from the government, will not drive the kind of transition required in the RE space of the Nigerian electricity sector, neither for off-grid nor grid-based development (Ozoegwu, Mgbemene and Ozor 2017). Therefore, the government should make better adequate provision for the public investments, loans and grants proposed in the NREEEP and Vision 30:30:30 (NREEEP 2015; Adeniyi 2019; Gungah, Emodi and Dioha 2019).

2.5 Nigeria, an Oil and Gas Dominated Country

2.5.1 Importance of the Oil and Gas Sector in the Nigerian Economy

Oil and gas exploration in Nigeria commenced before the country's independence in 1960, and since the 1970s, it has contributed significantly to the economy (Emoyan 2008; Etim, Ihenyen and Nsima 2020). Oil and gas has continued to be the major contributor to the GDP of the nation with Nigeria being the largest oil producer in Africa and the sixth largest among the Organisation of Petroleum Exporting Countries (OPEC) (Olujobi, Olujobi and Ufua 2020, OPEC 2023). The industry consists of the upstream, midstream, and downstream sectors (Olujobi, Olujobi and Ufua 2020), all playing one role or another in the country's development. Energy and non-energy actors do believe that the industry still has a part to play in Nigeria's economic development (NREEEP 2015, Ishiroro 2020, Borha and Olujobi 2023).

Crude oil sales have been a crucial part of government’s revenue for over four (4) decades with it making up more than 86% of the national income in 2021 (Emoyan 2008, Adiyoh Imanche et al. 2021). Therefore, the significance of the oil and gas industry to the economic development of Nigeria cannot be over-emphasised. Oil and gas and its byproducts have found massive utilisation in almost every aspect of society and contribute to every sector of the economy, from electricity, transport, aviation and several others (Ozoegwu, Mgbemene and Ozor 2017, Monyei et al. 2018; Adeniyi 2019).

The oil and gas industry is a significant sector of Nigeria's energy and electricity sectors. From Figure 9, almost 90% of electricity generation is from fossil-based sources (IEA 2020) even after the introduction of the Paris Agreement, which should have changed the country's dependence on fossil-fuel sources for electricity generation (Ozoegwu, Mgbemene and Ozor 2017, Monyei et al. 2018; Adeniyi 2019). Also, of the 12,500 MW grid installed electricity generation capacity in the country, about 11,000 MW are generated from gas-powered turbines (Aladejare 2014, Awosope 2014, Mas'ud 2015, Cookson 2019; IEA 2021). Therefore, it is a complex challenge to unseat the oil and gas industry, which occupies such a significant role in society. Governments usually use subsidies to allay these types of concerns (IEA 2010; Ovaga and Okechukwu 2022).

2.5.2 Petroleum Subsidies and Renewable Energy Development

Furthermore, to make oil and gas products affordable for the populace, the Nigerian government introduced petroleum subsidy schemes where prices are capped. The excess is paid to importers and marketers of petroleum products (Nwaokoro 2011, Balouga 2012, Orji 2014, Orji 2017, Olujobi, Olujobi and Ufua 2020; Orji 2020). The subsidy payments in 2019 accounted for 27% of the country's payment on petrol (NNPC 2020; Oduyemi et al. 2021) which experts believed was unsustainable (Aliyu 2009, Nwachukwu et al. 2013, Ekong and Akpan 2014, Gberevbie et al. 2015, Okwanya, Moses and Pristine 2015, Gidigbi, Bello and Babarinde 2019, Gidigbi and Bello 2020; Oduyemi et al. 2021).

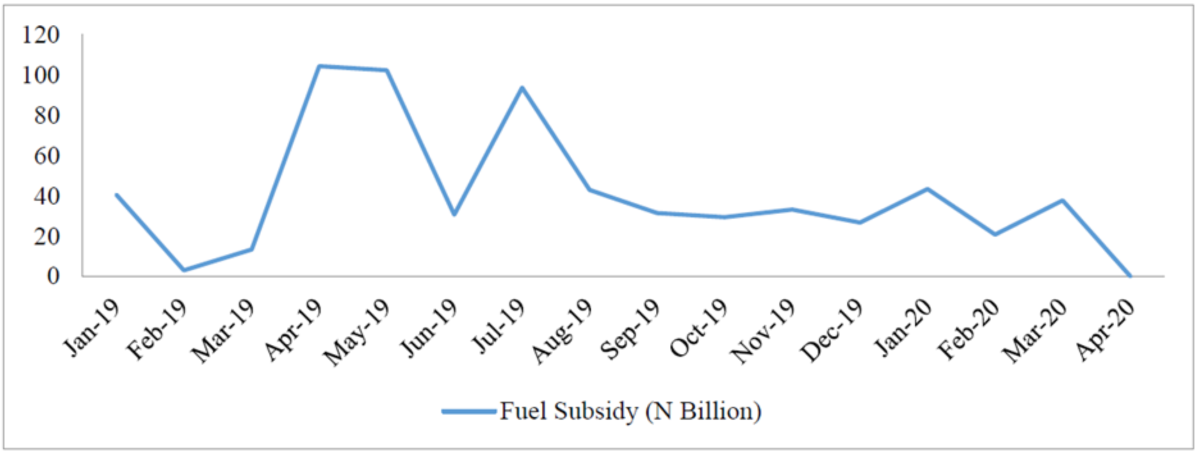


Figure 14: Total Nigeria Fuel Subsidy payment from Jan 2019 to April 2020. Source: NNPC Monthly report (Oduyemi et al. 2021)

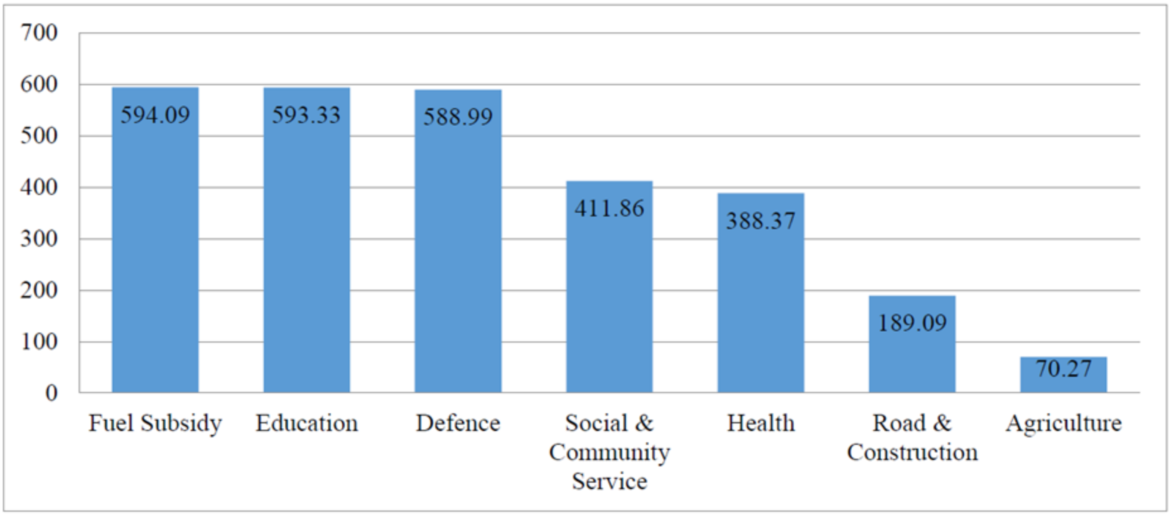


Figure 15: Nigeria 2019 Main Recurrent Expenditure (in N Billion). Source: NNPC Monthly report (Oduyemi et al. 2021).

In May 2023, upon inauguration, President Bola Ahmed Tinubu removed all subsidies from imported petroleum products, thereby causing an increase of about 175% to average pump prices of petrol across the country with all the inherent micro- and macro-economic effects (Ikenga and Oluka 2023, Ozili and Obiora 2023; Yunusa et al. 2023). Therefore, the country has had to court foreign investors for investments in the now free market and more competitive economy.

Hence, it is paramount that the country focuses these investments on renewable energy development activities. For example, the Chinese government has focused its attention on African countries, such as Nigeria, to help actualise the Sustainable Development Goals (SDGs), and one of the areas of interest is electricity generation from renewable energy (Adiyoh Imanche et al. 2021). China is a top development partner for Nigeria already (Hinga, Jun and Yiquan 2013), and with its Green Energy policy, major Chinese companies have continually partnered with the government. For instance, companies such as CNPC, SINOPEC, ZTE, SEPCO, HUAWEI, CCECC, CNOON and CSCEC are heavily invested in different sectors of the Nigerian economy (Omotoso, Kuti and Oladeji 2020; Adiyoh Imanche et al. 2021). Therefore, with the removal of subsidy, the renewable energy sector is expected to become more competitive and with foreign direct investments from countries such as China and Germany, who have shown interest, RE development on the grid would be realised as planned by the government.

2.5.3 Current Electricity Regime vs Renewable Electricity Regime

The electricity regulatory regime that will be applied when there is full-scale adoption of renewable energy on the grid is dictated by the Nigerian Electricity Regulatory Commission (NERC), which was created by the Electric Power Sector Reform Act (EPSRA) 2005 (Adeniyi 2019; NERC 2023). NERC aims to provide an avenue for reliable, affordable, and adequate electricity in Nigeria by ensuring uninterrupted electricity, private sector participation, consumer protection, and fair regulation for the industry (NERC 2023).

Similarly, the Nigerian Bulk Electricity Trading (NBET) Company was created as the go-between electricity sector companies and the consumers, that is, it purchases electricity from the Independent Power Plant (IPP) and Generation Companies (GenCos) to sell to the Distribution Companies (DisCos) and other eligible customers (NBET 2023). However, the enactment of the Electricity Act of 2023 (which repeals the EPSRA 2005) allows for individual and local entities to generate electricity (Electricity Act 2023).

All the current electricity laws, policies, programs, and agendas were created to govern the electricity sector and applied by the NERC to regulate the industry. This includes the National Electric Power Policy (NEPP) 2001, National Energy Policy (NEP) 2003, 2006 and 2013, Electric Power Sector Reform Act (EPSRA) 2005, Nigeria Vision 20:2020 2010 and 2013, Roadmap for Power Sector Reform 2010 and 2013, Vision 30:30:30 2016, Rural Electrification Strategy and Implementation Plan (RESIP) 2015 and Electricity Act 2023.

2.5.4 An Overview of the Rural Electrification Agency

The Rural Electrification Agency in Nigeria was created in 2006 through the Electric Power Sector Reform Act (EPSRA) 2005 to cater to electrifying rural and unserved areas (Diji 2014; REA 2023). The primary mandate of the agency, according to the REA website (REA 2023), includes:

1. Encourage rural electrification.
2. Organise and manage rural electrification programs and activities.
3. Oversee and direct the Rural Electrification Fund (REF) for rural electrification through Public and Private Sector Participation.

The agency's responsibilities are detailed in the National Energy Policy (NEP), the Electric Power Sector Reform Act (EPSRA) and the Rural Electrification Strategy and Implementation Plan (RESIP). However, the agency recently catered to grid, mini-grids, and standalone systems development (REA 2023). The agency is managed by an Executive leadership team led by the Managing Director and CEO, working with other executive directors. The activities of the executive team are overseen by the board and coordinated by the Board Chairman. Figure 16 below is a pictorial representation of the Executive Management team.

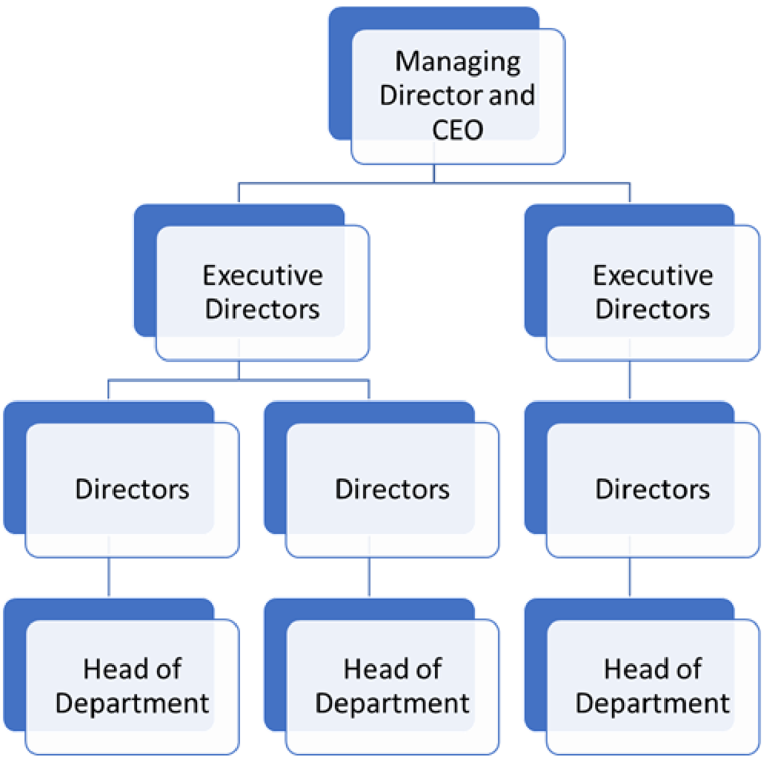


Figure 16: REA Organogram representation. Adapted by Author (Source: REA 2023)

The REA is funded through the provisions in establishing the Rural Electrification Fund (REF) through public and private partnerships and external participation (REA 2023). The funds are only meant for electrifying rural areas, development of off-grid and on-grid renewable electrification processes and enhancing the livelihood of rural settlers (Diji 2014; REA 2023).

The appointment of the chairman and members of the REA governing board and the executive management team is carried out by the Federal Government of Nigeria through the Ministry of Power (REA 2023). Other officers and staff members are recruited from within and outside the Agency.

2.6 Chapter Summary

The observation from the literature has been that grid-based RE failures are attributable to a lack of proper planning and implementation processes. Furthermore, the present planning and implementation processes lack transparency and accountability, which literature has characterised as being influenced by the government's substantial involvement and control. Additionally, there is a misalignment in policies and a lack of coordination among various actors. Also, the presence of institutional challenges is influenced by political regime changes.

Although there have been some notable successes in the power sector relating to overall energy access and rural electrification using renewable energy (solar technologies), there is still a significant gap in the urban area's electricity access, which has had a ripple effect on the country's economic development. Additionally, no solar and wind renewable technologies are installed on the grid.

The introduction of grid-based renewable energy technologies for electrification is a complicated task with no success, despite the various strategies, policies, and policy mechanisms and institutions in place over the last decades to support the development. Furthermore, introducing renewable energy on the national grid changes the setup of existing processes and systems in the sector. Consequently, these compound the challenges currently experienced in the electricity sector as the new structure comprises more actors and networks, requiring greater transparency and accountability.

In light of this, this research seeks to address the planning process and governance approach based on these shortcomings hindering the implementation of renewable energy development on the grid, highlighting key accountability and transparency concepts. At the same time, various past research has assessed the governance of RE in general, including community, rural and ocean-based renewable energy (Butu 2017; Osu 2017). The grid-based renewable energy development has yet to receive any attention. Also, previous work did not incorporate accountability and transparency in the transition planning process and governance. Therefore, this research work aims to close this existing gap.

This research attempts to provide a governance and planning process model incorporating accountability and transparency to ensure the successful implementation of RE strategies and identify inhibitors and enablers for implementing renewable energy on the national grid. To address these shortcomings, the research is veering toward the transition theories that comprise several models that give guidance and direction and illuminate how existing societal systems transition to accommodate innovative technologies such as RE technology development in the context of this research.

CHAPTER THREE: THEORETICAL AND CONCEPTUAL FRAMEWORK OF THE STUDY

3.1 Introduction

This chapter reviews relevant literature in transition theory: Multi-Level Perspective (MLP) and Transition Management Framework (TMF), and accountability and transparency concept. To achieve the research aim, the TMF and MLP serve as the theoretical underpinnings of the research. They are supported by accountability and transparency concepts to review the planning process and governance for deploying renewable energy technology, describe the drivers, enablers and inhibitors for the installation on the grid and develop a model to facilitate the transition.

Thus, the chapter commenced by reviewing transition studies, socio-technical transition perspective and lens, and transition theories (MLP and TMF) were critically discussed. Moreover, the rationale for utilising TMF, MLP and accountability and transparency concepts are discussed. Finally, elements for transitioning to a renewable energy system, especially on the grid is developed, which provides direction for research questions, and the chapter summarised.

3.2 Transition Studies

"Transition" was initially described by Alex Tocqueville in the 1800s as the "prevailing change that occurs in the dynamic system to accomplish liberation for humans (Lachman 2013). The term "Transition" has differing meanings to experts in different fields: economics (Olofsgard, Wachtel and Becker 2018), health (Frenk et al. 1991), energy (Demski et al. 2019), and environment (Perl and Calimente 2011). According to Lachman (2013), the expression appeared in the socio-technical literature during the 1990s. Kemp and van Lente (2011) referred to transitions as a long-term change to new technologies and infrastructures, which concurrently requires societal acceptance and changes. Similarly, Markard, Raven and Truffer (2012) defined transitions as "long-term, multi-dimensional and fundamental transformation processes through which established socio-technical systems shift to more sustainable modes of production and consumptions".

This study adopts the definition of transitions from the transition studies, which refers to the transformation and co-evolution of societal systems at various sub-systems, levels and scales (Rotmans and Loorbach 2009). This co-evolution could involve complex interaction among institutions, actors, cultures and values (Rotmans and Loorbach 2009), hindering incumbent systems' quick transition. They are characterised as being "locked in" and deeply embedded in the societal structures and systems politically, institutionally, technologically, socially and economically (Lachman 2013). The introduction of novel technologies or innovations might be; hence, diffusion of new technologies might be gradual due to the prevailing market structure, policies, societal habits, available infrastructure, and institutional and regulatory systems (Smith, Stirling and Berkhout 2005).

Systemic changes as a result of transition have occurred in the past. In the 19th century, the transportation industry experienced a shift from sailing boats to steamships. In the 1960s, the energy industry in the Netherlands moved from coal to natural gas usage (Kemp and van Lente 2011). While these transitions occurred, the changes were not facilitated by sustainability challenges but by modernisation and technology advancement. Today's transition in various sectors is confronted with numerous considerations, including sustainability such as energy generation, which is concerned with energy security, greenhouse gas emissions, energy poverty, depletion of oil and gas reserves, environmental pollution, and inadequate infrastructure (Markard, Raven and Truffer 2012).

The current energy transition implies transforming from the dominant energy systems to renewable energy systems (Bridge et al. 2013). Loorbach and Rotmans (2010) proposed that these changes are considered "fundamental changes". Several research works have sought to expedite this transition by setting up bases for achieving conversions in the infrastructures and promoting the expected energy sector transition (Geels 2004; Kemp 2010; Sawulki, Gałczyński and Zajdler 2019; Castrejon-Campos, Aye and Hui 2020).

Transition theory has gained prominence in energy and sustainability literature and appreciates radical change's role in achieving technology innovation and transformation (Bogdanov et al. 2019). Certain defining features of transitions were mentioned in Rotmans et al.'s (2000) studies, which highlighted transitions involving the interactions of technological, economic, ecological, socio-cultural and institutional factors, resulting in the coevolution of structures: "markets, policies, autonomous trends, technologies, institutions and individual behaviours" which occur over a long period of, at least, one generation, i.e., 25 to 50 years and involves the interaction of the niche, regime and landscape.

This transition needs government involvement through policies, support mechanisms, good management and including all stakeholders (Kemp and van Lente 2011). The "governance" dimension of socio-technical transitions was introduced at the beginning of the 21st century to aid transitions and has evolved over the years (Lachman 2013). Governance has different meanings in different fields. For example, Florini (2013) described governance "as how groups of people collectively make choices". Also, Florini and Sovacool (2009) mentioned governance in relation to actors, establishments and a process for evaluating service provisions. However, for the purpose of this research, 'governance" is described as those elements required for the management of grid-based renewable energy, such as institutions, stakeholders, practices and support mechanisms.

Likewise, the renewable energy planning process describes the practices and analytical model to optimise the RE produced to satisfy the energy demands of companies and countries by considering the entire energy mix (Cormio et al. 2003; Alizadeh et al. 2020).

For this research, the RE planning process is the route for deploying and installing RE initiatives. Smith, Stirling and Berkhout (2005) showed governance importance for piloting the transition. Several studies depicted the feasibility for the transition of the incumbent regime (systems) to a niche technology (new system). However, this transition has complexities as both the incumbent regime is constantly changing, and the niche technology is expected to match the changes to achieve an effective and sustainable energy system (Kemp and van Lente 2011).

Further consideration is the Andersen and Geels's (2023) work, the authors argued that socio-technical transitions involve the interactions of multi-systems which are pervasive and include various dimensions such as technologies, institutions and actors that co-evolve and projected that this would create further bottlenecks especially for on-grid electricity systems. Geels et al. (2018)

argue that transitions are typified by several transformation systems, culture, policies, political interference and uncertainty. Additionally, the governance of transition process involves multi-actors with different perspectives, values and goals (Loorbach 2007). Andersen and Geels (2023) further postulate that grid actor orientation and institutions needs to be managed closely to ensure alignment to achieve the transition to foster a low carbon environment. Arguments in literature have promoted market-related methods for RE innovation planning process and governance compared to the typical energy systems (Mcdowall 2012).

The next section of this study considers the socio-technical perspective of transition.

3.3 Socio-Technical Transition Lens

The Socio-technical domain is being viewed from two angles in energy transition studies. These angles are firstly from the socio-technical transition view and secondly from the technology innovation view. The first relates to societal transformation necessitated by system transitions from the emergence of innovations, which is a premise of this research. While the second refers to changes in a single technology innovation. Various studies have analysed system transition in the transportation, building, and electricity sectors. For instance, Verbong and Geels's (2010) study assessed the electricity system for a sustainable transition to understand the system's dynamics and the impact of innovation with policy and planning process implications. The socio-technical transition relates to this research as it explains the societal changes and interactions due to the introduction of technological innovation: RE technology.

3.3.1 Theories of Socio-Technical Transitions

The socio-technical perspective is appropriate for this research since this can provide the conceptual and theoretical premise as this study assesses the interdependence and complex interaction of people and technology systems (renewable energy technologies) in the grid-based electricity sector of Nigeria. Four prominent theories that will be discussed in this section include Multi-Phased Concepts (MPC), Multi-Level Concepts (MLC), Strategic Niche Management (SNM), and Transition Management Approach. Multi-Phased Concepts (MPC) and Multi-Level Concepts (MLC) have been extensively utilised as an analytical lens in transition studies to assess and proffer solutions for planning and governance of transitions. MPC and MLC provide an understanding of the dynamics and the evolving dimension of transition, which is reviewed subsequently.

3.3.1.1 Multi-phased concepts

Socio-technical transitions are not linear as it undergoes four stages (Rotmans and Loorbach 2009). Rotmans et al. (2000) assert that the extent and pace of change vary in every transformation stage. They argue that transitions require the displacement of incumbent's regimes by emerged and improved novel technologies and systems which emulates an "S-curve dynamic". These transition stages include pre-development, take-off, acceleration and, finally, stabilisation stage.

A. Pre-development

During the pre-development phase, the landscape is slowly changing; however, the regime is stable, and innovation is gradually developing at the niche level. At this early emerging phase, novel ideas, process and growth in the niche technology are altering the existing paradigm. However, the transformation is relatively insignificant and are not evident. Moreover, Rotmans et al. (2000) opine that many sustainability experiments are ongoing at this stage.

B. Take-off

At this phase, pressure from the changing landscape and niche development begins weighing in on the existing systems' state; hence, the regime begins to shift. This phase is referred to as the beginning of the transition process as structural changes occur. For this phase to occur, Brugge and Rotmans (2007) suggested sustainability innovations will need to reinforce each other and harmonise to form efficient blocs and stable network. Nevertheless, they argued that not all transitions have a successful outcome as innovation systems will need to be strong enough to compete with the existing regime. Conversely, "lock-in" is inevitable when the networks compete against each other, resulting in the transformation process's truncation.

C. Acceleration

During this breakthrough phase, structural and societal changes become glaring as markets, policies, technologies, institutions and individual behaviours evolve during this point and involves various processes, learnings, diffusion and institutional changes (Brugge and Rotmans 2007). The socio-technical innovation gains traction as the new technology and practice become mainstream. However, Chang et al. (2017) state that inherent deficiencies that were hitherto undiscovered could surface, resulting in the innovation system's stalled growth.

D. Stabilisation

At this point, the following occurs; the societal changes reduce, a new dynamic equilibrium is established, the new technology(ies) diffusion reduces, and the system stabilises and culminates. Subsequently, the new system gets embedded in the societal systems (Rotmans et al. 2000; Brugge and Rotmans 2007).

Brugge and Rotmans (2007) and Chang et al. (2017) argue that the MPC more or less is useful in deciphering the transition structure and, hence, might not generally follow the highlighted transition progression pari passu.

3.3.1.2 Multi-level concept

A wide variety of energy transition studies utilised socio-technical Multi-Level Perspective (MLP) to evaluate the energy and electricity systems. MLP emanated from the study of the previous transition to new socio-technical systems such as sanitation, electricity and food. The Framework has been widely applied as an analytical tool to evaluate the feasibility of renewable energy, especially in developed countries (Lachman 2013; Rosenbloom and Meadowcroft 2014; Geels, McMeekin and Pfluger 2020). Such transition processes of socio-technical systems are more complex due to the peculiarity of being deeply embedded in societal structures (Markard, Raven and Truffer 2012).

The fundamental use of MLP in transition studies has been for extensively complex socio-technical structures with unique tendencies (Elzen, Geels and Green 2004; Loorbach 2007; Smith, Voß and Grin 2010). MLP helps to address and ascertain the core concerns in transition, support mechanisms and stakeholder participation (Geels and Schot 2007; Geels 2011; Ruggiero, Varho and Rikkonen 2015; Geels, McMeekin and Pflueger 2020). The Framework provides the backdrop for understanding transition, especially how it relates to the interaction of the fundamental society levels that can cause transitions, such as stakeholders, environment and novelties (Geels 2002; Geels 2011). The theory analyses an entire system's innovation and takes root in innovation studies and system theories (Geels 2002; Smith, Voß and Grin 2010; Geels 2011).

MLP exist in the three fundamental hierarchical plains, namely macro, meso and micro levels. The macro-level is the socio-technical landscape, which is fundamentally extrinsic in the process that results in transitions in society and includes occurrences such as economic development, conflicts, customs, climate change, policies, concepts and worldview, as shown in Figure 17 (Geels and Schot 2007; Kern and Smith 2008; Kemp 2010). The transformations here are comparatively slow and affected by elements outside the current or new actors or institutions. However, support for innovation occurs at this level but is not powerful enough to affect the landscape.

Furthermore, at the meso level (regime), there exists structurally dominant stability, which comprises techniques, arrangements, philosophy, stakeholders, establishments and regulations that function to ensure the continuity of prevailing systems that manage the decision-making procedures in the regime (Loorbach 2007; Geels, McMeekin and Pflueger 2020). The regime is usually intransigent since basic relations, necessities and stakeholder collaboration (in all directions) have strengthened the system. Besides, sub-regimes within the regime level are partially structured to institutionalise current practices and behaviours, making the regime resistant to change, resulting in a "lock-in".

However, it is essential to note that Geels (2018) showed that transition could occur when sufficient forces from the landscape or novel innovation are applied to the regime system (Loorbach 2007; Geels, McMeekin and Pflueger 2020).

Finally, at the micro-level (niche), essential innovations are developed as a resultant effect of the anomalies at the regime and protected from market-related pressures. This level is where new birth of ideas and novel technological development occur even with being prone to constant changes. It is an environment conducive to knowledge, technological advancement and studies, and deploying novel concepts. It also helps the supporting network to grow, and this level is greatly affected by the changing landscape. In Figure 17, the innovative concepts (niche) are transferred to the meso level (regime) as the forces emanating from the macro and micro levels compress the system (Geels and Schot 2007; Geels, McMeekin and Pflueger 2020). However, some technologies fail at this level, while others develop and create a new pathway that destabilises the existing regime.

Geels and Ayoub (2023) advanced the multi-level perspective which suggests that transition occur across four multi-phases: experimentation, stabilisation, diffusion and disruptions, and institutionalisation by incorporating the positive tipping points. The authors argued that positive tipping point which refers to the state where a small upheaval leads to transformation of a system due to the self-reinforcing feedback loop occurs at the 2nd and 3rd phase of transition. Furthermore, seven co-evolutionary feedback loops, which are: users and technology; firms, technology, users; firms and policymakers; policymakers, technology and users; users and wider publics; wider publics and technology; wider publics and policymakers for sociotechnical transitions were applied to UK offshore wind and electric vehicle case studies and concluded that policy supports are crucial in tipping points for both case studies. However, there are limitations in the types of actors considered, the need for conceptual empirical application and consideration of regime destabilisation context.

Despite the extensive application of MLP, the framework is still critically challenged (Geels 2011). These include agency deficiency (Smith, Stirling and Berkhout 2005), regime operationalisation, strict use of bottom-up change approach (Berkhout, Smith and Stirling 2004; Geels 2011), and scanty deliberation on politics (Kern 2011; Meadowcroft 2011).

Nevertheless, an analytical tool like MLP cannot be used alone for complex challenges related to policies and governance processes (Kumetat 2012) because it can only represent the complex issue as a simple model: niches (micro-level), regimes (meso-level) and landscapes (macro-level) determined by scientific transitions, as illustrated in Figure 17 (Geels 2002; Geels 2011).

Though recent studies recognise that multi-niche, multi-regimes, and multi-landscape could steer that whole system transition, these transformations may not be far-reaching but slowly increasing and resulting in improved policymaking and administration (Geels 2018). The upside for MLP is the "broad and deep empirical evidence", making it critically invulnerable (Geels 2019).

Moreover, many interacting tools are not currently applied in the MLP (McMeekin, Geels and Hodson 2019; Andersen and Markard 2020). Nonetheless, MLP applies to this study by providing an analytical plan to evaluate grid-based renewable energy development. Also, MLP appropriately captures the multi-stakeholders and multi-actions that characterise the energy sector in Nigeria.

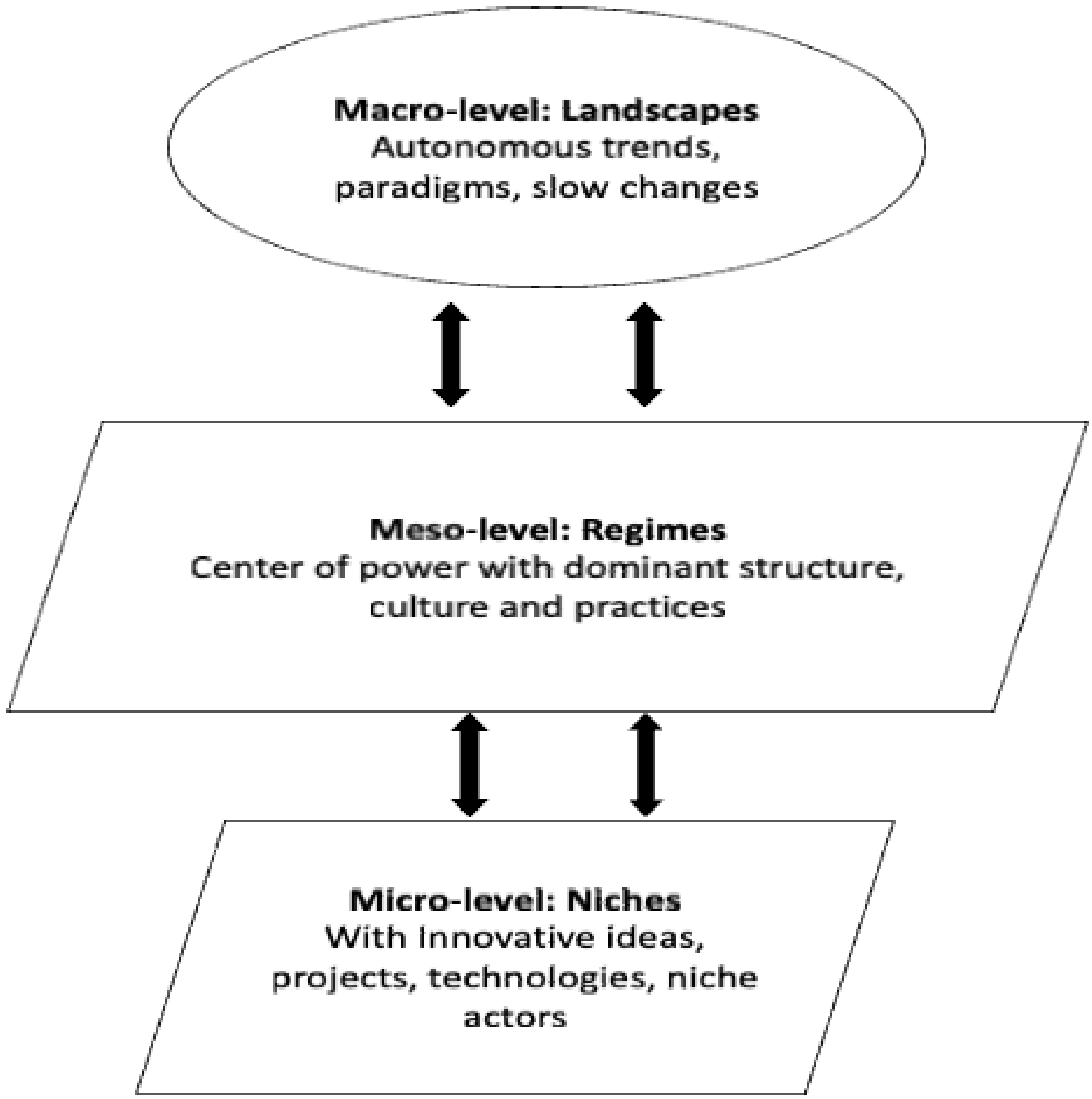


Figure 17: Multi-level perspective framework. Source: Adapted from Geels (2002)

3.3.1.3 Strategic Niche Management (SNM)

Some other frameworks that are used for the assessment of socio-technical transition include Strategic Niche Management (SNM) and Transition Management (TM) (Loorbach 2007). However, these are dissimilar because the modelling, descriptions, perspectives and span are different (Loorbach 2007).

Also, SNM concentrates on managing innovative ideas (niche regimes) while TM assesses the transformation that occurs in society to promote sustainable development. SNM and TM are based on the MLP and focus on multiple-level transformations. However, Lachman (2013) felt strongly about the suitability of applying SNM in other countries, such as those in the global south, whose socioeconomic, administrative, socio-cultural, institutional and circumstantial differences are visible bases for niche formulation. Likewise, Elmustapha, Hoppe and Bressers (2018) described the need to adapt SNM for the countries in question.

3.3.1.4 Transition Management Approach

Rotmans, Kemp, Geels, Verbong and Molendijk established the transition management concept (Rotmans et al. 2000), and additional upgrades occurred through the introduction of multi-phase theory (Rotmans and Loorbach 2009) and multi-level theory (Kemp 2010). TM's application has recently transcended into administrative and policy assessment (Loorbach 2004), especially useful for energy transition for renewable energy development (Kern and Smith 2008; Kumetat 2012; Ruggiero, Varho and Rikkonen 2015).

Debate in transition studies has proposed the need to evolve the existing processes as energy transition is complex, faced with many uncertainties and hurdles due to the focus on incorporating sustainability drivers, which necessitates facilitating the co-evolution of different systems, which still needs to be defined. Loorbach and Rotmans (2010) and Roorda and Wittmayer (2014) proposed various opinions in their studies on how to transform the system, including energy systems.

TM focuses on road-mapping transitions rather than the prescribed destination that results in changing societal systems, including policies (Loorbach and Rotmans 2010). Despite the transition roadmap's ambiguity, the approach's objectives drive the co-evolutionary processes with a long-term strategic plan as obtainable in sustainable energy systems.

Figure 18 shows the four activity levels to evaluate TM, namely strategic, tactical, operational and reflexive, and the four multi-standpoints, which are multi-phase, multi-level, multi-patterns and multi-actor.

The strategic level deals with broader societal issues, and it involves defining the problem and creating a long-term vision (up to 30 years) that considers the existing norms, values, and expectations of the society. This involves developing principles that serve as an evaluation and policy formation guidance. In contrast, Loorbach and Rotmans (2006, 2010) posit that the tactical level entails the structural hindrances to achieving the visions or goals, which could be in the form of incumbent institutions and regulations. Coalitions among various stakeholders are eminent at this level as they determine the transition pathway. Accordingly, the changes promulgated by the groups could encourage innovation and new technologies. The leadership required is both top-down and bottom-up, which includes goal setting, prioritising and accelerating the system toward transition (Meadowcroft 2009). This is dissimilar to the operational level, where the niche level contains all occurring events, including tests and trials of novel ideas. Finally, at the reflexive level, all actions aim for constant knowledge acquisition, revising the successful initiatives and applying feedback into the system. The framework utilises leadership concepts such as bottom-up methods, learning and experimentation, and modifying the system for sustainable development (Shove and Walker 2008; Stirling 2011; Avelino and Grin 2017).

TM processes involve four steps, which is a cyclic configuration and comprises structuring the transition problem, envisioning and transition arena organisation, developing sustainability images and building coalitions and agendas, mobilisation of actors and carrying out transition’s experiments, and the transitions are monitored and evaluated, which could occur between two to five years based on the transition type, as depicted in Figure 18 below

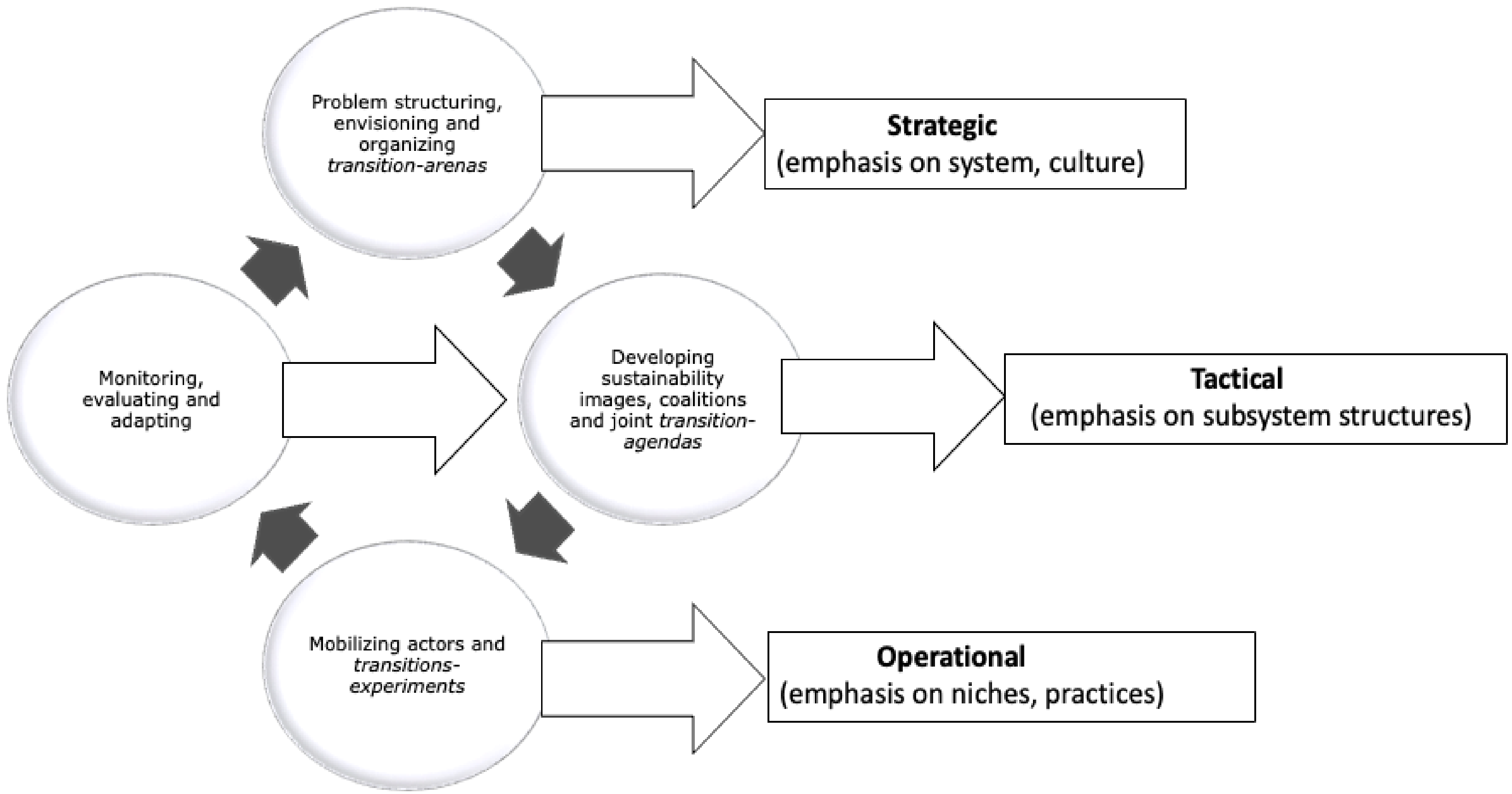


Figure 18: Transition Management Framework (adapted from Rotmans and Loorbach 2009)

Problem structuring, envisioning and organising transition arena

At the start of the TM cycle, the 'transition arena' is made up of a small group of diverse actors selected by a 'transition initiating core group' who are sponsors of the transition (Loorbach and Rotmans 2010; Roorda and Wittmayer 2014) that collectively describe and interpret the peculiar persistent problem in the socio-technical regime from different viewpoints. Additionally, they develop strategic plans to address the identified issues that affect the entire societal systems (Malekpour et al. 2020).

Whilst these actors, known as 'frontrunners', are selected from various establishments, they reflect the transition's complexity and are independent of the organisation. The transition process supports a feedback-loop system within the transition arena. Loorbach and Rotmans (2010) suggests that a cross-functional team should be the target, with a minimum number of ten and a maximum of 15.

Developing sustainability images coalition and joint transition agendas

Loorbach and Rotmans (2006) averred that "organising an envisioning process for sustainable development is a difficult task. This requires questioning one's paradigm and leaving aside the concomitant everyday noise". A typical transition agenda aspires in the larger society, and this occurs at the tactical level with a mid-term timescale (five to fifteen years) (Malekpour et al. 2020). Objectives, programmes, projects and policies are developed based on the guidance of the long-term plans (by way of back-casting) (Loorbach and Rotmans 2006) envisioned for the transition, representing the 'transition images'. Participants in the transition arena select 'a basket of images' that result in several visions and pathways that aim to reach an accord in the future. According to Loorbach and Rotmans (2006), the transition images should be multi-dimensional, embodying the three sustainability elements: economical, environmental and socio-cultural. Loorbach and Rotmans (2006) further assert that the transition process's optimisation is achieved when the transition images and the 'goal-seeking process' are allowed to develop over time and restructured based on new perspectives and learnings, rather than on a 'blueprint' approach. The transition agenda is a pivotal aspect of the transition process and poses the risk of undermining the transition if not properly formulated, which operates as a long-term framework for policies (Loorbach and Rotmans 2010; Gaede and Meadowcroft 2016). However, if adequately constructed, it will boost the process.

Mobilising actors and transitions - experiments

Initiation and execution of the transition occur at the operational level. It involves the operationalisation of projects and experiments to achieve concrete results once the transition arena and agenda have been realised. This serves a distinct purpose of furthering institutional and infrastructural changes (Loorbach and Rotmans 2006; Sengers, Wieczorek and Raven 2019; Malekpour et al. 2020), as the projects and experiments must tally with the transition objectives. For instance, in the case of energy systems transition, experiments must align with the sustainability objectives quantifiably and substantially. During the experiment, Loorbach and Rotmans (2006) aver that strict standards must be considered to ensure the experiments (projects) are interlinked and interdependent.

Furthermore, the variability of the system and uncertainty resulting from lack of knowledge are inherent during the transition process. Therefore, to bridge these complexities/intricacies, understanding the nature of uncertainty and exploring various avenues to alleviate, avert or reduce this uncertainty based on its nature is vital. However, during the transition process, the nature of uncertainty could evolve, which necessitates a ripple effect on the transition images, visions and goals. Hence, explorative scenarios can be exploited to generate various outcomes cognisance of existing and potential uncertainties (Loorbach and Rotmans 2006).

Monitoring, evaluating and adapting

A vital element of the transition process is continuous monitoring and evaluation, learning from the projects executed and adaptation of the experiments. However, the whole transition, including the transition management process, requires monitoring in light of the changing landscape, regime (that could be infiltrated), and dynamic niche level (Kemp and Rotmans 2005). Loorbach and Rotmans (2006) suggest that reflexive monitoring should be adopted as this entails learning involving a participatory process. However, they recognised that reflexive learning with a 'social phenomenon' is difficult to translate for monitoring. Hence, capturing the learning process poses difficulty when evaluating to adapt the new learnings to the transition (Loorbach and Rotmans 2006). Loorbach and Rotmans (2010) suggests navigating this difficulty by developing a specific metric to monitor and evaluate the experiment's learning process.

A wide range of learning exemplifies occurrences within the transition domain as the timescale of transition management long-term is twenty-five to fifty years and emphasises learning is bi-directional: learning by doing (deriving theories from the application) and doing by learning (gain practical knowledge from theories) (Loorbach and Rotmans 2006). Loorbach and Rotmans (2010) asserts that monitoring, evaluating and adapting the learnings provides the opportunity for course-correction toward an effective transition.

According to Kelly, Ellis and Flannery (2018), postulates the need for TMF to counteract the constant administrative changes occurring in societies which are opposed the transformation and path dependency. However, TMF is accused of not considering the influence of power and politics which are fundamental components for transitions. Similarly, scholars assert that TM do not function appropriately in the political concepts (Shove and Walker 2008; Meadowcroft 2009; Stirling 2011; Avelino and Grin 2017) and the TM model creation process (Loorbach, 2007). Roberts and Geels (2019) also identified a limitation of TM in driving deliberate acceleration of transition in their work, *investigation of the intervention strategies and condition for deliberate acceleration of transition in Dutch natural gas and Danish district heating transitions*. The authors argued that in both cases traditional policy tools were critical for accelerating transition. Although the authors recognised that TM policy mechanism are beneficial in the early phase of transition where it creates preconditions for transition, however, it did not drive accelerations. These confirms Meadowcroft (2009) and Geels et al. (2015) previous studies.

Moreover, TM's application does not span all empirical concepts for policy and governance in sustainable energy transformation. It has not been used to assess the Nigerian RE planning process and governance for grid-based electricity generation.

Therefore, this study adds to the socio-technical discourse and provides an additional basis for MLP and TMF empirical utilisation. The creation of the conceptual framework that integrates accountability and transparency concepts in the TMF assessment of grid-based RE generation in Nigeria is a novel idea.

3.4 Accountability Concept

Accountability is essential to every form of successful governance and administrative concepts (Osho and Afolabi 2014; Gberevbie et al. 2015). It is usually used with expressions such as transparency, responsibility, responsiveness, good governance and answerability (Mulgan 2000; Behn 2001; Pollitt 2003; Bovens 2007; Dubnick 2005; Bovens 2010; Osho and Afolabi 2014). However, authors do not have a defined way to express accountability, so there are as many definitions as there are authors, and this is constantly changing from year to year (Dowdle 2006; Bostrom and Garsten 2008; Ebrahim and Weisband 2007; Lindberg 2009; Bovens 2010; Osho and Afolabi 2014). Accountability is normally described as a perception that guarantees the responsiveness and answerability of public institutions to the people (den Boer 2002; Mulgan 2003a; Mulgan 2000; Bovens 2010); therefore, keeping the institutions responsible and responsive to the needs of the people and not above the law (Chandler and Plano 1988; Odugbemi 2008; Gberevbie et al. 2015). Nigeria's electricity sector is greatly influenced and controlled by the government; the government has a controlling interest in the sector. Additionally, the existing institutions are dependent on changes in political regimes. Therefore, a higher emphasis on accountability is required for RE development's governance and process to be transparent. A community without accountability is prone to corruption and mismanagement of public funds, resulting in underdevelopment (Adenugba and Sa 2010; Osho and Afolabi 2014). Summarily, for the purpose of this study, accountability is the liability of all stakeholders to behave and act uprightly, doing the right thing all the time (Schmitter and Karl 1991; Meijer and Schillemans 2009; Sareen 2020). This encourages politicians and all government representatives to ensure they fulfil the purpose of their positions (Dunn 1999; Adenugba and Sa 2010; Bowen et al., 2017). However, accountability as a concept is still foreign to most government officials in Nigeria (Osho and Afolabi 2014).

Historically, due to the power conferred on institutions, the societies have developed means to ensure there is "check and balance" to curb any excesses and hold any offender accountable (Kersbergen and Waarden 2004). However, this is not to stifle the system's effective working or to allow laxity; therefore, these checks and balances are applied as optimally as practicable. Bovens (2010) opined that accountability is strongly associated with accounting in bookkeeping. The concept can be traced back to the eleventh century when property owners were required to number and account for their possessions to the English Monarch and documented by the palace emissaries in the "Domesday Books" (Dubnick 2007). Dubnick (2007) concluded that this was an act to show that they are accountable for their actions when the need arises. Thus, from this etymological and historical definition, accountability can be described as a mechanism responsible for clarifying and explaining demeanours.

Bovens (2010) described the accountability concept as either a virtue or a mechanism. He explained that accountability as a virtue is used principally as a prescriptive concept, a set of ethical expectations from public actors. Therefore, accountability studies frequently emphasise these normative issues to adjudge the demeanours of public officeholders. However, accountability as a mechanism is used in a descriptive sense. It is seen as an institutional relation or procedure where public agents are responsible and responsive by an assembly. Hence, the accountability studies herein are focused on the means the institutional arrangements function and not the public officers' behaviour (Bovens 2010).

3.4.1 Forms of Accountability

Bovens (2007) described accountability in the different forms. This is based on the critical elements evaluated in the different forms, as illustrated by Figure 19 below:

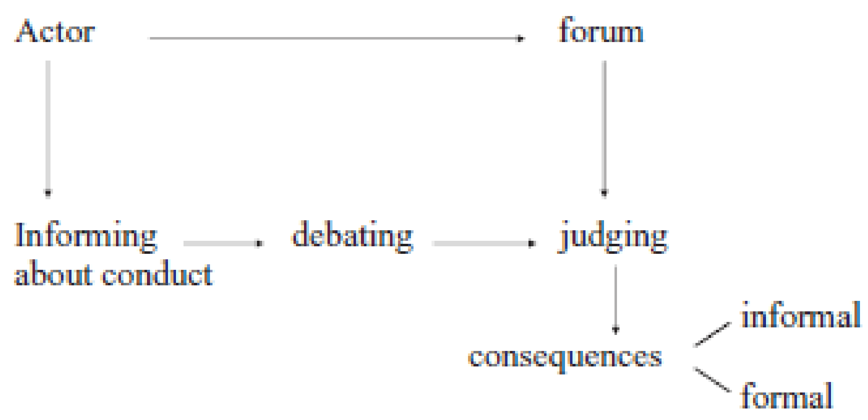


Figure 19: Components of Accountability Concept. Source: Bovens (2007)

Therefore, four (4) forms of accountability exist, and these are based on the nature of the forum, actor, conduct and obligation. Figure 20 depicts these different categorisations for accountability, and the major forms are described in the section below:

Based on the nature of the forum

- Political accountability
- Legal accountability
- Administrative accountability
- Professional accountability
- Social accountability

Based on the nature of the actor

- Corporate accountability
- Hierarchical accountability
- Collective accountability
- Individual accountability

Based on the nature of the conduct

- Financial accountability
- Procedural accountability
- Product accountability

Based on the nature of the obligation

- Vertical accountability
- Diagonal accountability
- Horizontal accountability

Figure 20: Four dimensions for accountability classification. Source: Bovens (2007)

Accountability Based on the Nature of the Forum

Political vs Legal Accountability: Political accountability is essential in democracies, including elected representatives, political parties, voters and the media. The populaces use votes to delegate sovereignty to their representatives, who then typically delegate most of the authorities to the executive council through the ministers. Subsequently, the ministers delegate authorities to other administrative bodies, such as ministries, parastatal and agencies. According to Bovens (2007), the reverse is true for political accountability. Conversely, legal accountability is becoming more prevalent, especially in Western countries.

Legal accountability is typically carried out by the courts, which could be civil, penal or administrative, based on legal guidelines (Bovens 2007; Bovens 2010).

Administrative vs Professional Accountability: Administrative accountability involves auditors, inspectors and controllers. These forums usually carry out unbiased and external administrative management and regulations. Others include ombudsmen, anti-graft agencies and chartered accountants. Contrarily, professional accountability is professional peers with codes and standards that public officials who are members of these bodies adhere to or face a disciplinary board.

Social Accountability: Social accountability involves interest groups, charities and other stakeholders. Non-governmental organisations have been, in recent times, able to serve as an intermediary for establishing policies and accountability between the government and the public (European Commission 2001; McCandless 2002; Malena, Forster and Singh 2004).

Accountability Based on the Nature of the Actor

Corporate vs Hierarchical Accountability: Most public institutions are incorporated legally and are, hence, expected to be accountable, based on the code of conduct in which they operate. Therefore, public organisations are liable for their misdemeanours. However, for hierarchical accountability, one person at the top, usually the minister, commissioner or director, is first held accountable for the organisation's activities. However, other lower cadre officials could also be called in for questioning (Bovens 2007; Bovens 2010).

Collective vs Individual Accountability: Collective accountability involves the entire organisation being accountable for one or a few organisation members. This method usually applies to specific circumstances, such as the European Commission (van Gerven 2005). Contrariwise, for individual accountability, each public officer is held accountable for his/her actions, especially during the judgement phase. Individuals are recognised and not the formal position they hold (Bovens 2007; Bovens 2010).

Accountability Based on the Nature of the Conduct

For accountability due to the conduct's nature, the type of conduct is determined by the most significant action. For example, the conduct is classified as financial accountability if the conduct involves financial misappropriation. Others include procedural and product accountability.

Accountability Based on the Nature of the Obligation

Vertical vs Horizontal Accountability: Offences in public service usually occur when the offender is forced or act voluntarily. Vertical accountability involves the former. However, horizontal accountability occurs when the actor acts voluntarily without any pressure from the top.

Diagonal Accountability: Diagonal accountability involves a thin-line reporting or influence from the top. For example, the relationship between the audit office and the minister does not involve any direct reporting line, but some influence can be exerted.

The importance of accountability cannot be overemphasised. The populace's confidence in the public institutions is wavering; hence, there is a need to restore trust (Dalton 2004; Dogan 2005; Pharr and Putnam 2018; Stimson 2015; Bovens 2010). The primary importance of accountability is to aid the restoration of lost confidence between citizens and government (Aucoin and Heintzman 2000). Accountability reports, especially from Transparency International or other local/national non-governmental organisations, can validate a government's activities, or otherwise. Accountability is influential in accomplishing accountable governance. These arrangements ensure that public officers or public establishments remain on the honourable route.

Accountability has been utilised in different areas. This is demonstrated by members of boards who do not have enough resources as staff of the organisation, but only depend on the information provided (Meijer and Schillemans 2009). Moreover, social accountability is demonstrated among civil societies and the media to allow the government to provide evidence and explanations for their actions (Bovens 2007).

Sareen (2020) identified that energy transition is capable of solving the fundamental challenges caused by accountability. A case study of Portugal's energy transition was provided, using solar energy, where accountability between stakeholders in the energy sector has aided the sector's improvement. Bowen et al. (2017) also explain the Sustainable Development Goals (SDG) 7, with many actors with different interests and stakes to achieve the goal. Hence, the energy transition process is suitable to resolve the complex issues amongst government, companies, communities and other stakeholders.

Bovens (2007) opined that accountability can be evaluated by types, which accounts for the different relations and engagements found in various administrative entities. They provide a larger framework for mapping of the other building strata for narrower classification (Bovens 2007). The relationship between accountability and transparency are discussed below.

3.4.2 Transparency Concept

Transparency and accountability are usually used inter-changeably, which means they can be one and the same but, most often than not, they are different. According to Bostrom and Garsten (2008), lack of transparency constitutes the biggest challenge experienced by organisations, groups, companies, governments and society at large. By definition, transparency can be referred to as “openness” or “accessibility”, unlike accountability which means “responsibility”, mostly (Bostrom and Garsten 2008). However, they discussed that even though transparency can be referred to as openness at a conceptual level but really difficult practically, “Modes of openness can empower some… and exclude others with unintended consequences… Mechanisms of accountability and transparency can therefore be quickly discredited in organisational settings, despite the best intentions of their designers” (Bostrom and Garsten 2008). This is corroborated by Drahos (2017) that law should be incorporated into a much bigger regulatory framework to be more effective whereby many people and institutions are positioned as “defenders, guardians and protectors of public interests”, meaning that everyone has complete information, mutual transparency and accountability.

Furthermore, transparency provides an avenue to show that decisions made, and the procedures involved, are impartial. The society want to see the government and institutions as being truthful and trustworthy, and the level of transparency is a barometer used to ascertain this (Drahos 2017). Nevertheless, O’Neill (2002, 2006) and Dubnick (2007) assert that transparency requests and expects that accounts should be given to the mundane things and activities; however, they believe that this jeopardises the purpose for setting up accountability. Hence, it is important to be strategic and thoughtful about the use of transparency and accountability for institutional processes. Moreover, Ebrahim and Weisband (2007) affirms that in global governance, accountability is subdivided into four components, i.e., transparency, answerability/justification, compliance and enforcement/sanctions. Thus, transparency is a sub-component of accountability and explains the reason for the construct “transparency and accountability”.

In Nigeria, transparency, like accountability, is a big problem that requires urgent attention and solutions to allow for the populace to enjoy all the “dividends of democracy” (Sen 1999; Kaufmann, Kraay and Zoido-Lobaton 2000; Todaro and Smith 2011; and Iyoha et al. 2015). Also, transparency and accountability are virtues connected to good governance, which is required for a government to achieve a great feat such as implementation of a grid-based renewable energy development planned for in Nigeria (World Bank 1989; UNDP 1998; and Iyoha et al. 2015). According to the Economic Commission for Africa (2012), there are five (5) types of freedom, namely: political freedom, economic facilities, social opportunities, transparency guarantees and protective security.

3.4.3 Challenges of Accountability and Transparency in Nigeria

Accountability and transparency challenges in Nigeria have proven challenging to surmount, up until now, even with immense human, capital and material resources imbued in the country (Kwanashie 2007; Gberevbie et al. 2015). However, academic literature has proffered several reasons for the country's inability to enjoy sustainable development; chiefly, poor leadership, resource management, and infrastructure maintenance have been identified (Obadan 1998; Obadan and Edo 2007). The different arms and government levels have been inundated with various reports of mismanagement and poor leadership, usually due to incompetence, low ethical character, indiscipline, corruption and innovative dearth (Chigbue 2007; Gberevbie et al. 2015). Furthermore, infrastructural decadence has resulted in most issues in the nation's power, transportation, and administrative sectors; current infrastructures have been poorly maintained (Ayanruoh 2013; Abiodun 2014). Nevertheless, other scholars have identified lack of accountability and transparency and unethical behaviours among public officials as another bane to development in the country, which results in lack of adherence to the rules and regulations as befitting of the public offices occupied (United Nations (UN) 2004; Anyim, Ufodiama and Olusanya 2013; Manuaka 2014; Gberevbie et al. 2015; Olaopa 2016). However, Gberevbie et al. (2015) concluded that the ineptitude of public institutions, excessive expenditure on governance, insufficient funds for significant capital projects execution, corruption and mishandling of public funds also aggravate the sustainable accountability and transparency challenges the country encounters (Awojobi 2014; Agbo 2015; Iyoha et al. 2015; Olaopa 2016).

3.4.4 The Interplay Between Energy Planning, Governance and Accountability and Transparency

Traditional governing mechanisms have experienced quite a disturbance recently; Kersbergen and Waarden (2004) opined that this results from modern societies' growth, as seen across both public and private sectors. The changes experienced are either provincial, regional, countrywide, international or all across the globe in the institutional and organisational societal sectors and spheres that are governed. There have also been administrative and regulatory changes that determine the governance's capacity and capability (Kersbergen and Waarden, 2004), which has far-reaching effects on the governability, accountability and transparency, awareness, and authenticity of governance institutions.

Bowen et al. (2017) discussed salient points that are affecting the implementation of the transition in the planning phase; these are mostly governance issues and include: promoting shared action by creating all-encompassing decision platforms for actor relations across several segments and dimensions, formulating difficult compromises which focuses on impartiality, justice and equality, and ensuring systematic means of holding institutional actors accountable for administrative, financial, performance and products result (Janus and Keijzer 2014; Ocampo and Gomez-Arteaga 2016). Bowen et al. (2017) recognised accountability and transparency as the principal avenues for overcoming governance challenges.

3.5 Rationale for Adopting Transition Management

This research adopts the MLP, TMF and accountability and transparency concepts as the foundational theories for assessing the planning process and governance of grid-based RE in Nigeria. The selection of MLP is based on understanding the influences and relations of fundamental issues in the society's structures, which could cause the transition. This is important as this research seeks to evaluate these relationships to see if they can trigger RE development on the Nigerian grid system. TMF's application for complex challenges to recognise reconfiguration potentials in society is the main reason for its selection for this study. Also, it can organise and manage multiple stakeholders, concepts, principles, stages and fields and, therefore, valid for the RE planning process and governance.

The rationale for selecting the accountability and transparency concepts in this research is the necessity for responsibility and responsiveness in governance activities. Also, it provides a means for cordial relations between actors in the sector, thereby leading to improvement in governance. Hence, accountability and transparency in the energy transition process are suitable for resolving the complex issues among government, companies, communities and other stakeholders (Bowen et al. 2017). Therefore, accountability and transparency support TMF and MLP in resolving governance challenges.

3.6 Theoretical Model for the Study

Transition literature in recent times has focussed extensively on transition for sustainability and cuts across various societal system domains, such as transportation (Watson 2012), health (Frenk et al. 1991), and energy (Demski et al. 2019). The transition of existing energy systems heavily reliant on fossil fuel has gained greater attention from scholars, climate change activists and governments. The nature of the transition required also poses significant difficulty in the transition, especially in the developing countries, where 100% energy access is still lacking, and most countries are economically deficient.

A model had been developed applying the theories and the understanding of the challenges documented in the previous chapters incorporating MLP, TM and accountability and transparency concepts and conceptualised as a theoretical underpinning of this study aimed at assessing the planning process and governance for sustainable development of grid-based renewable electricity generation in Nigeria to facilitate the transition.

Firstly, the transition process will commence by ascertaining the necessity for renewable energy development on the grid through the use of MLP (determining the landscape, regime and niche) to recognise the pressures on the current regime and potentials for deploying renewable energy technologies in Nigeria. Furthermore, the creation of the transition planning and arena formulation occurs to evaluate the transition challenges and other issues utilising policies, strategies, processes and accountability and transparency evaluated by the urgency mechanism derived from congruency and coalition. This is followed by the review of transition design to ascertain agreement with the transition planning phase.

The next phase includes evaluating the RE operationalisation of the policies, strategies, processes and accountability and transparency related to the transition design phase. Next, the reflexive learnings from the deployed pilots and analysis are assessed, including how they fit into the transition process. Lastly, the barriers, drivers and enablers of Nigeria's grid-based RE electricity generation are derived. Figure 21 visibly depicts this concept for the successful transition of grid-based RE generation in Nigeria.

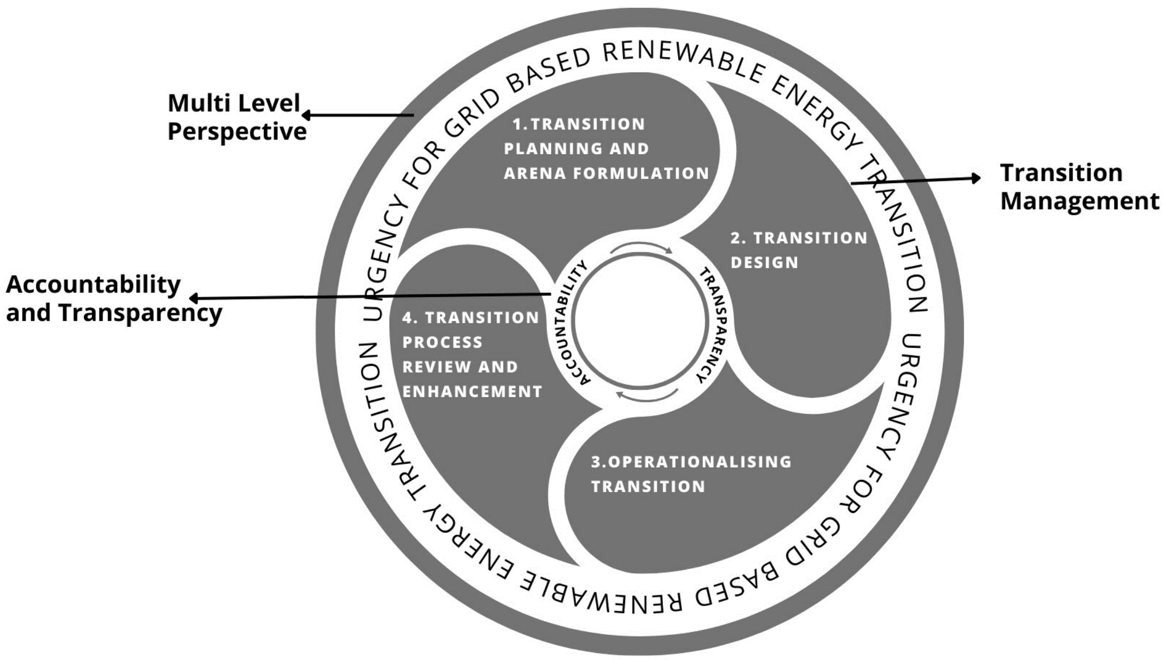


Figure 21: Modules for Successful Transition of Grid-Based Renewable Energy Generation in Nigeria (Source: Author)

3.6.1 Modules for Successful Transition of Grid-Based Renewable Energy Generation in Nigeria.

3.6.1.1 Module 1: Urgency for grid-based renewable energy transition

Understanding and contextualising the nature of transformation and the imperatives for the urgency for transition in the Nigerian electricity grid system is essential. This section highlights how global and national trends impacts established regimes and trigger transition in the socio-technical system. Also, the trajectory of niche technology, i.e., renewable energy, is discussed, and lastly, societal acceptance and social networks that resist or support renewable energy development is discussed (solar and wind). This is considered from literature under three critical contexts described by the Multi-Level Perspective for the innovative system: landscape, regime and niche context.

a. Landscape context

Utilising MLP to assess socio-technical transition, the "landscape" is characterised by autonomous trends and paradigms which facilitate a slow change that could destabilise the regime level and create the opportunity for a niche technology to develop (Geels 2002; Geels 2004; Geels and Schot 2007; Geels 2010; Geels 2018). Thus, climate change concerns and escalating global warming have placed pressure on unsustainable socio-technical systems to become more sustainable.

In the energy domain, the over-reliance on fossil fuel for electricity and heating which, according to IEA (2020), accounts for 25% of the 75% of CO_2 emissions, has led to cleaner technology initiatives to curb the growing global emissions to tackle greenhouse warming.

In the Nigerian electricity sector, the socio-technical landscape plays a pivotal role in the prevailing regime's lifespan and contributes to the pressure on the regime, which could give way to state-of-the-art ideas, niche technologies and actors (Geels 2002; Geels 2004; Geels 2018). Additionally, the effects of the Paris Agreement for the reduction of greenhouse gas (GHG) emissions adopted in 2015 by 195 countries aimed at tackling climate change have led to the formulation of policies to curb emission (UN 2020). This has also had a cascading effect on Nigeria's policy which now supports the development of renewable energy and is expected to contribute about 30% of electricity generated by 2030 (Vision 30:30:30 2020).

Similarly, the pressure to increase energy access and address energy poverty, as contained in the UN Sustainable Development Goal 7 (UN 2020), had led to more favourable global policies and partnership from developed countries and regions to promote energy development in Africa (including Nigeria) through the Sustainable Energy for All initiatives (SE4A 2020), Africa-EU Energy Partnership for renewable energy (EC 2021), UK Renewable Energy Performance Platform (DBEIS and Perry 2018) and so on.

Furthermore, at the national level, to boost electricity supply and address the inadequacies of the sector, privatisation and restructuring of the sector through the Electric Power Sector Reform Act (EPSRA) was introduced (Aliyu, Ramli and Saleh 2013; Monyei et al. 2018; Ayamolowo et al. 2019; NESO 2020). In contrast, various initiatives have been adopted to reinforce the existing national electricity grid regime centred on gas and hydro-dominated technologies (Monyei et al. 2018), including the formulation of policies and establishment of the Nigeria Electricity Regulatory Commission (NERC 2020) aimed at effective monitoring and regulation of the electricity sector to produce an efficient system. This has not fully resolved the issues or prevented a transition, hence providing a 'window of opportunity' for niche technologies (renewable energy solar and wind) which are beginning to gather momentum in the protective space in an attempt to resolve the persistent problem and navigate the transmission challenges in Nigeria.

Scholars in transition thinking have extensively assessed various energy system transition for sustainable development. Ruggiero, Varho and Rikkonen’s (2015) assessment of Finland's landscape suggested that developments influence changes in existing dominant systems in Finland, the Nordic region and the European Union, and social conditions defined at the regional level. Similarly, Peter et al. (2015), from a transition theory perspective, identified that political devolution (creation of elected governments for Scotland, Wales and Northern Ireland) influences the development of community renewable energy trajectory. Similarly, Essletzbichler (2012) confirmed that the transition of socio-technical systems in the UK to low-carbon in the electricity sector stems from climate change concerns and energy security from the depleting fossil fuel reserves.

Other frontier countries include the Netherlands and Sweden; liberalisation and Europeanisation have taken more credence than the driver of sustainability and have profoundly affected the Netherland's electricity regime (Kern and Smith 2008). Also discovered is that the Swedish heat regime is impacted at the landscape level by the falling demand in new houses and the pressure to comply with European Union energy efficiency standards, including the global warming concerns due to climate change (Dzebo and Nykvist 2017). Likewise, in developing countries such as South Africa, persistent electricity deficit that resulted in frequent blackouts led to a wind of opportunity exploited by the renewable energy technology introduced to the coal-dominated market to redress the prevailing challenge (Ting and Byrne 2020).

As could be observed, climate change challenges exert pressure on existing electricity and the heating regime in most reviewed countries. However, the transition in developed countries might not be the same as Nigeria, as these are countries with an achieved electricity potential, including stable and ample energy infrastructure. Hence, the landscape pressure creates urgency and opportunity for structural changes to resolve the low energy access and low electricity generation.

b. Regime context

The regime (meso-level) refers to dominant processes, practices and rules embedded in existing infrastructure and institutions that provide stability to prevailing socio-technical systems (Geels 2002; Geels and Schot 2007). Socio-technical transitions can be stimulated by niches gaining momentum or changes in the landscape individually or collectively, which exerts pressure on the existing regime and triggers transformation (Geels and Schot 2007). According to Osterblom et al. (2010), incumbent regimes are difficult to change or modify as they demonstrate technology "lock-in" and path dependency (Unruh 2000).

The government's efforts are yet to be rewarded with concrete evidence of having renewable energy on the grid. So far, the transition is slow, and all efforts to have renewable energy sources (wind and solar) on the grid are abortive (Ohunakin et al. 2014; Ozoegwu, Mgbemene and Ozor 2017; Adeniyi 2019). A study of South Africa's state-owned electricity system suggested that an analysis of endogenous institutional change is crucial for exposing regime tensions and drivers of resistance, which was a crucial factor in the South African electricity crisis (Ting and Byrne 2020).

Scholars have noted that Nigeria’s centralised grid system infrastructure since inception has favoured hydro technologies, and in the last decade, gas power plants (Ozoegwu, Mgbemene and Ozor 2017; Adeniyi, 2019). The system constitutes dominant actors: Ministry of Power, Government, GenCos, TransCo, DisCos, NESI and gas companies, including industrial and household consumers. The affairs of the network of actors are supervised by the ECN and regulated by the NERC.

Unruh (2000) posits that existing systems are prone to 'technology lock-in' due to path dependence. 'Technology Lock-in' indicates that incumbent social networks, actors, regulations and processes have formed strong path dependency, which prevent the existing systems from evolving to accommodate new technologies (Unruh 2000). These technologies have developed an interconnected pathway with a stable institutional, social and economic environment (Adeniyi 2019).

However, Nigeria’s current electricity system is characterised by energy generation (technical, infrastructural, governance and institutional) challenges and shortcomings, which are also present in the transmission and distribution systems (Ozoegwu, Mgbemene and Ozor 2017; Adeniyi 2019), despite the privatisation of the power sector in 2005 and introduction of renewable energy to mitigate the current issues (Ohunakin et al. 2014; Ozoegwu, Mgbemene and Ozor 2017; Adeniyi 2019; Gungah, Emodi and Dioha 2019). The system is pressured from exogenous events such as energy poverty and climate change (as discussed earlier) and the present infrastructural systems; hence, renewable energy technologies are being considered. While policies have been created to increase the renewable energy share to 30% on the national grid by 2030, there is still vested interest by various stakeholders and actors in the hydro and gas systems in Nigeria. Additionally, the fossil fuel generators industry also has a dominant presence in Nigeria and constitutes the national grid's strongest competitor. Thus, sunk investment by various actors has stabilised that industry and resisted RE growth. Dzebo and Nykvist (2017), from the study of Sweden-heat energy systems, affirmed that "interconnectedness, complementarity and saturation" were vital signs of the heat regime being "locked-in" unsustainable practice. The Nigerian energy transition plan emphasis the need to transition from diesel/petrol-based generators to cleaner alternative (ETP 2022).

Nonetheless, the stability of the system can be challenged by renewable technology development. The reduction in the technology "lock-in" or path dependency will indicate that renewable energy from solar and wind is adopted in Nigeria (Geels 2002). However, there is a need to understand how the flawed dominant regime adapts to these pressures and the urgency for developing a niche technology (Verbong and Geels 2010).

c. Niche context

Radical (or incremental) innovations occur in systems which emerge at the niche (micro) level, resulting in societal and technological changes, which are often interrelated. Geels (2018) claims that these changes occur at the primary, secondary and tertiary societal sectors such as the energy, agricultural, transportation, and other sectors like the electricity sector. Also, innovative practices and innovations such as renewable energy emanate from protective spaces and develop with time and start competing with the established regime (Smith, Stirling and Berkhout 2005). Furthermore, the niche experience regime resistance sometimes challenging to overcome, causing the innovation to fail before it becomes established (Batinge, Musango and Brent 2019, Markard et al 2020). However, some technologies surmount the challenges and the regime yield to the pressure from the niche, leading to the development and creation of a new pathway that destabilises the existing regime.

Kern and Smith (2008) argue that the regime resistance in achieving transition policy objectives could be fuelled by dominant actors selecting the transition themes subjectively, pathways, and experiments that undermine the transformation. Additionally, putting pressure on the regime to encourage niche technology would harm the incumbent actor, resulting in the actors' lack of support. Similarly, Essletzbichler (2012) suggested that to unlock an existing system, the landscape must exert sufficient pressure, which can be done through artificial pressures from policies. Additionally, extensive research and development activities could be embarked upon to speed up niche development. Finally, sub-regional policies should synchronise with policies at the national level, as this will involve the recruitment of participants of local actors, thereby creating policies that fit with a collective vision. Ting and Byrne (2020) found a similar finding on the regime resistance to niche development in the South Africa electricity system. They argued that incumbent actors employ resistance strategies to reinforce the existing regime through "selective environment" by influencing negative public discussion on RE, inciting dominant unions to embark on industrial action and refusal to implement market reforms that will unseat the regime to allow renewable energy to gain ground. Bhatia (2023) avers that in a case of India electricity system, employing incumbent actors as fore-runners would stall transition as there are conflicts in the focus on fossil fuel interests, which area being reinforced by existing institutional systems. This was also highlighted by Markard et al. (2020), who suggested that to overcome such resistance it is paramount for policymakers to gain a wide societal support and build coalition of supporting actors for transition.

In Nigeria, the government formulated the National Renewable Energy and Energy Efficiency Policy (NREEEP) to encourage renewable niche technology. The policy aimed to achieve 30,000 MW of electricity generation, including 30 per cent renewable energy sources in the energy mix by 2030 (NREEEP 2015). This led to the government imposition on distributing companies (DISCO) to compulsorily purchase 50% of RE electricity distributed to protect RE technologies from established competitors (Ozoegwu, Mgbemene and Ozor 2017; Adeniyi 2019). Verbong and Geels (2010) postulate that low price and performance ratio necessitates niche's protection by government or small groups of actors willing to invest in the growth. Despite the Nigerian government's plan to include renewable energy, the effort is inadequate as it has not achieved investors buy-in. This is owing to subsidies agreement being in limbo, and the government provides no funding securities or mechanism to de-risk or mitigate investor's risk to boost or steer the RE development (Ohunakin et al. 2014; Ozoegwu, Mgbemene and Ozor 2017; Adeniyi 2019).

Similarly, Aigbovo and Ogboka (2016) argue that the absence of an explicit legal framework in the EPSRA to harness the country's abundant renewable energy sources have contributed to the limitation of achieving the projected success. Additionally, the vested interest of incumbent actors (government, regulators and companies) in the prevailing technologies (hydro and gas) are resisting social network formation of RE technologies. Hence, for renewable energy policies as contained in the NREEEP to materialise, there is need to focus on grassroots projects and accentuate 'bottom-up' transitions that will exert sufficient pressure on the incumbent regime through effective policy mechanism and support schemes.

The state of Nigeria's renewable niche technology is continually changing; hence, there is a need to continually review and analyse Nigeria's grid-based renewable energy transition dynamics.

3.6.1.2 Module 2: Transition planning and arena formulation

The transition planning and arena formulation phase is an essential aspect for the successful implementation of RE on the national grid. The phase involves two steps which includes setting the transition arena, defining the transition problem, and identifying the existing challenges.

Firstly, the transition planning process is established through the transition arena and how successful the transition will be is dependent on the quality of the transition arena (Avelino and Grin 2017; Loorbach and Rotmans 2010). This provides the opportunity to create the long-term visions, goals and mechanism for the transition for sustainable development (Kelly, Ellis and Flannery 2018). According to Kemp and Loorbach (2003), this is driven by a network of actors called the "Transition Team" with a relationship that fosters interaction, knowledge sharing, and learnings among the team to drive niche innovation. Additionally, the network of actors and transition arena create a social movement that promotes social acceptance of the niche innovation (Loorbach 2007). While the arena constitutes actors called frontrunners of the transition, van Burren and Loorbach (2007) suggested that the yardstick for selection of frontrunners should stimulate innovation and management of the transition. Furthermore, there should be a balance of representation (frontrunner) across the various segments of the society, such as government, Non-Governmental Organisation (NGO), research institutions and liaison companies led by a transition agent (Loorbach and Rotmans 2010). Also, stakeholders can be recruited from the existing regime and across the industry value chain and non-industry actors. Rotman and Loorbach (2009) proposed that incumbent regime actors' inclusion could provide legitimacy and support the transition process.

For instance, the restructuring of the Netherland's energy system was led by the Ministry of Economic Affairs, serving as the transition agent and constituted various private and public sectors' stakeholders (Kern and Smith 2008). Similarly, the concept "transition arena" was implemented by Parkstad Limburg in the Netherlands to foster cooperation among eight municipals by developing a shared vision and goal for developing the region (Rotmans et al. 2000). This was achieved by recruiting participants from various societal domains and was distinguished from the political arena (Loorbach 2007; Loorbach and Rotman 2010).

In light of this, the Nigerian electricity generation sector constitutes of four significant entities: holders of concession of the privatised companies, NDPHC subsidiaries, Independent Power Producers (IPP) before privatisation that controls the gas power plants, and IPP pre- and post-privatisation (Adeniyi 2019). While the Ministry of Power exerts control over the entire value chain of the electricity sector, including the established entities, they cannot initiate and facilitate the transition. On the other hand, the government can be referred to as the transition agent as they can legitimise the transition serving as facilitators (Rotman and Loorbach 2009). However, the government can execute the transition objectives through the Ministry of Power.

Secondly, the transition planning process involves identifying the persistent problem through a common perception of actors, and possible solutions are collectively generated. A shared problem is defined from a multiple actor perspective which provides insights into the nature of the problem, and then a common transition challenge is derived, thereby providing an avenue for the creation of a transition vision. It is important to note that the shared vision is derived from the individual actor's perception of the persistent problem, fed into the collective box. For instance, the government will be concerned with creating innovational policies while companies will create a more sustainable business (Loorbach 2007).

During this planning process and after the transition arena has been formulated, it is essential to highlight accountability and transparency in ensuring the transition is actualised. While transition management had reiterated the steps involved in the transition planning process and arena formulation, keen attention has not been paid to accountability and transparency in this phase. Understandably, transition management has been applied extensively; however, this was created in the developed countries, which have a more advanced institutional structure than the developing and underdeveloped countries like Nigeria. This forms a unique contribution of the study to the transition management framework.

3.6.1.3 Accountability and transparency in the transition planning and arena phase

For the successful implementation of RE on the national grid, the transition process and governance must engender transparency and accountability. During the planning and arena formation phase of transition, accountability and transparency are very important. In the context of Nigeria's national grid structure, despite liberalisation, the government serving as the transmission company and the solely authorised middleman between the GenCo, and the DisCo makes them key actors in the transition process. Thus, it is impracticable to diverge the political arena from the transition arena. Furthermore, the team's formation is led by the government; therefore, political accountability comes to play. A significant number of institutions have been vested with government power (Raunio and Hix 2000), which includes ECN and NERC or the Ministry of Power in Nigeria. These institutions would usually represent the government and take leadership of the process. The openness of decision-making and problem-identification will be derived from this accountability and transparency (Harlow 2002; Erkkila 2007), as demonstrated by the European Union's governance (European Commission 2001).

Subsequently, professional and social accountabilities for other participants in the transition arena are apparent. Hence, representatives of the private sectors and industries, and the non-governmental organisations are guided by the codes from the professional bodies (Abbott 2014; Freidson 2001) and working as civil interest groups, respectively (Meijer and Schillemans 2009; Bovens 2007), which serves as accountability partners. Hence, this could be a guideline for the selection of actors within the transition process. Although concerns have been shared by scholars about the anti-democratic nature of expert authority (Sinclair 1995; Skogstad 2003; Erkkila 2007), peer reviews should be able to adequately allay this bias (Pierre and Peters 2000; Mulgan 2003).

3.6.1.4 Module 3: Transition design

The transition design entails creating the transition vision, which is the next phase of the process, leading to RE's successful implementation on the national grid, if executed correctly.

This involves a process of envisioning the transition vision. Thus, transition vision, goals and strategies and pathways are formulated, which encapsulates the short and mid-term solutions to the transition challenge framed, referred to as the transition agenda (Loorbach, van der Brugge and Taanman 2008). Roorda and Wittmayer (2014) and Kelly, Ellis and Flannery (2018) argue that "back-casting methodology" assist in creating pathways that align with the long-term vision. Back-casting has been used extensively to define the desired future and look backwards to ascertain fundamental changes and activities, policies, and pathways essential to achieve the projected future (Kelly, Ellis and Flannery 2018).

Perhaps it is important to note that whilst long-term visions inspire transition, the visions developed might be unrealistic to achieve (Verbong and Geels 2010). Nonetheless, Matschoss et al. (2020) assert that the long-term vision provides direction and focus for governance processes and encourages interactions among stakeholders for which transition pathways and agendas are developed. Thus, the transition vision could emanate as learnings occur, which leads to the novel insights within the transition arena. The combination of this approach is referred to as learning-by-doing and doing-by-learning, which is an essential strategy for developing niche technologies.

The next important step is to ensure broader actors and institutional alignment to get the vision enshrined in the network and organisation's system (Loorbach 2007). Additionally, the transition agenda actors should include individuals serving as representatives of organisations and networks involved in the transition process. However, there is a need to anticipate impediments emanating from technology rivalry, regulations, institutional bias, the economic terrain and physical infrastructure that could hamper the visions' actualisation (Loorbach and Rotmans 2010). Furthermore, Loorbach (2007) posits that as organisations begin to adjust policies and actions, this might create additional tensions. To overcome these impediments and tensions highlighted, Sondeijker et al. (2006) proposed developing various transition scenarios and reviewing the transition process.

Subsequently, the vision is translated into a collectively determined pathway and transition images from the inputs, motives, interests, and policies of various actors (Loorbach 2007; Loorbach and Rotmans 2010; Mulder and Loorbach 2016). This also cascades down to investment and strategic decisions. Aligning this with grid-based renewable energy development in Nigeria, existing regime, regulations, and institutions supporting other sources of energy could create tension for renewable niche development. The cost of renewable energy development and infrastructure construction to support RE development could create tensions and stunt the technology's growth.

In the context of energy, a review of the Dutch's Ministry of Economic Affairs outlined the Ministry's vision to achieve clean, affordable and secure energy supply in the future. This resulted in the creation of 'transition themes' which involved various platforms such as chain efficiency, green resources, new gas, sustainable mobility, the built environment and sustainable electricity and pathways in achieving them. The Netherlands has a centralised electricity supply, and the aim was to ensure an emission-free system (Kern and Smith 2008). However, as the transition process progressed, the pathways were modified, resulting in new transition themes. Another context is that of the Dutch government in 2007, who embarked on a reform of Carnisse, located south of Rotterdam in the Netherlands. The intention was to support and stimulate the locals to take charge of their community through a continuous participatory process; six visionary images were finally crafted to achieve the long-term vision in 2030 (Roorda and Wittmayer 2014).

While designing the transition, there is a possibility of the process forestalling the institutions and actors; hence, making the inclusion of accountability and transparency paramount. Therefore, this study's further contribution is to identify and incorporate relevant accountability and transparency concepts to consider at this phase.

3.6.1.5 Accountability and transparency in the transition design

Transition design involves vision formulation and conduct of the process is paramount. This ensures the functional teams justify and explain the actions and activities during the formulation and design phase (Day and Klein 1987). Hence, the essential mechanism to achieve success in the design includes financial and procedural accountabilities to provide a framework for the team's financial and procedural requirements (Bovens 2007). Moreover, transparency of the process (before, during and after) will produce a workable project with buy-in and contribution from all stakeholders viz collective accountability.

3.6.1.6 Module 4: Operationalising transition

Proceeding the transition vision, strategies and roadmap that align with the long-term vision of the transition. Activities are embarked on to make available the transition agenda to the public and present an opportunity to adopt, implement, and adapt the plan (Sengers, Wieczorek and Raven 2019; Rotmans and Loorbach 2009; Kelly, Ellis and Flannery 2018). In the context of grid-based electricity, the socio-technical transition is operationalised through projects, innovation and experiments that align with the transition agenda to deliver sustainable management of grid-based electrification. It can be further argued that the purpose of grid-based renewable energy experiments is to see how the introduction of a new energy system works in a given realistic environment and how the existing system responds to the new system (de Laat and McKibbin 2003).

Loorbach (2007) posits that transition experiments can compete, complement one another, or explore different options as long as they lead to the transition envisaged. In the context of Nigeria's grid-based renewable energy, experiments and projects are supposed to be conducted to contribute to the transition process, which aims to achieve 30% RE generation by 2030 (NREEEP 2015). This could be such that wind and solar technologies projects could be synchronised, contend or employed for different application.

Moreover, whilst the experimental projects are derived directly from the sustainability vision and transition objectives that tally with the transition paths defined, the projects can be linked to ongoing off-grid renewable energy experiments as long as they fit into the transition framework (Loorbach 2007). Subsequently, renewable technologies can be replicated or scaled up and extended to the national grid. Loorbach (2007) identified this stage as moving the niche technology (micro) to the system level (meso level).

Additionally, it is also crucial for a network of relevant actors to be created to facilitate and be involved in developing the grid-based RE. This sub-network of actors will be actively involved in the projects and development initiatives. Scholarly research (Kemp and Rotmans 2005; Loorbach and Rotmans 2006) postulate that engaging and anchoring sustainable development as one under this study is essential to ensure adequate support is garnered for the initiative to be successful. Butu (2017) proposed that the actors' network could include incumbent and new stakeholders inclusive of extrinsic stakeholders. In Nigeria's grid-based renewable energy development, the incumbent stakeholders may include hydro and gas power generating companies (GENCOs), the regulatory agency (NERC), Federal Ministry of Power, and ECN, overseers of energy activities and the national government. On the other hand, new regime actors could include wind and solar companies, including the Nigerian government, who is the singular authorised bulk purchaser of electricity from the generating companies. Extrinsic stakeholders could include research and development centres such as the Centre for Energy Conservation and Energy Efficiency and the National Centre for Energy Research and Development, Renewable Energy Technology Funding Company, and Nigeria's citizens, including the buy-in of associations: Renewable Energy Association and Power Generating Association.

In light of this, stakeholders' networks demand maximum cooperation and management for long-term structural change to occur (Kemp and Loorbach 2003). Roorda and Wittmayer (2014) identified that there could be difficulty changing ingrained patterns of behaviour about the expectations and behaviours between government and outside actors (actors outside the incumbent regime, like citizens), as actors outside of the systems are accustomed to being asked for their views, rather than taking an active role in the societal impact. Similarly, the government is familiar with citizens complaining, rather than showcasing strategic decisions and leading societal change (Roorda and Wittmayer 2014). Therefore, mutual respect among actors should be promoted. Also, clear communication within the teams on each actor's role to prevent disowning the ideas is provided. Hence, a collective agreement must be reached to agree to the consensus if all stakeholders buy-in is unattained.

In this phase, mutual accountability between stakeholders is vital to ensure all stakeholders in the process own the transition. Similarly, there must be transparency in the outcome of the experiments or initiatives introduced. The incorporation of accountability and transparency is an additional contribution to this study.

3.6.1.7 Accountability and transparency in the operationalising transition phase

The initiation and implementation of experiments and projects are measured vis-à-vis the transition design through the performance during execution (Kersbergen and Waarden 2004). While the RE experiment's performance metrics are determined and compared to the design expectations, there must be transparency in reporting to encourage feedback, learning, and reflexive inputs in the whole experiment process before upscaling to the national grid. Consequently, the public is aware of the operational challenges and how they are being addressed; hence, this will boost the societal acceptance and buy-in of a renewable niche technology. To support this suggestion, Skogstad (2003) posits that performance has become the mechanism for measuring success in most public organisations against rules and regulations. However, Scharpf (1999) argues that, over time, performance cannot replace the absence of procedural accountability and improved performance are not expected to be tantamount to reduced political accountability (Aucoin and Heintzman 2000, Romzek 2000; Behn 2001).

Furthermore, horizontal accountability to solve challenges of the day-to-day running of the agencies and government institutions during the operationalisation phase as against hierarchical accountability, is usually crucial (Meijer and Schillemans 2009). In the context of the grid-based RE transition process, horizontal accountability serves as the gatekeeper in ensuring all actors within the team are committed to transparency and mutual accountability throughout the process. This is more dispersed and include mutual relations among the transition team (Braithwaite 1999; Behn 2001; Roberts 2001; Bovens 2005) or work with the network of other interdependent teams (Harlow and Rawlings 2007).

3.6.1.8 Module 5: Transition management process review and enhancement

The next point of transition involves learning through continuous evaluation and monitoring of the transition's management, transition actors, agenda and experiments and the process of transition, success pace, barriers and areas for change (Loorbach and Rotmans 2010). Loorbach and Rotmans (2010) postulate that applying this to each transition phase and the stage will propel social learning resulting from the interaction and engagement with multiple actors and also promote institutional learnings. Notably, learning steers transition and aids uncertainty management to a low carbon future (Laes et al. 2014).

Furthermore, Roorda and Wittmayer (2014) pointed that the reflective evaluation of the transition process and experiment delivery should be conducted by actors in both arenas and the experiment leading to the formulation of an emergent future outlook based on the learnings from the evaluation.

This step is crucial for renewable energy development on the national grid. Despite the absence of a dominant path dependency on energy infrastructure, the process's governance and management are complex due to external factors such as political and socio-cultural influences. Hence, this provides the opportunity to re-invent the wheel or improve for learning. This will increase the chance for a successful launch and improvement of grid-based renewable energy in Nigeria.

Unless the whole process of transition is accountable and transparent, realistically reflecting monitoring and evaluation of the transition management and the transition process is suboptimal; hence, this study seeks to boost the accountability component with the Transition Management Framework, which serves as an underpinning of this research, which is hitherto taciturn.

3.6.1.9 Accountability and transparency in the transition management process review and enhancement phase

Conclusively, the transition review and enhancement phase where monitoring, evaluation and reflection occur are polished via administrative and legal accountabilities for successfully implementing grid-based RE. Thus, auditors, inspectors, controllers, and other regulatory agencies provide accountability at this stage, and the courts provide an additional layer to ensure unambiguous and transparent conduct during the execution and operation of the transition (Bovens 2007). In this research, aside from the internal evaluation and monitoring, there is a need for external monitoring and evaluation by funding agencies and partners, which will make the process more effective. Additionally, the checks and balances the legal accountability provide lead to more trust in the process (Erkkila 2007).

3.7 Chapter Summary

Various transition studies research literature has been critically discussed, including the four prominent transition theories. To this effect, a conceptual model was developed which will serve as a guide for the research questions aimed at assessing the RE energy planning process and governance to identify inhibitors and enablers of the grid-based RE in Nigeria.

CHAPTER FOUR: RESEARCH METHODOLOGY AND METHODS

4.1 Introduction

Chapter Four is for research methodology and the methods employed for this research to address the research aim, objectives and questions. It is subdivided into ten (10) sections. The chapter starts with explaining the reason for an empirical study. Next, the research design's philosophical stance encompassing the rationale for selection is discussed and how this connects to the research methods employed. Furthermore, the literature search strategy adopted is explained; previous and recent studies in this research area are also reviewed.

Subsequently, the section elucidates the data collection method and suitability of the approach. Proceeding this is the population and sample section, which justified the sample and sample size chosen for the study. Then, the data management and analysis are discussed, and the rationale for selecting the method, including considerations for research credibility, validity and reliability. Finally, the ethical consideration of the research is discussed, and the chapter is summarised.

4.2 Empirical Study

This research attempts to provide solutions to the insistent challenges that are deeply rooted in the present planning process and governance and the impacts of the extrinsic and intrinsic forces (institutions, stakeholders and regulators), emphasising the influence of accountability and transparency as it relates to grid renewable energy transition in Nigeria (Frantzeskaki, Loorbach and Meadowcroft 2012; Haukkala 2019; Mahroum et al. 2020). Therefore, the unavailability of data required for assessing this transition and the discussion among scholars showcases the importance of having empirical and reliable proof for RE deployment in Nigeria. The following section discusses the philosophical stance of this research.

4.3 Philosophical Stances Around Research Design and Strategy

The philosophical stance chosen by a researcher represents the world's orientation (Yin 2014; Kenneth 2015). A philosophical view offers a path and leadership for research design, providing a premise for assessing and evaluating a subject (Kenneth 2015). Hence, having a holistic view of the research paradigm as the research is designed is pertinent to having an aligned research approach with other research segments to ensure an iterative research process (Creswell and Creswell 2017). The philosophical stance around this research's design and strategy is described as follows: research paradigm, ontology and epistemology, inductive and deductive approach and case study strategy.

4.3.1 Research Paradigm

'Paradigm' was first used in "The Structure of Scientific Revolution", authored by Kuhn (1962). He defined a paradigm as a unified compilation of ideas, variables and challenges and all the corresponding programmes and methodology (Kuhn 2012). In other words, these are general beliefs and agreements among scientists on the proper manner for problem definition and solutions (Kuhn 1962). The research paradigm provides guidelines for research methodologies and methods. This includes ologies (ontology and epistemology), research strategies, methods, techniques and procedures adopted in a study (Yin 2014). Selecting the research paradigm for this research was carried out systematically to obtain responses to the research questions involved in the assessment of the energy planning process and governance by incorporating accountability and transparency for the deployment of RE technology in Nigeria and producing a roadmap that includes solar and winds energy sources on the national grid.

4.3.1.1 Ontology

Ontology is a constituent of the research paradigm, focusing on the existing realms (Thomas 2022). Goertz and Mahoney (2012) also suggested that ontology concerns concepts that occur practically. Therefore, the application of ontology in the qualitative and quantitative approaches is distinct, with the latter concentrating on data and how this can be measured. At the same time, the former considers that concepts are abstract phenomena and depends on describing the concepts from a semantic viewpoint (Goertz and Mahoney 2012). Goertz and Mahoney (2012) also stated that the concept's meaning in quantitative research is a foundation rather than an emphasis. Notably, ontology's preference relates to the researcher's philosophy and the research design (Kenneth 2015).

4.3.1.2 Epistemology

The second constituent of the research paradigm, epistemology, emphasises the process of acquiring valuable knowledge. Kenneth (2015) posits that epistemology is concerned with the "theory of knowledge". Epistemology varies across disciplines; however, the field and industry's influence determine the terms used in management. Armand (2005) argues that in management research, there is no use or place for purely personal and individual action without an observer, stakeholder or cooperation, as these occurrences will be in doubt. Kenneth (2015) avers that there are various ways in which epistemological differences in management impact researchers' ideologies: qualitative versus quantitative, statistical technique, choice of validity and reliability process. Management research has three popularly used epistemologies: Positivist, Interpretivist and Pragmatism paradigm.

A form of epistemology, the positivist view, emphasises that dependable and consequential data are obtained only from apparent and quantifiable occurrences. Myers (2008) examines a single, objective reality governed by a stable universal law that can be observed and measured without bias using standardised methods. Furthermore, Myers (2008) posits a need to observe and recount the occurrences systematically and investigate the phenomenon's causal principles to grasp the universal laws. For the positivist management researcher, objectivity is only empirical (Kim and Donaldson 2018), and positivist scholars imagine that behaviours and attitudes can be studied empirically. However, management scientists hardly apply empirical testing to moral concepts (Kim and Donaldson 2018).

On the other hand, interpretivist scholars critique the positivist view from the standpoint that culture and history influence people's interpretation of a given reality (Creswell and Creswell 2017; Alharahsheh and Pius 2020). Alharahsheh and Pius (2020) posit that circumstance and time evolve, leading to different social realities for people. Thus, interpretivists' argument is that people produce meaning, which can be interpreted to obtain beneficial perception (Saunders, Lewis and Thornhill 2019). The view emphasises the importance of profoundly fathoming a concept and understanding the universe (Rahi 2017). Hence, interpretivists are subjective and give significance to individual views and perspectives. However, the view of the critique is that this does not consider the knowledge acquired from the bases of universal laws, which needs alternative criteria from the positivist paradigm (Alharahsheh and Pius 2020). Thomas and Myers (2015) aver that the interpretivist inclusion of various aspects, as earlier discussed, enhances the data validity of the paradigm.

Lastly, the pragmatic view considers that knowledge and reality are constantly renavigated, disputed, and deciphered based on their efficacy in a new volatile state (Dawson 2019). Besides, pragmatism targets addressing real-world problems not focussed on knowledge judgement from assumptions (Johnson and Christensen 2019; Saunders, Lewis and Thornhill 2019; Creswell and Creswell 2017). Biddle and Schafft (2015) suggested that the philosophical view advocated using a single (qualitative or quantitative) or a mixed methodology to respond to the research questions. A criticism of the methodological view implies that until the research's conclusion, the method's suitability cannot be determined (Hall 2013). However, Maarouf (2019) suggests that pragmatism can lead to philosophical justification for a mixed research method but also provide a door to various possibilities available for research based on different philosophies.

From the discourse above, the interpretivist paradigm is very appropriate for tackling this study's research questions. Interpretivism applies to this research because this study seeks to comprehend more profound realities and their resultant effects. Also, this standpoint provides a viewpoint that social reality has several interpretations, influenced by human experiences and social contexts. Consequently, investigating social reality requires subjective interpretation from various participants' views, which is suitable for this study and, hence, the adoption of the interpretivist paradigm. Additionally, qualitative research relates favourably to the interpretivist paradigm, the obvious choice.

4.3.1.3 Inductive and deductive approach

Rossman and Wilson (1985) mentioned that the research approach aids in easily comprehending the research problem. Selection of the most appropriate research approach is vital to delivering a useful research process during any investigation. Consequently, the philosophical stance of a study, research design, data collection method, analysis and interpretation influence the choice of an appropriate approach. Figure 22 shows the method and methodology espoused in this research. Additionally, the type of the research problem and audience also impact the research approaches adopted in a study (Thomas 2022).

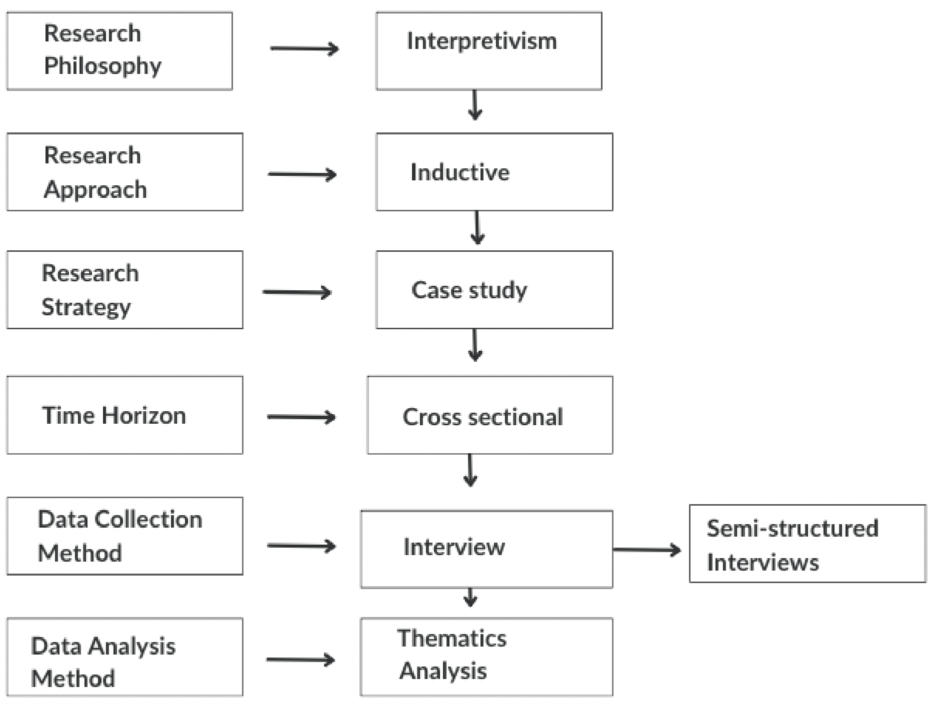


Figure 22: Research philosophy, methods and design. Source: Author-generated

Creswell and Creswell (2017) explain that a deductive approach proposes to authenticate or substantiate a theory by collecting proofs to validate or discredit the finding. However, the inductive approach aims to improve theories from the outcomes acquired from the available evidence. A significant difference in both approaches is the application; the deductive approach begins by developing a social theory or hypothesis and focuses on causality, and the theory serves as a framework for the study (Creswell 2003). In contrast, the inductive approach commences with a research question or empirical observation, establishes patterns, and creates new theories based on the patterns (Saunders, Lewis and Thornhill 2015). Consequently, the former's benefit is that it provides a means to establish causal relationships between variables. At the same time, the latter allows flexibility and pays keen attention to the context to develop new ideas for developing a new theory.

Most quantitative research is associated with a deductive approach, while most qualitative research utilises inductive approaches (Saunders and Lewis 2017). However, both inductive and deductive approaches can be used in qualitative research, individually or collectively (Scott and Carrington 2011). Both approaches have limitations: for the inductive approach, observation and conclusion could become incorrect and invalid despite sound reasoning as further observation and investigation are conducted (Thomas 2022). For the deductive approach, however, a limitation exists where the premises of the study are incorrect or the facet of logic that seems interrelated is not connected, leading to an inappropriate conclusion (Thomas 2022).

Therefore, this research adopted an inductive approach because the research problem needs a conceptual framework to assess accelerating the deployment of

RE on the grid in Nigeria from the empirical findings. This can be explained as there are no current framework designed to analyse grid-based renewable electricity generation in Nigeria. Moreover, the current popular ones have been designed for and used in only developed countries where the energy transition problem is totally different, as they usually involve replacing current fossil-fuel based one with renewable alternatives; energy demand growth is almost non-existent, they have more decentralised systems and have a higher rate of electricity consumption. Also, the administrative and infrastructural perspectives is dissimilar from the developing countries. Therefore, qualitative data from the research participants were applied inductively using thematic analysis. Hence, a case study strategy was adopted and expounded in section 4.3.1.4 to develop a theory.

4.3.1.4 Case study strategy

Yin (2009, p.18) defined a case study as "an empirical inquiry that investigates a contemporary phenomenon in-depth and within its real-life context, especially when the boundaries between phenomenon and context are not evident".

The definitions ascribed to case studies differ based on themes and priorities (Thomas and Myers 2015). In support of the earlier definition, Simon (2009 p. 21) referred to a case study as "an in-depth exploration from multiple perspectives of the complexity and uniqueness of a particular project, policy, institution, program, or system in a 'real-life context".

Yin (2014) stated that a case study method is appropriate when the researcher has little to no influence over the contemporary phenomenon. Moreover, Farquar (2012) postulates that the case study approach allows for the researcher to utilise one or more data sources to deeply evaluate, seek explanations and comprehend a phenomenon and proceed to test or create a theory. The author avers that the method is specifically appropriate when the intention is to describe, explain or explore. This is similar to Yin's (2009) view that case studies explain, describe, illustrate and enlighten. Case study seeks to answer the 'how' and 'why' (Thomas and Myers 2015). A case study research strategy is engaged in this research because it allows for a deep understanding and perception into the planning process and governance for the development of RE on the Nigerian grid, including the transparency of the process. Furthermore, the Nigerian electricity sector relating to renewable energy needs to be examined practically and in a 'real-life' context. Therefore, this is used to recognise the crucial elements of the roadmap for the successful implementation of grid-based renewable electricity generation strategies in Nigeria.

Swanborn (2010) avers that the research questions determine the strategy to adopt: intensive or extensive. The author further suggested that the research question's character and specific conditions should provide a rational argument for conducting a case study, such as if the aim of the research is centred on some extensive, familiarising questions about the social process. A further justification for the case study strategy is that the method enables the researcher to gain insight into the experience and perception of several groups of energy actors, non-energy actors and other stakeholders on how they perceive bottlenecks and ways they find solutions concerning grid RE development and also explain the reason for that. Additionally, this provided a means to test the agreement in the realities of energy actors, non-energy actors, and other stakeholders and compare them with the theoretical framework underpinning this research.

However, a significant limitation of this strategy is that participants' statements are only sometimes the ultimate truth as they represent the view of only a group of people, and there are many groups. Furthermore, another limitation is the inability to generalise findings (Thomas and Myers 2015). In contrast, a significant strength of this method is the particularisation, the ability to study a phenomenon in-depth and identify unique attributes and ways in which they interact or relate to generating a specific outcome and explanation based on their unique attributes and combination (Lee and Saunders 2017).

This research adopted an exploratory case study which seeks to investigate the grid-based renewable energy planning process and governance for renewable energy development. The following sections discuss the literature search strategy, research method and the methods employed by previous and recent studies in the research area.

4.4 Literature Search Strategy

In recent decades, energy transition and renewable energy have gained significant attention as researchers are challenged with the need to address the restructuring of unsustainable energy systems to more sustainable forms (see Kern and Smith 2008; Cowell et al. 2017a; Cowell et al. 2017b; Aldersey-Williams, Strachan and Broadbent 2020). Furthermore, several authors studied Nigeria's renewable energy policy, planning, and governance (see Butu 2017; Osu 2017; Gungah, Emodi and Dioha 2019). Energy transition and RE can be studied from multiple disciplines and domains (policy, economics, finance, politics, governance and planning) globally, regionally, nationally and locally. The planning process, governance and accountability for the successful implementation of RE on the national grid is the focus of this research; however, literature beyond these areas were evaluated to develop the literature review and the reasoning outlines for the research.

The secondary data was obtained from peer-reviewed articles and other publications, including government documents, conference materials, seminar papers, gazettes, legislations, constitutions, policy documents and newspapers (Lee and Saunders 2017), including those from the RGU repository. These data were quantitative and qualitative (Yin 2014) and provide a better understanding of the research problem and affects the adoption of the TM framework, MLP and the accountability and transparency concept for grid-based renewable electricity generation on the Nigerian grid, and also later for the interview schedule design.

The literature repository was acquired using "Google Scholar" and other multidisciplinary databases such as Scopus and SpringerLink, ScienceDirect, Sage and Emerald. This research strategy provided an avenue for a broad review of relevant information and established knowledge and literature arguments (Poklepovic and Tanveer 2019). Furthermore, key search terms and similar words were utilised individually and jointly to the "title and keywords" and article abstracts. Moreover, cited sources in the articles were reviewed, and relevant sources were included in the literature review. Title, authors categorised data extracted from the literature, year of the article, the subject of the study, the aim of the study, key findings, the methodology utilised, conclusions, application to the research of study, possible author bias and the articles' positions were considered to build the main arguments of this study. The key search terms and prominent authors' names were used to create a "Google alert" for up-to-date notifications of new publications.

4.5 Research Methods

Different types of research methodology can be utilised in research, namely quantitative, qualitative and mixed methods (Creswell and Creswell 2017). Researchers believe these methods are not flexible, unique or polar classified but polar opposite instead (Newman, Benz and Ridenour 1998; Creswell 2014; Creswell and Creswell 2017).

The fundamental difference is in the manner of the types; the qualitative approach tries to determine/find the importance of an occurrence from the interviewees' perspectives, while the quantitative approach explores the reason and purpose for an event analytically and numerically (Dawson 2019). However, the mixed method is positioned at the centre of the spectrum as this combines the two methods simultaneously or sequentially in research design (Creswell and Creswell 2017; Watkins and Gioia 2015). Furthermore, the basic philosophical assumptions and ground rules vary; the positivist paradigm agrees with quantitative research. This involves numbers, whereas qualitative research does not utilise numbers, but is oriented towards "words, thoughts and images", which aligns with interpretivism (Thomas 2022). Qualitative analysis typically includes inductive methods, while quantitative research is often concerned with deductive approaches.

Moreover, both approaches' research strategies and techniques for gathering data contrast (Creswell and Creswell 2017). Thomas (2022) postulates that the research approach should be determined based on the best pathway to answer the research question, not the other way around. Therefore, the purpose is to ensure the proper form of inquiry (words, numbers or both) is espoused to answer the research question and decide on an appropriate design frame.

So far, and from the preceding arguments in Section 4.3.1.3, the qualitative research method is used in this study as it allows for assessing the energy sector planning process and governance to ascertain the crucial elements for the roadmap to develop renewable electricity. Also, this aligns with the interpretivist epistemology philosophy. The following section assesses the research methods employed in previous and recent research work.

4.6 Research Methods Employed of Previous and Recent Studies

This section reviews the research method and methodologies employed by previous and recent studies on renewable energy development to ascertain various techniques utilised in various studies and justify the method adopted for this study. A review of the studies on renewable energy suggested that various methods can be employed. However, the semi-structured interview is popularly used to address studies similar to this research.

Cantarero's (2020) studies focussed on reviewing energy transition from the global south perspective, including identifying inhibitors and enablers of the transition and practical approaches adopted in the global north. The study addressed these issues using scientific and grey literature, and the outcome of the study was to accelerate and enhance the transition to renewable energy by proposing a roadmap encapsulating technology, society and policy dimension. Similarly, Li et al. (2020) utilised secondary data by analysing 118 documents through a systematic literature review to investigate renewable energy potential, policies and policy mechanisms in Australia. The work aimed to provide information on renewable energy's status and recommendations to surmount existing challenges. Using a case study approach, Zaman and Brudermann (2018) investigated pertinent energy governance indicators influencing energy security in developing countries. The study adopted a systematic review process, and the outcome was aimed at addressing the challenges in the transition of energy systems. Equally, Batinge, Musango and Brent (2019) explored the electricity system's sustainable transition, intending to propose a sustainable energy transition framework for the unmet electricity market. The authors utilised a systematic literature review to ensure that energy and transition literature were sufficiently considered to achieve the research objective.

In contrast, the studies reviewed adopted various secondary research approaches to address their research issues. This research employs secondary data, providing an avenue to access a vast body of knowledge on renewable energy development, globally and nationally. However, this study requires empirical data as existing data needs to be updated, is insufficient, or a misfit to answer the research questions, which aims to evaluate the planning process and governance of grid-based renewable energy in Nigeria, emphasising the transparency of the process.

Furthermore, Lee, Glick and Lee (2020) employed a case study approach using both documentary analysis and in-depth interviews to assess the Hawaiian energy system transformation and social-technical innovations to foster the transition of the large-scale energy system. Also, Mah et al. (2012) examined the governance of the transition of socio-technical systems in the context of motivation, process and outcome using the development of smart grids in Korea as a case study. The study conducted desk research and used semi-structured interviews. On the other hand, Ruggiero, Varho and Rikkonen (2015) examined the potentials and inhibitors to the transition to distributed energy transition in Finland. The study aimed to contribute to the acceleration of energy transition and employed qualitative and quantitative approaches using a semi-structured interview of 15 experts and 26 questionnaires. While these studies have adopted more than one approach to addressing their research question, the quantitative approach is inappropriate for this study as it needs to consider the meaning behind a social phenomenon. Hence, this study's goal differs from this one, which seeks to obtain people's views, opinions, and perceptions of the planning process and governance of the central grid systems in Nigeria.

However, secondary data aided the selection of energy and non-energy actors and other stakeholders involved or knowledgeable on the governance and the planning process in Nigeria and the structuring of the interview schedule. Also, this is appropriate to generate a detailed description of the Nigerian electricity sector, renewable energy and the development that has occurred since the establishment of the sector. Nevertheless, this approach is insufficient to provide answers to the research questions; thus, this will be combined with another method, "realising triangulation" (see Lee et al.), to boost credibility and provide a confluence of evidence to obtain convergence and corroboration of the findings (see Rossman and Wilson 1985; Silverman 2019; Corbin and Strauss 2008; Bowen 2009).

Furthermore, Mattes, Huber and Koehrsen's (2015) study focussed on sub-systems' influence on local development dynamics. The research assessed the transition process from a local perspective. The authors conducted 30 semi-structured interviews with participants representing various sub-systems in the various regions. The study's outcome elucidates the interactions of actors and institutions in the transition process. Also, Kern and Smith (2008) assessed the transition approach in the Netherlands to understand and ascertain the influence of incumbent energy regimes to undermine the radical transformation of energy systems. Their research involved a semi-structured interview of 27 participants, including policymakers, NGOs, researchers and businesses in the Netherlands. Likewise, Edomah, Foulds and Jones (2017) studied governance in the electricity sector, emphasising policymaking and energy infrastructural change and the influence of the conventional decision process. The study examined the dynamics of policymaking, comparing previous and current utilising semi-structured interviews. Similarly, Nwozor et al. (2021) assessed the green energy systems in Nigeria from the policy domain. The study employed a semi-structured interview and interviewed 10 participants to investigate if policy formulation has resulted in the accessibility of renewable energy and the magnitude to which the renewable energy policy milestone has been actualised.

This research adopted the semi-structured interview method as utilised by the studies reviewed above. Face-to-face interviews are preferred and more applicable for policymakers, top executives and public officials in Nigeria. This is due to the research area's sensitivity, especially on the issue of accountability and transparency in the transition process to the development of renewable energy on the central grid. This method builds trust between the interviewee and the interviewer, enhancing the discussion. Moreover, this technique helps acquire information on complex and multi-layer transition processes and governance dimensions.

In summary, this study employs semi-structured interviews supported by secondary data for the above reasons. Thus, the following section further justifies the selection of the data collection method.

4.7 Data Collection Methods

This section introduces data collection methods after discussing the previous sections' various research methods. There are numerous qualitative methods for data collection. The literature review shows that various research tools can be employed, including questionnaires, interviews, surveys, and more (Thomas 2022; Ruggiero, Varho and Rikkonen 2015; Carafa, Frisari and Vidican 2016; Creswell and Creswell 2017; Cheung, Davies and Bassen 2019). Standard qualitative research methods for data collection are focus groups, interviews, observations and documents. The subsequent section expatiates on the interview and selected research instrument: a semi-structured interview.

4.7.1 Documentation

Documentation involves reviewing historical incidents to investigate past human intentions and behaviours to ascertain the meaning, value, and linkages to the phenomena and events (Tharenou, Donohue and Cooper 2007). However, one of the significant drawbacks of the technique is that accessing documents for review could pose difficulties if there are protected files or incomplete or erroneous, undermining the technique's effectiveness (Yin 2014; Cassell 2015).

4.7.2 Observation

Observation is a process of collecting data on observed behaviours and events. Specifically, participant observation involves a participatory process as the researcher is immersed in the scene and phenomena being observed (Tharenou, Donohue and Cooper 2007). Furthermore, the observation utilises a methodological approach in gathering, recording or writing exhaustive field notes

(Tharenou, Donohue and Cooper 2007). A significant benefit of this method is that it permits the researcher to observe participants in a natural setting and to review deep insights that otherwise would not have been obtained using other methods, such as focus groups. However, this method is prone to the researcher's bias and influence on the observed behaviour, thereby distorting and undermining the data's validity (Yin 2014). A significant drawback of this method is the ethical concerns as the observed illegal or unethical behaviour could be uncovered. Hence, due to the nature of the research, keen attention must be paid to obtaining participants' consent (Creswell and Creswell 2018).

4.7.3 Focus group

Focus groups involve individuals with common interests whose reaction to specific research-posed questions is studied (Saunders, Lewis and Thornhill 2019). Therefore, the researcher must be skilled in interview techniques for focus-group research. A vital advantage of the method is the interaction among participants to stimulate the dynamic discussion that otherwise would be arduous to achieve using other qualitative research methods (Cassell 2015). Furthermore, a focus group allows participants to leverage other participants' responses, yielding valuable data (Creswell and Creswell 2017). However, the focus group's challenge is the possibility of a few participants controlling the discussion, impacting the outcome of the result (Creswell and Creswell 2017).

4.7.4 Interview

Research interviews are purposeful conversations in question structures to elicit information on people's perception of a subject, issue, events and so on (Saunders, Lewis and Thornhill 2019). Interviews after questionnaires in management research are the most common technique as it is well suited when the aim is to understand and assess 'why' and 'how' an interviewee's objective or subjective perspective on a topic or nature of reality (Tharenou, Donohue and Cooper 2007). The interview places control over the participants' environment. However, this data collection method could be expensive for a large target population (Creswell and Creswell 2017). Also, the interview questions may receive a diverse response, requiring skills to conduct (Yin 2014).

From the above analysis of the qualitative data collection methods, the interview method was selected as suitable for this research. A qualitative interview is apt because it helps gain the participants' contextual narrative (McNamara 1999). Also, it is valuable when the investigation deals with complex questioning and considerable probing (Gubrium and Holstein 2001), which is the aim of this research. Furthermore, an interview is better than other methods of orally conducted research and more effortless than written statements for participants (Yin 2014). Moreover, the primary data collected was aimed directly at the context of the research problem (Lee and Saunders 2017), thus improving the research's precision and reliability (Creswell 2003).

The interview can be categorised by formality and strictness and grouped as structured, semi-structured and unstructured (Cassell 2015). Various studies have applied different interview structure categories based on the purpose and discipline of the study, including the nature of the research questions. For instance, the purpose of some studies focussed on testing hypotheses and theories and adopted a structured interview approach involving pre-set standardised questions. Studies that aimed to understand a topic's issues better and seek answers to specific questions to develop a theory used a semi-structured approach involving guided, focused and open-ended communication (see Kern and Smith 2008; Nwozor et al. 2021). A study aimed at understanding and exploring individuals' personal lives adopted an unstructured interview approach, which does not employ a predesigned set of questions (Cassell 2015). The overview of the interview categories used in management works of literature is discussed below.

a. Unstructured interview

In this category of interviews, there are no pre-specified guidelines, formats or questions. This method's logic accommodates the interviewee setting the direction of the open and spontaneous discussion on the research topic (Thomas and Myers 2015). Although this category offers valuable and voluminous data, they are suitable for topics requiring in-depth understanding and insight into interviewees' experiences (Lee and Saunders 2017). However, the interviewee might veer off the focus topic and require prompting to discuss some essential highlights (Lee and Saunders 2017). Furthermore, this type of research is more time-consuming and expensive, and data analysis is usually challenging (Thomas and Myers 2015).

b. Structured interview

The structured interview involves a standardised inquiry approach involving asking a predetermined close-ended question on a particular subject and soliciting answers that can be compared and quantified among participants (Brinkmann 2013). This type of interview is beneficial when the study involves generalising a large population, and the research logic is similar to questionnaires and is typically used in surveys (Creswell and Creswell 2017).

However, this method's major disadvantage is that it needs to provide for dialogue between respondents and participants, thereby missing the advantage of in-depth conversations (Brinkmann 2013).

c. Semi-structured interview

This involves a combination of structured and unstructured interviews; this format is the most common form used in management research and has been extensively reviewed in textbooks on qualitative research (Bryman, Teevan and Bell 2009; Brinkmann 2013; Brinkmann and Kvale 2017). Brinkmann and Kvale (2017, p. 3) defined a semi-structured interview as having "a purpose of obtaining descriptions of the interviewee's life world to interpret the meaning of the described phenomena". The interviewer may have predetermined open-ended questions allowing all participants to provide information on similar questions (Bryman 2008). Given this, the semi-structured interview offers an outlet for discussion between the interviewer and the subject, allowing follow-up and probing areas that need further dialogue or asking supplementary questions (Brinkmann 2013). Likewise, the interviewer has a greater ability to direct the discussion to important areas necessary, thereby enhancing the data's richness (Brinkman 2013). Furthermore, this type of interview helps obtain in-depth information on a topic from several participants. However, the interviewer must be knowledgeable in the research area to ask valuable questions effectively (Bryman, Teevan and Bell 2009).

Hence, based on this study's nature and purpose, a semi-structured interview was employed to acquire data to address the research question. A further justification is that the method harnesses the benefits of both structured and unstructured formats as it combines both approaches, thereby creating a flexible structure and pattern for which questions were asked during the interview and allowing questions to be omitted based on the nature of the conversation. This is further explained in section 4.7.5 below.

4.7.5 In-depth semi-structured interviewing technique and process

An in-depth interview was conducted with respondents as this study aimed to understand respondents' opinions on the key theme relating to the enablers, drivers and barriers to the Nigerian grid energy transitions and electricity sector, including the transition planning process and accountability and transparency. Morris (2015) asserts that this form of interview promotes structure and flexibility and involves a detailed conversation with individuals or groups on their perspectives and opinion on a specific research area of focus. This study adopted an in-depth semi-structured interview online through Zooms and Teams with public authorities, policymakers, regulators, ministries and parastatals included in the sample categories. This allowed the researcher to acquire vast and valuable data from the respondents as it provided a relaxed and comfortable environment, especially with policy authorities (Dioha and Kumar 2020).

The relevance and suitability of this technique to encourage participants' views and tackle the research questions were assessed based on the following considerations:

1. The semi-structured in-depth interview allowed the participants to speak freely on complex issues and disclose detailed understanding of the planning and governance of grid renewable electricity generation in Nigeria, especially on pertinent matters relating to the transition process's accountability and transparency. Also, it provided an opportunity to

critically investigate and identify critical elements of the roadmap for the successful implementation of grid-based renewable electricity generation strategies in Nigeria.

2. They are promoting a holistic understanding of the transition process and how it is governed to identify hindrances and determinants to the RE development on the grid system.
3. The data collected provided an avenue to confirm the conceptual framework developed from Transition Management, Multi-Level Perspective framework and accountability and transparency concepts that underpin the research.
4. This approach also provided an avenue to unearth further information from the participants by exploring opinions and experiences during the interview.

In the end, the perspectives provided by participants were synchronised to resolve the research questions and accomplish the research aim by deriving critical elements for designing an implementation roadmap for grid-based renewable electricity generation strategies in Nigeria.

4.8 Population and Sample

Saunders, Lewis and Thornhill (2019, p.37) explained population "as a full set of cases or elements from which a sample is taken". The research population in this context are the energy experts (industry and non-industry actors) and actors who are crucial to the transition process and well-informed on energy transition in the cities situated in the 36 states and Federal Capital Territory (FCT) in Nigeria (Miles and Huberman 1994; Creswell and Creswell 2017). However, the research question and the cross-sectional nature of this study guide the selection of an appropriate setting (Silverman 2019; Flick 2022). Lune and Berg (2016) posit that the decision to use a particular research site should be tied closely to access to the appropriate population and not the easily accessible population. Furthermore, poor choice of research sites replicates sample selection, the outcome of findings, and research quality (National Research Council 2005; Marshall and Rossman 2014). The sampling strategy was based on access to experts from across the country and the location of the institutions, companies, universities and research institutes, NGOs, and associations.

However, examining the whole population in a study is impracticable when the number of cases is substantial and with budget and time limitations (Saunders, Lewis and Thornhill 2019). Therefore, sample selection is a valid alternative (Saunders, Lewis and Thornhill 2015). Sampling draws delegates by choosing exact sampling units from the total. The two forms of sampling include probability (Kern and Smith 2008) and non-probability (Mattes, Huber and Koehrsen 2015). Probability sampling comprises the random selection of representation from a population, while non-probability does not (Lyons and Doueck 2010). Hence, based on the preceding discussions and the research aim, a purposive sampling technique was applied in this research for its appropriateness, as the specific study group was predetermined.

These are entities, directly and indirectly, involved with the energy planning process and governance of grid-based renewable electricity generation in Nigeria (Creswell 2014), selected as actors in the value chain, energy and non-energy industry. Purposive sampling was selected because it provided a means to logically decide and select information-rich participants to acquire valuable insights to accomplish the research aim (Newman, Benz and Ridenour 1998).

Furthermore, it is compatible with case study research as it is primarily employed in case study research (Newman, Benz and Ridenour 1998). Likewise, disproportion stratified sampling was utilised to increase the sample's confidence by allotting the sample frame into subgroups from which the participants were selected (Saunders, Lewis and Thornhill 2019). Snowballing sampling was employed, where it took more work to recruit participants directly (Tharenou, Donohue and Cooper 2007).

The sample size in qualitative research using the non-probability sampling technique has been an ongoing conversation, although probability sampling has rules and non-sampling is ambiguous (Saunders, Lewis and Thornhill 2015; Lune and Berg 2016; Hagama and Wutich 2017). Quinn Patton (2002) avers that while using a semi-structured interview, the data's credibility and validity depend on the data collection and analysis skills rather than the sample size. Various research literature has instructed that the appropriate number of interviews is determined by "data saturation", meaning when additional data collection provides little or no new information or by the number considered adequate based on the nature of the study (Creswell and Creswell 2017).

4.8.1 Overview of Research Participants

This section presents an overview of energy and non-energy industry participants representing various groups. Thirty-one (31) participants were selected, as shown in Table 21, based on expertise and knowledge of this research subject. The groups were selected to represent public authorities, climate change movements, NGOs, research and development centres, universities, industry actors, funding companies, GenCos, TransCo, DisCos, researchers and businesses. The groups are described below. These stakeholders comprise actors involved in the decision-making process and implementation of renewable energy strategies and policies on the national grid and the other actors, who are outsiders, but knowledgeable on the issue investigated. The stakeholder selection was also significantly informed and influenced by the transition management, multi-level perspective framework, and accountability and transparency concepts. Thus, these groups are described below.

Table 21: Energy and Non-energy Industry Actors (Source: Adedokun, Strachan and Singh 2023)

<table>
<tr><th colspan="2">Energy and Non-energy Industry Actors</th><th>Number of Participants</th><th>Interviewee Codes</th></tr>
<tr><td rowspan="3">Public authorities</td><td>Regulatory</td><td>2</td><td>IR11, IR16</td></tr>
<tr><td>Policymaking</td><td>6</td><td>IR08, IR15, IR17, IR22, IR25, IR27</td></tr>
<tr><td>Government Ministry and Parastatal</td><td>4</td><td>IR09, IR20, IR23, IR31</td></tr>
<tr><td colspan="2">Research and development institute</td><td>1</td><td>IR29</td></tr>
<tr><td colspan="2">Association</td><td>1</td><td>IR30</td></tr>
<tr><td colspan="2">Climate change movement</td><td>2</td><td>IR24, IR28</td></tr>
<tr><td colspan="2">NGO</td><td>1</td><td>IR18</td></tr>
<tr><td colspan="2">Universities</td><td>2</td><td>IR02, IR07</td></tr>
<tr><td colspan="2">Electricity generation companies</td><td>2</td><td>IR01, IR14</td></tr>
<tr><td colspan="2">Electricity distribution companies</td><td>3</td><td>IR03, IR05, IR06</td></tr>
<tr><td colspan="2">Electricity transmission company</td><td>2</td><td>IR10, IR19</td></tr>
<tr><td colspan="2">Renewable energy investment company</td><td>1</td><td>IR26</td></tr>
<tr><td colspan="2">Independent researchers</td><td>2</td><td>IR12, IR21</td></tr>
<tr><td colspan="2">Renewable energy businesses</td><td>2</td><td>IR04, IR13</td></tr>
</table>

4.8.2 Interviewing Process

Interviewees were recruited directly through email, phone calls, professional networks or through the snowballing approach. The research information document was sent to participants, followed by a consent form upon acceptance to be interviewed. An interview appointment was set, and the interview was conducted through Zoom and Teams. The interviews were conducted between April and December 2021, and the duration was between 18 to 108 minutes, with an average duration of 61 minutes. To address questions 2, 3 and 4, 31 interviews were conducted with executives, directors, managers, researchers or experts in Nigeria's energy/non-energy sector and data saturation was reached at the 28th interview with no new insights generated; however, three (3) additional interviews were conducted to ensure saturation was reached. Reaching saturation is essential to ensure the quality and validity of the study (Kvale and Brinkmann 2009; Fush and Ness 2015; Saunders, Lewis and Thornhill 2007).

The online Zoom/Teams interviews were conducted on an RGU ABS account, recorded and saved on an RGU OneDrive to ensure the interview recordings were safe and backed up. This was also supported with note taking throughout the interviews; this provides a basis to cross-confirm opinions, comments and views with other respondents. All participants indicated they should be disidentified from the data; therefore, their identity was anonymous.

4.9 Data Management and Analysis

4.9.1 Data Management

The data management plan is a vital piece of the research and involves capturing the data collection process of a study to assess, preserve and ensure legal compliance (Ball 2010). Also, the plan contains the shareability of data, including for re-use and re-purposing. A data management plan was designed, including the following: data obtained from the administered semi-structured interview were recorded using an encrypted audio device, transcribed through

Otter software, and stored in RGU's cloud database, encrypted and secured with a password. This aligns with the RGU data management policy. Also, the data will comply with the RGU retention policy and will be held for five years.

4.9.2 Data Analysis Approaches

Qualitative research could adopt a deductive approach, inductive approach, or a combination of which influences data analysis (Miles and Huberman 1994; Silverman 2019; Saunders, Lewis and Thornhill 2015). Yin (2014) explains that a deductive approach entail using theory or theoretical propositions as a model to guide data analysis. Alternatively, in inductive analysis, no theories or frameworks are used as guidance; instead, concepts and themes are developed from raw data without restriction, which is then construed to develop new theories or models grounded in data (Strauss and Corbin 1998; Thomas 2006).

According to Miles and Huberman (1994), there are three main phases of data analyses in qualitative research, namely, the process of reducing data, the removal of invalid data and the creation of an aggregate array and then the presentation of evidence that includes the graphical depiction of the text data and, finally, the drawing of conclusions. Several researchers adopt a general inductive approach to data analysis without explicitly identifying the analysis strategy (Bryman and Burgess 1994; Creswell and Creswell 2017). However, some study attempts to provide a commonly used strategy that is easy to use for analysing qualitative data, which can help achieve a range of results distinct from the general inductive approach (Thomas 2006). The inductive perspective on data is helpful for the explorative purpose (Thomas 2006). However, for the inexperienced researcher, the approach's strategy might be challenging to follow and lead to incorrect conclusions (Saunders, Lewis and Thornhill 2019). Hence, Saunders, Lewis and Thornhill (2015) propose that data should be examined as they are collected to define patterns and themes emanating to create a conceptual framework to direct future data collection.

On the other hand, the deductive approach, which seeks to assess if data adapts with a previous hypothesis or theory, is criticised by researchers because qualitative data analysis limits recognising germane innovative themes (Thomas 2006; Saunders, Lewis and Thornhill 2015; Creswell and Creswell 2017), thus restricting the acceptable analysis of the meanings supplied by the research participants. This research adopts an inductive approach to data analysis as the research seeks to understand the social reality, knowledge and insight of research participants on the planning process and governance of grid-based renewable energy. The approach is selected as this study aims to create a roadmap model for the development of RE on the national grid.

4.9.3 Method of Data Analysis

The oral data acquired through an in-depth semi-structured interview for this study was recorded using an audio device, transcribed verbatim and analysed. Content and thematic analysis are used to analyse qualitative data, which possess similar characteristics; namely, both techniques are categorised as qualitative descriptive design and have a comparable analytical process to describe textual data patterns and themes (Vaismoradi and Snelgrove 2019). Moreover, the coding process approach to ascertain the meaning of a phenomenon and elucidate social reality through themes and patterns is standard in both techniques (Thomas 2006).

The thematic analysis identifies and examines implicit and explicit patterns, characters and themes in qualitative research (Guest, Macqueen and Namey 2011). These themes are acknowledged and designated within the data set, transformed into codes, and relevant classifications are created for analysis (Thomas 2022). Namey et al. (2008) posit that categorising enables the comparison of emerging themes or topics to identify simultaneous code phenomena and links within codes. An advantage of the approach is that it is flexible as it is adaptable to any epistemology or theoretical viewpoint (Braun and Clarke 2006) and allows both inductive and deductive approaches (see Bryman 2008). Furthermore, the thematic analysis skills are transferable to other forms of analysis (Alhojailan 2012). However, various thematic analysis techniques recognised in literature result in confusion on which should be adopted (see Alhojailan 2012; Maguire and Delahunt 2017; Vaismoradi and Snelgrove 2019).

On the other hand, qualitative content analysis is defined by Quinn Patton (2002, p. 453) "as any qualitative data reduction and sense-making effort that takes a volume of qualitative material and attempts to identify core consistencies and meaning". Content analysis is suitable for quantifying qualitative data. However, content analysis's subjective approach to coding is a significant drawback. The thematic analysis was selected as the method of analysis and is appropriate for this study, which aims to discover the objective view or viewpoints of an occurrence through interpretation (Alhojailan 2012).

Additionally, the method can be used with any theory; thus, it was compatible with the theoretical perspective. Furthermore, the flexibility aided the production of a rich and detailed description of data emanating from participants' perceptions, opinions or experiences. Braun and Clarke's (2006) six (6) step framework for thematic analysis was utilised as it is a well-established process in social science research and provides a straightforward, easy-to-understand, applied and used framework. The adapted Braun and Clarke's thematic analysis framework is presented in Figure 23 below.

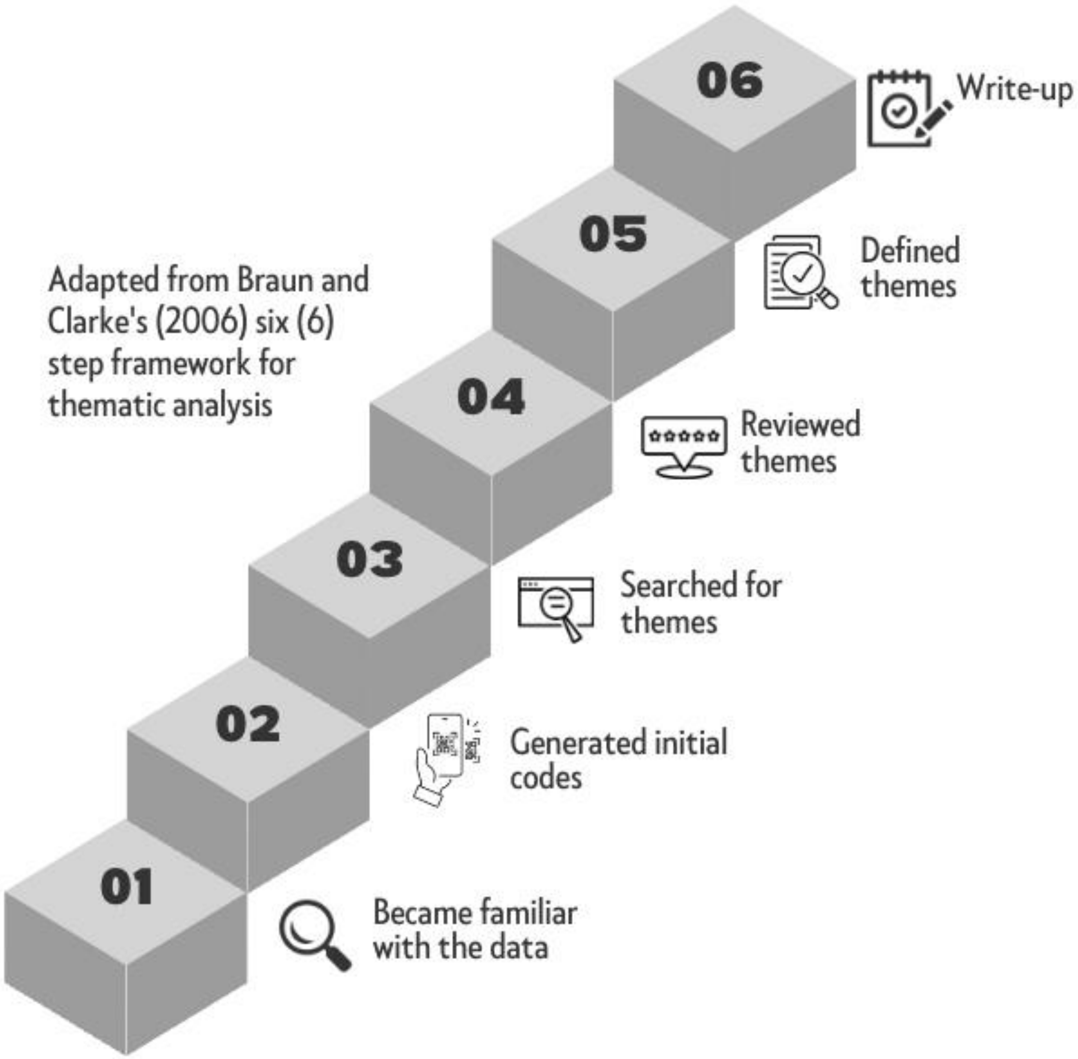


Figure 23: Adapted from Braun and Clarke's (2006) six (6) step framework for thematic analysis.

4.9.4 Analytical Method for Coding Process

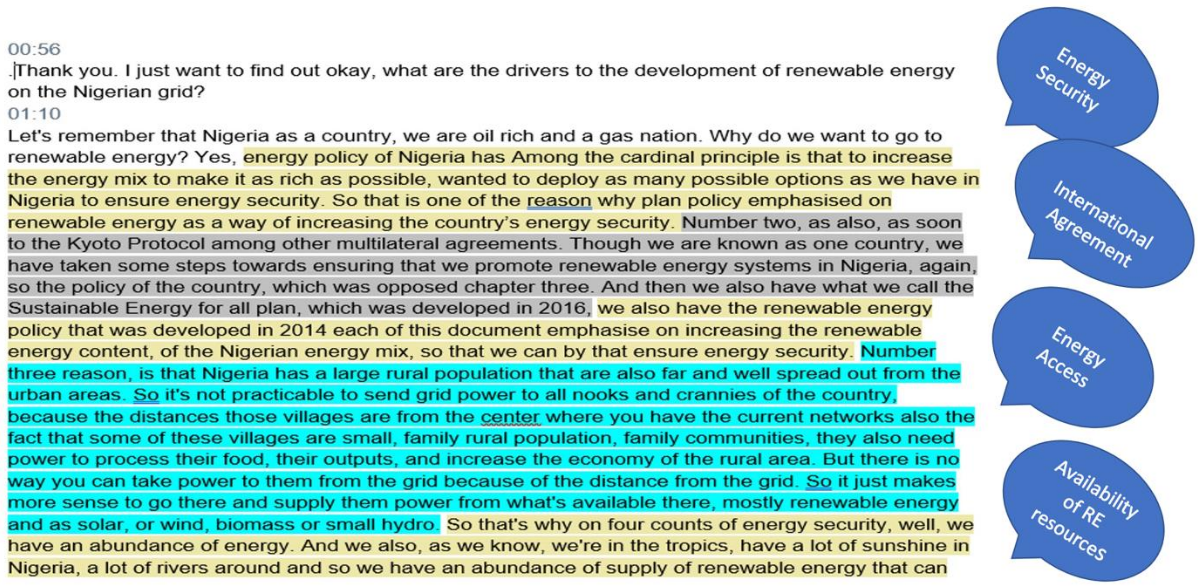
The study adopted Braun and Clarke's (2006) six (6) steps for thematic analysis for the semi-structured interviews of energy and non-energy actors. This section explains the observed steps: becoming familiar with the data, generating initial codes, searching, reviewing, and defining themes, and, finally, writing up the report.

Step 1: Became familiar with the data

The first step involved familiarising data; the investigator listened to the recordings after the interview before transcribing and taking notes of observations (Brinkmann 2013). This is followed by reading and re-reading each transcript after transcription to identify codes based on the analysis unit related to the research questions/objectives (2, 3 and 4). In addition to this, the familiarisation of data was further enhanced through the review of the transcribed transcript and listening over and over to the interviews to improve the quality of the transcription, which promoted the immersion into the data as the researcher was able to take into consideration the broader context and deep meaning of the information provided by participants. Also, the researcher made notes and jotted observations (Bryman 2004; Maguire and Delahunt 2017).

Step 2: Generated initial codes

The next step involved generating initial codes; the generation of codes was done by identifying predetermined codes from the literature, and the theoretical underpinning of the study, often referred to as 'priori codes' and also from the iterative review of the data sets. Next, other codes were identified from the open coding of the transcripts. NVivo software, a qualitative computer data analysis software, was utilised for the thematic analysis. This program provides a means to readily arrange, sort and search text and image databases (Creswell and Creswell 2017). However, Thomas (2022, p. 244) suggests that "intelligent reading of data" is vital to complement the usage of any software program for analysis. NVivo was utilised as it promotes transparency in coding and flexibility, and it is easy to use and beneficial for various forms of qualitative data analysis. There are other applications, such as Atlas.ti and CAQDAS. The RGU-licenced NVivo version was used to generate these codes: see Figure 24.



00:56
Thank you. I just want to find out okay, what are the drivers to the development of renewable energy on the Nigerian grid?
01:10
Let's remember that Nigeria as a country, we are oil rich and a gas nation. Why do we want to go to renewable energy? Yes, energy policy of Nigeria has Among the cardinal principle is that to increase the energy mix to make it as rich as possible, wanted to deploy as many possible options as we have in Nigeria to ensure energy security. So that is one of the reason why plan policy emphasised on renewable energy as a way of increasing the country's energy security. Number two, as also, as soon to the Kyoto Protocol among other multilateral agreements. Though we are known as one country, we have taken some steps towards ensuring that we promote renewable energy systems in Nigeria, again, so the policy of the country, which was opposed chapter three. And then we also have what we call the Sustainable Energy for all plan, which was developed in 2016, we also have the renewable energy policy that was developed in 2014 each of this document emphasise on increasing the renewable energy content, of the Nigerian energy mix, so that we can by that ensure energy security. Number three reason, is that Nigeria has a large rural population that are also far and well spread out from the urban areas. So it's not practicable to send grid power to all nooks and crannies of the country, because the distances those villages are from the center where you have the current networks also the fact that some of these villages are small, family rural population, family communities, they also need power to process their food, their outputs, and increase the economy of the rural area. But there is no way you can take power to them from the grid because of the distance from the grid. So it just makes more sense to go there and supply them power from what's available there, mostly renewable energy and as solar, or wind, biomass or small hydro. So that's why on four counts of energy security, well, we have an abundance of energy. And we also, as we know, we're in the tropics, have a lot of sunshine in Nigeria, a lot of rivers around and so we have an abundance of supply of renewable energy that can

Figure 24: An illustration of extracts and the codes generated

Steps 3, 4 and 5: Searching, review and defining of themes

The initial codes generated in step 2 were repeatedly interpreted to reflect the extracts and then organised, grouped and categorised into similar themes and an under-arching theme based on the research question being addressed in the study: What are the determining factors for the successful planning process of grid-based renewable electricity generation in Nigeria? Moreover, what are the renewable energy planning processes and governance for sustainable development in Nigeria? Furthermore, how accountable are the processes? (See Figure 25).

The codes and themes were iteratively reviewed to establish the relationship between the variables and elements of the codes and data set. This implies that the relationships and pattern between the barriers, enablers and drivers of transitions, transition management process and governance, including accountability and transparency of the process, was ascertained compared with the literature and MLP, TMF and accountability and transition concepts. Against this backdrop, findings contradicting the expectation were a foundation for formulating and refining the modules for grid-RE transitions in Nigeria (Yin 2009; Brinkmann and Kvale 2017).

	Main Category	Interpreted repetitions	Extracts
BARRIERS OF GRID-BASED RENEWABLE ELECTRICITY GENERATION IN NIGERIA	Policy and Regulatory	Lack of continuity in policy and government synergy	*...the issue of synergy is a challenge? All the key players I mentioned are playing their game not as stakeholders, they are playing their games individually... IR13* *...taking renewable energy to a different level, but what we have right now is, several agency objecting to one thing or the other on renewable energy, and there is no synergy, that synergy among them is lacking and that is why I'm canvasing for having institutional and regulatory support if there is an institutional leadership then all these agency that are actually doing one or two things on renewable energy can... IR15*
	Administrative	Existing bureaucracy	*...all of them are also the various levels of check. So yeah, the bureaucracy is much and all of these people in one way or another, you interact, keep you on your toes and ensure that the right things are been done...IR09* *...I don't have any problem, but because of that bureaucracy introduced, you know, so, so, the thing now is that there are so many people that need power and so many they want to sell power, because of ... and the distribution companies, these solutions have not seen the light of day. And that is reason why I feel that, you know, you know, something needs to be done. And this is this something is a total U-turn in policy... IR01*
	Infrastructural	Obsolete infrastructure	*...Because there are other issues that are connected to the centralised grid, for example, we have cases lots of losses, we have lots of old infrastructure that needs upgrade... IR O2* *...Because you have old technologies on it the eight of them cannot work... IR05*

Figure 25: An illustration of extracts, codes and themes

4.9.5 Research Credibility, Validity and Reliability

Kirk, Miller and Miller (1986, p. 20) defined “reliability as the degree to which findings are independent of accidental circumstances of the research and validity as the degree to which the findings are misinterpreted”. Reliability and validity originated from quantitative research and are now applied to qualitative research (Golafshani 2003; Thomson 2011). However, reliability and validity are applied differently in both types of research (Maxwell 1992; Strauss and Corbin 1998). A significant distinction between the validity of quantitative and qualitative research is that the former's measurable nature makes it possible to assess its accuracy and rigour; however, this is not attainable in the latter; hence, the yardstick for assessing reliability and validity varies. Consequently, qualitative researchers have developed new concepts that allow qualitative research's validity and reliability to be tested (Maxwell 1992; Walsh 2003; Auerbach and Silverstein 2003; Thomson 2011).

More significant concerns are placed on the consistency, replicability and repeatability of findings to measure reliability in qualitative research (Joppe 2000; Golafshani 2003). Quinn Patton (2002) affirms that reliability and validity are fundamental concepts researchers should reflect from the stage of designing the study, analysing results and evaluating the quality of the research. However, qualitative research findings result from subjective interpretation (Maxwell 1992; Walsh 2003; Auerbach and Silverstein 2003; Thomson 2011). Kirk, Miller and Miller (1986) posit that obtaining perfect reliability and no validity is possible. Still, perfect validity will assure perfect reliability; however, in social science research, reliability is obtained by relying on techniques to provide necessary reliability because perfect validity is theoretically impossible.

This research has incorporated the credibility, validity and reliability concept. For instance, the research participant's selection was based on a broad literature review to guarantee that data obtained from these categories of participants are quality and tackle the research aim. The data reflected the participants' opinions, and the transcription of the participants' utterances was accurate. Furthermore, the research objectively interpreted the data obtained by ensuring the interpretation was carried out from the participants' stance. Care and rigour were observed by dividing codes into segments for ease of verification and revision. Also, the researcher was detached from the data itself. Moreover, patterns from the data obtained supported the theoretical research frameworks and the relationship among the frameworks. The next section discusses the ethical considerations.

4.10 Ethical Considerations of the Study

Ethics is a "set of principles that embody or exemplify what is good or right or allow us to identify what is bad or wrong" (Hammersley and Traianou 2012, p. 16). The principle could apply to character, discipline, domain or perspective, including academics (Hammersley and Traianou 2012). The history of research ethics can be traced back to the publishing of the 'Nuremberg Code' in 1948 in the aftermath of atrocities perpetrated in Germany by Nazi health researchers during World War II (Amdur and Bankert 2007). The Nuremberg Code aimed to protect participants from abuse by highlighting that research relating to humans should only be conducted after informed consent has been obtained (Amdur and Bankert 2007). Since then, research ethics have evolved and become more sophisticated and inclusive (Leach et al., 2012).

Ethical concerns in research are related to essential values researchers should have, such as uprightness, truthfulness, justice and openness (Kakabadse, Kakabadse and Kouzmin 2002). In addition, ethical standards, such as conflicts of interest and plagiarism, need to be observed (Patton 2002). Ethical issues arise when the researcher's deed or choices impacts people directly or indirectly (Kakabadse, Kakabadse and Kouzmin 2002). Given (2008) avers in qualitative research, ethics is an essential aspect of decision-making that must be considered from the inception of the research to the findings report. The author stated that the researcher must ensure that harm to participants' mental and physical well-being through privacy, confidentiality, dignity or character and others as a result of the study is averted, prevented or mitigated; this is termed Nonmaleficence. However, measuring probable harm to participants is subjective and challenging (Given 2008). Creswell and Creswell (2017) posit that researchers must be proactively ready to predict the ethical issues that are accrued to their studies. Therefore, to address this issue, the researcher needs to inform participants of the potential harm before obtaining consent. The researcher also needs to ensure the utmost care is applied to develop plans to address the potential harm, as suggested by the principle of Proportionality (Given 2008).

The study addressed ethical issues during the study by carrying out an ethics assessment and appraisal with safeguards put in place. This aligns with Robert Gordon University's ethics policy and process, which involved submitting the assessment for review and approval by the Aberdeen Business School Ethics Committee. Safeguards put in place included deidentification of participants in the presentation of the findings of the results as they are senior experts and executives in Nigeria's energy and non-energy industries, and some hold sensitive positions. Therefore, these respondents were assured of confidentiality and anonymity and informed that participation is voluntary. Others include, at the beginning of the study, the research and data management plan's purpose were enunciated to interviewees with consent and approval obtained based on the information of the study.

Furthermore, the reason and how the information will be used during the interview was communicated to interviewees, including that the recordings would be de-identified to protect the participant's identity. Also, that interviewee had the right to discontinue the interview at any point, and their information will be destroyed (if they so choose). Data storage and sharing were handled appropriately during the analysis and reporting phase. Subsequently, the research ethics review and update were tracked as the study progressed. This study is an independent study and could be adopted by policymakers and other stakeholders for planning and governance reasons.

4.11 Chapter Summary

This research adopts an interpretive philosophical stance necessitated by the study’s aim and review of existing literature. The research also adopts a case study strategy and employs the interview method using a semi-structured format to elicit opinions, perspectives and experiences from energy actors, non-energy actors and other stakeholders in the grid-based electricity sector relating to the development of renewable energy in Nigeria. The interview was conducted through Zoom/Teams, transcribed verbatim and analysed thematically. Furthermore, the data management approach and ethical considerations are elucidated. Against this backdrop, the next chapter will explain the study's findings.

CHAPTER FIVE: PRESENTATION OF RESULTS AND FINDINGS ON THE BARRIERS, DRIVERS AND ENABLERS FOR RENEWABLE ENERGY DEVELOPMENT

5.1 Introduction

This chapter presents the results and findings obtained from a semi-structured interview with industry and non-industry experts and senior executives on the barriers, drivers and enablers to implementing the grid renewable energy strategy to answer questions two and four of this study.

Q2. What are the determining factors for successful planning process of grid-based renewable electricity generation in Nigeria?

Q4. What are the key elements of the roadmap for the implementation of grid-based renewable electricity generation strategies in Nigeria?

The interview was carried out to elicit the perspectives and opinions of the study's respondents on the development of renewable energy on the Nigerian grid. The data were analysed inductively using thematic analysis. The analysis identified and validated the following key themes which incorporate the opinions and views of respondents on the drivers for renewable energy development, perception and identification of existing enablers and barriers of the grid renewable strategies implementations. Respondents' views, personal opinions, perceptions and experiences are represented using quotes which are anonymised to protect respondents' identity and ensure confidentiality. Furthermore, tabulations utilised were appropriate to present a pool of respondents' views and enhance the richness, robustness and transparency of the data obtained.

Organisations of the chapters

The results and findings of this study is divided into two chapters to make for an easy read and comprehensible. The table below presents the structure of the chapters, contents and research questions that the chapters address:

Table 22: Organisations of the chapters

<table>
<tr><th>Chapters</th><th>Contents</th><th>Questions</th></tr>
<tr><td rowspan="2">Chapter 5</td><td>Barriers to implementing the grid renewable energy strategy.</td><td rowspan="2">Q2, what are the determining factors for successful planning process of grid-based renewable electricity generation in Nigeria?

Q4, what are the key elements of the roadmap for the implementation of grid-based renewable electricity generation strategies in Nigeria?</td></tr>
<tr><td>Drivers and enablers for the energy transition vision for the Nigerian grid system.</td></tr>
<tr><td>Chapter 6</td><td>Transition planning process highlighting the accountability and transparency of the process.</td><td>Q2, what are the determining factors for successful planning process of grid-based renewable electricity generation in Nigeria?

Q3, what are the renewable energy planning process and governance for sustainable development in Nigeria? and how accountable and transparent are the processes?

Q4, what are the key elements of the roadmap for the implementation of grid-based renewable electricity generation strategies in Nigeria?</td></tr>
</table>

Section 5.2 provides the findings on the barriers to Nigeria's grid-based renewable energy strategies implementation process through eleven (11) subs-sections. Section 5.3 provides the findings on the drivers for renewable energy

development while section 5.4 highlights the findings on the enablers for grid-renewable energy development. Section 5.5 presents a summary of the chapter.

5.2 Determining Factors for Successful Planning Process of Grid-Based Renewable Electricity Generation- Barriers to Nigeria's Grid-Based Renewable Energy Strategies Implementation Process.

This section presents participants' views on the barriers to implementing the grid renewable energy strategy. The synthesis identified eleven (11) barriers, and each is discussed below.

5.2.1. Policy and Regulatory

According to the interviewees, the sector has a policy and regulatory challenge. Gungah, Emodi and Dioha (2019) included this aspect in their study. This study's respondents provided a nuanced view of the policy and regulatory-related issues; these are lack of continuity in policy (policy somersault) barriers, lack of realistic regulations, government control of the system, policy and programme duplication and policy misalignment and lack of deep thinking in the policy and strategy formulation and no clear policies and implementation action plan for the policies. Research shows that a lack of regulations is a perceived risk deterring solar penetrations in Nigeria. Furthermore, Ogunmodimu and Okoroigwe (2019) and Emodi and Ebele (2016) aver that though there are laudable RE policies in Nigeria, it lacks active implementation and follow-up.

5.2.1.1 Lack of continuity in policy (policy somersault) barriers

During the research interview, respondents identified a few policy and regulatory barriers, including a lack of policy continuity (policy somersault). This is occasioned by the change of government, which Nigeria experiences with every administration coming up with its policies. These policies are usually different from the previous ones. Respondents IR03 and IR04 agree that this lack of continuity is a massive barrier to renewable energy development in Nigeria, especially on the grid:

Respondents	**Extracts**
IR03	... But yes, lack of continuity is a major problem for us...”
IR04	“...Now our policies don't talk to themselves. I'll be honest with you, why, because our policies are mostly resultant of knee jerk, you know, type relationships, or knee jerk type occurrences?... So, when there's a problem, a policy gets formulated to deal with that problem...”

5.2.1.1 A. Lack of realistic regulations

Respondents added that the current regulations are unrealistic and require a holistic review. There is a need to strengthen the regulations and implement them fully:

Respondents	**Extracts**
IR01	“...I would say regulation...” “...there is no proper regulation...”
IR11	“...this is all the reason why they're having a problem with that. So, we are reviewing the regulation currently. We are working with some support groups as well, development partners to review the regulation and make it more realistic, to increase the capacity...”

5.2.1.1 B. Government control of the system

Also, respondents such as IR02, IR08 and IR18 suggested that the development will be stalled as long as the government controls the system. They advocated that the regulatory bodies be made independent of government to be able to achieve their mandates:

"...Yes, I think the regulatory bodies should be allowed to, to operate independently, so that will actually push for more transparency and accountability. But with context, in Nigeria context, I don't think they can. They can't, but that is the way forward, existing independently, because that will actually make them move faster..." IR18

5.2.1.1 C. Policy and programme duplication

Furthermore, some respondents also added that the duplication of policies and programmes needs to be addressed to achieve renewable energy development:

"...we mentioned the issue of even duplication of policies within the government, so I was saying that could, the fact that when you're carrying out activities, you are funded by the government to do those activities, begin your own agency..." IR21

5.2.1.1 D. Policy misalignment

Finally, some respondents made a case for policy alignment and harmonisation of institutions that carry out similar functions for effectiveness. An extract from IR18 is shown below:

"The problem is from the foundation, people, the governments have not, should be able to ensure harmonisation of these ministries or commission to be under one body. In that way, they can harmonise different policies instead of having several policies. And it'll be difficult for another to bow to the other. So, I think that's the major problem." IR18

5.2.1.2 Lack of deep thinking in the policy and strategy formulation

Based on the respondents' opinions, detailed considerations are lacking in formulating policies and strategies for RE and its long-term effect. Some respondents attested that deep thoughts are not given to policy formulation, and the process is usually fraught with no strategic planning involved. This is a barrier to renewable energy development, which requires long-term thinking and adequate planning, see IR04 and IR14 below:

"...we don't have deep thinking around the policies we formulate. And this is very evident..." IR04

"Sometimes I feel as if some approach we go through in deploying our strategies in the country is a bandwagon approach, there's really some kind of the thoughts pen to paper kind of research in direction of how to deploy it..." IR14

5.2.1.3 No clear policies and implementation action plan for the policies

Furthermore, respondents commented that there is no implementation action plan for the policies, and, at best, the policies could be more transparent. According to respondents IR02, IR03, IR04, IR07, IR08, IR09, IR12, IR18 and IR28, this is a huge bottleneck that needs to be addressed to achieve grid-based renewable energy development. IR02 and IR09's quotes are below:

Respondents	**Extracts**
IR02	"…they've been given lots of talk for over a decade, but the reality on the ground cannot translate that talk to practical usefulness..."
IR09	"...now its implementation that is problem and implementation is hindered…"

5.2.2 Socio-Cultural Barriers

The finding from the interview indicates that the implementation of renewable energy strategies is faced with a socio-cultural barrier. The socio-cultural barriers are a lack of awareness of benefits, distrust in the management of the national grid, land use issues and insecurity (kidnapping, banditry and vandalism).

5.2.2.1 Lack of awareness of benefit

Some respondents believed that the need for more awareness of the benefit of renewable energy hinders renewable energy development. This is because the Nigerian people are more interested in improving the energy supply than the source of energy supplied. Respondent IR25 stated:

"...many people didn't know up till now, many people didn't know about the benefits of renewable energy, the lack of awareness..."

This is similar to the findings by Olayinka et al. (2014), that the policymakers and decision-makers are naïve of the environmental and economic benefits the adoption of renewable in Nigeria will generate for the country.

5.2.2.2 Distrust in management of the national grid

Participants firmly believe that distrust in the management of the electricity sector hinders the acceptance and implementation of the renewable energy initiative and projects. However, Enserink et al. (2022) argue that future research should focus on understanding the nuance of trust in influencing renewable energy project execution. Cowell and De Laurentis (2022) assert that the day-to-day experiences of the populace could contradict the formal narratives which may fuel distrust and disengagement in the drive for transitions. This is similar to the findings in this study and some comments imply that potential investors, developers and users are worried that that their needs and interest would not be considered in the renewable energy projects. Extracts from the interviews are presented below, which buttress this:

"...I mean, no one trusts the national grid. So, anything that comes from the national grid is always seen by many people as a failed project... they are a bunch of dogmatics set of fellows. They do things the way they like, they don't care about what we think. They don't care about how we feel. I mean... anything that is grid connected? No, no, no, no, is a bunch of problematic people. We don't want to see them. So that is this general idea that some people hold..." IR02

Some respondents believe there are unethical practices and behaviours in the energy value chain, which fuels distrust in the energy sector. According to the respondents, the existing unethical behaviour exhibited by regime actors creates problems that obstruct the uptake and implementation of renewable energy. A respondent expressed this as a vicious cycle of distrust:

"...Well, there are certain vicious cycles that the government needs to eliminate. The first of such cycles, I believe, is the distrust cycle that exists between the distribution companies and consumers. Because this distrust is a fuelled on one hand by electricity theft, on the part of some Nigerians. And some Nigerians are choosing to pay their bills..." IR22

This unethical behaviour is exhibited by some policymakers who want elongation of tenure, as pointed out by one respondent:

"...some of those, some of these things actually came out from some people who work in some of these places. And then one of the things they mentioned was that, see and imagine a case where the managements of the company are okay, the tenure will elapse at this time they want tenure elongation. So, one of the things they did was the gas purchase agreements, they made sure that they didn't tie all those ends. So, imagine lots of, lots of problems around the power purchase agreements…" IR02

Consistent with behaviour-related issues, some participants identified that the electricity consumption behaviours encouraged a wastage culture. According to IR06, mismanagement of these resources impedes the effective implementation of renewable energy:

"...I think, looking at renewable energy in the rural area, and increasing the megawatts in the urban area will be easier for the government to adopt, but bringing renewable energy to the urban area. Because I told you we've not learned to manage our resources in Nigeria. So, there will be too much effect..." IR06

5.2.2.3 Land use issues

Based on the response of participants, the evidence suggests that land acquisition for the siting of renewable energy infrastructure is a social barrier that portends a roadblock to the deployment of renewable energy on the national grid. A few respondents are concerned over the environmental degradation, loss of ownership and narratives of waste and spill impacts from the oil and gas industry activities, which presents ownership of the lands by developers or investors. This is especially the case where the land to be used is private lands, which in Nigeria have ancestral connotations and are utilised for agricultural purposes. Some respondents stated:

Respondents	**Extracts**
IR04	"...legal advice around land acquisition, you know, so many things..."
IR13	"...we have the issue of land again, land that is required..."

In a similar vein, respondents IR08, IR11 and IR15 indicated that the ownership and use of land depend on whether it is a state or federal acquisition, which poses a barrier to RE implementation as there is a lack of collectiveness and synergy between the federal and state government. In addition, participants' responses implied that landowners are not ready to forgo or forfeit their lands for RE development to produce electricity. It is essential also to note that a large scale of RE development implies more land usage, which leads to greater resistance from landowners. This barrier can be explained as there is collective hindrance by communities at the local level when there is a new development and initiatives that impact the whole community. This can be described by a similar case of Chile's land securement for renewable energy project deployment. A study conducted by Shahriyar et al. (2015) indicates that existing land-related conflicts between the local communities and the federal government hinder development. Similarly, Cowell and De Laurentis's (2022) study showed that national to local coordination is a difficult land-use planning challenge for renewable energy. This could further be explained by González et al. (2016), who argued that people accept renewable energy deployments as long as it has no consequences on property or land they own, referred to as NIMBY syndrome

(Devine-Wright 2009). Furthermore, Cowell and De Laurentis (2022) findings from the study of spatial planning in Italy and UK suggests that spatial planning policies and mechanism are important to drive RE development especially where the initiative is driven from the central or federal level. However, Brunet et al. (2022) mentioned that "if green energy is considered to be a promising answer to climate change problem, the way electricity is produced through large photovoltaic solar plants and its accessibility to the local population must be paid appropriate attention". These extracts explain the nature of the land issues:

Respondents	**Extracts**	**Nature of land issues**
IR08	"...The federal government will say one thing, you get to the State and the State says, no, the federal government has a say to a certain point. But the truth is, when it comes to land use, the state government will now tell you, no, you. So even the idea of wind farms if you do not have a cooperative state government. I'm sorry, solar farms, firms, the whole solar mini solar off-grid thing that is happening, if the state government says no, it doesn't matter what the federal government wants to do, unless it's on federal government land, state government says no, because they're like, what, what is what is in it for us to provide your electricity?... land is a problem..."	Synergy between the federal and state government
IR11	."... Now along the way it was revived, but the initial problem of how much of the power can be generated, they also wanted to use the same land to generate solar power, they want to have solar panels within the land..."	Landowners' resistance

5.2.2.4 Insecurity (kidnapping, banditry and vandalism)

Participants' statements indicate the role security issues had played in impeding the development of renewable energy on the Nigerian grid. The development of grid RE has been affected by insecurity issues that take various forms, including kidnapping, banditry and vandalism. Ogunmodimu and Okoroigwe (2019) elucidate that these activities lead to a risk of the high investment cost of renewable energy deployment, which puts investors off. Respondents' statements indicated that this had affected ongoing pilot studies for grid-based or off-grid systems.

Respondents	**Extracts**
IR07	"...But you can be sure that that will not happen because of the current insecurity that is happening. Most of those companies will not be able to go there because of banditry, kidnapping, and the rest of them, so you can already see that. That is part of the problem that we have..."
IR11	"...And then when they had a first problem of insecurity started there with kidnap and the project went halt for a while…"

Infrastructure security has also been identified as a significant bottleneck for RE deployment on the Nigerian grid. The results demonstrates that the security challenge in Nigeria has affected conventional electricity infrastructure, off-grid and potential grid projects implementation:

Respondents	**Extracts**
IR08	"...So, there's lack of security for infrastructure is an issue..."
IR13	"...There are places that my office will not even allow you to go. So even if they say you should even go, I will say no... Because there have been a lot of kidnappings..."

A participant suggested that the security issues affecting the sector are perceived to be better for community-based electricity than the grid-based system. This is evidenced in the statements below:

"...because for security reasons, sometimes this community-based electricity is the best…if you can have those grid systems that are based decentralised, they don't have to be connected to the national grid..." "... the advantage of it. If

there's any problem with the grid, they can just switch onto their system..."

IR21

5.2.3 Economic Barriers

Respondents identified economic barriers to the deployment of renewable energy. These barriers are presented under three tenets: economic decline and slow down, social budgeting and the impact of the national debt. According to the finding, Nigeria's economy is slowing down, and their constraints on the social budgets with impacts of national debt prevent the implementation of the renewable energy strategies.

5.2.3.1 Economic decline and slow down

The economic decline noted by the participants is represented by the fluctuating foreign exchange caused by the deficit in foreign exchange, which has impacted the financial and economic outlook of the country. The response demonstrates that the economic limitation on the deployment of RE projects needs to be more robust to the usage and uptake of the alternative energy source in the country. These findings confirm Amir and Khan's (2022) arguments that the global economic recession has resulted in reduced investments in renewable energy investment globally:

Respondents	**Extracts**
IR17	"…And also, another challenge we've also had that has made the scenario as peculiar, as strange, as I said, is the issue of dollar. They fluctuations makes it difficult, even for a genuine investor. To break even, the year the model I predicted, because in the last six months dollar move from 300 to over 500 in the last three months. So, you can imagine someone that had concluded a deal before now dollar-based deal, you can see the impacts on the model is wrong…"
IR22	"I guess maybe it might have something to do with the Naira/Dollar exchange rates. I really can't put my finger on why

	exactly that is the case. But I'll take a guess, I'd say it has to do with the influence of the dollar on naira. Okay."

Responses from participants highlight the issues relating to foreign exchange and its impact on potential investors as it keeps investors at bay, halting the implementation of grid-renewable energy projects. A respondent indicated that the slowdown in the country's economy has also created a barrier to the development of RE technologies:

"…And then there's also the problem of slowdown in Nigerian economy, there is a serious problem…" IR07

5.2.3.2 Social budgeting

Also, from the respondents' statements below, it can be inferred that RE growth is ranked lower in the government's priorities. This can be explained as the existing inefficiencies in the electricity system requiring more expenditures, and the current dependence on oil and gas makes policymakers unconcerned with investing in renewable integration on the Nigerian national grid. Some extracts from the data analysis are presented below:

Respondents	**Extracts**
IR07	"…but you don't find any form of seriousness on the part of the Federal government to even get that done, it is not in the 2021 budget..."
IR19	"…they privatise everything, but nothing works except if they privatise it or if they run it on a very extraordinary huge budgets, which the country cannot cater for. It becomes very expensive…"

Respondents implied that reduced revenue from oil production had a direct impact on the social budget of the country as it is based ultimately on oil revenue; therefore, there is little or no budget for RE since the government have to prioritise other demanding services.

5.2.3.3 Impact of national debt

Besides the economic barriers earlier highlighted, from respondent IR18 the introduction of renewable energy on the Nigerian grid is also impeded by the country's debt burden, hence hindering the economic opportunities for grid RE projects investments. However, other cheaper alternatives are being embraced. The respondent's statement is:

"…The government is actually in debt right now. So, there's actually a political will but there's little or nothing coming from there. Although the government is doing a lot to ensure the distribution of home systems in rural communities in Nigeria, so I think they're doing their best. Yeah…" IR18

Similarly, IR09 stated that other constraints on the government are the internal pressure from subsidising the electricity bill that is presently not cost reflective:

"…So, the tariff we currently pay is not what we ought to be paying because it is not cost reflective. And government is getting bogged down. Because of the huge bills that come from trying to subsidise this debt. So, all they need to do is a hard one..." IR09

5.2.4 Political Barriers

Another barrier indicated by respondents is the political barrier which constitutes political risk and influence, lack of government synergies and fragmentation in political decisions, corruption, lack of government commitment and political will to transition the conventional energy sources to renewable energy sources, as represented by Figure 26. This uncovering aligns with the findings of Adeyanju et al. (2020) and Nwozor et al. (2021).

5.2.4.1 Lack of government synergies and fragmentation in political decisions

A key informant's opinion is that the nature of centralisation in political and institutional decision-making creates fragmentation and less synergy concerning the implementation of renewable energy technologies as the local, state and federal governments have contrasting expectations and demands. Finon (2006) argued that in policy formation, political decisions are influenced by the government preferences and culture of the country:

"…that's part of our problem is centralisation. We need to decentralise the way things are done in this country. So, at some point, it needs to be okay. The government, the state government should have like a say, or even bring in the projects at the same time. Hey, what about the local governments? Because sometimes at that level, they're the ones that know what they need the most. And unless we actually address them on those or, you know, almost individualistic levels, we keep centralising everything, and it doesn't work for us…" IR08

5.2.4.2 Corruption

Several interviewees stated that corruption is endemic and prevalent in the incumbent power generation regime, hindering the investments, development and execution of RE projects on Nigeria's grid. While some interviewees indicated that corrupt practices are salient among policymakers and public officials, and they take the form of bribery (called 'egunje' in Nigeria, see Osunmuyiwa et al. 2018), embezzlement, nepotism and sectionalism. Despite the government's effort to curb corrupt practices in Nigeria, this has remained superficial, with no notable change recorded (Oseni 2011; Ijewereme 2015). Political corruption has derailed meaningful development projects in Nigeria. As Nwozor et al. (2021) pointed out, the interest of opposing politicians, regime actors and inefficiencies of the electricity sector impedes the drive for transitions in Nigeria. In previous years, Osunmuyiwa et al. (2018) have argued that while actors can support transitions, the transformation can be constrained in the face of political challenges within the incumbent regime that is contrary to the transition idea. Similarly, Newell et al. (2022) explained that policymakers heed to incumbents due to political and elections cause and switch camps when other issues arise in the public domain. The authors concluded that incumbent regime's participation in the transition process may accelerate transformation but lead to transition pathways with ingrained injustice. Furthermore, a study carried by Mirzania et al. (2023) of the existing unsustainable energy system transition in South Africa concludes that corrupt practices are major hinders to embracing sustainable technologies. This explains the situation of transitions in Nigeria. The statements are below:

Respondents	**Extracts**
IR08	"…It is invest in it; we do not want to put money in it. If someone brings in the money, everybody wants to get their share, like, okay, you have to settle groups of people before you get the job done…"
IR15	"…see everything relating to Nigeria, we have this issue of corruption, sometime that corruption tendency is what actually is dragging Nigeria backwards and you can see it everywhere, including planning for renewable energy as the case maybe, but then the government of today is fighting very hard to see that the level of that corrupt tendency gets to the barest minimum in Nigeria…"

Correspondingly, IR12 suggested that there exists geographical sectionalism for political gain by policymakers, which hampers the opportunity for proper planning and implementation of RE technologies to the best locations that support the uptake and effectiveness of the technology. The statement is below:

"…I think it's political manoeuvring… with the move to this current dispensation, we've seen that everything has clearly been, I mean, it's not just power, it's that every single policy, or every single improvement in the country is clearly tilt towards one path, one segment of the, of a nation. And, well, it's unhealthy... And so, for you to sustain that vote ban, you need to give them something, and that's why projects are going there. It's a political move. It's not developmental… there's a lot of sectionalism going on in Nigeria, but that's not the case…"

5.2.4.3 Lack of government commitment and political will

Several interviewees flagged the political will and government commitment to the progression of clean energy as restrictive to off-grid systems for rural electrification. Respondents stipulated that support for grid RE needs to be improved, creating a barrier to introducing new renewable energy technologies on the Nigerian electricity grid, thus stunting the growth and advancement of energy transition in Nigeria. This is projected by Kemp, Schot and Hoogma (1998) that radical niche innovations could encounter regulatory limitations in the form of a lack of political will. Gungah, Emodi and Dioha (2019) posit that government commitment is integral to successfully implementing renewable energy strategies in Nigeria.

Several Nigerian governments just develop new polices without recourse to previous ones. The ways the policies are developed are great on paper but without any strong implementation basis (Nwozor et al. 2021).

Respondents	Extracts
IR05	"…we have small scale companies who are doing the solar thing, but on the large scale for the government. I don't think the government has really put in effort into diversifying…"
IR18	"…In Nigeria, right now, the new regime, they're actually supports of renewable energy, most especially solar, solar energy, so they're actually doing a lot to promote the use of solar energy, but not grid type yet, but off-grid. So, with time, I'm sure with advocacy and involvement of different players with their complimentary efforts with the government, it's going to go a long way in actualising this…"

In the same light, IR15's opinion was that Nigeria is sending a mixed signal about her commitment to RE development by exploring non-renewable sources of energy, which impedes the uptake of RE technologies. This was made about the subject under study:

"Nigeria is even planning to have power generation through nuclear and coal power plants. That commitment is sending the signal that Nigeria may not actually go deeply into renewable energy because in other, the other plan that we are going into renewable energy to replace fossil and now you are talking of generating through coal power plant or through nuclear power. So, they are already putting an impediment to the realisation of renewable energy…"

5.2.4.4 Political risk and influence

This section considers the barriers to grid-RE as a result of the influences of the political regime. Talking about this issue, several respondents noted that the political domain controls the provision of large-scale infrastructure; therefore, energy infrastructure decisions are primarily political choices. Alasti (2011) pointed out that renewable energy acceptance is highly politically motivated. There was also an opinion that the political risk in the implementation of RE strategies in Nigeria creates a bottleneck and discourages investors from entering the sector, thereby impeding the success of the implementation.

Respondents	Extracts
IR17	"…Where we have had issue is the conventional electricity where the regulator because of political reason, cannot review the tariff because the tariffs should be reviewed… Almost every year, but unfortunately now they wanted to review in February, they couldn't because government came in because the labour wanted to go and strike. They wanted to review two months ago too. Labour came up and say that is a no-go area. The minimum wage is 30,000, there is COVID issue, there is no palliative, and you still want to increase the tariff, whereas on the mini grid or the renewable energy sector, the contract is between the private sector and the community it's not affecting in any way…"
IR28	"…when the next administration comes, which was what happened with the Sam Amadi and the rest of them, because they had already, they have clear political affiliation. It was not they had to go. It wouldn't be centre was up, but they still had to go. And somebody else was put in there. And the person that has been put in there..."

The comments below also illustrate those changes in a political regime leading to administrative transitions and affect project continuity, implementation and funding. Respondents report that this has stalled activities in the electricity sector and delayed RE implementation.

Respondents	Extracts
IR21	"…you can see that with each change of government there will be abandoned projects going on, the government need to be committed, it is a project that should be continued, it should be seen to the end, irrespective of who comes or who takes over. But we having this issue, which is beyond even those administering, electricity, because they need the funding of the government. And if there's a change of government, and there's no funding, there's nothing they can do…"
IR25	"…but I know Nigeria, we do not have continuity in our policy, and we do not respect what other governments do, you understand? There is no synergy among the governments…"

One interviewee felt that:

"…But we have been lucky to have leaders that listen to the people that have

been in the system for long. So, in as much as they get instructions from above, they still liaise with the people that have been in the system for long, to be sure that you ask how does this affect what we have been doing before? And try as much as possible to avoid us just abandoning projects that we have been working on before and start a new project…" IR22

5.2.5 Legal Barriers

Respondents stated that numerous RE policies pertain to the grid and off-grid systems; however, a significant element impeding the actualisation and development of on-grid RE in the electricity sector is the delay in approval and lack of enforcement of the legal framework and requirement to encourage the rapid growth of RE in Nigeria. This was supported by Elum and Momodu (2017), who indicated that the Renewable Energy Master Plan was a document without a legal framework to support it. Likewise, Gungah, Emodi and Dioha (2019) posit that the lack of legal backing and compliance deter potential investors seeking to align projects to the Nigerian renewable energy policy. This was also identified by Ajayi and Ajayi (2013). In the United Kingdom, renewable energy policies are backed by a legal framework encouraging investment and addressing concerns about investment risk. Some of the comments from interviewees are presented below:

Respondents	**Extracts**
IR17	"...we are not in that scenario; our legal system had not gotten to that stage..."
IR28	"...So, the policy is already there, it is just for the marching orders, how will I put it now, this is for those who need to do the groundwork. And that is what some of us as civil society are trying to do..."

5.2.6 Administrative Barriers

Gungah, Emodi and Dioha (2019) found that energy research centres were established to deploy renewable energy innovations linked to bureaucratic and management challenges. Effective management is crucial for transforming large systems such as the grid electricity (Batinge, Musango and Brent 2019). This study found that administrative barriers in the form of bureaucratic processes and management challenges prevent optimal policy implementation processes for grid renewable energy development. Ovwigho (2020) concluded that there needs to be better management to actualise sustainable electricity.

5.2.6.1 Existing bureaucracy

Informants enunciated that the public bureaucracy has acted as a significant barrier to investment in on-grid renewable energy as there are deficiencies and issues in the processes, making it cumbersome for potential investors and stalling the implementation of RE on the grid:

"...because of that bureaucracy introduced, you know, so, so, the thing now is that there are so many people that need power and so many they want to sell power, because of NBET and the distribution companies, these solutions have not seen the light of day...this bureaucracy can be a killer. Yes. Yeah, gotta get the permission or get approval from the DPR guy, get approval from REA, get up from NERC, you are running round trying to get the approval. A lot of companies have actually changed their mind about deploying solar systems because the regulatory requirements were enormous and too voluminous..." IR01

5.2.6.2 Management challenge

Furthermore, respondents IR13, IR15 and IR19 commented that there is ineffective leadership and management, which is deterring the implementation of the RE strategies, and IR19 stated that this could be attributed to the lack of a designated agency handling grid renewable energy affairs:

Respondents	Extracts
IR19	“And politics, largely, the people are willing, the leadership has been the issue here... I think I answered this person before you even ask it, it’s just management and politics actually...”

5.2.7 Financial Barriers

The existing financing and market structure of the power sector and RE investments' drawback regarding lack of investment and security of investments are hindrances to implementing grid RE strategies in Nigeria. While the FIT regulation was designed to encourage investments in the sector, this has yet to translate to a favourable pathway for renewable energy project deployment (NREAP 2016). These findings are similar to Nwozor's et al.’s (2021) conclusion that the investment climate in Nigeria is unconducive for potential investors and needs to be addressed to encourage economic development.

5.2.7.1 Existing financing and market structure of the power sector

Informants stated that the existing grid market and financing structure of the electricity sector creates liquidity constraints, which serve as a deterrent for investments in grid RE in Nigeria. This is captured in the sentence below:

Respondents	Extracts
IR15	"...even the financial institutes are not even ready to give loan for renewable energy businessmen and women, because they are not sure because renewable energy is a project that if you venture into it, you are not gaining right now…"

5.2.7.2 RE Investments drawback

Informants discussed two significant investment-related challenges hindering the implementation of grid RE technologies. These include the lack of investment and the perceived risk and security of the technology.

5.2.7.2a Lack of investment

On-grid renewable energy deployment requires enormous investments, which could pose a challenge for deployment. Some participants commented:

Respondents	Extracts
IR02	"...The reason is, if you say, if we say we have all of these efficiency issues, and then we need to address them, it requires a lot of investment and that investments cannot happen…"
IR13	"…another challenge on that is the issue of financing. The renewable energy system is actually very expensive…"

Furthermore, some participants commented that the Nigerian Government are meant to be pace setters by investing in the grid RE to encourage and motivate private investors:

Respondents	Extracts
IR03	*"...the renewable energy for us comes with investments that have to be purpose investments from all parties, there have to be a motivation from the government, public sector, a motivation to encourage people to want to get into that..."*
IR15	*"...you need to put an investment to make people to see, but the government itself, in terms of his political position, is quite insufficient..."*

5.2.7.2b Security of investment

Another challenge concerning investment is in terms of the security of investment. A participant commented that:

"…and all those investment risk and other things… but any investor coming here wants to get money, they want to make money quickly before something changes…" IR03

Similarly, this was further implied by IR12 in their comment:

"...And I think that is a very wrong signal to send to potential investors. Because if you are going to force people to take agreements in Naira, when they are getting their funds in dollars, it is a business suicide..."

While some other participants commented that the absence of a Partial Risk Guarantee (PRG) facility and Put Call Option Agreement (PCOA), which is supposed to reassure private investors of their investment, have deterred private investors from going through with the investment. This is evidenced below:

"…So, they want guarantees that their investment will yield money as being projected, and that at the end of the day, they will be able to make profit. If that is done, so government needs to reassure the private investors, not just reassuring them out there... but the other aspect of security of investment, that is the place that may be a serious problem…" IR07

5.2.8. Institutional Barriers

There are two (2) sub-themes under the institutional barriers to implementing grid-RE. These include a lack of institutional synergy or mandate overlap and the need for a specific agency for grid renewable energy/too many agencies without institutional leadership, as shown in Figure 26. This can be summarised by the extract below:

"...I still think institution in the, obviously, we still have a lot of issues. Institutional framework is still a big problem for us because our institutions are broken. In fact, the work they do and how they are supposed to do it, and how they are also supposed to be held accountable, but so we have these two things that keep working against us..." IR08

5.2.8.1 Lack of institutional synergy or mandate overlap

Several respondents indicated that there are conflicting roles and mandates among various ministries, posing difficulty for the uptake of RE on the grid. Respondent IR18 suggested that the objective of attracting funding fuels these conflicts and misalignments:

Respondents	Extracts
IR18	"...So, some of these roles are conflicting. So, if these actors do not come together, and synergise, it is actually going to be difficult. So there needs to be a master, shall I say, there needs to be a complementary action among these people... The problem is from the foundation, people, the governments have not, should be able to ensure harmonisation of these ministries or commission to be under one body, in that way, they can harmonise different policies instead of having several policies. And it will be difficult for another to bow to the other…"

A few respondents disagreed that there are structures for coordinating renewable energy deployment in Nigeria. This is indicated by IR20's comment below:

"... *in 2013, this issue of coordination came up..." "... So, the structure is already there, there is no need to disorganize the structure. So, it is just for it to keep moving is just for it to be alive, and to be able to serve you if you are operate that way. Sorry, sorry, there is no conflict..."* IR20

A key issue pointed out by several respondents is the situation of ECN under the ministry of science and technology. Participant IR11 commented that ECN have the required expertise to advise the Presidency or Ministry of Power on RE development; however, presently, they are not. In the same vein, respondent IR12 pointed out that the present structure implies that ECN is not in the right parent body; therefore, they have no jurisdiction in power:

"... you see that people are reaching beyond their mandates, because it gives them the opportunities to expand their portfolio in terms of their project portfolio. And so, yeah, so there's a lot of misalignments if people are going the, on demand, is that's definitely sure they are going whether where the money is, it's just, it's a matter of money." IR12

Lack of synergy and harmonisation from the government circle, according to the respondent, is having a spiral effect in the sector, thereby distracting from addressing and fostering an enabling environment for the uptake of the RE technology on the grid.

5.2.8.2 Too many agencies need institutional leadership/Lack of specific agency for grid renewable energy.

The finding indicated that there are too many agencies in the Nigerian electricity sector; however, there is no institutional leadership and lack of a specific agency saddled with the responsibility of coordinating and implementing grid renewable energy initiatives:

Respondents	Extracts
IR08	"...Truth is that too many of us, I'm not saying there are too many workers, there are too many agencies…"
IR14	"...So, if you have one agency that is around, managing all our weather and things like that..."

5.2.9 Market-Related Barriers

Also, this study identified market-related barriers in the form of a lack of cost-reflective tariffs, pre-existing industry agreements, resistance and sabotage from current energy producers and liquidity challenges (ineffective revenue collections), as shown in Figure 26 below. It has been observed that the feed-in tariff for renewable energy could be more attractive for potential investments in the sector compared to South Africa. The reluctance of the Nigerian government to introduce an effective tariff system can be explained as FIT policies are politically risky as they increase the electricity rate for producing companies and transfer money from the fossil fuel industry to renewable energy companies (Baldwin et al. 2019). This is a similar situation in Nigeria as the electricity tariff remained fixed for over six (6) years, with pushbacks from the populace in 2014 and 2020 due to political concerns. This has more than doubled between 2020 and 2023 (Premium Times 2023). Furthermore, the present Nigerian REFITs system has not been able to be translated to renewable energy development.

However, the regulations introduced by NERC mandate that 50% of electricity should be sourced from renewable energy sources.

5.2.9.1 Lack of cost-reflective tariff

Another vital set of barriers is market-related, an example of which includes the lack of cost-reflective tariffs. According to several respondents, tariffs are significant issues that need addressing before implementing grid-based renewable energy. The current tariffs and tariff system is ambiguous and very confusing to customers and investors; hence, this is a significant concern to attract the type of investments required for such development activities:

Respondents	**Extracts**
IR04	"...because tariffing has also been an issue around, you know, electricity, that has countered the progressive supply of electricity. So, tariff has been an issue, so we are under paying for electricity..."
IR22	"Another vicious cycle that we need to get rid of is that which will prevent NERC, the regulatory commission NERC, from implementing cost effective tariffs as part of this regime, the lots of it, it is not as straightforward as we'd like it to be. For all these factors play, make it difficult to move forward as it were..."

5.2.9.2 Pre-existing industry agreements

Also, the current and pre-existing industry agreements constitute a barrier to future development, unless adequately addressed. Respondents IR04, IR13, IR18 and IR28 mentioned MYTO as one major obstruction and suggested that a new system be reviewed and implemented to pave the way for grid-based renewable energy development. Below is IR18's extract:

"*...one of the major obstacles is because of the MYTO. They are really not ready to actually make good use of it because, for example, the distribution companies in Nigeria, they actually, the MYTO have not been able to pay them well..." IR18*

5.2.9.3 Resistance and sabotage from current energy producers

Likewise, respondents also identified that the resistance and sabotage from current energy producers is a significant barrier to grid-based renewable energy development in Nigeria. It was noted that respondents agreed that entry into the energy sector is extremely difficult as current actors tend to stifle new entrants to maintain their market share. Hence, unless government pave an easier route for new entrants and allay the fear of current participants on the benefit of complementing their efforts, the actualisation of grid-based RE will be difficult in Nigeria:

Respondents	**Extracts**
IR07	"...no free entry and free exit for other investors to come in, so they have a monopoly, and they determined the number of hours to supply light to various sections of the communities..."
IR25	"...they may not like renewable energy to be on stream, because they know they will be phased out of markets..."

5.2.9.4 Liquidity challenge (ineffective revenue collections)

Finally, the last market-related barrier illustrated by respondents is the liquidity challenge. Research participants believed that the current process for revenue collection is challenged and requires addressing. For example, respondents IR10, IR11, IR12, IR13, IR14 and IR17 all lamented the difficulties of getting paid for services (generation, transmission or distribution) rendered, which causes challenges to electricity companies which invested heavily in the sector with only meagre returns. They also made a case that new entrants seeing this will be deterred from investing in the sector. An extract from IR13 and IR17 depicts this:

Respondents	Extracts
IR13	"...there is that issue already with the GENCOs, that they do not get what they give out? Because people do not pay, people steal electricity... So, people bypass meters. So, and if people do not pay, DISCOs will not be able to remit to NBET, and NBET will not be able to remit to transmission and GENCOs..."
IR17	"And the collection ratio is also within that range, which is about, let me, average of 35%. And that is why there is a huge liquidity issue in the power sector... it is a particularly strange scenario, a scenario where the collection by the DisCos is average of 40% collection of revenue. Most likely will that, we will default on the payments to these independent power producers because the DisCo is not able to collect, despite you have about 1000 megawatts of renewable solar energy on the grid..."

5.2.10 Technological/Technical Barriers

Technical and technological barriers to implementing RE on the Nigerian grid (i.e., human capacity development), including lack of expertise and RE technology capacity in the sector and grid-related RE research and development and technology-related issues, lack of infrastructure, limited storage capacity, unreliability of the renewable energy technology, cost of technology, narratives from off-grid systems, technology maintenance, technology implementation challenge and data challenge hinder energy transition in Nigeria. This is similar to Chanchangi et al.'s (2022) categorisation of critical technological and technical barriers to renewable energy technology adoption. The study highlighted a lack of adequate research, substandard renewable energy equipment, inexperienced and lack of technical know-how, including poor maintenance of electricity systems.

5.2.10.1 Lack of expertise and RE technology capacity in the sector

According to participants, the implementation of grid RE failed due to a lack of competence in the electricity sector. Two areas were identified from the participants' perspective: a lack of expertise in the power sector and local technical know-how for RE technologies. Some respondents identified that poor technical personnel and lack of capacity building are major challenges in the electricity sector, a barrier to RE development and implementation on the Nigerian grid. This is evidenced in the respondent's statements below:

"...And it is the fundamental issue, most of those who bought over the DISCOs did not have the requisite expertise..." IR28

Similarly, the absence of grid RE local know-how was identified by some respondents as a barrier to implementing RE on the national grid. This is evidenced in the respondents' statements below:

Respondents	**Extracts**
IR15	"...The technical know-how is low, that we have not had enough capacity in that area of renewable energy…"
IR25	"...Well, the expertise we need to have, you need to train the, the engineers that are monitoring the projects, most of the engineers currently in Nigeria that are monitoring renewable energy projects are not expert in that field..."
IR31	"You know, the technological knowhow is not readily available. Do you understand? And the knowledge capacity is not yet there."

IR11 implied that grid projects are also affected by the lack of capacity of construction companies available in Nigeria to embark on large grid projects. This is shown in the comment:

"We also have large construction companies in the country, if we are going to construct large project with large wind master you need large construction

companies to do that, we do not have many of that. So, we are limited to what we can do holistically within our own capacity..." IR11

5.2.10.2 Unreliability of the renewable energy technology

Several participants described the RE technology as unreliable due to the intermittency of sunlight radiation and wind speed, which serves as a barrier to the uptake:

"...And then you have lower demand during the day, but at night when they come back, you're high demand So, for me, this can, you know, pose a bit of a problem for renewables, especially solar, because solar has its peak during the day, you understand, when there is sunlight, you get the maximum irradiation to the solar panels, and then at night, you know, the solar panels do not have…" IR01

5.2.10.3 Cost of technology

Some of the respondents mentioned that the high cost of RE technology is a barrier to the implementation of RE strategies on the Nigerian grid. See extract from IR12:

"...One, and I also think that apart from the grid cost. I also think that renewable energy systems itself, especially grid centred renewable energy systems are variable in the sense that they need extra technologies to support them like storage systems..."

5.2.10.4 Narratives from off-grid systems

Also, the narrative from off-grid systems and home systems has created an image and perception in the populace that RE is inefficient, which is serving as a limitation to the implementation of the technology:

"...So, the substandard nature of batteries has also contributed to selling the wrong narrative on renewables, especially solar, they say, oh well, it is not as reliable, because the batteries go off in time and so on..." IR04

5.2.10.5 Technology maintenance

One respondent also mentioned that the need for constant maintenance of RE technology is also a challenge that inhibits grid RE implementation in Nigeria. Similarly, IR05 indicated that the maintenance culture is poor in Nigeria:

"...the main problem with Nigeria, it's the maintenance culture..." "we do not have maintenance culture..." IR05

5.2.10.6 Technology implementation challenge

It is interesting to note that several respondents identified that the significant barriers to RE development on the national grid are the implementation due to the eccentric nature of power supply in Nigeria:

Respondents	Extracts
IR07	"...we would like to sit and develop beautiful documents and so on. At the end of the day we will shove it aside and that is the end of the matter, and then we will still go back to conventional, conventional means of generating power, going back to revamp the various old hydro powers, and other fossil fuel equipment and so on and so forth. Instead of veering off and taking the giant stride towards developing the, the renewable energy sector that we have already committed ourselves to doing, even if we have to do that at the level of upgrade..."
IR09	"...all of those things are in place already, to be honest, now its implementation that is problem and implementation is hindered because of the very nature, like I had explained of the country, very peculiar nature of electricity supply, and how sensitive it is..."

5.2.10.7 Limited storage capacity

Respondents also believe grid-centred RE systems need other supporting technologies to work effectively. Hence, the limited storage capacity is pointed out as a barrier to grid RE power generation uptake. This is demonstrated in the response below:

"...I also think that renewable energy systems itself, especially grid centred renewable energy systems are variable in the sense that they need extra technologies to support them like storage systems..." IR12

5.2.10.8 Lack of research and development initiative

According to participant IR14, the lack of research impedes the commercial viability of various RE technologies on the Nigerian grid:

"To be frank, I am not sure if enough research has been done. To be able to okay, so you know, there is the angle of, can I harness wind energy in my country..." IR14

Also, participant IR07 stated that incumbent electricity players are disinterested in commissioning research and development activities. IR15 identified the need for improved research and development:

Respondents	Extracts
IR07	"So, they are not motivated to even invest or the look for alternative means of generating electricity, they are not interested in commissioning, research and development..." "...I am not aware that there is any university that has any of these DISCOs as a collaborator..." "…So, that, those are issues. So, no research and development investment in that area..."
IR15	"...and the research and development we need to improve on that one if they are able to improve on research and development and training of personnel, that area will also drive renewable energy in Nigeria..."

A few respondents indicated that a lack of structured data inhibits renewable energy investment decisions. Below is a sample of the extracts:

"...we have too much data, and Nigeria, would you believe me if I say, we have too much data. Okay, this is what I always say, we have too much data, we challenge is structure, structure data. I think that is really what the challenges is, not lack of data at all... Credibility of data might be suspect. Again, you can see that from the outcome of the kind of analysis that comes out from the data that people access eventually..." IR14

5.2.11 Infrastructural barriers

Grid unreliability, obsolete infrastructure, grid expansion challenge (grid capacity), transmission line and distribution challenges and metering are infrastructural challenges impacting Nigeria's transitions to renewable energy technology, as pictorially presented in Figure 26 below. Edomah, Foulds and Jones (2016) charted a clause for the actualisation of renewable energy on the national grid in their work; the author indicated that the energy infrastructure deficit needs to be tackled coupled with the replacement of existing obsolete infrastructure. This study's findings re-echo those of Edomah, Foulds and Jones (2016) and Cowell et al. (2017).

5.2.11.1 Grid unreliability

Principally among the infrastructural barriers identified by respondents is grid unreliability. Most research participants identified this as a major issue. For instance, several respondents mentioned that the current grid system is failing and requires an upgrade to address the unreliability before introducing new power to increase the capacity. They opined that without addressing this, grid-based renewable energy development is bound to fail:

Respondents	Extracts
IR01	"...the grid is still very unreliable... we must not have one national grid that collapses in one day and whole countries in darkness..."
IR11	"...not yet because our grid is still weak in sense of if you allow the renewable energy too much into the grid, it can affect the grid stability..."

5.2.11.2 Obsolete infrastructure

Also, research participants pointed out that other systems attached to the grid and energy system require upgrades. Some respondents said the systems are old and need to be updated to newer technologies of this time to be able to function properly:

"... I do not want to call it archaic, but it is our grid, our grid is really just old and has never been updated. We have been using the same system..." IR08

5.2.11.3 Grid expansion challenge (grid capacity)

Additionally, interviewees identified that increasing the grid capacity is a great challenge. This is like Cowell and De Laurentis's (2022) assertion that regions seeking to explore RE for economic development are often faced with grid expansion challenges. Respondents IR02, IR07, IR08, IR13 and IR15 said that even though everyone knows the grid capacity is limited, expanding this capacity is a herculean task which has defiled all solutions thus far. So, there is a need to rethink the strategy to address this:

Respondents	**Extracts**
IR02	*"…if we continue to depend on large scale, I mean, on the expansion of the national grid, we'll still have more people not having access to the grid, that percentage will increase..."*
IR15	*To drive the grid base renewable energy in Nigeria, then there is need for us, for the country, to improve or strengthen our grid capacity so that it can be strong enough to accommodate renewable energy"*

5.2.11.4 Transmission line and distribution challenges

Furthermore, there is a need to address the mid-stream and downstream challenges before additional upstream potentials are targeted. Respondents IR08, IR09, IR13, IR17 and IR18 all believed that the transmission and distribution lines need to be reviewed, upgraded and certified to receive additional power before any further work is instituted for power generation. They mentioned that, currently, the energy generated is not fully appropriated by the system, and the issues need to be addressed to avert failure of the grid-based renewable energy development:

Respondents	Extracts
IR08	"...Well, I think our, our grid itself needs to be upgraded, and also the transport. But I mean, like transmission, our transmission infrastructure is way, it's failing us, because what I can see is the GENCO generation companies are generating electricity. In fact, a lot of times they have to step down, which cost them a lot of money..."
IR09	"...So, the there is a pushback from the transmission company of Nigeria, because we do not have the capacity yet, according to them, to manage large, renewable energy injection into the grid... The distribution companies and the transmission company are having funding challenges..."
IR18	"And for the distribution company, for example, they've actually not been able to, they've actually not been able to, should I say, get the system right in terms of electricity distribution. So now bringing in renewable energy is a bit complex..."

5.2.11.5 Metering

Lastly, research participants also identified the metering issue as a fundamental factor under the infrastructural challenges that should be addressed. Respondents IR07, IR17 and IR28 mentioned that most houses need to be metered, so it is difficult to correctly estimate the payment due, resulting in a fractured relationship between the consumers and distribution companies. They advised that every house should be metered for effective revenue collection, which will translate to a transparent and more effective system and pave the way for grid-based renewable energy development:

Respondents	Extracts
IR07	"Can you believe that most of the houses have not been able to get prepaid meters, most houses still rely on estimated bill..."
IR28	"…there is no metering, nothing going on there, just pays to the distribution company and the supplier is electricity perhaps twice or three times a week for about five, six hours or eight hours or thereabout…I applaud the CBN for the 41 billion they gave to the companies to provide metering for every customer, but they are not doing so they have refused, in fact, they have refused to do so..."

5.3 Determining Factors for Successful Planning Process of Grid-Based Renewable Electricity Generation - Drivers for Renewable Energy Development

This section investigates the drivers that spurred the energy transition vision for the Nigerian grid system and factors stimulating the transition to renewable energy on the Nigerian grid. Analysis of data from participants interviewed articulated the following drivers:

5.3.1 Energy Access and Security

The first set of important drivers are energy access, security and quality. The energy access in the country is currently low; hence, renewable energy will need to be included in the current energy mix to improve this. According to several respondents, there is sufficient evidence, corroborated by experts, that to improve energy access in the country, Nigeria needs to include renewable energy sources such as wind and solar on the grid. Extracts from IR09, IR11 and IR29 is presented below:

Respondents	**Extracts**
IR09	"…the lack of access challenge all over the country..."
IR11	"...ensure that energy access is increased in the country. So, on all counts, we are for renewable energy because of these reasons..."
IR29	"In terms of energy security, we have a lot of sunlight here, really, we are very close to the equator. So the solar radiation in the region is so high"

Energy security, just like access, is also essential for renewable energy development in Nigeria. The lack of constant electricity can be addressed by including renewable energy, especially on the grid. The respondents also support this assertion, stating that RE can help the country achieve energy security.

Respondents IR11, IR13 and IR22 all agreed that introducing a new energy source will improve energy security issues in the country. A sample quote from IR 11 is below:

"Energy policy of Nigeria has among the cardinal principle, is that to increase the energy mix to make it as rich as possible, wanted to deploy as many possible options as we have in Nigeria to ensure energy security. So that is one of the reason why plan policy emphasised on renewable energy as a way of increasing the country's energy security..."

Likewise, the country's need for quality and equitable power supply is another primary driver. Respondents all support the need to introduce renewable energy to the grid system to tackle the incessant power supply situation in the country. Extracts from IR08, IR21 and IR28 is captured in the table below:

Respondents	**Extracts**
IR08	"But now the inclusion of solar, the real reason for it is just basically because of lack of access, and then even having quality electricity, you will see some places where you might have electricity, but it is not good quality electricity, it is poor electricity, voltage, just terrible current fluctuates, that sort of thing..."
IR21	"…with grid, you are generating a huge capacity in just one location that you can be able to just connect to the grid..."
IR28	Renewable energy is a bit more democratic in nature. It could be off-grid, it could be even in an urban area, it could be placed wherever. You do not need to spend all of those expensive amounts to move energy to particular location..."

5.3.2 Energy Mix and Diversification

Another critical driver for renewable energy development in the country is the need for an increased energy mix and diversification of resources. This was made evident by interviewees during the research. A number of respondents made a case for an increased energy mix to augment the current one. A sample of the extracts from IR10, IR18 and IR27 in table below explains the diversification of our system is required to bring the country out of energy poverty and increase energy access. Sustainable Energy for All sets a target for renewable energy to account for 30% of the total energy generation by 2030.

Respondents	Extracts
IR10	"…And because of that, I think they want to meet up to this argument of increasing the energy mix and renewable energy percentage to the NESI, that is the electricity supply industry..."
IR18	"...for us to have 24 hours of electricity in Nigeria, once we diversify the sources of energy..."
IR27	"...The whole idea is for us to diversify our energy portfolio by having a mix of different sources of traditionally, or conventionally, what we have now that powers, our grid is either we have thermal power stations or hydro stations..."

5.3.3 Sustainability and Environmental Considerations

Also, the need for the Federal government to ensure that the pursuit for better energy access and security is carried out sustainably means that renewable energy will be preferred to additional fossil-fuel-based energy resources. Some respondents made a case for this and expect that this will contribute to the drivers for renewable energy development in the country. Extracts from IR01, IR17 and IR19 is captured in the table below:

Respondents	Extracts
IR01	"...one of the major drivers is that is sustainable. For sure, you know, you are not buying fuel. You know, in Nigeria, there has been cases where people are angry whenever there is a fuel shortage or whenever the refineries are not working. Because even if I cannot drive, at least let me have, you know, electricity in my house to watch television. So that is ruled out, you know, because with solar power, you are not waiting for anyone to give me a fuel..."
IR17	"...And if we are really passionate, which I know we are about increasing electricity access, and making it more affordable, sustainable and reliable manner..."

IR19	"…also, the normal global warming we are talking about, so everybody wants a renewable, renewable energy is better. So, that is just it…"

The environmental drivers are also crucial for renewable energy development. According to respondents, climate change mitigation and the need for lower carbon implementation provides unique opportunities for renewable energy development. Numerous respondents commented that renewable energy development would benefit significantly from the push for lower carbon adoption for climate change mitigation. Extracts from IR04 is presented below:

"But, in a place like Nigeria, that believe has not been embraced in whole form, meaning politically, they see it as some mantra of discussion, but in practice they are not able to adopt or accommodate, you know, wanting to protect the environment. Now, in Nigeria, over the years, I have seen the growth of renewables, starting from 2003. Right, where, when the major I would say, initiative, around wanting to switch began, this was the time when governments started to discuss it..." IR04

5.3.4 International Influences

Examples include international agreements such as the Kyoto Protocol and the Paris Agreement, signed by world governments to tackle particular climate change issues. Some respondents pointed this out how Nigeria is obligated to tackle climate change issues due to the agreements signed with other government(s) and, thus, would have to utilise renewable energy sources for energy generation to achieve this. IR07, IR14 and IR27 statements are below:

Respondents	Extracts
IR07	"Now, another, those issues from the domestic environment, there are also issues from the international environment, issues relating to global shift to renewable energy as a result of climate change challenges, and Nigeria is reacting or rather following the path that has been chartered by the international community in that regard. So, it is in vogue for countries now, you know, to begin to look towards transition to clean energy options. So, you know, that is one of the drivers from the international…And then there is also the need to align with the global quest and trend for green energy by replacing inefficient fossil for technologies, you know, so that is also part of that Nigeria is a signatory to several conventions in the global arena. So, in the context of being the responsible member of the global community, they have also decided to see to what extent they can implement some of those things they signed in the international arena. They replicate them in the global domestic context..."
IR14	"...you still hear things about Nigeria signed into the Paris, I think, is it the Paris Accord or something around them evergreen. Exactly. So, and still having a tariff structure for renewable is also a driver..."
IR27	"...same way we have our experts who go to the International Committee and make certain agreements, for things like their NDC..."

Furthermore, other international influences, such as trends and pressures, drive renewable energy generation in Nigeria. As mentioned by the interviewees, adopting new and cleaner technology and the pressure from such a trend will drive the country to implement renewable energy on the grid. A number of respondents opine that the country has to shift as there are shifts from other parts of the world and adopt newer and cleaner technologies. Extracts from IR03 is below:

"...Yeah, we do not want to be left behind. As much as possible. I do not think anybody wants to be left behind. So, when there is a lofty idea, it is good to latch on, maybe something will come out, if you don't achieve 30% and you achieve two or 3%, or 5% is a move in the right direction, rather than stay aloof and say I do not want to join..." IR03

Finally, the last driver mentioned by the interviewees is the influence of international grants and funding. International organisations such as the United Nations and other developed countries have made grants and finances available to encourage smaller economies and less developed countries to develop renewable energy to achieve the goals of the Paris Agreement and other international pacts. Many respondents mentioned that there are a lot of fundings and grants available to countries who are adopting cleaner technologies such as renewable energy for electricity generation; hence, Nigeria will also want to partake of this to develop the economy, but can only accomplish it by developing renewable energy, especially on the grid. See extracts from IR02:

"So, lots of those things are going on. The numbers have been scaled up. There are lots of funding now that have been made available..." IR02

5.3.5 Growing Energy Demand and Population

One of the primary drivers of renewable energy development on the Nigerian grid system is the growing energy demand. Several respondents agreed that the energy demand by Nigerians for residential and industrial uses is enormous and that the current systems are not working optimally. Hence, an opportunity exists for a new energy system to complement the existing ones. According to respondents IR10 and IR20, the population and size of the country mean that energy demand will always continue to grow. The situation will only compound if a solution is not sought and implemented now. Ojo, Awogbemi and Ojo (2020) postulate that the energy demand needs to be fulfilled by enacting policies:

Respondents	Extracts
IR10	"...the demand is really large..."
IR20	"The need is also there, demand is there, because if you look at a country like Nigeria..."

Likewise, just as the increased energy demand is a good driver for renewable development in Nigeria, so is the increased population. The respondents agreed that the country's huge population could help drive renewable energy development and believe that Nigeria's population should catalyse renewable energy development, which will further lead to economic development:

"I would say first, population… what drives it, I said one, population, which is very key, we have had like an increase in population over a period of time. Then we have had, when I said increase, I mean growth, then we have had also because of the growth in population, more demand for energy. And, unfortunately, the DISCOs though, generates a certain amount of energy..." IR13

5.3.6 Economic Development

Additionally, the accrued benefit of increased energy access is another primary driver. The companies and industries in the country need constant energy, which hitherto is not readily available. Therefore, having an additional source of electricity will only improve the country's economic development. For instance, respondents IR09, IR11, and IR28 mentioned that the profits, productivity and general human capital development and improved living standard that increased energy access brings to a society cannot be over-emphasised and that the development of renewable energy can only bring positives to the country's economy:

Respondents	Extracts
IR09	"…And the very critical role the electricity plays in our economy is very sensitive..."
IR11	"…can also help to increase the economy from renewable energy on the grid..."
IR28	"...it wants to have as much as possible, a healthy mix of sources of energy to supply electricity to the Nigerian economy and to the Nigerian people..."

5.3.7 Availability of RE Resources

Furthermore, research respondents justify that abundant renewable energy resources, such as water, wind, and sun contribute hugely to the drive for renewable energy development. For example, several respondents spoke about the abundance of water, the strength of the wind from the Sahara Desert and Atlantic Ocean and the all-year presence of sunlight with its high intensity, showing some of the examples of resources the country can harness for electricity generation, especially on the grid:

Respondents	Extracts
IR03	"...We are blessed with natural resource... But I think, realistically, for a country like Nigeria that is blessed with natural resource, exploits your natural resource, use the renewable energy for areas where you should not be extending grid to..."
IR22	"...And considering the vast renewable energy potential that we have in Nigeria, especially when it comes to solar and biomass. It is a no-brainer to focus on renewable energy moving forward..."

5.4 Determining Factors for Successful Planning Process of Grid-Based Renewable Electricity Generation - Enablers for Grid-Renewable Energy Development

This section showcases the enablers for grid-based renewable energy development as identified by respondents.

5.4.1 Support Mechanism

Participants stated that operationalising support mechanisms such as feed-in tariffs, reducing risk with renewable energy investments and introducing new incentives will encourage investment in the sector and accelerate transitions. The following extracts support this:

Respondents	Extracts
IR01	"I think this can be achieved is to decouple renewable Tariffs from normal tariffs, they keep making that mistake, how do you compare tariffs from a solar power plant is helping the environment not taking fuel..."
IR02	"...there are lots of issues from Tariff to feeding tariff..."

5.4.2 Financial Enablers

The respondents, during the interview, also identified enablers for grid renewable energy development in Nigeria. This includes financial enablers like financing as platforms to encourage renewable energy implementation. Respondents IR18 and IR25 show that the considerable financing is available to countries that develop using renewable energy technologies serves as an enabler for the implementation of the technology in Nigeria:

Respondents	Extracts
IR18	"...So, I will say funding and advocacy are one of the major drivers for the uptake of renewable energy in Nigeria at the moment..."
IR25	"The main driver is the penetration. The acceptance by the people and invest in finance. They are not also finance. Basically, finance and penetration, acceptance..."

Another critical financial enabler is the presence of private investment arrangements to encourage the participation of more private companies and institutions in developing renewable energy in Nigeria. Respondents commented that private investment would serve as a good enabler for the implementation of the technology in the country and encourages that agreements should be reached between the government and private companies to speed up the actualisation of renewable energy development on the grid. Extracts from IR27 is below:

"But in terms of the drivers, you are looking at investment within the sector. So far, the Federal government has been the main driver, the Federal government is more like the primary source when it comes to funding for renewable energy projects in Nigeria... But the private projects are not really much, because even people who have participated in that sector, that is, the private sector guys still rely on funds from the Federal government to be able to execute some of this project. So financing is one driver I will consider to be something that is trying to help us forward the movement in that sector. So that is just one of the drivers..." IR27

5.4.3 Technology Enablers

Another enabler, as identified by interviewees, is the technology enabler, including technological advancement. Respondents believed that using the latest technologies would lead to transparency and make the development of renewable energy for electricity generation easier. For example, respondents IR01 and IR10 mentioned that technological advancement would help track every molecule of energy generated; hence, companies will be able to recoup their capital and make profits:

Respondents	Extracts
IR01	"This problem does not exist, with renewable energy, when you have distributed electricity systems, it is easy to measure what was generated, what was used. So that another plus to your number one collection is not questionable. It is straightforward to understand what was generated was distributed..."
IR10	"Secondly, technological advancement, what I mean is that the solution, tariff capital costs, buy in by the government intermittency of the output of generation onto the grid, this might cause problem of power flow, powerful unit direction, also change of protection settings for our high-cost equipment on the grid."

Another form of technological enabler is the competitive cost of renewable energy which has occurred in recent years due to more adoption and utilisation of the technology. This has led to lower manufacturing and production costs of components required for the technology and subsequently reduced prices to customers. Respondents IR17 and IR22 opined that this scenario is a good development, and if the technological trend continues, it will drive the cost down significantly and make for a competitive cost for renewable energy development:

Respondents	Extracts
IR17	"The, that and another reason why we are looking at renewable is the cost of renewable energy come down sharply in recent years and is very competitive with the conventional electricity, conventional oil-based, diesel-based or heavier based generating equipment. So, we have no option but to move in this direction. And also, apart from that, Nigeria is a very large country..."
IR22	"Now, when it comes to pricing of grid renewable energy, there are a lot of factors that perhaps push those prices up. One of those will be the cost of materials such as solar panels and wind turbines and the likes. But, thankfully, with the technological advancements, those prices are coming down. And, with people being more interested in renewable energy as they were, it means that the people producing these panels and turbines and the likes are doing so in larger quantities, and that will, in the long run, will push the prices down..."

In the same vein, respondents also mentioned that reduced cost of production would translate to cheaper maintenance costs so that governments concerned about the technology's operating cost are fully pacified. For instance, many respondents concluded that this would lead to easier deployment of renewable energy technologies since installation and maintenance costs are cheap. Also, local crews can be easily trained to carry out maintenance going forward. IR25 stated:

"…because the maintenance cost is almost zero, or the running costs, but the initial investment cost is very high, which is not too affordable..." IR25

5.4.4 Political Enablers

Likewise, the next set of enablers identified by the interviewees are political enablers. This includes government policies formulated to encourage the development of renewable energy. Various respondents mentioned that the government already created the policies, but they still need to be fully implemented. Nevertheless, they commented that the presence of these policies serves as a good backdrop for the technology to be developed now since so many other factors are aligning. See below some quotes from transcript:

Respondents	**Extracts**
IR08	"So, that is basically what started driving it before the government got more involved in like introducing policies and even, was it even the organisations like Energy Commission existed a while ago..."
IR28	"…government already has all of this policies in place..."

Another political enabler mentioned by the interviewees is government partnerships. Improving relationships between governments and other institutions is another good framework to encourage renewable energy development in Nigeria. According to some respondents, these partnerships can only bode well for the actualisation of renewable energy on the Nigerian grid. An extract is below:

"...I see a lot of partnerships also going on between the governments through the REA and other multilateral agencies for and unfunded institutions like the, the African Development Bank, for example. So, make more funds available to be able to scale up energy access. So, there are lots of things going on..." IR02

5.4.5 Support Network

As identified by interviewees, the next renewable energy enabler is the role of support networks to push the technology to the limelight. Respondents mentioned that more awareness is required to make decision-making simpler for politicians and other stakeholders with no limited knowledge of the technology. Support network groups can quickly do this. For example, respondent IR13 mentioned that support network groups are already undertaking this role to create awareness in the different segments and sectors of government, and this would lead to increased adoption of the technology, especially for grid development:

"…the customs officer don't really understand some of these things. Right now, we are trying to train them, we are trying to create sensitization awareness within them to know the difference between a solar panel and a solar cells coming in. Because what they are saying is that once it comes in, all the aluminium and whatever the frames will actually be sourced locally. So, you're, what you're trying to do is create employment for people here. So, that's the only way they can, they can give zero duty in terms of the solar system, then..." IR13

Also, other respondents added that there are associations and advocacy groups whose general purpose is to increase the level of awareness in society and drive the adoption of the technology:

"So, I feel like, you know, organisations like the Renewable Energy Association of Nigeria..." IR12

Another critical enabler is the improved technology standards and regulations to encourage trust in the technology. Respondent IR13 mentioned that the standardisation of the system has led to increased utilisation of the technology and will make it easier to implement this on the grid:

"*Yes, there is also that one too in fact, up till now in Nigeria, some people do not believe that renewable energy will work for household appliances and everything, they will tell you that it does not work. So that is why we supported the standardisation of the system itself..." IR13*

Additionally, respondents identified a one-stop investment shop as another key enabler. According to respondent IR13, this platform allows participants, both locally and internationally, investors and manufacturers to meet to discuss opportunities for growth and development of renewable energy technology and the presence of such a platform is a great contributor to encouraging renewable energy development:

"I do not know if you have heard about that, where at least investors, local and international investors can also see where investment opportunities and the kind of investment to find information on the investment opportunities in the sector to be able to invest." IR13

5.4.6 Societal Acceptance

Another enabler is the societal acceptance and the level of technology penetration currently being experienced in the country. Respondent IR25 identified the acceptance by society has led to increased investment in the technology.

5.4.7 Emerging Information

Lastly, participants identified emerging information as a key factor enabling renewable energy development on the Nigerian grid. This information includes data, plans, studies and tools for renewable energy development. According to most respondents, the collection of this emerging information is making the process of implementing renewable energy easier. Some quotes are presented below:

Respondents	**Extracts**
IR15	"...what I am saying is that most of this energy modelling tools that they have, they rely on the usage of data collected. There are officer that goes out to collect primary, secondary and tertiary data, this is what they input, it actually brings out result for them which they will use in energy policy..."
IR17	"...I will say the drivers from our own study, I will share a link with you that is, nigeriasaforall.gov.ng. It is a central data management system, which we work on presently. And that shows you the grid lines, the low voltage grid lines that is the 11 kVA and 33 kVA lines..."

5.5 Chapter Summary

This chapter presented the qualitative data on the barriers, drivers and enablers of the grid renewable energy strategies implementations obtained through semi-structured interviews. In summary, the following were mentioned as factors inhibiting renewable energy development in Nigeria and are represented pictorially by Figure 26 below. These include policy and regulatory, financial, socio-cultural, legal, economic, administrative, political, technological/technical, market-related and institutional barriers.

This chapter presented the result and findings of the barriers of the grid renewable energy strategies implementations. The chapter shows that the challenges to grid renewable energy deployment are complex and multifarious taking into consideration the unique situation of the Nigerian grid system and the country being one of the major exporters of crude oil, with a large population and energy access and poverty challenges.

Discussions in the chapter focussed on the various dimensions of barriers to renewable energy incorporation on the grid; policy and regulatory, socio-cultural, economic, political, legal, administrative, financial, institutional, market-related, technology and infrastructural barriers. These barriers generated from the interviewees' responses are a part of the key elements of the roadmap for the successful implementation of grid-based renewable electricity generation strategies in Nigeria that need to be addressed.

Notwithstanding the challenges and barriers to grid renewable energy development on the Nigerian grid, there are drivers for renewable energy development identified from the analysis of the data obtained from the interview participants including enablers for the successful deployments of the renewable energy technologies. This chapter showcased these drivers that spurred the energy transition vision for the Nigerian grid system and factors stimulating the transition to renewable energy on the Nigerian grid.

The findings suggest that addressing the energy access and security issues are important drivers to the deployment of renewable energy technologies among other drivers such as: availability of renewable energy resources in Nigeria, the need to meet the energy needs of the country's teeming population and to boost economic activities, excellent external influences such as the international community, agreements, trends and pressure, and the need to address climate change on global warming by advancing low carbon initiatives. The different drivers for renewable energy development in Nigeria identified by respondents are captured in the diagram below. Figure 27 represents these drivers and some of the inherent elements.

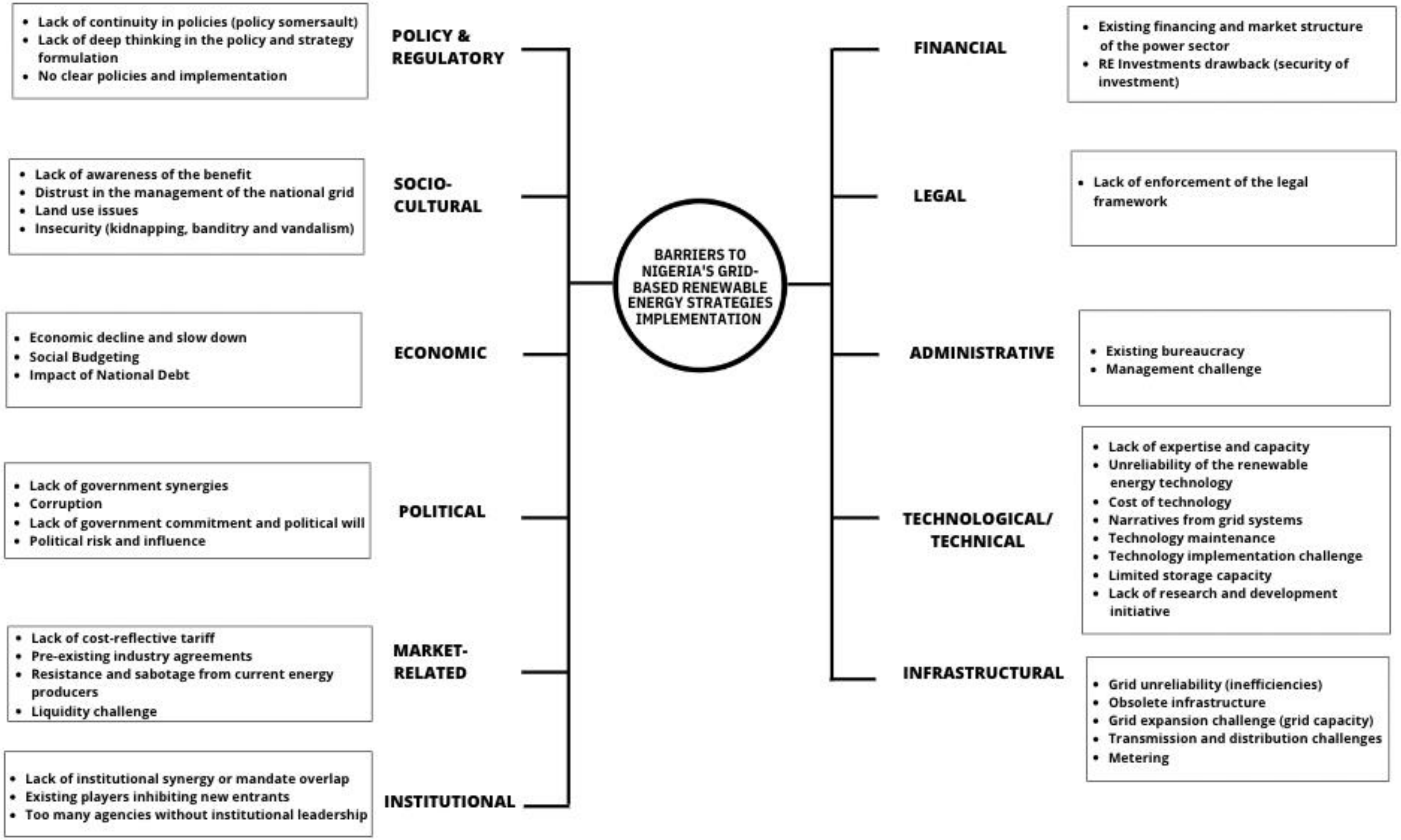


Figure 26: Factors inhibiting renewable energy development in Nigeria. (Source: Adedokun, Strachan and Singh 2023)

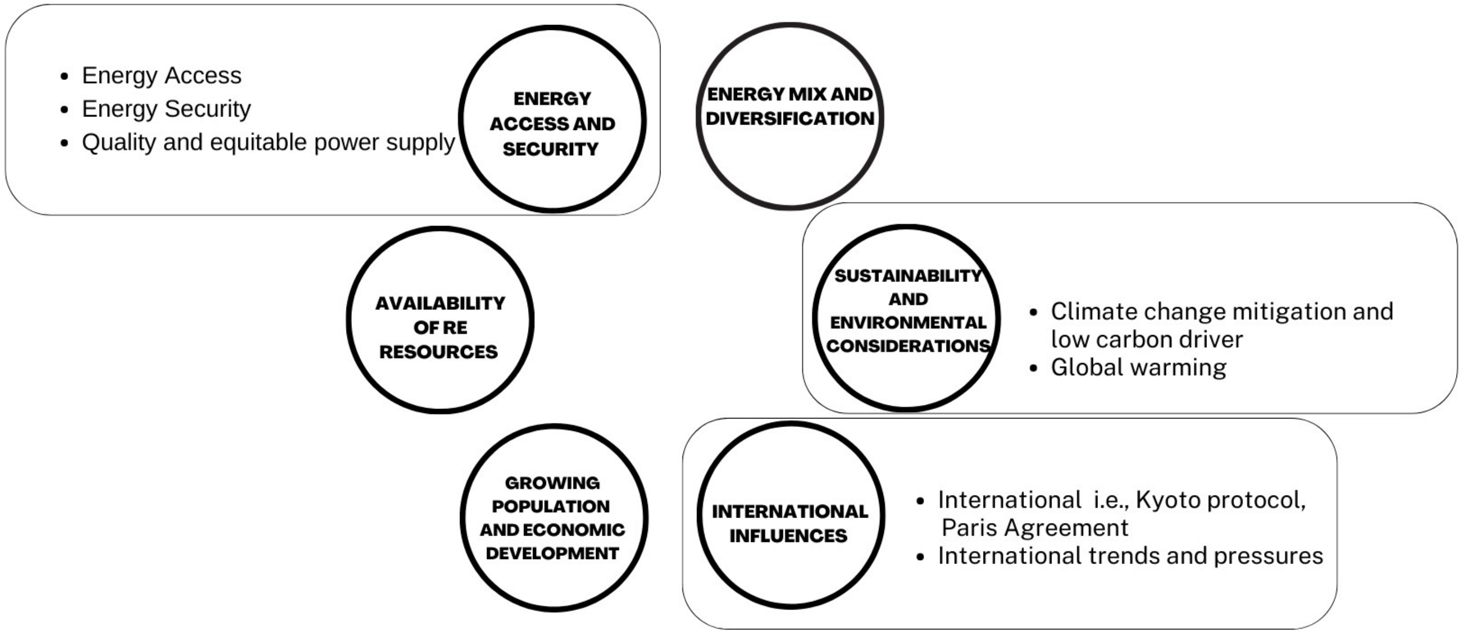


Figure 27: Drivers for renewable energy development in Nigeria (Source: Adedokun, Strachan and Singh 2023)

Furthermore, the findings presented in the chapter also suggests that there are enablers influencing the successful implementation of renewable energy technologies.

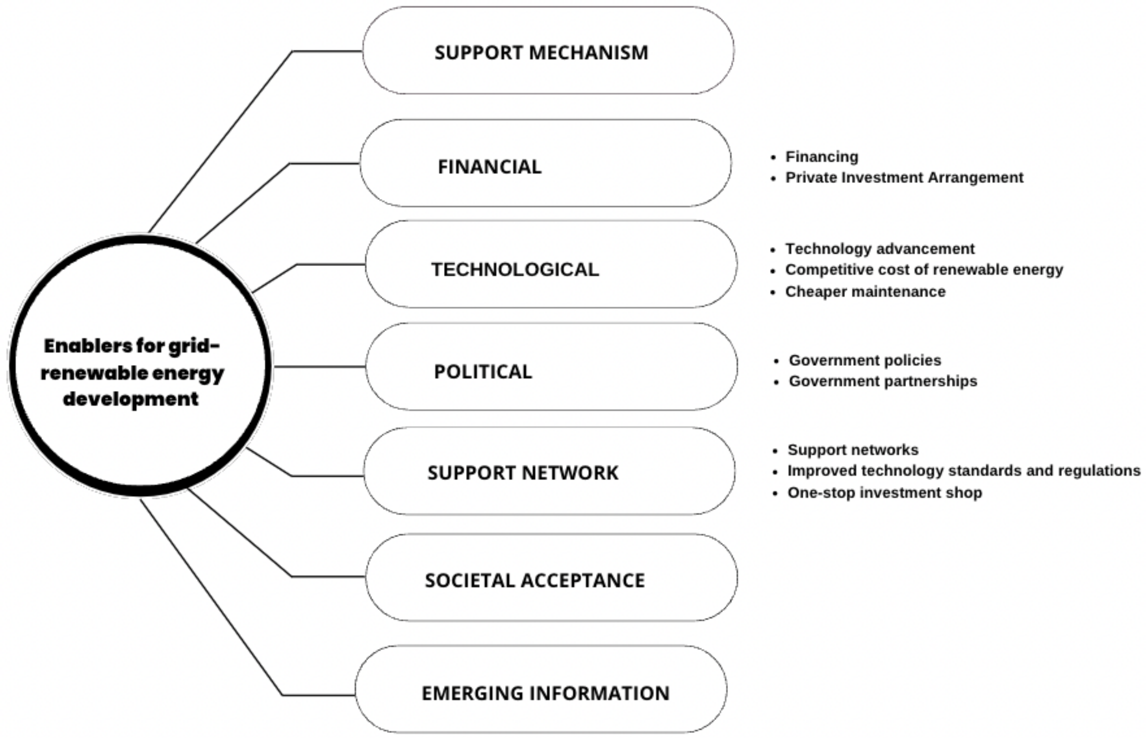


Figure 28: Enablers for grid-based renewable energy development in Nigeria (Source: Adedokun, Strachan and Singh 2023)

Figure 28 is a diagrammatic representation of all the enablers mentioned by respondents during the interview for grid-based renewable energy development in Nigeria. These include support mechanisms, financial, technological, political, support networks, societal acceptance and emerging information, which are all factors enabling the development of renewable energy on the Nigerian grid system. The chapter presented interview findings from the semi-structured interviews used to elicit opinions, views on perception of respondents on the barriers, drivers and enablers for the development of renewable energy on the Nigerian grid.

CHAPTER SIX: PRESENTATION OF RESULTS AND FINDINGS ON THE TRANSITION PLANNING PROCESS AND THE ACCOUNTABILITY AND TRANSPARENCY OF THE PROCESS FOR RENEWABLE ENERGY DEVELOPMENT

6.1 Introduction

Chapter five presented an overview of the barriers, drivers and enablers to implementing the grid renewable energy strategy to incorporate renewable energy technologies on the Nigerian grid.

However, this chapter presents the analysis of findings of the qualitative interviews obtained from industry and non-industry experts and senior executives. The identified themes which incorporate the opinions and views on the experience and observation of respondents of the planning process, procedure and governance, and perception and opinion of respondents on the transition planning process, governance and challenges of transition accountability and transparency. This chapter answer the research questions two, three and four of this study.

Q2, what are the determining factors for successful planning process of grid-based renewable electricity generation in Nigeria?

Q3, what are the renewable energy planning process and governance for sustainable development in Nigeria? and how accountable and transparent are the processes?

Q4, what are the key elements of the roadmap for the implementation of grid-based renewable electricity generation strategies in Nigeria?

The chapter is divided into four sections. Section 6.2 provides the findings on Transition planning process and governance for Nigeria's grid-based renewable energy strategies implementation. Against this backdrop, Section 6.3 discusses the accountability and transparency of the transition planning process and governance. Section 6.4 presents a summary of the chapter.

6.2 The Transition Planning Process and Governance

This phase involves two steps, which include setting the transition arena and defining the transition problem and identifying the existing challenges.

6.2.1 Transition Planning and Arena Formulation

This section presents findings on three aspects of the transition planning and arena formulations phase. These are:

1. Formulation of transition arena and groups for on-grid renewable energy deployment
2. Formation of on-grid renewable energy target and vision, and
3. The objectives of on-grid renewable energy development.

Firstly, the formulation of transition arena and groups for on-grid renewable energy deployment. From the findings, it was deduced that the arena for on-grid renewable energy deployment in Nigeria was in two forms, i.e., the international and national arena. Secondly, the formation of on-grid renewable energy target and vision; a vision was set to achieve 30% of 30GW of grid electricity generation by 2030. Thirdly, the objectives of on-grid renewable energy development; there are a number of objectives for the on-grid renewable energy goal, which includes but are not limited to: achieve a healthy energy mix, increase energy access, improve energy security and address the issue of transmission voltage losses.

6.2.1.1 Formulation of transition arena and group for on-grid renewable energy deployment

From the respondents' view, it appears that there were two arenas (international and national arena) that resulted in the formation of the policies, vision and target that drives renewable energy development on the Nigerian grid.

International arena

Some stated that decisions made at international committees, such as the Paris Agreement, impacted the transition agenda for renewable energy development. This is evidenced in the comment below:

"…Sometimes, some of these targets to the same way we have our experts who go to the International Committee and make certain agreements, for things like their NDC contributions and all of that, and then they set all kinds of ambitious targets without really sitting down to see if these targets are achievable or realisable. So, if those things are not working, we can go back, like I say, go back to the drawing board and see what we need to adjust. That will be more realistic…" IR27

National arena

The majority of respondents described the transition planning process and governance as involving the establishment of a transition group/team. The group selected participants from various ministries, departments and experts from pro-renewable companies to participate in the “Inter-Ministerial Committee” and “National Council on Power”. This committee, according to respondents, was initiated and led by the Ministry of Power for coordination purposes. From the participants’ perspective, the transition problem was collectively defined, and the desired transition was defined regarding off-grid and grid-based renewable energy. The quote support this:

“…they have Inter-Ministerial Committee, so you know, the coordinating ministries, departments…” IR07

However, some respondents stated that some ministries, agencies, or key stakeholders were left out of the discussions when sending out invitations for stakeholder meetings. This is evidenced by the comment below:

“…what we do is to set up an Inter-Ministerial Committee that will eventually give birth to a committee that will now work on how policy is effected, after which that person will be presented at the stakeholder workshop. We hold several stakeholder workshops after the policy have been drafted and it is, then we have evaluation of fund where the policy is validated, but then all along as you gather to make the policy through that inter-ministerial committee then there tendency, that while inviting members of the committee sometime we may” IR17

6.2.1.2 Formation of on-grid renewable energy target and vision

The Inter-Ministerial Committee and National Council on Power established renewable energy targets in the Vision 30:30:30 document. According to respondents, a vision was set to achieve 30% RE of 30GW of grid electricity generation by 2030: Extracts from IR10 and IR22 explains this:

Respondents	**Extracts**
IR10	"…we just launched our 20-year master plan, which includes the integration of renewables, mostly solar. And some wind aspects as well. Right now, I am in a committee…"
IR22	"That includes coming up with policies and strategies that will make this goal. One such goal you have probably heard of is Vision 30:30:30, which is perhaps the backbone of everything that we are trying to do, which is to ensure that we achieve a target of at least 30 gigawatts of on-grid electricity by 2030…"

And, also, for off-grid systems through rural electrification, as articulated by IR20:

"…there is a huge market for it, there is a huge demand for it. The population that is, no, sadly still huge, especially in rural areas. This can help us, you know, to reach our 2030 target quite early enough if you want to say so..." IR20

Some respondents remarked on the grid renewable energy targets as being too ambitious. Some indicated that the targets are realisable with a strong commitment, discipline, investment and a stable and expanded grid system. In contrast, others described it as unattainable by 2030, especially since there has yet to be any notable progress since these visions and targets were formulated:

"Those targets are there in the NREEEP. But I do not know to what extent we'll be able to achieve those targets. Because if you look at that document says by, I think 2030, that is when we expect to be able to achieve that target... Well, for me, the target is very ambitious… But that is not to say those targets are not realisable if we already are committed to meet those targets. So, for us to meet those targets, it means we must be ready to make the kind of investments that will ensure that we can achieve those targets set in those documents..." IR27

Respondents indicated that this target was set through the guiding vision of the international arena, influenced by the Paris Agreement obligation - Nationally Determined Contribution (NDC) of Nigeria, which need to be seen through and impacts the implementation and progress of the initiative. This was well articulated by IR03 below:

"But for the grid applications, I think we are still a bit way off to be able to generate sufficient capacity in a single location. I am talking about megawatts, not in kilowatts. What we have done quite a lot, even Nigeria and this our company have been providing rural power... The only challenge we have is that we do not follow through on policies, we make the policies, we have all the rules, we have all the regulations that we do not follow through on it. We get to that 2030, and we look back, we only came 1%, we will set another one again. But if we can begin to put some discipline in our practice, I think we can be measuring up to some fellow African countries that are doing much better, especially in this area of meeting targets with plans..." IR03

6.2.1.3 The objectives of on-grid renewable energy development

Participants specified various reasons and objectives for the renewable energy vision. Most participants stated that the Nigerian government's purpose for the on-grid renewable energy agenda is to achieve a healthy energy mix through diversification of the existing energy system reliant on gas, which is inefficient and is faced with constraints. This is effectively presented in extracts from some respondents below:

Respondents	Extracts
IR05	“...diversify in renewable energy. Cause renewable energy is the in-thing now many countries... I am suggesting 100% ownership by the Federal government and diversifying in other means of electricity. We should not, not just focus on only hydro; we should have other means...”
IR27	“...The whole idea is for us to diversify our energy portfolio by having a mix of different sources of traditionally, or conventionally, what we have now that powers our grid is either we have thermal power stations, or hydro stations. So, I think the whole idea was to see how we can bring in a percentage of renewable energy systems into the grid...”

Furthermore, there is a drive to increase energy access and improve energy security, especially for areas with weak grid voltage supply; extracts from respondents IR14 and IR28 suggest that the energy access objective is to improve energy security:

Respondents	Extracts
IR14	“...I said, there is still that gap between people that have access to the grid power. And as long as that is the case, it means that there's always the potential for solar deployments to cover the gap in power supply...”
IR28	“...you want to be able to provide energy to your people...”

On the other hand, IR10 and IR11 emphasised that one of the purposes of renewable energy on the national grid is to address the issue of transmission voltage losses since power is generated mainly from one part of the country and transmitted to other parts. Hence, renewable energy aids in achieving equitable generation and availability of power in Nigeria:

Respondents	Extracts
IR10	"...from the technical side, I think why it was straightforward is because in our grid system, we have more of generation, especially the gas, and fossil fuel that is the coal, mostly in the south, and we have little or no generation in the northern side of the grid or the country. The only generation which we have is still renewables is the hydro, which is Kanji, Shiroro and Jeba, and I think one is coming up very soon in Zungeru, which is about 750 megawatts... and because of the long distance, which are to electricity to the northern side to kind of support the, the generation deficits in the northern side..."
IR11	"...when it comes to grid supply, our purpose is to increase the amount of renewable energy on the grid because it has the potential to ensure our equitable availability of power in our country, the way the country is stated. The gas supply and I wish I use most of our grid supply by about 80% of it is from gas, while 20% is from hydro. Now, the gas have around the southern fringes of the country, meaning that if you are going to have gas power plants, you are going to be near the gas supply sources…"

Several respondents opined that the bandwagon effect influences the on-grid renewable energy deployment initiative to latch on the global trend to decarbonise unsustainable grid systems by utilising renewable energy sources. This is to show support and take deliberate steps to deal with environmental concerns and climate crisis to achieve the vision of sustainable development by 2030, as obligated in the Paris Agreement, of which Nigeria is a signatory. Respondent IR28 postulates:

"...we have a global phenomenon, the climate crisis, and the fact that all around the world countries are transiting from fossil fuels to renewable energy..." IR28

Some similar comments regarding this objective are captured below:

Respondents	Extracts
IR03	"...we do not want to be left behind. As much as possible. I do not think anybody wants to be left behind. So, when there is a lofty idea, it is good to latch on, maybe something will come out. If you do not achieve 30% and you achieve two or 3%, or 5%, is a move in the right direction, rather than stay aloof and say I do not want to join..."
IR21	"...but if you look at what is globally, there are these drive for the use of renewables. Let us take, for instance, countries that are calling or using, trying to make renewable energy 100% the electricity coming from renewable sources 100%. Nigerian should not be left out of that global drive. And that there is this vision of achieving sustainable development by 2030, which Nigeria is a signatory to the Kyoto Protocol. So, we need to play our own role in order to keep the environment safe."

The long-term objective for renewable energy development, including off-grid systems in Nigeria, is to have a connected grid. An important informant indicated that:

"…one of the things that I know at the long run is that it will have to come on-grid, the REA energy sources will have to come on-grid, although the system that we are proposing is actually not the one with storage for now, because of the kind of investments that is required…" IR13

Other informants also indicated that the government is interested in large-scale renewable energy deployments to meet the growing demand of the Nigerian populace; IR05 and IR13 illustrate this opinion:

Respondents	Extracts
IR05	"...So, when the power want to let you understand we have small, small-scale companies who are doing the solar thing, but on the large-scale for the government..."
IR13	"...So, the objective was actually to improve upon the energy supply that we already have, though we have a shortfall of it. Nigeria is actually blessed with a lot of renewable energy sources, which you know, and tapping into these resources is something that either now or in the future, we will have to like dive in for the policies and the Vision 30:30:30. We have the short-term, medium-term and long-term strategies in terms of implementing it..."

A few respondents stated that the objective is to improve the economic situation and drive job creation. For example, here is an extract from IR11:

"…because, as a country we also want to ensure that we engage people in those areas where you have renewable energy power as a way of job creation for those areas."

6.2.2 Transition Design

According to the transition management framework, this phase involves the participation of stakeholders at various levels, i.e., sector and sub-sector. This comprises representatives, actors and networks which work to establish the transition agenda (pathway and images), often in the form of directives, strategies, guidelines and plans.

6.2.2.1 Transition coalition building and Stakeholder participation

A coalition was built in the on-grid renewable energy transition process to attain the unified goal of incorporating novel technologies on the Nigerian grid. Decision-makers, non-decision-makers and value-chain players constituted the coalition formed. These frontrunners were selected to develop large-scale power integrated into the grid for electricity development in Nigeria. Developing coalition and multi-stakeholder participation was identified as part of the transition process.

6.2.2.1A Decision makers: Governing and regulatory institutions

Respondents recognise various governmental institutions and agencies as critical stakeholders and players for grid renewable deployments. Respondents indicated that the Energy Commission of Nigeria, Nigerian Bulk Electricity Trading Company, Nigerian Electricity Regulatory Commission, Nigeria Electricity Management and Safety Agency, Ministry of Power, Ministry of Environment, Ministry of Finance and Standard Organisation of Nigeria have their functions, roles and mandate for renewable energy initiatives. Here are some extracts from the respondents:

Respondents	**Extracts**
IR10	"…the Ministry of Power deals with more of the policies for say, maybe the renewable on grid that ECN as well has that same rule. Energy Commission of Nigeria deals with that, same looking at where the potential sources of energy around the country and projection of the energy mixing in future expansion and all that. Then for the NBET, is the Nigerian Bulk Electricity Trader, they are the ones that actually buy the power from this generating company and, so, all these stakeholders have different roles that they play for the government concerning the policy of the renewable… the Minister of Finance deals with more of financing the tariff and all those financing methodology…"
IR25	"…then the Energy Commission of Nigeria, which is saddled with the responsibility of coordination of national energy in all its ramifications and not coordination, they also popularise new emergence energy. So, the new emergence energy, Energy Commission of Nigeria is one of the first agency of governments that popularised solar in the early 2000s…"

Several respondents recognised NERC as the key driver of the RE initiative as they are in charge of regulations, setting the rules and guidelines for the sector on the deployment of renewable energy:

Respondents	Extracts
IR14	"…it is only NERC, that is the regulator, probably they will work with the bulk buyer NBET. And that is for probably major deployments… those are at that level. And in terms of governance, really, those are really the people that would actually key, in terms of policymaking…"
IR15	"The major actor is Nigeria Electricity Regulatory Commission. That is the major actor, because if you are coming into Nigeria for renewable energy business, it is them that will give you the license, it is them that will regulate your activities. So, Nigeria Electricity Regulatory Commission is the major actor."

However, according to IR01, the Ministry of Power ought to be the main driver as they report directly to the presidency; they are in charge of policies and decision-making in the electricity sector:

"…the Ministry of Power… should actually be number one, because the minister, you know, is the one who accepts, you know, and drives initiatives. He reports to the presidency and is supposed to be the experts in power related issues. So, when something is referred to from the Minister to the President, then is put on the table and then that NERC can adopt it. So, Ministry of Power is overlooked a lot of times and Ministry of Power is quite critical…" IR01

IR20 mentioned the Niger Investment Promotion Commission participation in the transition programme through adoption and adaptation of the transition plan to investment practices to investors and potential investors:

"…now you then have the Nigeria Investment Promotion commission. So, to drive, you know, to drive investors coming in, they should be, you know, and then if we are to do what we need to do, right and get it right…" IR20

A notable agency mentioned by respondents who are not direct decision-makers in the planning process for on-grid RE are the Rural Electrification Agency (REA).

Here are extracts that demonstrate respondents' comments on REA's functions and roles for renewable energy deployments:

Respondents	Extracts
IR01	"Then REA is a stakeholder because the few solar power deployments that happened in Nigeria, happened through REA."
IR15	"…they are the major stakeholder, but they can sometimes liaise with agency like Energy Commission of Nigeria. I can remember that each time they want to draft feed-in tariff they usually have consultation with some agencies like Energy Commission of Nigeria, Rural Electrification Agency and Standard Organization of Nigeria. Those are the sister agency that they usually work with, coming up with some of their policies…"

While IR10 and IR25 stated that all organisations and institutions have their roles:

Respondents	Extracts
IR10	"…These four Ministries or these four stakeholders I've mentioned all have their different rules and all of them are actually under the government…"
IR25	"…there is no conflicting issue. Everybody has a clear mandate and vision. Energy Commission of Nigeria is saddled with responsibility for any new emergence energy to be popularised. People should accept it and embrace it, like now, they are going into solar thermal, solar water heater…"

6.2.2.1B Non-decision-making players

From the respondents' perspective, other stakeholders that are not decision-making players but influence the direction of RE development according to the respondents are identified as:

i. International and Development Partnership/ Donors/ Investors

These constitute multilateral agencies, interest groups, USAID, GiZ, UNDP, French Development Agency, the Japanese International Cooperation Agency and the World Bank. According to respondents IR07 and IR25, this category are stakeholders that may not take part in the decision-making process of grid renewable energy; however, they play a significant role and influence the direction of the initiative:

Respondents	Extracts
IR07	"…some other players that are not decision-making stakeholders, but they play some vital role, particularly in influencing what gets done..."
IR25	"There are funds from World Bank, FDI, many other bureau."

ii. Support networks/environmental actors

A few participants indicated that local organisations are support networks to reach the envisioned future. IR12 postulates that REA should be included in conversations concerning grid RE to exploit future opportunities and integrate current decentralised RE projects into the grid. Here are extracts that demonstrate respondents' comments on local organisations for renewable energy deployments:

"Then there are local organisations, and I do not think they are involved in the decision-making process. So, I feel like, you know, organisations like the Renewable Energy Association of Nigeria, I am not sure they are involved in talks around feed-in tariffs, or which they should be because they are stakeholders out there. I mean, even though they have been mostly involved in decentralised energy systems, but they should be involved because this, you know, the small-scale systems can potentially be integrated, or curbside into the national grid." IR12

iii. Training institution, civil society, research institutes and academia

A few respondents stated that training institutions, civil societies, research institutes and academia are stakeholders or transition actors for renewable development:

Respondents	Extracts
IR11	"…Then when it comes to training, capacity building is the NAP team that is the Power Training Institute that is put in place to train and develop capacity of Nigeria's on power supply, including renewable energy supply…"
IR20	"…these key stakeholders from public sector, private sector, and then the civil society or international NGOs, which are put there. The academia is also very, very important, as well."

However, IR14 and IR28 stated that local and state governments have not been part of the transition process and need to be included:

Respondents	Extracts
IR14	"Once we can align all of these stakeholders, for me, for us as civil society, we think it will be the local government. And they have not been part of this process at all. And this is what we were hoping to get them involved because these are their people. They are the nearest government to communities, especially most of our communities that are off grid."
IR28	"So, what I think is required is getting state governments and local governments into this very seriously because, right now, they will appear as if it is just the Federal government and the Rural Electrification Agency with the green bond that is actually doing something around it. I know Lagos State government just instituted a green bond also to deal with some of these issues, environmental issues, and then for renewable energy and stuff. But that is just one state. We need most, all of our states, the 36 states of the country to be involved in this so that you know how this, this works. There has been this argument that electricity is centralised. And we have argued that this is not, you can actually generate electricity and distributed between your state. And this is your best way of, instead of supply to the national grid, why not do a small mini grid within your state and loop it to the national grid. It is very simple."

Nevertheless, the electricity act of 2023 approved by President Tinubu supersedes the Electricity and Power Sector Reform Act of 2005 which provides for state autonomy to engage in electricity generation, transmission and distribution activities. This new development gives rise to Cowell and De Laurentis (2022) assertions that values and priorities could differ where infrastructures are entwined in scales of governance reconfiguration creating tensions which can be seen in the case of Brexit and the Ukraine invasion. Also, IR12 and IR27 stated that households are important stakeholders that should have been considered in the planning process for transitions. However, they were left out of the conversation. Here is an extract:

Respondents	**Extracts**
IR12	"I think householders should be involved, which is weird. Households... I mean, we already have people like wind generators in their homes, they might actually be interested in switching and producing power for the national grid, feeding that into the central grid. But these are the people that are excluded from the conversations, and they are the people that you need to include in the conversation. Because, quite frankly, you cannot, I do not think Nigeria can make this 9000 megawatts ambition without including householders. I do not know, not with our level of governance."
IR27	"And then other stakeholders, you want to look at those who are actually depending on or utilising the power that the Nigerians who actually need this power. So, you have Nigerians who have a major stake in that sector. So, Nigerians are also one of the primary stakeholders..."

Furthermore, IR07 suggested that involvement of a large stakeholder could have created difficulty in harnessing the strength of the diverse input:

"…these are all part of the actors, so you find, some kind of bloated, I don't know whether it's also part of the problem, you have a bloated bureaucratic structure, and then there is difficulty in harnessing these various strengths, and then in pushing forward…" IR07

Similarly, IR13 posits that:

"…the issue of synergy is a challenge. All the key players I mentioned are playing their game not as stakeholders, they are playing their games individually. So, that is the challenge. So, if all of them are playing their games individually, then definitely everyone will be left behind, some that are supposed to be carried along…" IR13

Moreover, several respondents commented that this committee has been abandoned along the line and might not be functioning:

"It may not be visible because we are already at the year 2021? Yeah. We just have nine years on to do, so it is not feasible because currently we are not up to 10,000 megawatts, so what kind of magic can we do within this periods to achieve that amount of energy? Actually, the ambition is, may not be practical by that, 2030." IR25

6.2.2.1C Value-chain players

From the respondents' comments, various stakeholders were included in the planning phase for renewable energy. Generating, transmission and distribution companies were also identified as stakeholders for renewable energy deployment on the Nigerian grid. This is evidenced below:

Respondents	**Extracts**
IR02	"…we have the big generation companies… We have the transmission company of Nigeria. And of course, we have distribution companies…"
IR12	"So, apart from the DISCOs, GENCOs, TCN…"

Furthermore, IR01 and IR03 identified that key stakeholders consulted were the International Oil Companies (IOCs) involved in power generation. This is evidenced in the comments below:

Respondents	Extracts
IR01	"…have actually invited us and my company setup renewable energy, think-tank. I am a member of that think-tank, and we did a lot of extensive work…We are a stakeholder for sure. But the IOC, that is who we are, the international companies are producing in Nigeria, especially the ones that have gone into power generation… we have attended a lot of good or not so good workshops organised by government. So, I have attended one or two on renewable energy…"
IR03	"Similarly, but I was fully aware when the Ministry of Power and others were doing projections. They called in some experts and others. I do not know if there was any consultation that was taking place. But, of course, promoters of renewable energy were part of that process to project of, you will not discuss those kinds of things with conventional power generators and other things, except those ones that want to diversify…"

6.2.3 Operationalising Transition (Steering Process an Experiment)

6.2.3.1 Transition projects and actors

These schemes are introduced and adapted to operationalise the transition plans and align with the agenda. The adaptation is through learning from the practice, which could be along a transition pathway. The transition pathway, in this study, refers to transitions through a grid-connected renewable energy technology option. This section presents, from the participants' perspective, the status of on-grid projects and actors who are engaged in the execution of the projects.

6.2.3.1 A. Status of ongoing projects

At the time of data collection, many interviewees stated that no grid RE projects were implemented. However, the majority recognised that decentralised renewable energy projects are being implemented in the off-grid space, but the on-grid transition pathway has yet to record success. Here is an extract illustrating these:

"When you say grid related renewable energy at the moment, most of the RE projects that we find in Nigeria, still, what we refer to as decentralised systems, more of off-grid RE systems and systems that are not actually connected to the grid. At this point in time, the sector is still developing. We have not gotten to the point yet where we have some of these RE project being interconnected or tied into the grid. Reason being that we do not yet have a very stable grid… But if you recall, not too long ago, the Nigerian government, if I remember, had a partnership with Siemens to see how they can help us revamp the entire grid network. So, until we are able to have a very simple grid, it becomes not too easy for RE projects, or RE systems to be integrated into the grid. So, most of the projects you find being promoted or developed by either the REA or the Federal Ministry of Power, or some other agencies, are more decentralised systems. So, in some cases, you have solar hybrid systems that are just been developed to serve particular communities that are cut off from the grid. So, most of these systems are not directly connected to the grid." IR27

A divergent opinion from some interviewees is that only two projects (the Katsina wind and Lower Usuma Dam solar project) relate to the grid. However, respondents stated that these projects are small scaled, which are tied to the 11 KVA distribution lines and not the 132 KVA transmission lines, which implies that the reach of the power supply is limited:

"We have on-grid renewable energy project. The issue like I was even involved in one, that is the Lower Usuma Dam is 1.2 megawatts, it is in Abuja. Lower Usuma Dam is a water treatment plant in Nigeria. So, the Japanese government, through JICA, Japan International Cooperation Agency, built the 1.2 megawatts is tied to the grid. There are no batteries, it is tied to the grid at 11 kVA inside

the grid at 11 kVA, but, you know, some engineers will say no, since it is not on 132 or 33 kVA, but it is tied to the grid, because it sees the grid to generate power. If the grid collapse it cannot generate, so that is the first grid connected and, as I told you also, two interconnected mini grids also, but those ones are in small-scales, they are just 60 and 100 kilowatt, they are small systems. Where is those ones are located, the one is in Sokoto Tunrunkawa, in Sokoto State. Okay, that is also the first inter-connected mini grid in country." IR17

Numerous respondents stated that the Katsina project has not been completed. A sample extracts from IR10 and IR13 is presented below:

Respondents	Extracts
IR10	"I think the capacity is still too small, I think it should be ranked up with it. We can see the effect after it has been."
IR13	"No, no, no, this one is yet to be connected to the grid because the grid, yeah, it is, this one is actually below, but that of Jigawa will definitely be connected to the grid. That is why we are working hand-in-hand with Kano Disco, if you remember, I said. Okay, Kano Disco is one of our stakeholders, which I did not mention. So, we will definitely connect it to the grid. TCN is also aware that there is a project like that. So, we will definitely connect it to the grid."

6.2.3.1 B. Transition Network of Actors (Stakeholder involvement and participations in the projects)

Only a few respondents provided information on the network of actors involved during the project execution. Some interviewees stated that the stakeholders during the transition design phase are constituents of a network of actors in the implementation phase. Furthermore, some respondents indicated that the transition team of the grid RE implementation selected mobilising actors to influence and accelerate the transitions to sustainable alternatives. Informants stated that some RE companies were selected as frontrunners in the transition process, which the Ministry of Power facilitated. These were pioneers of grid renewable energy deployment, as suggested in the quote below:

"...But I learned there are a number of companies that have been licensed to go into making renewable energy procurement for Nigeria. Now I do not have the record, what I only know is that we have about 11 companies that have already signified investment to go into renewable energy procurement in Nigeria..."IR15

Furthermore, informants indicated that the environment for grid RE frontrunner's innovation needed to be more enabling to stimulate the development of RE on the Nigerian grid. This is presented in the view of the following respondents that the Power Purchase Agreement was not concluded due to the state of the grid. Respondent IR04 stated that PCOA and PRG were accompanying agreements that were requested by the frontrunners for the financial closure to be reached:

"...So, the plan was not firm, to be honest. And the selection process, even though it looked transparent, was probably not just some others, yes, there were a number of them that were selected, and they closed the transactions at 11 cents. They wanted beyond the PPA, and they wanted to have the put call option agreements that say, you know, government in the event of change your policy, government should buy over these assets. Right, some also wanted the inclusion of the PRG, which is a partial risk guarantee. This typically emanates from the World Bank and the African Development Bank. Others started processing the PRI, which is the partial risk insurance. And this mostly would come from Miga, the two multilateral investment guarantee agency overwhelming now, because the structure was faulty, this and it happened based on a very blind direction or approach. I did not expect it to last, I will be honest

with you, for that sort of thing to exist within the current situation or current state of our electricity industry, you must first understand..." IR04

Furthermore, respondents IR11 and IR12 suggested that the PCOA agreement hit a gridlock due to the contention between the IPPs, the Ministry of Finance and the Federal Government. See extract from IR11:

"...So, I think eventually the project did not start on time because they cannot complete the PCOA agreement. We are not even so ready to take as much the grid at that time, we know if we sign it we have to pay for it whether we take it on, once you enjoy it you have to take up or you pay? So those are the hindrances that happen, but as the grid becomes stronger. Then you are able to take such kind of agreement that we now have more experience in terms of agreement, a better grasp on what is implied when you sign an agreement on renewable energy that, you know, you cannot take all at the time you are going to produce it, we already having issues with such agreement as well. So that means that with time we will be able to assign more realistic agreement on renewable energy and be able to take those agreement..." IR11

Some respondents also implied that the lack of government backing, and international bank's Partial Risk Guarantee have further stalled the transition process and implementation of grid and off-grid projects.

6.2.4 Projects Monitoring, Evaluation and Learnings

However, it was implied that the pioneers were selected through an informal process other than a competitive bidding process. Also, there are no monitoring, evaluations or learning findings from the study, as no grid-based renewable energy was executed at the time of data collection. Some respondents suggested that learning from the off-grid space can inform decisions, and respondent IR09 postulates that there are various monitoring processes that depend on the project being executed:

"We have a various level of monitoring. In the agency, we have a department called the monitoring and evaluation department. We have a project department. And then we have the user department. So, it depends on who is funding, what if it is coming from the rural electrification fund. We have various committees at various stages that monitor implementation, which includes the project department, which includes the monitoring department and after post commissioning, we also have an agreement that is signed with the developers that allow for monitoring as, within the agency, people can come from anywhere at any time from the Auditor General's office, from external auditors from the Ministry, from National Assembly, and we also embark on monitoring exercises. So, you have to get it right from the beginning, from the system design, to ensure that everything is done in line with high technical standards." IR09

6.3 The Accountability and Transparency of the Transition Planning Process and Governance

Having obtained presented data of enablers, drivers and barriers and the transition planning process and governance to grid RE implementation strategies, this study proceeds to assess the accountability and transparency grid RE strategies. This section is discussed based on the themes that emerged from the data analysis conducted.

6.3.1 Accountability Challenge and Level of Transparency

Some respondents indicated that their peculiar roles limit them from expressing an opinion on the issue of transparency and accountability in the Nigerian electricity sector for renewable energy development. Furthermore, some respondents indicated that the renewable energy policy documents communicate the targets of transitions, hence fostering transparency in the sector. However, the issues of transparency and accountability are pronounced in selecting an area of incentives and support mechanisms to enable transitions. There seems to be diverse opinions and perspectives on the level of transparency and accountability of the transition process.

6.3.1.1 No/low accountability and transparency

Some respondents assert the transparency and accountability for renewable energy development is absent or low. Extracts from some respondents is presented below:

Respondents	**Extracts**
IR18	"For accountability, if you do not really have data to, to back up your claim, it's actually a bit difficult to be accountable. So, for accountability, accountability is low too because of the data, access to data is low. So definitely, accountability is low."
IR19	"Out of a scale of 10, I would give them 4."
IR24	"No, the process cannot be transparent. Nigeria is whoever is in power, try to dictate what you want. And the party in power, I will tell you will have an next election by 2023. When, at least in new party comes in, the father catches on all those that you see that is happening and start a new thing. But the only way you can get it done is when the private sector is allowed to play its role governed by a very, very strict rule that nobody can defy your rule, you can go to court anytime and that is the only way we can get it."

6.3.1.2 Relative accountability and transparency

Respondent IR18 indicated that there are some levels of accountability and transparency when compared to other sectors in Nigeria:

"For me, um, for me, I think there is transparency sort of in a way because the stakeholders, take, for example, there is actually an alliance right now, in Nigeria, that is the synergy of different Renewable Energy Association in Nigeria, in line that is working with the governments. So, for me, I think there is a little bit of transparency. If I am to put a percentage to that, I could say 60%. So, there is, there is a little bit of transparency. I think that there is transparency for me, there is no, the energy sector in Nigeria is actually transparent compared to other sectors in Nigeria." IR18.

6.3.1.3 Affirmative accountability and transparency

Several respondents affirmed that there is transparency: a considerable level of transparency in the sector. Some comments are presented below:

Respondents	Extracts
IR02	"Very transparent."
IR13	"Now, first of all, in terms of transparency, we are not there yet. But I think that is literally past the 50% mark. In terms of transparency, we have passed the 50% mark."
IR30	"so well, because grid renewables has not been on the grid yet. So there's no issue of pricing and transparency otherwise"

6.3.2 How to Improve Transparency

A number of respondents provided suggestions on how to improve the transparency challenge of renewable energy implementation.

6.3.2.1 Publicly informed

Respondents expressed the need for the public to be informed of any strategies, projects or initiative which boosts transparency and makes the public demand accountability from the executors. For example, respondent IR14 asserted that there should be more publicity around projects so that the populace is aware of the activities, and that appropriate parties could be held accountable when progress stalls. Here is an extract from the source:

"…more transparent. I think the starting point is let it start from the outside. So, what I mean by that is when you want to deploy this kind of project, it could be good if the projects start as a publicly informed, or strategies publicly informed. So, people at the onset know that something is happening that suggests that people are likely to keep tracking it. Yes. And if he goes, if he starts to go dark or shady, or let people ask questions, right? Yes. So, I guess that is the one way to ensure transparency, start it off transparent, start it off open. So, if he starts to go down somebody somewhere, will just jump on Twitter, or whatever happened to this and that is how the light come on that stuff again, people will now start having to come out of the dark if they are getting opaque about it…" IR14

6.3.2.2 Metering of customers

Likewise, respondents suggested that the low metering of electricity consumers in Nigeria affects the implementation of renewable energy initiatives. The lack of metering is inhibiting transparency and accountability along the electricity value chain. However, the advent of metering will drive the necessary effectiveness and efficiency in the sector across policymakers and other players in the sector:

"…Because, as we speak, we have not been able to agree at the associated technical and commercial losses, so I believe if we could do, roll out an aggressive metering programme, where people get meters, everybody sits up. And from that, if I look at my income, then I will stop practicing energy efficiency, even without being taught… We have divergent views, even as policymakers and players in the sector based on different interest and backgrounds. But I have always insisted once there is metering everybody will sit up because there will be transparency, accountability… So, the first we need to do is to make sure we roll out an aggressive metering programme where at least 70 to 80% are metered. That brings in transparency, it brings credibility to the system. And it also brings accountability. Because all we have now is that there is bulk shifting of bulk between the generating companies, the transmission, and the distribution companies. Because, as we speak, we have not been able to agree at the associated technical and commercial losses, so I believe if we could do, roll out an aggressive metering programme, where people get meters, everybody sits up. And from that, if I look at my income, then I will stop practicing energy efficiency, even without being taught…" IR17

6.3.2.3 Introduction of competitive bidding system

Moreover, the present bidding system is tagged as not transparent enough as depicting the actual cost of renewable energy generation. Some respondents indicated that the introduction of a competitive bidding system will address this and foster transparency. Here is a sample quote from IR10:

"…Secondly, I think how to improve transparency, is by improving, The yeah, to put it, is like this bidding, there is this thing that they call competitive bidding. This can improve the transparency for infusion of renewable energy. Quantity

bidding is what we wanted to start using for generation requirements at different areas. So, by using competitive bidding, it will kind of give us the least cost generation tariff for any of this for renewable integration into the grid…" IR10

Likewise, respondent IR17 posits that the 14 frontrunner solar companies were selected based on unsolicited bids. However, a competitive auction scheme will encourage more bids and better offers, which will enhance transparency:

"…what I would say is that the 14 companies we had, they were unsolicited bids. And we discovered that some of them have a portfolio development tower cos, was even saying about 3 million USD. And noting on the ground now, wonder maybe it is for hotel bills, bringing in experts, travels and all that. And that is why, as a government, we have said, moving forward we will be doing competitive tenders so that there will be transparency, it will be open book, and there will be accountability. And also, we have discovered in the scenario of 2016. To date, we started with 16 cents per kilowatt hour. By the time we signed this 14 PPAs. In 2016, we signed that 11 cent and, as at that time, the average kilowatt hour of our mix was 7.5 cent. I was in the convention in 2020. The warden summit in Abu Dhabi, UAE. And we discovered that Egypt and even UAE… they sign power purchase agreement of two cents, or two US dollars cent per kilowatt hour. I know our infrastructure is not as advanced as UAE or Egypt? Well, the truth is that the 7.5 cents is still far from what they are getting. And that is cost reflective also because the cost of renewable energy is coming down. And that is why we are now championing for more transparency, accountability, then we should do competitive tender." IR17

6.3.2.4 Improved leadership

Some participants stated that the leadership of the electricity sector could improve transparency and accountability by exercising the power vested on them through enforcement. A respondent also suggested transparency and accountability can be improved through sensitisation of Nigerians to be more patriotic and encourage the implementation of renewable energy:

Respondents	Extracts
IR15	"…Of course, if an agency like a Nigeria Electricity Regulatory Commission can do their job as they ought to do is already there. Already they are within the regulatory agency of the government, and government has given them all that they need to use to do their job, and then they should just sit up and do it. They have the power to do, they have that power to sack the individual within that space, let them just do it, if they can do it, then everything will fall in place…"
IR19	"…It is leadership… So, the problem is not only the leadership, it has now gone to the people. So, the people need to be sensitised to be patriotic. So, patriotism is another thing, so that is why you will find out that it is mostly private sector, mainly foreigners that will come and do this job for us. A lot of people, it has become another thing, not just the bribery and corruption stuff that is going to another level. Some people do not believe in Nigeria anymore…"

6.3.2.5 Monitoring and audit

Respondents further argued that adherence to the auditing and monitoring process will improve transparency in the transition process of grid RE development:

"…there are already checks and balances when it comes to ensuring that these processes are transparent. As long as those checks and balances are adhered to by checks and balances, I mean, there are always audits that are carried out. If all this is adhered to, then it will be easy to ensure that it stays transparent or even becomes even more transparent…" IR22

6.3.3 The Role of Transparency in Grid RE Development

6.3.3.1 Effectiveness and efficiency in the system

Respondents affirmed that transparency is an enabler for the effectiveness and efficiency of grid renewable energy implementation. According to participants, the effectiveness and efficiency in the system means that major roadblocks presently experienced by various stakeholders will be surmounted. Here are quotes illustrating some informants' perspectives:

Respondents	Extracts
IR13	"…If transparency is put in place, you know, the challenge I told you about the solar home systems? Yes. Without going to the bank, the commercial banks, it is no longer going to be a challenge. Yeah, nobody needs to tell me I need to pay my bills, I need pay back what I need to pay back what I owe, and everything."
IR18	"…Yes, for the, for accountability and renewable energy. If a system is transparent, it means stakeholders will have access to collective data they can use to actually implement this system. So, accountability and transparency are actually key in actualising the grid system…"

6.3.3.2 Education and acceptance of actual cost of electricity generation and supply by end users

Respondents suggested that a transparent system will educate Nigerians on the electricity usage and promote responsible energy consumption and acceptance that electricity is not cheap, which has been a major bottleneck for RE development as the Nigerian government have had difficulty revising the electricity tariff paid by end users:

"…I think people will be more. So, for example, if you ask the average Nigerian, how do you, have you heard about feed in tariff? They do not know. Yeah, absolutely. No idea. I also had absolutely no idea until I started my research.

Yeah, yeah. No idea. And some state quite interesting, because some state like Lagos, they had a, they had a feed-in tariff policy during Fashola's time. They were creating one. I think they actually, I do not think they eventually pass it into law, but I remember they were creating one, then Damilola was there, she was the head of LSCB. The current S.A for president. Yes. And so, for me, it is like, if the system is that transparent, the average Nigerian will know about feed-in tariffs So first of all, let us educate everybody about what our electricity sector is like, because it is quite interesting that I remember I had a conversation just about, I think it was about two, three months ago. I was in Lagos, and I was having a conversation with my neighbours. And they were like, I do not even know how much I consume in terms of electricity. Like, you are seeing kilowatt hours, because I was telling them about solar, I put solar in your house. Who do not even know what kilowatt hours meant? And I am like, interesting. Right? So, transparency means education, not just of the people in organisations, but everybody, right..." IR12

6.3.3.3 Encourage investment and boost business confidence

The uncertainty around when investment will be recouped by developers has been a major concern for investors in the renewable energy technology space due to the large initial cost required. Respondents posited that a transparent system would provide more assurance and confidence for investors:

"…But let us assume that becomes priority today, then transparency would be critical transparency as to what is the need for all the stakeholders. So, for example, if you are going to incentive the deployment, then has to be clear what the incentives are so that as many people that has the ability or capability to get you to be able, they know what they are getting into, that should be that level of

predictability as well. Now, you know that, for a long time most of these big, in fact, solar generally, it's a long game, is not, and I guess that’s the reason why that could interesting be the reason why it is expensive or tends to be expensive, because people are trying to recover as quickly as possible, because they do not know what will happen tomorrow. Yeah. So, if there is that strategical rise and clarity, you can see beyond the 10-year rise, and you can see clearly what the strategy landscape looks like, it is possible that you might decide to just let the cost be over to a longer period is cheaper. So, transparency will do a lot to encourage business confidence …” IR14

6.3.3.4 Good governance of grid RE

The informants argued that the lack of transparency has been an inhibitor to implementing grid RE strategies, causing lack of synergy and conflict in roles and responsibilities of government institutions and agencies. Transparency will provide good governance of RE and foster successful implementation of RE on the grid:

“…Oh yes, if things are being transparent, everybody will see it very clearly. Yeah, and because there's no transparency, there's this conflict or a kind of multiplication of duties, even from within the government act as the institutions, you see one aspect of the institution playing a role that is supposed to be played by another party. So, you get this conflict of rules or conflict of responsibility from the government agencies. They need to come up and set of transparency units that things will be very clear to each of this parties at the end of the day. Yeah, of course, I agree with you. 100%. If there's transparency, yes, you can see some positivity in the governance of renewable energy…” IR21

6.3.3.5 Growth in RE deployment

The respondents emphasised that transparency would foster growth in RE deployment as it will be more open, and Nigerians will be more knowledgeable on the technologies:

"…Of course, rapid growth, rapid growth. If that is taken out of it? No corruption? Transparency everywhere? Then you expect the growth of renewable energy…" IR15

6.3.4 Responsible Party for Accountability

Respondents were asked who should be responsible for ensuring the grid RE planning and implementation process was transparent, and accountability and divergent opinions were obtained. Respondents indicated that no specific agency charged with grid RE deployment would have been held accountable. Most respondents asserted that the Nigerian government should be responsible for ensuring the transition planning and process for grid-RE deployment is transparent, and its institutions should be tasked with this responsibility. A few indicated that the Ministry of Power should take the lead role. The quote below explain this:

"…I think is the Ministry of Power that should be held responsible for renewable because they are the ones that set the policy…" IR10

A considerable number of respondents asserted that NERC should be held accountable for coordinating people to be transparent as they are the key promoter of renewable energy, hence, should regulate the influx and activities of renewable energy actors as well. Below are some extracts of respondents' views:

"Nigerian Electricity and Regulatory Commission that is supposed to oversee this and ensure that appropriate sanctions are handed out, and then we can be sure that most of the people, I am not saying this with all amount of certainty, but you can be sure that most of them are already compromised, that they will not be able to impose the appropriate sanctions on these DISCOs, so that is part of the problem." IR07

Contrary to this opinion, some respondent postulates that NERC is not independent from the political regime, which impedes the level of transparency and accountability that can be demonstrated by the government institution. Quote from IR12 is an illustration:

"Well, the NERC is the regulator, but they regulate the electricity sector, right. So, who regulates them, and then by that definition, they are supposed to regulate the influx of the renewable energy actors as well. Right. So, but then they are still part of, they are not independent of the government. And they are not interested, they are not insulated from the politics of electricity in Nigeria, they actually part of it. So, they actually part of it, right. And so, in that sense, I do not know how independent in an ideal world would have an independent organisation, or an independent NERC, that, you know, sort of governs this processes. But the NERC is neither independent. In this current world that we are in, they are not independent. So unless you have a, somebody who is a, it's will call you calling them policy entrepreneurs who are actually interested in making a change, like a bureaucrat who is actually, you know, fire driven, which is not sustainable on its own, because once it leaves, then the system you know, it collapses, but so, but then I guess it will probably start with that kind of

person who then institutes or initiates a system wide change, to sort of create the kind of regulations that we want to see, because right now, I do not know what NERC is doing, quite frankly." IR12

Some respondents also indicated ECN should be saddled with the responsibility. This is illustrated below by IR18:

"Yes, for me, the Energy Commission of Nigeria, actually, I would not say they are not doing a great job, they are doing their best, but they need to do more in ensuring that this data is available to the general public. So, the Energy Commission of Nigeria should actually do more in ensuring that these data are available for transparency and accountability." IR18

Furthermore, some respondents believed all stakeholders should be held accountable for the roles played within the activities of execution of the grid RE implementations:

"The developers, the communities, the households, the government institutions to all be held accountable. Because if you say the governments, we also have the developers who cut corners. So was it a government? It was the developer. Now, the community people, again, also need to be blamed, because they are expected to like, we put like a reporting system. But, to us, efficiency of the system, effectiveness of the system. They do not do that. Because, for example, we have the developers go there, they find some boys with them in charge, they give them some money. So, they are like, cash cows. Oga, this thing is not working. Okay, I have said something to you. So, they do not report back to us. You get it? So, so I think it is an issue of the system. Now, the whole system is

already corrupt. And I am sorry to use that word. So that you blame one side and leave the other side? No, I do not think it is possible." IR13

6.4 Chapter Summary

This chapter presented the themes which incorporate the opinions and views on the experience and observation of respondents of the planning process, procedure and governance, and perception and opinion of respondents on the challenges of transition accountability and transparency for grid renewable energy strategies implementations. This chapter presented key themes of this study in two sections: the first section detailed respondents views on the transition planning and arena; transition design; operationalisation; network of actors and lastly the projects monitoring and evaluation for grid renewable energy deployment. Secondly, the chapter detailed the opinion and perception of the interview participants on the accountability challenges and level of transparency; how to improve transparency; the role of transparency in grid renewable energy development and the responsible parties for accountability.

The chapter presented interview findings from the semi-structured interviews for the transition planning process and governance and accountability and transparency for the development of renewable energy on the Nigerian grid. Furthermore, the findings in this chapter showed that the transition planning process constituted the international and national arena leading to the formation of the renewable energy target set to achieve 30% of 30 GW of grid electricity generation. This involved multiple stakeholders; however, some key stakeholders were left out of the planning process. The researcher subsequently found out that no grid renewable energy projects were implemented hence, there are no monitoring and evaluation carried out yet. Likewise, the findings suggests that the accountability and transparency of the process and governance are below the expected levels. The next chapter presents the discussion and synthesis of major findings.

CHAPTER SEVEN: DISCUSSION AND SYNTHESIS OF MAJOR FINDINGS

7.1 Introduction

This chapter critically discusses the findings from the in-depth semi-structured interviews of 31 informants, presented in Chapters 5 and 6 to address the aim of the study. The aim, as presented in section 1.5, seeks to assess the renewable energy planning process and governance for sustainable development and propose a roadmap model for implementing strategies for grid-based RE electricity generation in Nigeria. The chapter discussion is structured to address the research objectives/questions, which is a deconstruction of the study aim. The discussion will be supported by findings from literature and categorised based on themes from transition theories, specifically the Multi-Level Perspective: urgency for transition, Transition Management Framework: transition planning and arena formulation, transition design, operationalising transition, transition management process review and enhancement, and Accountability and Transparency Concepts: accountability and transparency in transitions. Furthermore, new insights obtained from the empirical investigation in the Nigerian context are presented and discussed as additional elements contributing to the final conceptual framework proposed in this section.

This chapter is structured as follows; Section 7.2 discusses the determining factors of grid-based renewable electricity generation. Section 7.3 discusses the transition planning and governance, while the accountability and transparency of the transition planning and governance is discussed in section 7.4. The chapter is summarised in section 7.5.

The sections below articulate the fusion of the empirical investigation, theoretical underpinning, and discourse from the data.

Question2: What are the determining factors for successful planning process of grid-based renewable electricity generation in Nigeria?

To address this question, the following section is discussed under the theme 'Urgency for Transition', adopting the multi-level perspective.

7.2 Determining factors for successful planning process of grid-based renewable electricity generation.

This section discusses the determining factors for successful planning process of grid-based renewable electricity generation to understand the urgency of the transition. The urgency of transition is categorised into three sub-sections based on themes from the multi-level perspective framework. These central themes include landscape, regime and niche contexts, and are explored below.

7.2.1. Landscape Context

The findings from the semi-structured interviews and supporting literature indicated that there are pressures affecting the landscape, which are resisting or supporting on-grid renewable energy development. Furthermore, the findings indicate socio-cultural, socio-ecological and environmental, social-political, social-economic, and technological elements re-configuring the socio-technical landscape of the on-grid renewable electricity sector. These are discussed alongside prevailing literature in the following section below under the headings: energy poverty, growing population and demand, an abundance of renewable energy sources, economic development and international influences.

7.2.1.1 Energy poverty: Energy access and security and quality of supply

A major factor, as shown by the qualitative data obtained from respondents, driving the transition to renewable energy for grid electricity supply is the presence of energy poverty in the form of lack of energy access, need for energy security and improvement of quality and power supply which plagues the whole country, with a more significant effect in the rural communities. However, the urban areas are also challenged, with some areas near the national grid not connected to the grid. Furthermore, the deficient energy access is also conflated with poor quality power supply and incessant power outages. Hence, fossil-based generators are used to augment and address these issues. Respondents indicated that the prevalence of energy poverty is a major issue that necessitates adopting an alternative energy supply through renewable sources. There are similarities and differences in the existing literature of the empirical findings; for example, Brendan Flynn's (2016) findings postulate that energy security concerns are the significant landscape pressures affecting marine wind energy and the North Sea offshore grid initiative in the United Kingdom. However, lack of energy access and poor power supply are not major drivers identified in the studies. This is understandable and explained by Batinge, Musango and Brent (2019), who argued that the existing paradigms on transition are formed based on developed countries' narratives where access to electricity is relatively satisfied and, hence, will differ when compared to developing countries' context. This view is also supported by previous studies, which argued that these "social-spatial dimensions" differences should be considered in assessing energy transition in regions, countries and contexts to capitalise on transition opportunities (Chandrashekeran 2016). There is a dearth of literature that explored this concept in the context of developing countries in

Africa; however, findings from this research corroborate Judit et al.'s (2018) studies on the exploration of determinants of utility-scale solar PV in Rwanda, which posits that energy access is one of the major landscape pressures for solar technology development.

7.2.1.2 Growing population and demand

The study shows that the great demand for electricity and the unavailability of the conventional electricity system to satisfy this demand has resulted in consideration of on-grid renewable sources to augment supply. Furthermore, the results indicated that the rate of population growth and forecasted growth are major drivers for the approval of the vision of renewable energy integrations on the grid systems by the National Council on Power in 2016. This finding echoes Schneider's (2022) studies on Nigeria, which concluded that there are positive linkages between population growth, electricity demand, individual income, and carbon dioxide emissions in the power sector. Renewable energy could be embraced to address these issues. This is similar to Zaman and Brudermann's (2018) work. The United Nation's recent report provided a comprehensive review of the global population, trends and prospects for the future; the most important comments are that the Nigerian population is the fastest-growing country among the top 10 largest countries. Notably, the country is projected to shift in rankings from 7th to 3rd by 2050, exceeding the United States of America (United Nations 2020).

7.2.1.3 Abundance of renewable energy sources

Against this backdrop, the result also showed that the influence to diversify the existing energy mix, which is dominated by fossil sources, to renewable energy, is driven by two reasons. Firstly, to leverage the abundance of natural resources, especially solar radiation and, secondly, to address the location disadvantage of energy supply. This result is consistent with those of Stulberg's (2015) study on the changing geopolitics of natural gas in Europe, Ukraine and Russia, which revealed that Europe's diversification from Russian gas was notably prominent in parts of Europe not near other sources of gas, such as the national and imported pipeline supplies, and Flynn (2015) argues that renewables have unique energy security advantages in a situation of a significant disruption to energy supply. However, this is a different context to Nigeria, which has national reserves and where the location disadvantage of gas supplies are inter-states rather than across borders.

7.2.1.4 Economic development

Another important revelation from the empirical data was that adopting the grid renewable energy pathway was to improve economic activity and development as it plays a pivotal role in national development. The results coincide with Schneider’s (2021) findings, which averred that Nigerian economic development could be stimulated through increased grid low-carbon electricity supply and availability for household, industry and manufacturing needs; this is similar to Adesina (2016) and Aladejare’s (2014) findings.

This study found that grid renewable energy is seen as a channel to reduce the costs of power shortages and operating costs of fossil fuel generators for the Nigerian populace, thereby improving the quality of life. These results are unsurprising as the energy access diagnostic report from the World Bank indicated that electricity challenges have devastating economic implications, with an annual loss of $26.2bn (World Bank 2020b). Furthermore, IEA 2020 stated that reliance on fossil-fuel-based generators has inherent environmental impacts, health implications, and higher electricity consumption costs cascaded to the manufacturing and production cost (Uduma and Arciszewski 2010; IEA 2020c). Previous studies have indicated that the country is recognised as the largest importer of fossil-fuel-based electricity generators on the continent and the world (NINDC 2015; Adesina 2016; Adhekpukoli 2018).

7.2.1.5 International influences

Furthermore, an interesting finding is that respondents perceived the need to fulfil international obligations and agreements, such as the United Nations, through its Conference of Parties (COP) and the Paris Agreement, as driving the adoption of renewable energy for the Nigerian grid. Based on findings in this study, climate change and low carbon drive are mostly perceived as international initiatives charted by the international community. Furthermore, the current study also noted significant international pressures from developed countries through two means. Firstly, indirect pressures from renewable trends and spillover effects, as Nigeria: "*we do not want to be left behind. As much as possible. I do not think anybody wants to be left behind. So, when there is a lofty idea, it is good to latch on, maybe something will come out, if you do not achieve 30% and you achieve two or 3%, or 5% is a move in the right direction, rather than stay aloof and say, "I do not want to join"."* IR03. Secondly, direct pressure through fundings and grants: *"... So, if you want to get a grant from Europe, they will be asking you, are you deploying it into core technology or not influence. So, influence is inevitable*." IR14.

The Nigerian government has committed to decarbonising society through various pathways, including the grid system pathway. It has created various renewable energy policies and documents, such as the NREEEP or REMP. Furthermore, the Nigerian government has entered partnerships, for example, with Siemens, to see how they can help revamp the entire grid network and technical partnership with GIZ and UNDP. Compared to developed countries, international pressure and trends still need to be identified as major drivers of sustainable transition (see Mattes, Huber and Koehrsen 2015; Flynn 2016). Furthermore, a study on drivers of renewable energy development in OECD countries by Damette et al. (2019) indicated that national revenues, energy demands, and security are the major elements significantly impacting renewable development.

Thus, while landscape elements exert pressure on the fossil fuel electricity regime change, the cultural values dimension, as portrayed by Geels (2004), is not present in the findings of this study. Though there is growing international and national pressure to support renewable energy on the Nigerian grid, the pressure could also be increased through cultural values change and national ownership of sustainability in Nigeria, which might shorten the length of the regime's reign. Energy transition education could foster not just a top-down transition pressure, but also bottom-up, where the cultural orientation of Nigerians is reconfigured to fit the transition context. This finding also accords with the study of Sovacool (2014), who argues that transition studies should encompass the cultural dimension and compatibility for climate-friendly technologies and adoption. The reason is that "some emerging energy and low-carbon innovations can create, challenge, or reinforce existing cultures. In other situations, embedded cultures can challenge, shape, and entrench particular low-carbon innovations and practices" (Sovacool 2014, pg. 7). Geels et al. (2018) support this point that cultural changes should orientate the populace.

7.2.2. Regime Context

At the regime sociotechnical level, there is an indication that the incumbent electricity system is characterised by several inadequacies which undermine the capacity to meet the energy demand and improve energy access in Nigeria. This section is discussed under the theme of incumbent regime value chain challenges.

7.2.2.1 Incumbent regime value chain challenges

From the dominant source of supply 'gas' angle, the value chain is plagued with several challenges. For instance, the existing gas thermal generations are low, coupled with frequent transmission pipeline vandalisation and inadequate distribution capacity, thereby hampering energy supply to end-users. On the other hand, the hydro-power system, which generates a smaller portion of the energy needed, is also affected by seasonal water variations, which impact the supply capacity.

Also, the existing electricity infrastructure is obsolete, making meeting the demands of the teeming population difficult. Respondent IR17 indicated that the liquidity challenges facing the sector cripple the ability to resolve some issues, which has had economic and sustainable development implications.

Aside from this, the high dependence on fossil fuel sources of electricity has meant that the sector's greenhouse gas emissions are high and are projected to increase as demand and supply reach equilibrium. Hence, the Nigerian government introduced the on-grid renewable energy pathway to diversify the energy portfolio, surmount some of the challenges, and improve electricity generation.

Despite the strong dependence on fossil fuels and the nation being a net exporter of crude oil, the deficiencies created a window of opportunity for exploring on-grid renewable energy. This result coincides with the findings of the study of the Ontario electricity system by Rosenbloom and Meadowcroft (2014). The author postulates that the growing dissatisfaction with the electricity supply resulted in the destabilisation of the incumbent regime despite the political administration support for the system, resulting in the niche innovations development.

However, available evidence shows cracks and build-up of pressure from the landscape and regime system. The incumbent regime systems are still reinforced by factors such as favourable gas policies, resistance and sabotage from incumbent gas producers, petroleum subsidies and support, to mention a few. Therefore, creating technology and institutional lock-in inhibits a favourable and protected space for a renewable niche to develop and mature. Furthermore, the existing inefficiencies which gave rise to on-grid RE are also a significant deterrent to its development. This corroborates Adeniyi’s (2019) work, which concluded that transmissions losses are the primary concerns of potential renewable energy investors as this will hamper recouping of investments. In similar light Markard et al. (2020) and Hess (2014) presented in their study that transitions may be opposed by existing regime actors which often reinforce the dominancy of existing system especially were policies introduced are also abating existing unsustainable systems such as seen in this study.

7.2.3 Niche Context

In the niche context, this empirical investigation finds the urgency of transition evident through societal acceptance and support networks as enablers for renewable energy deployments. This finding is consistent with Geels and Schots's (2007) argument that the transformation of a socio-technical system for developing a niche is usually enacted by social movements and advocacy exerting pressure on regime changes.

Furthermore, respondents indicated that emerging information, government policies, partnership, and RE technology cost reduction and advancement foster transitions in the electricity sector and the development of RE technologies. These findings are similar to Moallemi et al.'s (2017) study of India's electricity sector and confirmed that the empowerment of solar and wind technology in India through government stimulations and renewable energy profitability is leading to the attractiveness of the technology.

However, transitions are also being inhibited by challenges with mobilising investment and finance for RE technologies due to market-related and liquidity risk in the country, with a major hindrance from lack of agreement on the feed-in tariff structure and political risk cover and insurance. The ETP (2022) stated that transition to a net zero economy by 2060 will cost Nigeria about $1.9 trillion which means $10 billion annually. This further emphasises Verbong and Geels's (2010) argument as the authors postulate the need for infrastructure and investment for transitions. This espouses a similar study by Moallemi et al. (2017) of India's on-grid renewable energy development and concludes that it still requires impediments to be surmounted to be considered competitive to conventional sources.

Other factors indicated by respondents are the need for a sufficient focus on research and development, technology-related issues, poor narratives from low-standard home energy systems, and the need for a detailed RE action plan. Bhatia (2023) reported similar findings of the socio-technical transition of India electricity system and concluded that research and development are not adequately funded, inhibiting development of low carbon technologies.

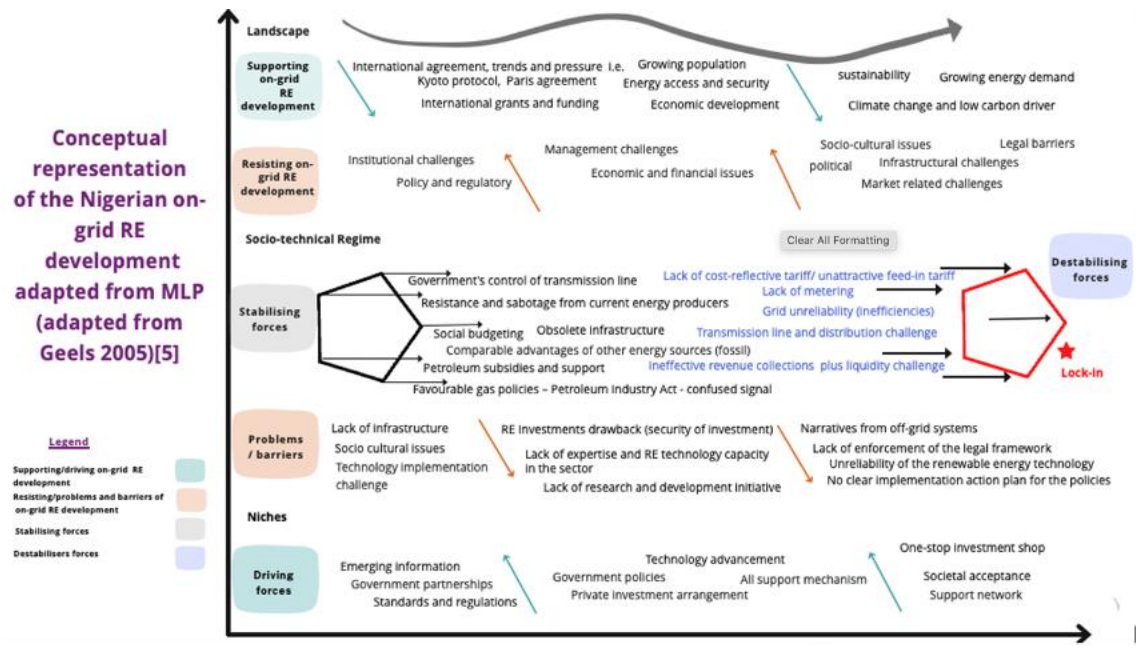


Figure 29: The conceptualisation of multi-level perspective framework in the Nigerian on-grid renewable energy sector (Source: Adedokun, Strachan and Singh 2023)

Question 3. What are the renewable energy planning processes and governance for sustainable development in Nigeria and how accountable and transparent are the processes?

To address this question, the following section is discussed under the themes ‘Transition Management’ and ‘Accountability and Transparency’.

7.3 The Transition Planning Process and Governance

This section discusses the on-grid energy transition process, as indicated in Chapter 7, through the lens of the Transition Management Framework, and discussions are under four sub-sections. These sub-sections include transition planning and arena formulation, transition design, operationalising transition, transition management process review and enhancement, and are considered below.

The transformation of socio-technical systems deeply rooted in societal structures is difficult to facilitate as these systems have developed path dependence and institutional dependence. According to Loorbach, Frantzeskaki and Avelino (2017), these result in incremental changes that may inhibit the implementation of sustainable management practices (Loorbach, Frantzeskaki and Avelino 2017; Mulder and Loorbach 2016). The transition management framework has been applied in various research to understand the transition complexities and inhibitors for the governance of large infrastructural systems in the Nigerian electricity sector, though applied differently in several research, and the application of the steps may differ.

7.3.1 Transition Planning and Arena Formulation:

This phase of the transition constitutes two steps: establishing a transition team and arena and identifying existing challenges.

In the first step in a transition process, the transition arena and team should constitute outside and inside stakeholders that are renewable energy, hydro and innovative fossil fuel players and non-energy actors that are change inclined to foster the transition of the existing energy systems (Loorbach and Rotsman 2010). This study's finding suggests there were two arenas established for envisioning. The transition arena comprises the international and national arenas. The first arena, which is the international arena, was described in the results chapter as constituting the international committees on climate change, such as the UNFCCC, which chartered the path for renewable energy deployment to tackle climate change issues in Nigeria. This was through setting an obligation for Nigeria to achieve by establishing an Intended National Determined Contribution (INDC) and creation of sustainable energy for all programs and involved government, climate change activists, NGOs, multi-national companies and so on. The second arena refers to the national arena, which constitutes the Inter-Ministerial Committee and the Nigerian National Council on Power. The former constitutes the selection of stakeholders, which included federal ministries, departments, experts and pro-renewable energy companies and groups, while the latter, as presented in section 6.2.1.1, consists of representatives of the 36 states of Nigeria, including the private and public sector key players. Rotmans and Loorbach (2009) proposed that incumbent regime actors' inclusion could provide legitimacy and support the transition process.

Furthermore, the study's findings suggest that the government initiated and coordinated the affairs of these arenas through the Ministry of Power, which was part of the transition team. However, due to the political regime's significant role in the power sector, it took much work for the Nigerian government to facilitate the process and initiative of renewable energy effectively. The Nigerian government was unable to exercise objectivity in forming the transition teams. Interview respondent 04 indicated that political and vested interests in the incumbent fossil fuel electricity sector create a transition problem. For instance, IR04 posits, *"Nigeria, as a country, relies intensely on revenues from the sale of our hydrocarbon; they will want to, as a matter of fact, maximise any adventure or any opportunity that provides additional revenues for economical utilisation. This would be the social budgeting components because we have a social budgeting component, which most budgets are built on the back of dollars per barrel in terms of, you know, anticipated production of oil and gas. And they also hold ownership in some of the distribution companies. So, government's involvement creates a social outlook around electricity supplies, and this is a problem*." This is in accordance with findings of the India energy transition where the role of the state was significant and not left to market forces (Bhatia 2023). This finding is consistent with the transition management process case study of MUSIC-city Ghent, which identified that strong influence from the political domain in the transition process hinders the creation of a conducive space and condition for multi-stakeholders' interaction and participation (Roorda and Wittmayer 2014). Similarly, Hölscher, Roorda and Nevens (2016) explained that the government's nature of control and obligation could put pressure and limit co-creation among arena participants of the transition process.

Also, the findings presented in section 6.2.1.1 shows that although multi-stakeholders were involved in the transition process, some stakeholders were left out of the discussions by the Ministry of Power as the process progressed due to their opposing views. This finding aligns with Loorbach and Rotmans' (2010) and Roorda and Wittmayer's (2014) assertion that the transition arena is an evolutionary process which continuously mutates and dynamically changes because of stakeholders leaving and entrants of new players and transition teams involving actors with diverse views on the transition views.

While the second step focussed on defining the transition problem and identifying the existing challenges, the result of the study suggests that persistent societal problems were recognised and shared among actors. These problems are low energy access, insufficient power supply, growing energy demand, climate change challenges and sluggish economic growth. This espouses several cases of transition management practices reviewed; for example, the Ghent transitions initiative set out various sustainability objectives to address climate change issues which spurred consideration of energy poverty and the well-being of the people of Ghent (Holscher, Roorda and Nevens 2016). Similarly, the application of the transition management approach to historically analyse and reflect on the sustainable transformation of a city in Japan, called Kitakyushu, shows that the transition problem was centred on resolving the pollution issues (Hideaki and Kajii 2016).

7.3.2. Transition Design

This phase involves structuring the transition problem, which involves a process of envisioning which is part of the co-evolving processes in transition because of the interaction between society and technology to establish a transformation of systems aimed at long-term change (Loorbach 2004; Loorbach, Frantzeskaki and Avelino 2017). Long-term vision necessitates the creation of a visionary image for transition. This fosters consideration of present and future socio-technical systems transition challenges and the ripple effect on the future due to decisions made in the short-term (Harlow et al. 2018). Hence, various scholars assert that back-casting enables an alignment between the desirable futures and the current plans and strategies (Quist and Vergragt 2006). The transition management back-casting technique is also incorporated in the transition governance, which then charts a collectively determined pathway and transition images (Loorbach 2007; Mulder and Loorbach 2016; Loorbach, Frantzeskaki and Avelino 2017).

In the current study, as indicated in section 6.2.1, to address the transition problem through the inter-ministerial and Nigerian National Council on Power, a long-term vision was formulated to achieve a 30GW of electricity generation by 2030 and 30% from renewable energy sources. Furthermore, respondents indicated that a coalition of a range of stakeholders was formed, which led to adopting off-grid and on-grid pathways to realise this energy transition vision. However, which stakeholders were involved? Respondents stated that the transition process involves decision-makers (i.e., governing and regulatory institutions), non-decision-makers (i.e., international and development, investment and donor companies, support and environmental actors and networks, civil society and academia), and electricity value chain players (i.e., generation, transmission and distribution companies, including potential renewable energy developers), as presented in section 6.2.2, which is similar to the frontrunners network in transition management (Nevens et al. 2013). Wittmayer et al. (2012) defined *frontrunners* as sustainability-inclined people with innovative opinions. This aligns with Kemp and Loorbach's (2003) publication that transition vision may constitute multiple pathways that become a basket of transition images. It further agrees with the transition management principle. Likewise, this approach was adopted in Australia, where the Queensland government established the Queensland Renewable Energy Expert Panel (QREEP) and engaged in various stakeholder consultations from the multi-domain sector to develop pathways to achieving a long-term vision of a 50% renewable energy generation target by 2030 (Goddard and Farrelly 2018).

However, findings indicated that local and state governments had not been actively involved in the transition process as required. Cowell and De Laurentis (2022) posit in their examination of two regions in Italy that though the national level played a pivotal role in the development of RE to boost energy security and modernise the grid system and diversify the energy mix, the regional levels are also important in energy planning, administrative matters, provision of expertise, funds, and networks. Moreover, this is consistent with Goddard and Farrelly's (2018) study of Queensland's energy transition process, involving the government's participation.

Furthermore, some responses indicated that the involvement of a large group of stakeholders might create difficulty in harnessing the strength of the diverse input. This contravenes the opinion of Wittmayer and Loorbach (2016), that a larger group of frontrunners will accelerate development and transitions. Similarly, Smith and Stirling (2010) argued that focusing on a selective participant might hinder the legitimacy and support for the transition agenda.

Notably, respondents indicated in section 6.2.2.1B that the committee had been abandoned along the line. This aligns with Holscher et al.’s (2019) investigation that connections between the government and frontrunners are crucial to maintaining a joint commitment to a transition image. The government's active participation and role are central to follow-up action. This is evidenced in the Ghent and Ludwigsburg transition management practice case study, where the ties between transition frontrunners and the government weakened. The government needed more extensive follow-up actions (Holscher et al. 2019).

7.3.3. Operationalising Transition

This phase of the participatory transition process involves the operationalisation and modification of actions to account for the transition context's dynamic (Grin, Rotmans and Schot 2010; Luederitz et al. 2017). This module, under transition management, requires the implementation of a transition agenda known as transition experiments and constituent project execution and engagement of diverse actors, including operational actors (Hoogma 2002; Kern and Smith 2008). These experiments provide an opportunity for learning, exploration and interaction with institutions, cultures and society (de Laat and McKibbin 2003).

The result of the current study found that no renewable energy technology project relating to the grid has been executed. However, respondents indicated notable off-grid projects are ongoing, including projects that feed into the 11KVA distribution lines. Even so, these are too small to serve as a pilot project for grid connection into the 132KVA transmission line. IR10 stated, "I think the capacity is too small". Regarding the coalition of stakeholders, respondents indicate that the transition design stakeholders should also be part of the practice of the experiments. The nature of the finding can be explained by Brugge and Rotmans' (2007) study of European water resources, which concluded that the interconnected and internal logic of existing institutions inhibits innovation which persists in the societal problem relating to water; they argued that involvement of incumbent regime players with vested interests undermines the participatory process and institutional transformation (Brugge and Rotmans 2007). They argued that transition actors should be renewable energy players, enabling them to create a network (internally and externally) of experienced and skilled stakeholders to attract potential like-minded actors, albeit findings show interest in experiments of smart grid and off-grid pathways.

7.3.4. Transition Management Process Review and Enhancement

This phase of the transition process should constitute learning from reviewing the experiments process and implementation (Loorbach and Rotman 2010). This is carried out through transparent continuous monitoring and evaluation of the actors, agenda projects and transition processes as the Nigerian on-grid system is faced with complexities called reflexive (Wittmayer and Loorbach 2016). Learnings encompass successes, failures, and underperformance to identify areas of improvement, modification or adaptation (see Li and Strachan 2019). As articulated by TM, the learning process shows monitoring and evaluating the energy transition management process and also changes and transforms the energy systems. In this study, information on learnings was not obtained as there are no projects executed that are connected to the grid yet. However, follow-up regarding implementing renewable energy policies and targets are identified as lacking. IR07 stated, "but nobody is following through, this is beautiful documents everywhere, beautiful projections and then nothing is done, no follow up". Loorbach (2004, 2007) avers that the transition agenda should be monitored regarding goals and targets. He also argues that actors in the transition arena should be monitored with responsibilities and their activities reviewed to allow for learning (Wittmayer and Loorbach 2016). This is confirmed by respondents' opinion that the government needs to establish a specialised division tasked with monitoring and evaluating projects and responsibilities of renewable energy. These considerations can also be transferred to the on-grid space.

Table 23 below represents and tabulates the summaries of the transition management framework, which includes the conceptualisation of each step and summary of findings:

Table 23: Summary of findings for TMF steps

Steps by TMF	Conceptualisation in an ideal electricity system	Summary of findings
Transition planning and arena formulation	This phase involves defining the transition problem through envisioning transition team and frontrunners. This phase of the transition constitutes two steps. The first step is the establishment of a transition team and arena and identification of existing challenges.	Two arenas were established for the purpose of envisioning. The transition arena comprises international and national arena (i.e., inter-ministerial and Nigerian National Council on Power). Government initiated and coordinated the affairs of these arenas through the Ministry of Power, which was part of the transition team. The result of the study suggests that persistent societal problems was recognised and shared among actors. These problems are low energy access, lack of sufficient power supply, growing energy demand, climate change challenges and sluggish economic growth.
Transition design	This phase involves developing a transition pathway, defining the agenda of transition and the target or objective of transition. Long-term vision necessitates the creation of a visionary image for transition.	A long-term vision was formulated, which is aimed at achieving a 30GW of electricity generation by 2030 and 30% from renewable energy sources.
Operationalising transition	This involves the execution of pilot projects and experiments to obtain learnings from the system before expansion.	The result of the current study found that no renewable energy technology project relating to the grid has been executed. However, respondents indicated there are notable off-grid projects ongoing, including projects that feed into the 11KVA

		distribution lines, but the capacity is too small.
Transition process, review and enhancement	The phase of obtaining learning from monitoring, reviewing and evaluating the experiments and implementation process, actors, targets and agenda. Learning in this phase involves a reflexive process.	Information on learnings were not obtained as there are no projects executed that are connected to the grid yet. However, IR07 indicated that there is no follow-up in regard to implementation of the renewable energy policies and targets.

7.4. The Accountability and Transparency of the Transition Planning Process and Governance

Previous sections 7.2 and 7.3 discussed the urgency of the Nigerian electricity sector energy transition and the transition management process and governance. This section presents discussions on the findings from the study as regards the perception of the energy and non-energy actors on accountability and transparency in the grid-RE space in Nigeria concerning planning, governance and implementation. Therefore, to incorporate accountability and transparency to create a conceptual transition management framework in the Nigerian electricity sector, the following research questions are addressed:

- The perception of the energy and non-energy actors on the level of accountability and transparency in the grid-RE space in Nigeria.
- The role of transparency in facilitating grid RE development.
- Transparency mechanisms by actors that would accelerate grid renewable energy development and perception of the actors on who should be held accountable for the grid RE development.

There is a gap in the energy transition literature that applies TMF, as most research focuses on developed economies with advanced institutions and higher levels of accountability and transparency. This study attempts to close the gap by applying TMF to a country whose existing institutions are not advanced and inefficient, with accountability and transparency challenges. A few research has investigated accountability and transparency in energy transition relating to planning, governance and implementation. However, few or no studies found incorporated accountability and transparency into transition management, especially in the context of developing economies like Nigeria. Therefore, this study attempts to close the gap by developing a transition management conceptual framework that incorporates accountability and transparency. This study contributes to energy transition literature on the planning process, governance and grid RE strategies implementation in developing countries like Nigeria.

7.4.1 The Perception of the Energy and Non-Energy Actors on the Level of Accountability and Transparency in the Grid-RE Space in Nigeria.

The levels of transparency and accountability demonstrated in the sector speak volumes about how the sector is managed and how they want to be perceived by the community. These include agencies, ministries, associations, and parastatals (Sareen 2020). The findings indicate that the energy and non-energy actors interviewed have diverse perceptions of the level of accountability and transparency in the grid RE sector. The findings indicate that accountability and transparency are below the expected standard for the transition to grid RE energy (see 7.3). In addition, findings from the study accentuate the low level of transparency and accountability in the power sector.

For instance, research participant IR18 argued that being fully transparent and accountable is impossible when data is not readily available. This aligns with

Astoria (2017), Lockwood, Mitchell and Hoggett (2017), Brisbois (2019) and Brisbois (2020), who stated that data are used to maintain political leverage; hence the reason it is usually inaccessible to the public. However, there is a need for "data, information, financing, regulatory frameworks and innovation" for efficient and effective governance (Brisbois 2020), even if it requires a lengthy and tortuous political process for data collection, which might be deemed proprietary (Brisbois and De LOË 2017). Also, Yu et al. (2011) and Boardman and Subrahmanyam (2015) summarised how crucial transparent data is to governing the electricity sector. This is not only the case on a country level, Sovacool, Daniels and Abdulrafiu (2022) study of global funding for research and development relating to energy and climate across seventeen (17) countries and European Commission from 1990 to 2020 found that there are issues regarding limited data. Mirzania et al. (2023) study of the south African energy system concluded that lack of transparency in the implementation process.

Furthermore, research participants IR07 and IR24 argued that the general administrative process of the electricity sector creates bottlenecks for adequate transparency and accountability. This is supported by Henricks (2009), who demonstrated that accountability, and to a large extent transparency, is a "managerial/administrative phenomenon". This explains why the OECD's good governance principles are also designed to address accountability and administrative concerns (Akhmouch and Correia 2016). This is further corroborated by Sareen and Wolf (2021), who described the difficulty of finding accountability in an authoritarian and laissez-faire administration and aligns with an earlier study by Smith (2007), that renewable energy governance is technocratic and controlled by specialist partnerships and policy networks. This further supports Sareen's (2020) arguments that there is a need for more even and inclusive accountability relations and suggestions for encouraging a participatory decision-making process of various actors to foster energy transition towards sustainability. This necessitates improving and thriving for balanced accountabilities and transparency of energy transition actors to foster the deployment of renewable energy on the Nigerian grid.

7.4.2 The Role of Transparency in Facilitating Grid RE Development

From the study, transparency plays five identified roles important in actualising the goal of renewable energy on the Nigerian grid. This section will discuss the five themes supported with existing literature.

7.4.2.1 Effectiveness and efficiency in the system

Research participants described the importance of having transparency as it promotes the effectiveness and efficiency of the system, which will drive the development of grid RE in Nigeria.

IR05, IR13 and IR18 provided justifications that accountability and transparency will lead to a successful implementation of renewable energy on the Nigerian grid as transparency will encourage investment (Duraskovic et al. 2021). According to Araujo (2014), efficiency is one factor that determines an energy system's quality, hence understanding a country's socio-political system (dos Santos and Balestieri 2018; Adewuyi et al. 2020).

7.4.2.2 Education and acceptance of the actual cost of electricity generation and supply by end users

Furthermore, findings from the study identified transparency and accountability as critical ingredients for the Nigerian populace's social education and electrical technology orientation. Research participant IR05 argued that because of a lack of/inadequate transparency and accountability in Nigeria, most people are ignorant of the cost of producing electricity, especially since the government subsidises these costs without providing a comprehensive detail of the process. Also, research participant IR12 believed that more education is required, which will lead to the development of the energy sector, especially for grid-based renewable energy development. This is supported by Acikgoz (2011) and Cantarero (2020), who argue that the lack of awareness and interest and the low level of education in developing countries have resulted in "inadequate planning and investment decisions". Also, Walker and Devine-Wright (2008) and Cantarero (2020) corroborated this assertion that educating the populace leads to benefits such as accepting renewable energy projects in society. Segreto et al. (2020) posit that the availability of quality information and active participation in the process of planning will foster the growth in renewable energy.

7.4.2.3 Encourage investment and boost business confidence

Another important contribution of transparency and accountability is encouraging investment and boosting business confidence. Koster and Anderies (2013) explained that institutions must promote investments and innovations. This is similar to respondents' comments that investors are sceptical about considerable investments in the Nigerian renewable energy grid because of the uncertainty concerning investment returns. Cantarero (2020) stated that most people would not be aware of the government's activities for renewable energy development when they are kept behind closed doors. Research participant IR14 concludes that transparency, especially regarding available incentives for renewable energy development, will encourage more investments in the sector. This is supported by Adewuyi et al. (2020), who describe the challenges of slow recovery and return on investment as a significant challenge in the power sector and call for a favourable environment for sound policies and legislation.

7.4.2.4 Good governance of grid RE

Another major challenge in the power sector, especially in developing renewable energy on the Nigerian grid, is the duplication of roles and responsibilities by different government agencies and ministries. This creates a bottleneck in improving governance and implementation of renewable energy on the Nigerian grid (Caralis et al. 2013; Adewuyi et al. 2020). This finding aligns with Aliyu, Ramli and Saleh (2013).

Research participant IR21 expresses the opinion that the lack of transparency in this institution is the main reason for the duplication of duties and that with improvement in transparency, there will be lesser opportunities for different institutions to be charged with performing the same role, which hinders good governance of the administration of the grid RE in Nigeria. Kivimaa and Kern (2016) and Morgunova and Shaton (2022) support this conclusion, saying that the "institutional and governance process" requires investigating and correction when necessary to benefit the community.

7.4.2.5 Growth in RE deployment

Furthermore, research participants opined that accountability and transparency would lead to growth in implementing and developing renewable energy on the Nigerian grid. Research participant IR12 stated that Nigerians and other international investors are willing to invest in renewable energy development in Nigeria, especially on the grid, but for various uncertainty concerns and accountability and transparency challenges. However, participants IR12, IR15 and IR17 expect growth in renewable energy development on the grid when these concerns are addressed. This is similar to Koster and Anderies (2013), who stated that investment in RE development coincides with strong institutional development.

7.4.3 Transparency Mechanisms by Actors that Would Accelerate Grid Renewable Energy Development

7.4.3.1 Publicly informed

The respondents provided suggestions and recommendations on improving accountability and transparency to accelerate grid renewable energy development. One way is to increase publicity about the issues to keep society informed. For example, research participant IR14 commented that the public should be informed about happenings in the renewable development space to create more awareness, fostering accountability and transparency. This is supported by Hall et al. (2018), who suggested sharing all information with the community and potential investors to help them make the best decisions, and Stritzke et al. (2021) argue that this is fundamental for transparency for good governance.

7.4.3.2 Metering of customers

Another avenue to promote accountability and transparency is to cease the culture of flat billing and provide every household with a meter (pre-paid or post-paid) to avert the challenges of over-billing, which occurs with the flat billing system. Research participant IR17 proposes that metering will promote accountability and transparency, making the process more effective and creating a conducive atmosphere for the development of renewable energy on the grid. This is similar to Adewuyi et al.'s (2020) suggestion that every household should be metered to pave the way for development of the power sector.

7.4.3.3 Introduction of the competitive bidding system

Also, respondents suggested that introducing a competitive bidding system for renewable energy development which is open, fair, and accessible, will lead to a more accountable and transparent system. For instance, research participant IR10 mentioned that competitive bidding would make the process accountable and improve transparency. Also, research participants IR05 and IR17 supported this recommendation. They opined that if competitive bidding were used for selecting the 14 solar companies, work would have progressed significantly on the renewable energy development on the grid. Ojijiagwo, Oduoza and Emekwuru (2018) and Adewuyi et al. (2020) also advised creating a "competitive, efficient and private sector is driven" power sector to derive the benefits of renewable implementation on the grid.

7.4.3.4 Improved leadership

Furthermore, participants mentioned the need to improve the quality of leadership in the electricity sector to improve the accountability and transparency of the sector. For instance, research participants IR15 and IR19 suggested that solving the leadership challenges of the sector by appointing qualified and professional leaders will improve the accountability and transparency of the sector and bring back trust from the populace. This is supported by Hamilton and Kellett (2013), who argued that lack of leadership hinders development; however, they recommend that local leadership is the most important. Also, Strizke et al. (2021) demonstrated the need for leadership to respond quickly to the need of the populace, especially at the local government level to promote the development.

7.4.3.5 Monitoring and audit

Finally, respondents suggested increasing awareness and implementing the audit and monitoring process to complete the loop, improving accountability and transparency for renewable energy development on the Nigerian grid. For example, research participant IR22 advised that strict adherence to the checks and balances process in place will foster accountability and transparency in the electricity sector. This is similar to Adewuyi et al.'s (2020) advice to include advanced technology in the audit and monitoring process to make it seamless.

7.4.4 Perception of the Actors on Who Should be Held Accountable for Grid RE Development

To ensure accountability and transparency of the renewable development process on the Nigerian grid, research participants identified the following stakeholders who are mostly government ministries, agencies, and parastatals.

7.4.4.1 Nigerian Government/Ministries

First on the list is the Nigerian government and its ministries. Most respondents ascribed the responsibility of ensuring accountability and transparency to the government and the ministries responsible for implementing the government's policies, programmes, and action plans. Research participants IR14, IR15 and IR27 stated clearly that it is the duty and responsibility of the government because it is empowered to do so, but it requires political will. Also, participants IR10 and IR22 distilled this down to the Ministry of Power because they are the ministry responsible for all issues in the power sector. This is similar to Adewuyi et al.'s (2020) assertion that governments are responsible for taking action that will lead to renewable energy development. Also, this is supported by Araujo (2014), who states that the government should take an "active interest" in all that concerns energy because it is fundamental to human existence.

7.4.4.2 National Electricity Regulatory Commission

Another important organisation that participants pinpointed to be responsible for ensuring accountability and transparency is the National Electricity Regulatory Commission (NERC). NERC, which is the agency of government that regulates all electricity-related issues in Nigeria, was identified by participants to be responsible for the improvement of accountability and transparency in all aspects of the power sector and for the renewable energy development on the Nigerian grid (NERC 2017; Adewuyi et al. 2020). Research participants IR02, IR05, IR07 and IR28 all agree that the regulatory commission provides the legal framework for the power sector, so they should be able to police and implement them to ensure everyone adheres to the dictate of the regulations. This is supported by Michalena and Hills (2013), who confirmed that better regulation and implementation were part of the success factors identified in the various case studies on the successful implementation of renewable energy, which was conducted in several countries, including Brazil, China, Spain, and the USA.

7.4.4.3 Energy Commission of Nigeria

Also, respondents recognised the Energy Commission of Nigeria (ECN) as another organisation that should be charged for improving accountability and transparency in the Nigerian power sector and, specifically, for the renewable energy development in the country. Research participants IR04 and IR18 responded that since the ECN currently take charge of the renewable energy development on the grid, they should be responsible for the accountability and transparency of the sector. According to Oyedepo (2012), government employees are not accountable for the electricity used in their offices; hence, they suggested that the ECN should start by encouraging accountability and transparency in government offices, thereby leading by example, and others would follow.

7.4.4.4 All stakeholders

Finally, respondents acknowledged that no specific person or organisation is responsible; however, all stakeholders should bear the responsibilities (government, non-government organisations, and private enterprises). Research participants IR13, IR20 and IR21 argued that no single entity could make this work unless every stakeholder played their part. They further explained that the government and its institutions have responsibilities, but so do the society, private companies, research institutes, NGOs, and external stakeholders, who could encourage accountability and transparency in the sector for renewable energy development. This is supported by Koster and Anderies (2013), who mentioned that every stakeholder has a role in renewable energy development. Therefore, a "framework of understanding and mutual compromise" should exist among all stakeholders to encourage the implementation of renewable energy on the Nigerian grid (Cristobal 2011).

7.4.5 Roadmap for implementing the on-grid renewable energy transitions strategies in Nigeria.

What are the key elements of the roadmap for the implementation of grid-based renewable electricity generation strategies in Nigeria?

Table 25 is the roadmap for the implementation of grid-based renewable energy development in Nigeria. The components of the roadmap include identified issues, planning process using TMF, recommended accountability measures, linkage to actors/stakeholders, drivers/goals and transparency goals.

The key elements of the roadmap for implementing renewable energy transitions strategies are highlighted below:

7.4.5.1 Barriers to grid based RE deployment implementing grid-based renewable energy development in Nigeria.

The first component of the roadmap is the list of all identified issues mentioned as barriers. These include infrastructural, policy and regulatory, socio-cultural, economic, political, market-related, institutional, financial, legal, administrative and technological barriers. These are the factors that respondents identified as mitigating the development of renewable energy in Nigeria, especially on the grid as described in Section 5.2. The factors encompasses Grid-Network-related and Renewable Energy Development-related concerns as summarised in Table 24. While the table shows the distinction, all these factors, that is, the Grid-Network-related and Renewable Energy Development-related, inhibit the development of renewable energy on the Nigerian grid. Addressing this barrier will aid the acceleration of renewable energy on the Nigerian grid. The next component is the review of all stages of grid-based renewable energy deployment on the Nigerian grid.

Table 24: Problems in Grid-network Electricity Provisions and Renewable Energy Development Related Concerns

Grid-Network-related	**Determining Factors**	**Renewable-Energy Development-related**
	Policy and Regulatory	Lack of continuity in policy Lack of deep thinking in the policy and strategy formulation No clear policies and implementation action plan for the policies
Distrust in management of the national grid Insecurity (kidnapping, banditry and vandalism)	Socio-Cultural Barriers	Lack of awareness of benefit Land use issues
Social budgeting	Economic Barriers	Economic decline and slow down Impact of national debt
Corruption	Political Barriers	Lack of government synergies and fragmentation in political decisions Lack of government commitment and political will Political risk and influence
Existing bureaucracy Management challenge	Administrative Barriers	
Existing financing and market structure of the power sector	Financial Barriers	RE Investments drawback
	Institutional Barriers	Lack of institutional synergy or mandate overlap Too many agencies need institutional leadership/Lack of specific agency for grid renewable energy
Pre-existing industry agreements Resistance and sabotage from current energy producers Liquidity challenge (ineffective revenue collections)	Market-Related Barriers	Lack of cost-reflective tariff
Technology maintenance	Technological/Technical Barriers	Lack of expertise and RE technology capacity in the sector Unreliability of the renewable energy technology Cost of technology Narratives from off-grid systems Technology implementation challenge Limited storage capacity Lack of research and development initiative
Grid unreliability Obsolete infrastructure Grid expansion challenge (grid capacity) Transmission line and distribution challenges Metering	Infrastructural barriers	

7.4.5.2 Planning process and actors/ stakeholders of transition for grid based RE deployment in Nigeria.

The roadmap planning process is patterned after the four stages of the transition management framework to cover all areas from problem structuring, envisioning and organising the transition arena, developing sustainability images, coalitions and joint transition agendas, and mobilising actors and transitions (experiments) to monitor, evaluating and adapting. For stage 1, an independent agency should be established to handle all grid renewable energy development affairs established by the government, Inter-Ministerial Committee and Nigerian National Council on Power. Also, a transition team was formulated to frame the issues and transition barriers and challenges identified above. The transition team should consist of representatives from the government, NERC, ECN, NEMSA, NBET, Ministry of Power, Ministry of Environment, Ministry of Finance, Non-Governmental Organisation (NGO), research institutions, universities, support networks such as the Renewable Energy Association of Nigeria, and potential end users tasked with the purpose of envisioning. For stage 2, a strong coalition of a wider stakeholder group should be constituted: representatives from the government, NERC, ECN, NEMSA, NBET, Ministry of Power, Ministry of Environment, Ministry of Finance and Standard Organisation of Nigeria, Non-Governmental Organisation (NGO), research institutions, universities, industry value chain actors and representatives of organisations, and support networks such as the Renewable Energy Association of Nigeria, potential end users and pro-renewable energy groups tasked with creating a basket of transition images and agenda.

Furthermore, existing renewable energy electricity generation targets were reviewed; a long-term vision was formulated to achieve a 30GW of electricity generation by 2030 and 30% from renewable energy sources. A support mechanism for grid renewable energy development must be implemented, and new mechanisms, such as a green certificate, must be introduced. Stage 3 is the introduction of renewable energy initiatives, programmes and projects sponsored by the government. These will be small-scale RE projects that relate to the grid from which learnings can be obtained. Also, learnings from the decentralised RE projects can be leveraged by introducing grid RE experiments. The result of the current study found that no renewable energy technology project relating to the grid has been executed. However, respondents indicated notable off-grid projects are ongoing, including projects that feed into the 11KVA distribution lines, but the capacity is too small. Mobilised actors for transitions at this stage should include generation, transmission and distribution companies, the regulatory agency (NERC), the Federal Ministry of Power, and ECN, wind and solar companies, the Nigerian government, research and development centres such as the Centre for Energy Conservation and Energy Efficiency, and the National Centre for Energy Research and Development, Renewable Energy Technology Funding Company, and Nigeria citizen's representatives, and associations (Renewable Energy Association and Power Generating Association). The final stage, stage 4, should involve a lookback and gathering of lessons learned and best practices. The process should be monitored, reviewed and critically evaluated to identify what this should involve (system and actor analysis), i.e., the target and agenda. Learnings should lead to revising the existing transition process and plan with the previous transition process and include new learnings in the new plan. Also, the next component is the stakeholders/actors required to ensure a successful implementation of renewable energy development. The identified actors are generation, transmission and distribution companies, the regulatory agency (NERC), Federal Ministry of Power and ECN, wind and solar companies, the Nigerian government, research and development centres such as the Centre for Energy Conservation and Energy Efficiency, and the National Centre for Energy Research and Development, Renewable Energy Technology Funding Company, and Nigeria's citizen's representatives associations (Renewable Energy Association and Power Generating Association), auditors, inspectors, controllers, and other regulatory agencies. The next sections discuss the accountability measures to be incorporated at each stage of the planning process for the actualisation of renewable energy on the Nigerian grid.

7.4.5.3 Measures to foster accountability in the transition planning process and governance of grid-based renewable energy development in Nigeria.

The suggested accountability measures will be presented based on the stages of the proposed transition planning process. Stage 1 is establishing a singular agency responsible for grid renewable energy projects and initiatives. A hybrid accountability mechanism should be implemented to foster accountability throughout the transition process and in the governance of transitions. At stage 2, transition agenda formation should be an open process with the inclusion of all necessary stakeholders (identified in section B above). There should be the dissemination of information on the participants' selection process, meetings and outcomes. Also, there should be an enforcement of the current legal frameworks. For stage 3, there should be an introduction to accountability and transparency through a competitive bidding system for project execution. Furthermore, information about the status and state of the project should be published regularly and disseminated to the public. Finally, at the last stage, learnings should be made publicly available and accessible, and implementation of better monitoring and audit process and robust societal engagements ensured.

7.4.5.4 Strategies for implementing grid-based renewable energy development in Nigeria.

The roadmap provides ten (10) measures that can be considered to foster the implementation of grid-based renewable energy development in Nigeria: an enabling environment for the growth and maturity of the technology, the introduction of an education fund for the development of the necessary skills, upgrade and increase of the Nigerian grid capacity to take on renewable energy. Furthermore, the development of renewable energy on the Nigerian grid will be complex without the implementation of a support mechanism, as contained in the policy document, to foster transition and establishment of a feed-in tariff that will make it competitive with petroleum products which are presently subsidised and creating mixed signals for renewable energy development. There is also an opportunity for introducing a smart grid to capitalise on the high societal acceptance by devising engagement initiatives like intelligent grid options. Without the establishment of a dedicated agency to handle grid renewable energy innovations and projects and the creation of a clear and detailed actionable implementation plan. This recommendation might not amount to anything as it serves as a foundation for further strategies, such as the encouragement of existing and new support networks, and the government should leverage policies and partnership with technology providers and financiers to foster transitions and encourage investment. This is discussed in-depth in section 8.6 of this study.

7.4.5.5 Drivers for renewable energy development and transparency goals

Finally, the last component of the roadmap is the drivers for renewable energy development and transparency goal. The findings in section 5 suggest that the Nigerian grid's vision to achieve 30GW of electricity generation by 2030 and 30% from renewable energy sources was driven by the goal to improve energy access and security of supply, energy mix and diversification. Furthermore, there are sustainability and environmental considerations, international influences, meeting the growing demand and boosting economic development, and leveraging and utilising the nation's renewable energy resources. Moreover, findings in the section indicate that transparency in the grid RE development planning process and governance will promote an effective and efficient system, education and acceptance of the actual cost of electricity generation and supply to end users, encourage investment and boost business confidence, good governance of grid RE and growth in RE deployment.

Also, the roadmap is useful for decision-makers, policymakers, planners, and energy and non-energy actors to implement grid-based renewable energy development in Nigeria. However, this is supposed to be evergreen and incorporate new ideas as the projects evolve to achieve a successful development.

Table 25: Roadmap for implementing grid-based renewable energy development in Nigeria.

Barriers	Infrastructural, Policy and regulatory, Socio-cultural, Economic, Political, Market-related, Institutional, Financial, Legal, Administrative and Technological/Technical Barriers			
Planning process	• Formulation of Independent Agency • Selection of Transition Team (Frontrunners) • Problem Framing	• Formation of a strong coalition of a wider stakeholder group • Review of the existing renewable energy electricity generation targets. • Support mechanism for grid renewable energy development needs to be implemented and new mechanism introduced such as green certificate.	• Introduction of renewable energy initiative, programmes and projects sponsored by the government. This will be small scale RE projects that relates to the grid from which learnings can be obtained. • Also, learnings from the decentralised RE projects can be leveraged in the introduction of grid RE experiments.	• The process should be monitored, reviewed and critically evaluated to identify what this should involve (system and actor analysis). i.e., the target and agenda. • Learnings should lead to revision of the existing transition process and plan with the previous transition process and include new.
Actors/ stakeholders	Government, inter-ministerial and Nigerian National Council on Power. Representatives from the Government, NERC, ECN, NEMSA, NBET, Ministry of power, ministry of environment, Ministry of Finance Non-Governmental Organisation (NGO), Research Institutions, Universities, Support networks such as the Renewable Energy Association of Nigeria, potential end users.	Representatives from the Government, NERC, ECN, NEMSA, NBET, Ministry of power, ministry of environment, Ministry of Finance and Standard Organisation of Nigeria, Non-Governmental Organisation (NGO), Research Institutions, Universities, industry value chain actors and representatives of organisations and support networks such as the Renewable Energy Association of Nigeria, potential end users and pro renewable energy groups.	Generation, transmission and distribution companies, the regulatory agency (NERC), Federal Ministry of Power, and ECN, wind and solar companies, the Nigeria government, research and development centres such as the Centre for Energy Conservation and Energy Efficiency and the National Centre for Energy Research and Development, Renewable Energy Technology Funding Company, and Nigeria's citizens representatives, and associations (Renewable Energy Association and Power Generating Association).	Generation, Transmission and Distribution companies, the regulatory agency (NERC), Federal Ministry of Power, and ECN, wind and solar companies, the Nigeria government, research and development centres such as the Centre for Energy Conservation and Energy Efficiency and the National Centre for Energy Research and Development, Renewable Energy Technology Funding Company, and Nigeria's citizens representatives, associations (Renewable Energy Association and Power Generating Association), Auditors, Inspectors, controllers, and other regulatory agencies
Accountability measures	Establishment of a singular agency responsible for grid renewable energy projects and initiatives. Introduction of hybrid accountability.	Transition agenda formation should be an open process with inclusion of all necessary stakeholders. There should be dissemination of information on participants selection process, meetings and outcomes. Enforcement of current legal frameworks.	Introduction of accountability and transparency through competitive bidding system. Information about the status and state of the project should be published regularly and disseminated to the public.	Learnings should be published. Implementation of better monitoring and audit process and robust societal engagements.
Strategies	• Enabling environment for the growth and maturity of the technology. • Introduction of education fund for the development of the necessary skills. • Upgrade and increase of the Nigerian grid capacity. • Implementation of support mechanism as contained in the policy document to foster transition. • Establishment of a Feed-in tariff that will make it competitive with petroleum products which are presently subsidised and creating mixed signals for renewable energy development. • Embarking on societal engagement initiative through the introduction of smart grid. • Establishment of a dedicated agency to handle grid renewable energy innovations and projects. • Creation of a clear and detailed actionable implementation plan. • Encouragement of existing and new support networks. • Government should leverage policies and partnership with technology providers and financiers to foster transitions and encourage investment.			
Transparency goals	• Effectiveness and efficiency in the system. • Education and acceptance of actual cost of electricity generation and supply to end users. • Encourage investment and boost business confidence. • Good governance of Grid RE. • Growth in RE deployment			

Drivers /goals

- Energy Access and security of supply.
- Energy Mix and Diversification
- Sustainability and environmental considerations
- International influences
- Growing demand and economic development
- Utilisation of renewable energy resources

7.5 Chapter Summary

The chapter presented a rich discussion of the qualitative data analysis for the development of renewable energy on the Nigerian grid. The discussions indicates that findings align with the MLP, TMF theories and the introduction of the accountability and transparency concepts are important elements in the context of Nigerian transition which was not considered in the theories. There are pressures affecting the landscape, which are resisting or supporting on-grid renewable energy development. Furthermore, the discussion revealed that socio-cultural, socio-ecological and environmental, social-political, social-economic, and technological elements re-configuring the socio-technical landscape of the on-grid renewable electricity sector. Moreover, findings in this chapter shows that the incumbent electricity system is characterised by several inadequacies which undermine the capacity to meet the energy demand and improve energy access in Nigeria. However, it is evident that there are developing support for RE niche innovations through societal acceptance and support networks as enablers for renewable energy deployments. Furthermore, the findings suggests that the accountability and transparency of the process and governance are below the expected levels. To conclude the chapter, a roadmap with key elements from the study are recommended to accelerate grid renewable energy development. The next chapter presents the summary, conclusion and recommendation.

CHAPTER EIGHT: SUMMARY, CONCLUSION AND RECOMMENDATION

8.1 Introduction

This chapter summarises the research work and describes the key research contribution, policy and recommendation, including the originality and generalisation, and the limitation and future area of research.

The chapter is structured as following: Summary of key research findings in section 8.2, the implication of the study in section 8.3 followed by Research contribution in section 8.4. Furthermore, section 8.5 discusses policy implication and recommendations, section 8.6, originality and generalisation and lastly the limitation and future research direction presented in section 8.7.

8.2 Summary of Key Research Findings

This study aimed to assess the renewable energy planning process and governance for sustainable development and propose a model roadmap for implementing grid-based RE electricity generation strategies in Nigeria. The roadmap developed is a significant contribution to new knowledge. In light of this, the study sets out to answer the following research questions and achieve the objectives (indicated in section 1.6) which have been achieved in this thesis. The study’s objectives and questions are presented below and then answers to the research questions summarised.

Table 26: Research objectives and questions

Research Objectives		Research Questions
1	To critically assess Nigeria's electricity generation sector and the development of renewable energy.	What are the challenges of Nigeria's electricity sector and the role of renewable electricity generation to address them?
2	To design a conceptual framework for the successful transition planning process of grid-based renewable electricity generation in Nigeria using MLP, TMF and accountability and transparency concepts.	What are the determining factors for successful planning process of grid-based renewable electricity generation in Nigeria?
3	To critically assess the renewable energy planning process and governance incorporating accountability and transparency for sustainable development in Nigeria using the developed framework.	What are the renewable energy planning process and governance for sustainable development in Nigeria? and how accountable and transparent are the processes?
4	To critically investigate and analyse, using the developed framework, the key elements of the roadmap for the implementation of grid-based renewable electricity strategies in Nigeria.	What are the key elements of the roadmap for the implementation of grid-based renewable electricity generation strategies in Nigeria?
5	To propose recommendations that policymakers and other stakeholders can adopt to steer the renewable electricity generation growth and development in Nigeria.	

The summary of the conclusions to the research questions is discussed below.

Q2. What are the determining factors for successful planning process of grid-based renewable electricity generation in Nigeria?

It was discovered in this study that there are various determinants for the successful planning process for grid-based renewable energy development. These determinants are in the form of barriers, drivers and enablers to the actualisation of the implementation strategies. The barriers are multifaceted and complex and outweigh the drivers for the transition; though there are enablers, most of these enablers are not fully functional as they are only contained in the renewable energy policy documents; however, they are identified in this study as critical facilitators and strong signal of transitions.

The study reveals the nuance of policy implementation and regulatory issues in the form of policy discontinuation, unrealistic regulations, government dominance in the electricity sector and lack of deep thinking around policy formation and execution and achievable action plans. Furthermore, the socio-cultural barriers, such as a lack of societal understanding of the benefit of renewable energy technology deployment, distrust in the management of the national grid and the security issues in Nigeria. It was also found that the high cost of the deployment of RE technologies is a major deterrent to the present state of the Nigerian economy, which is characterised by a decline and slow down as the nation's primary revenue is from fossil fuel exportation, and this has been imparted by the downturn in oil and gas sector, thereby affecting the social budgets and increase in national debt.

A dimension of the determinant is the political segment which this study reveals also serves as a bottleneck for transitions as there is a lack of government synergy and fragmentation in political decisions, corruption, paucity of government commitment and political will, presence of political risks and influence which discourages potential investors from investing in the sector. This is coupled with the lack of enforcement of the legal framework and requirement to encourage the rapid growth of RE in Nigeria.

Other barriers include:

- Administrative barriers; existing bureaucracy and management issues.

- Financial Barriers; existing financing and market structure of the power sector, RE investments drawback, lack of security on investment.
- Institutional Barriers: institutional synergy or mandate overlap, too many agencies need institutional leadership/Lack of specific agency for grid renewable energy.
- Market-Related Barriers; lack of cost-reflective tariff, pre-existing industry agreements, resistance and sabotage from current energy producers and liquidity challenge (ineffective revenue collections).
- Technological/Technical Barriers; lack of expertise and RE technology capacity in the sector, the unreliability of the renewable energy technology, cost of technology, narratives from off-grid systems, technology maintenance and implementation challenges, limited storage capacity, lack of research and development initiatives.
- Infrastructural barriers; grid unreliability, obsolete infrastructure, grid expansion challenges (grid capacity), transmission lines and distribution challenges and metering.

Furthermore, regarding drivers as determinants of transitions, in the context of the Nigerian grid and most African countries with unmet energy needs, the essential drivers revealed in this study for consideration of RE are to address the energy access, security and quality challenges, including diversifying the energy mix, which is mainly based on gas, taking into consideration the growing energy demand and population in Nigeria. The study also revealed that RE harnesses the country's vast renewable sources (solar and wind) and boosts economic development. Other drivers identified are the need to foster a low-carbon economy and address the issue of climate change. An interesting find is the international influence inform of agreements, trends and funding, which serves as pressure to transition.

Lastly, this study revealed support mechanisms, financial, emerging support networks, social acceptance and emerging information on renewable energy as facilitators for its development. However, the support mechanisms and financial backings are not yet enforced in the renewable energy policies, but the study found that it gives a positive signal and encourages its development.

Q3. What are the renewable energy planning process and governance for sustainable development in Nigeria and how accountable and transparent are the processes*?*

Qualitative findings have shown that the transition planning and governance revealed insights into the processes' accountability and transparency. These were presented in Chapter 6 in sub-sections: i.e., the transition planning and arena formulation: formulation of transition arena and groups for on-grid renewable energy deployment, formation of on-grid renewable energy target and vision, and the objectives of on-grid renewable energy development; transition design: transition coalition building and stakeholder participation; transition network of actors: stakeholder involvement and participation in the projects and projects monitoring, evaluation and learnings. The summary is presented below:

Firstly, the transition planning and arena formulation, the formulation of transition arena and groups for on-grid renewable energy deployment. From the findings, it was deduced that Nigeria's arena for on-grid renewable energy deployment was in two forms, i.e., the international and national arena.

Furthermore, an on-grid renewable energy target and vision was formed to achieve 30% of 30 GW of grid electricity generation by 2030. Also, there are several objectives for the on-grid renewable energy goal, including achieving a healthy energy mix, increasing energy access, and improving energy security.

Secondly, the transition design was sub-sectioned into transition coalition building and stakeholder participation. The study revealed that a coalition was built in the on-grid renewable energy transition process to attain the unified goal of incorporating novel technologies on the Nigerian grid. This coalition involved multiple stakeholders classified in this study into decision-makers, non-decision-makers and value-chain players and frontrunners.

Thirdly, based on the literature, the operationalising transition relates to the steering process and experiment. The discussions were divided into transition projects and stakeholder involvement and participation in the projects. It was found in this study that the on-grid transition pathway has yet to record success, as no RE project on the grid has been executed. Also, the transition network of actors consisted of a transition team with RE companies selected as frontrunners in the transition process, which the Ministry of Power facilitated. Furthermore, the study revealed the need to foster an enabling environment for grid RE frontrunners to innovate, stimulating RE development on the Nigerian grid. This was found in the literature and analysis of the qualitative data that the Power Purchase Agreement for grid RE deployment was not concluded due to the state of the grid. It further revealed that the Put-Call Option Agreement and Partial Risk Guarantee were accompanying agreements requested by the frontrunners for the financial closure to be reached. Put-Call Option Agreement hit a gridlock due to the contention between the IPPs, the Ministry of Finance and the Federal Government.

Fourthly, the study found that pioneers were selected through an informal process other than a competitive bidding process relating to project monitoring, evaluation and learning. Also, there has yet to be any monitoring, evaluations or learning put in place, as no grid-based renewable energy project was executed at the time of data collection. However, an interesting revelation is the need to take on learnings from the off-grid space and monitoring processes which have recorded a level of success to inform decisions regarding grid deployment.

In addressing the question of how accountable and transparent are the processes? The study revealed that there are diverse views on the level of accountability and transparency; however, this is below the expected level. While transparency is fostered in the renewable energy policy, which charts out the government plan for RE development, incentives and support mechanisms to enable transitions are susceptible to accountability and transparency issues. It was revealed that transparency could be improved by setting up mechanisms to keep the populace informed. Others include metering of customers, the introduction of a competitive bidding system, improving the leadership of the electricity sector and introducing monitoring and auditing initiatives.

The qualitative data showed that transparency plays a role in Grid RE development. The emerging themes was *effectiveness and efficiency in the system, education and acceptance of actual cost of electricity generation and supply by end users, encourage investment and boost business confidence, good governance of grid RE, growth in redeployment.*

Furthermore, to establish how accountable and transparent the processes for transition are, a qualitative data analysis of the interviewees' responses on who should be responsible for ensuring the grid RE planning and implementation process was transparent and accountable showed divergent opinions, and there is no specific agency charged with grid RE deployment accountability and transparency. Although, the results indicated that the Nigerian government should be responsible for ensuring the transition planning and process for grid RE deployment is transparent, and its institutions should be tasked with this responsibility.

Q4. What are the key elements of the roadmap for the implementation of grid-based renewable electricity generation strategies in Nigeria*?*

In furtherance to answering questions 2 and 3, the key elements emerged from the roadmap captured in Table 25, which are essential for grid-based renewable energy implementation in Nigeria based on the qualitative analysis. This study revealed the key components of the roadmap necessary for the successful deployment of grid renewable energy technologies in Nigeria. These include identified issues, planning process using TMF, recommended accountability measures, linkage to actors/stakeholders, drivers/goals and transparency objectives.

Multiple barriers need to be surmounted, and its multifaceted dimension creates more complexities to overcome. This cuts across infrastructural, policy and regulatory, socio-cultural, economic, political, market-related, institutional, financial, legal, administrative, technological and technical barriers.

The study also revealed essential elements in the planning process, with the need to establish a dedicated agency to handle grid-related matters and promote accountability and transparency, as there is an absence of adequate oversight and a dedicated agency addressing issues relating to the grid.

Furthermore, the study reviewed some crucial stakeholders who were left out of the transition process, and this highlights the importance of establishing a transition team tasked with envisioning the nature of the transition. This should consist of government players, NERC, ECN, NEMSA, NBET, Ministry of Power, Ministry of Environment, Ministry of Finance, and other groups such as NGOs, research institutions, universities, support networks such as the Renewable Energy Association of Nigeria, and potential end users. Furthermore, this same group of players should be part of the next stage of creating a basket of transition images and pathways. It should also consist of broader stakeholders such as the Standard Organisation of Nigeria, the industry value chain actors, and representatives of organisations to execute renewable energy projects. Also, this study reveals the vision was 30GW of electricity generation by 2030 and 30% from renewable energy sources; however, though there are support mechanisms, there is a need to expand this support to implementation and introduction of new mechanisms such as green certificate. Furthermore, small-scale projects should be introduced and executed with learnings, monitoring and audit processes. Moreover, transparency should be fostered through societal participation, information dissemination, and legal framework implementation.

The roadmap also recommends accountability measures and strategies to boast and promote an enabling environment for the growth and maturity of the technologies, introduction of education fund for the development of the necessary skills, upgrade and increase of the Nigerian grid capacity, implementation of support mechanism as contained in the policy document to foster transition, establishment of a feed-in tariff that will make it competitive with petroleum products which are presently subsidised and creating mixed signals for renewable energy development, embarking on societal engagement initiative through the introduction of smart grid, establishment of a dedicated agency to handle grid renewable energy innovations and projects, creation of a clear and detailed actionable implementation plan, encouragement of existing and new support networks and government should leverage policies and partnership with technology providers and financiers to foster transitions and encourage investment.

Transparency goals were revealed in the study, such as supporting effectiveness and efficiency in the system, education and acceptance of the actual cost of electricity generation and supply to end users, encouraging investment and boosting business confidence, good governance and growth in RE deployment.

These should promote access and security of electricity and increase and diversify the energy sources. In addition, meet the growing demands, sustainability and environmental goals and embrace global transitions.

8.3 Implication of the Study

This sub-section presents the implication for energy transition studies from a socio-technical lens. This implication of the study will be discussed in the context of a multi-level perspective, transition management framework and accountability and transparency theory. The implication of the study will be provided from two aspects: the theoretical and practical implications of the study.

8.3.1 Theoretical Implications of this Study

This study's results confirm the usefulness of the multi-level perspective and transition management framework, including accountability and transparency concepts, in investigating renewable energy transitions on the Nigerian grid.

The research findings corroborate other previous research that understanding transitions and how to accelerate the transformation of complex systems such as electricity systems involves the study of the society and interaction with the technological aspect of transitions (socio-technical transitions) (such as Geels 2002; Smith, Stirling and Berkhout 2005; Geels and Scot 2007; Ruggiero Varho and Rikkonen 2015; Geels 2019). The findings of this study enhance the understanding and contribute to the literature on energy systems transformation tenets. The findings imply that the dynamics of socio-technical change involve factors such as policy and regulatory, socio-cultural, economic, political, market-related, institutional, financial, legal, administrative, technological and infrastructural factors. Some of these factors are articulated in previous research (see Elzen, Geels and Green 2004; Sovacool 2014; Strachan et al. 2015; Cowell et al. 2017; Butu 2017, De Laurentis and Cowell 2022).

Furthermore, this study contributes to the operationalisation of MLP and transition management theory, as it lacks substantial empirical analysis, especially in developing countries where energy access is not optimal by the application to Nigeria, as most prior applications have been in developed economies, mainly in Europe (Geels 2002; Kemp et al. 2007; Sarrica et al.

2016). Findings from the study show that the challenges of the Nigerian electricity system transition are multifaceted and complex. At the same time, this is similar to the developed countries' context, and the formal is colossal, different and unique. This supports Batinge, Musango and Brent's (2019) conclusions that the multi-dimensionality of sustainable transitions differs for countries like Nigeria, which are developing to developed economies.

Also, this research contributes to the discussions that the multi-level perspective and transition management framework needs to be modified to apply to developed nations like Nigeria as it is mainly constructed in developed countries' context and for developed countries (Rotmans et al. 2000; Geels 2002). The present study reveals that the investigation of energy transition from a socio-technical perspective should take into consideration the sensitivity of the region and country.

The study designed a conceptual model for the Nigerian on-grid RE, contributing to sustainability transition studies. The model is a fusion of multi-level perspectives, a transition management framework and accountability and transparency concepts. The Nigerian Grid Renewable Energy conceptual model is an adaptation of Geels' (2002) multi-level perspective framework, which provides an understanding of the transition dynamics of large socio-technical systems such as the electricity system. Also, Loorbach and Rotmans' (2010) transition management framework guides a sustainable future by prescribing a transition planning process, stakeholder involvement, coordination and engagement and decision-making (governance and societal actors). It provides insights into elements that foster transitions in the pre-development phase of transitions. Therefore, it implies that understanding elements of transitions in the take-off, acceleration and stabilisation phase of transitions in a developing country context like Nigeria will be a useful insight in comprehending the variances in this phase.

Furthermore, the accountability and transparency concepts, which is a dimension of accountability, provide principles to promote good governance (Bovens 2007). The model designed demonstrates the dynamics of the electricity system transition, identifying the different dimensions of interactions and tensions in the context of the Nigerian RE sector. It also presents the governance and planning process of the Nigerian grid RE actualisation, with a specific focus on the accountability and transparency of the process.

Furthermore, the case study approach and contextualisation of this study to a specific country (Nigeria), sector (electricity) and sub-sector (renewable energy) have theoretical implications for transition studies as it contributes to the limited spatial dimension considerations in the discourse of energy transitions.

The conceptual framework shows that though there are significant pressures from the landscape level and evidence of cracks in the incumbent fossil-fuel-based regime, the immaturity in the renewable energy projects and the multifaceted challenges of the grid system are preventing renewable energy penetration on the grid. This implies that the inefficiencies of the existing regime systems, which provide a window of opportunity for niche development, also could inhibit or deter niche development; whereas weak regime systems are necessities for socio-technical transitions (cf Roberts and Geels 2019, Morgunova 2021).

Also, the findings of this study show that the dynamics of governance and societal actors' engagement in the transition to a sustainable future could differ in various socio-political transition contexts. This implies that the transition management framework cannot be applied as a definitive guide for systemic transformation as the context (i.e., socio, political, economic and cultural elements) of transitions are evolving. Therefore, this furthers Loorbach and Rotmans' (2010) and Kelly, Ellis and Flannery's (2018) arguments for more research to adapt TMF to various regions, countries, contexts and sectors. Furthermore, this implies that transition studies need more development of conceptual models for energy transition within different spatial, institutional and governance conditions.

The finding also suggests that accountability and transparency are below the expected level, and it is an essential condition for accelerating transitions to a sustainable future. The findings within this study build on the debate of accountability and transparency design that factors in the specificities of the context of accountability and transparency by applying this study to the context of the Nigerian electricity sector (see Fox 2010; Bovens, Goodin and Schillemans 2014). It also serves as a bridge between transition studies and the accountability and transparency domain.

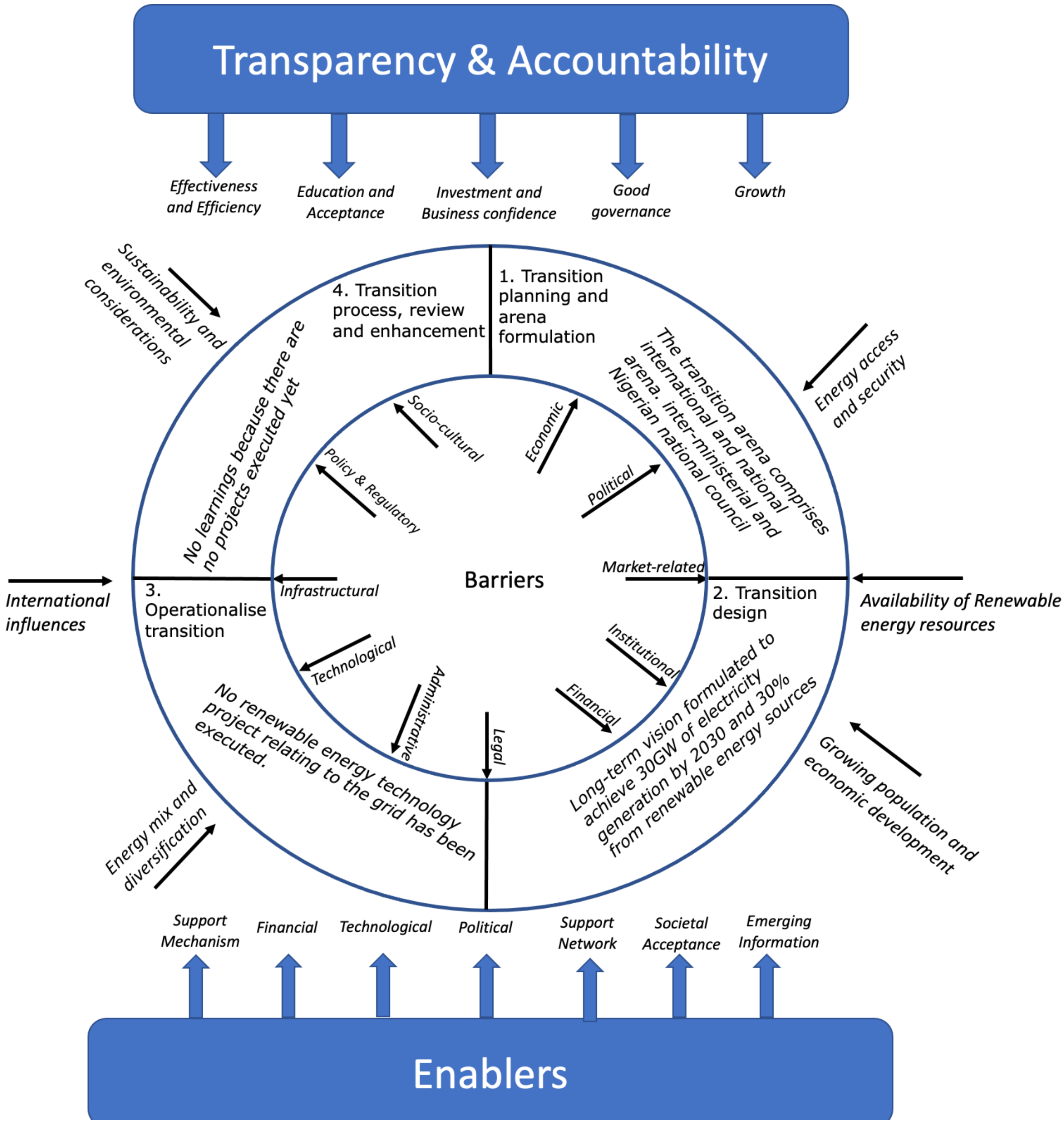


Figure 30: Updated Conceptual Framework: Modules for Successful Transition of Grid-Based Renewable Energy Generation in Nigeria

The updated conceptual framework is represented by Figure 30, which comprises two (2) concentric circles bordered within and without by forces representing barriers and drivers for renewable energy development. The concentric circles are placed on a smooth platform representing enablers for renewable energy development and are illuminated above by transparency and accountability. The space between the concentric circles (divided into four (4) equal parts) represents the four (4) modules of a successful transition, i.e., transition planning and arena formulation, transition design, operationalise transition and transition process, review and enhancement. However, conceptualising this to the results of the studies, each stage means that the transition arena comprises the international and national arenas (inter-ministerial and Nigerian National Council on Power), a long-term vision formulated to achieve 30 GW of electricity generation by 2030 and 30% from renewable energy sources, no renewable energy technology project relating to the grid has been executed and no learnings because there are no projects executed yet, respectively.

However, the internal forces (barriers) preventing the development of grid-based renewable energy development in Nigeria, as described by the respondents, include the following: political, market-related, institutional, financial, legal, administrative, technological, infrastructural, policy & regulatory, socio-cultural, and economic barriers. Also, the external forces (drivers) pushing for the grid-based renewable energy development in Nigeria include energy access and security, availability of renewable energy resources, growing population and economic development, energy mix and diversification, international influences, and sustainability and environmental considerations.

Furthermore, the smooth platform underneath the concentric circles (enablers) would help ensure grid-based renewable energy development in the country. These factors, as identified by the respondents, are called the enablers of renewable energy development. These include support mechanisms, financial enablers, technological enablers, political enablers, support networks, societal acceptance, and emerging information. Finally, the illuminant at the top of the model represents transparency and accountability, which illuminates the other parts of the model. These factors include effectiveness and efficiency, education and acceptance, investment and business confidence, and good governance and growth.

The updated conceptual framework shows an interplay within the entire system and the impact of all forces (internal and external forces) on the stability or otherwise of the system. For the system (grid-based renewable energy development) to work, the external forces (drivers) must overpower the internal forces (barriers) with the help of the enabling factors. However, this must be done with transparency and accountability to ensure success.

8.3.2 Practical Implication

This study's findings suggest that the Nigerian grid system's inherent inadequacies and inefficiencies are inhibiting transitions. The findings suggest that the governance system and management could be improved to accelerate the transition. Prior studies have spotlighted the Nigerian electricity sector's challenges, especially regarding renewable energy (Gungah, Emodi and Dioha 2019; Nwozor et al. 2021). This serves as a recipe for energy planners to have a good overview of elements determining the successful implementation of grid-based renewable energy strategies. The findings also suggest that the governance system and management structure needed for transitions in developing countries differ from the developed countries' perspectives. This could be explained as the unique context of transition in such areas as sub-optimal institutional maturity, transparency, and accountability. Therefore, this study recommends that an independent agency facilitates the transition into the grid-based renewable energy space through public-private partnerships.

The updated conceptual model also has implications for planners, representing the modules for the successful transition of grid-based renewable energy generation in Nigeria. It depicts the understanding of the barriers, enablers, drivers and accountability and transparency elements required for Nigeria's grid-based renewable energy transition's governance and planning process. Against this backdrop, the roadmap for implementing renewable energy transition strategies in Nigeria is developed, which suggests the pathway to achieving 2030 renewable energy targets to policymakers and planners. The suggestion is presented in section 7.4.5.

8.4 Research Contribution

The study contributes to theory and practice in transition studies of socio-technical transition of large-scale energy systems. It advances the debate that the transformation of energy systems involves the interactions of economic, ecological, socio-cultural and institutional factors, which are difficult to change (see Rotmans et al. 2000; Kemp and van Lente 2011; Geels and Schot 2007; Geels 2011; Ruggiero, Varho and Rikkonen 2015; Geels, McMeekin and Pfluger 2020; Loorbach and Rotmans 2010; Roorda and Wittmayer 2014; Verbong and Geels 2010).

This research shows that the transition of the Nigerian electricity system is complex and faced with multiple challenges in the inhibiting introduction of renewable energy on the Nigerian grid, including transparency and accountability challenges. Moreover, this research develops a conceptual framework and energy transition roadmap for the acceleration of renewable on the Nigerian grid system to the field of transition studies. This was achieved by integrating the multi-level perspective framework, transition management framework and accountability and transparency concepts to analyse Nigeria's sustainable transition of electricity systems. This was done from a socio-technical pathway as it focuses on understanding and studying the influences of renewable energy technology on society and the development of policy and planning processes. Hence, it provides insights into the societal changes and interactions due to the introduction of RE technology. This provides the conceptual and theoretical premise as this study assesses the interdependence and complex interaction of people and technology systems (renewable energy technologies) in the grid-based electricity sector of Nigeria.

Despite the extant literature on renewable energy in Nigeria, no theoretical framework contains all the elements for facilitating and managing energy transitions relating to the on-grid renewable energy sector. Against this backdrop, this research sets out to create a model for renewable energy planning and governance to foster the implementation of grid-based renewable electricity generation strategies for sustainable development in Nigeria. Before forming the conceptual framework, the researcher identified the need to incorporate transparency and accountability as it is crucial for grid RE policy execution (Gungah, Emodi and Dioha 2019; Adeniyi 2019; Ayodele et al. 2021). This research recognises that the energy transition complexities can be understood by considering the social and technical aspects by espousing the multi-level perspective and transition management framework from transition studies and incorporating the accountability and transparency concepts. Therefore, this research on the inception reviewed and explored global energy transition and determining factors for successful planning and governance of renewable energy. This provides a strong foundation and explicates the transition model developed in the study. Butu (2017) presents some of these concepts for an off-grid shape project in Nigeria. However, the findings of this study relates to a Grid system and can be replicated by other countries with similar techno-economic, socio-technical and political considerations to Nigeria and serve as a basis of research for other countries.

8.5 Policy Implications and Recommendations of the Study

The role of the Nigerian government is critical for the successful implementation of grid renewable energy strategies. In light of this, the following are policy recommendations based on the interview results. These recommendations could accelerate the energy transition discussed in three parts. Firstly, the results of the study showed that the Nigerian grid electricity system faces multifaceted challenges that inhibit the introduction and development of renewable energy on the Nigerian grid. These barriers emanate from technical/technological, policy and regulatory, institutional, infrastructural, socio-cultural, economic, political, market-related, legal, financial, and administrative. The most significant barriers identified from the data analysis are the policy, regulatory, infrastructural, institutional, financial, market and technology barriers.

8.5.1 Recommendations to Address the Barriers to Grid-Based RE Deployment.

At the end of this research, the following recommendations are apparent to encourage the development of grid-based renewable energy in the Nigerian electricity sector:

1. **Provision of an enabling environment for the growth and maturity of the technology through research and development and introduction of education fund for the development of the necessary skills**.

   Providing an enabling environment for renewable energy technology's growth, development, and maturity, especially on the Nigerian electricity grid, cannot be over-emphasised. The government must ensure policies and policy instruments cater to investors, developers, financiers, supply chain managers and other stakeholders required to enable the sector's development. Also, more emphasis and attention should be placed on research and development of the technology to build capacity and further reduce cost by utilising readily available resources in Nigeria, instead of depending on importation to develop the technology. Furthermore, the introduction of an education fund for the development of the necessary skills is paramount. This will encourage young people interested in building capacity in various aspects of renewable energy development to do so at the lowest cost possible. This is an incentive to get the best brains and hands to help develop the sector without the deterrence of tuition costs.

2. **Upgrade and increase of the Nigerian grid capacity.**

   Another critical factor that requires urgent consideration is the upgrade and expansion of the power capacity of the Nigerian grid. Presently, the amount of partial and total collapse the grid has experienced across the nation recently is astounding. This implies that the grid capacity is limited; therefore, to introduce additional energy sources into the grid, there is a need for massive upgrades to ensure the grid can absorb the new proposed power capacity. Also, because of the dilapidated state of the current grid, there is an urgent need for a total upgrade. The government should conclude the arrangement with Siemens and others to ensure the grid is improved and expanded.

3. **Implementation of support mechanism as contained in the policy document to foster transition.**

Likewise, the support mechanisms included in the various policy documents formulated to foster energy transition must be fully implemented. Most stakeholders are awaiting the implementation of these support mechanisms, such as incentives, reduced taxes, feed-in tariffs, and others, to dictate the government's direction, integrity, and seriousness in addressing the challenge of energy security and poverty in the country. Additionally, investors need assurance that they will accrue their investments and make profits before undergoing cost-extensive activities like investing in renewable energy development. One way to do this is by implementing support mechanisms.

4. **Establishment of a feed-in tariff that will make it competitive with petroleum products which are presently subsidised and creating mixed signals for renewable energy development.**

For example, there is a need to establish a feed-in tariff system for renewable energy projects to provide a level-playing ground and competitive environment for the technology compared to other sources, especially oil and gas, which are currently heavily subsidised. This creates mixed signals to investors and other renewable-energy technology stakeholders; hence, sorting out the feed-in tariff system will ensure clarity and unambiguity, likely leading to the sector's development.

5. **Embarking on societal engagement initiative through the introduction of smart grid**.

   Furthermore, to ensure public buy-in of the technology, there is a need to embark on comprehensive societal engagement initiatives. This could be through news, bulletins, and social and regular media adverts to underscore the importance of renewable energy technology to the broader society. Also, introducing a smart grid system where an individual household can generate electricity and profit from excess quantities generated will be essential for the societal-wide buy-in that will lead to the sector's development. Even though a few members of society may kick against the establishment of the technology, having the wider public's support will result in accelerated development of renewable energy utilisation.

6. **Establishment of a dedicated agency to handle grid renewable energy innovations and projects.**

   This addresses the issue of too many agencies but no leadership and alignment amongst multiple and conflicting actors’. Similarly, establishing a dedicated agency to oversee activities regarding grid renewable energy innovations and project development will ensure focus and reduce unnecessary interruptions and bureaucratic slowness that results from multiple agencies and parastatals of government addressing similar or the same issue. For instance, the significant development experienced in recent years in rural electrification projects can be associated with having the Rural Electrification Agency (REA) oversee projects and the reduction of complexity of working with several agencies. Hence, a single agency overseeing grid electricity development will reduce the current leadership challenges and adequately align all actors' and stakeholders' interests.

An independent grid renewable energy agency should be established and tasked with overseeing and managing renewable energy development and implementation relating to the electricity grid system. Presently, this function is performed by the Ministry of Power who oversees the whole energy sector and functions under the executive arm of the Nigerian government (NREEEP 2015, Audu et al. 2017, Olujobi 2020; Babatunde et al. 2023). The NREEEP (2015) document mandates the Ministry of Power to coordinate the affairs of grid renewable energy development, however, the Ministry of Power created the policy contained in the document which undermines the spirit of independence. A similar argument was made by Decker (2014), Obeng-Darko (2019) and Afful-Dadzie et al. (2020) that an independent agency should have autonomy, free from political or governmental control and have specific functions, mandates, or goals. The study adopted the 'Independent' definition by Scholten (2011: p8) as "complete absence of any dependence, it is an overarching notion that excludes any oversight authority over an independent body". The scholar argued that the independence of an agency is based on four criteria:

i. Institutional: an agency is not auxiliary to a ministry;
ii. Personnel: appointment and removal process of agencies heads;
iii. Financial: separate budget and financial autonomy; and,
iv. Functional: an agency free to conduct its own affairs the way it wants.

By this characterisation, the current composition undermines the development of grid renewable energy because findings from this study show that the vested interest of incumbent actors (such as government and regulators in the oil and gas sector) deters renewable energy development; added to this is the sensitivity of the ministries to change in government regime, which retards grid RE discussions (Osunmuyiwa et al. 2018). Hence, establishing the independent agency will increase investors' confidence and signal a political will to drive renewable energy development (Obeng-Darko 2019).

The agency will foster an effective and transparent governance through embodying the concept of accountability. Gabriel and Castillo (2019) aver that accountability is intertwined with transparency and described as presence of openness and free flow of information. Mallya (2009) opines that for an institution to be accountable it has to imbibe transparency virtues and in most situations, organisations that imbibe transparency virtues are usually accountable. The constant demand for effective performance by the populace make institutions responsive (Boven 2005, Schillemans 2008, Schillemans and Boven 2011). Furthermore, Mulgan (2003) as cited in Boven (2005) defined this as holding agencies to account in fulfilling their mandate. Two concepts are important to promote accountability; answerability and sanctions. A hybrid relationship in governance by downward and upward accountability enables this (Boven 2005, Schillemans 2008, Schillemans and Boven 2011).

From the findings of this study, it is recommended that the independent agency should encompass horizontal accountability relationship among agencies on the same level of policies and vertical relation with actors at another level which could be above or below. This study proposes that the structure be accountable horizontally to the NEMSA, NERC, ECN and the Ministry of Power. Vertically, the agency reports directly to the Presidency through the inter-ministerial committee, thereby limiting interference from other groups. This institutional independence structure is similar to the United State of America's structure where certain agencies report to the President. Though, this is a different structure in the European Union where the agencies are embodied in the communities (Scholten 2011). But this study recognised the importance of closing the gap with the populace by suggesting the agency be answerable to consumers and end-users and promote transparency through regular reports, citizen oversight committees, regular information sharing, audits and introduction of right-to-know initiatives.

Similarly, to ensure personnel independence, the Management team of the proposed agency should be comprised of the Executive Directors and Chief Executive Officer (CEO), who are appointed by the President and confirmed by the National Assembly (Senate and/or House of Representative: the elected representative of each State and local areas in Nigeria).

In addition, a Board should be constituted with members appointed by the Ministry of Power and approved by the Presidency. This Board will be headed by multiple members confirmed by the National Assembly. This will ensure the independence of the Board and cushion the effects of political affiliation and influence. Also, according to the directives of the Federal Character Commissions, members must be selected equitably from the six geopolitical zones of the country. The board will be made up of twelve (12) members whose tenure will be such that only one member's tenure expires yearly this will ensure that all the members of the board are not changed, and only a few members appointed are by the President during a four- or eight-year tenure.

The removal of the Head of the Agency should not be within the powers of the Presidency but rather by the National Assembly. This is consistent with the US form of Management Board appointment which differs to the European Union

(Scholten 2011). Also, the removal of any member of Board can only be from other members obtaining a two-third vote. However, a member of the public can file a complaint against Board members through the National Assembly, and the Senate President will form a bi-cameral committee to investigate and submit a recommendation which will be accepted and implemented.

Funding will be provided directly from the Nigerian budget and supplemented by private public participation, contractual services partnership, Foreign Direct Investments, and grants from Multilateral Development Banks (MDBs). This is a combination of the US and the European states funding structure. In the EU, most agencies are funded by the general budgets and must provide an account on how the money was spent. For the United States, funding is from the federal budget (Scholten 2011). Hence, in both cases there is dependence on the political institutions for funding. Currently, this is how the REA is funded and so far, the agency has been successful based on its mandate.

The agency should be allowed to conduct its affairs. A provision will be made in the constitution that states the absolute independence of the agency. Also, there is a need to ensure accountability and transparency through issuance of fines, sanctions, and removal management process. Consequently, a comparison of performance to that of the REA could be used as a performance measurement metric to ensure excellence in implementation. The structure, funding and appointment of the REA, as discussed in Section 2.5.4 has some similarities and differences to the suggested Grid Agency. The similarities will allow the agency to enjoy some of the success recorded by the REA, while the notable differences would address the apparent deficiencies of the REA.

7. **Creation of a clear and detailed actionable implementation plan.**

Another critical recommendation from the interviews and concerns from respondents is to address the current implementation plans, which have been accused of being ambiguous and lacking clarity. Therefore, creating a clear and detailed actionable implementation plan for renewable energy project development, especially on the grid, is very important. Previous governments have had plans which needed to be implemented and, as such, resulted in further deterioration of the electricity facilities. Hence, to avoid past mistakes and errors, the new implementation plan should be clear, detailed, and actionable and include the responsible parties for each activity to ensure accountability and responsiveness.

8. **Encouragement of existing and new support networks.**

Engagement of these networks in the planning and policy execution of the grid renewable energy deployment. Also, there needs to be an encouragement for strengthening existing professional support networks to aid the country's development of renewable energy technology. The encouragement is carried out by involving the networks as essential stakeholders in policy formulation and implementation planning processes, enabling a well-rounded conversation and discussion at the table. Similarly, the establishment of new support networks should be encouraged to complement the effects of current ones. Besides, having a group of professionals with similar ideologies and backgrounds will provide the professional and human capacity required for renewable energy development in the country.

9. Government should leverage policies and partnership with technology providers and financiers to foster transitions and encourage investment.

Additionally, the government should leverage policies and partnerships with technology providers and financiers to foster transitions and encourage investment. Other key stakeholders, such as the technology-developing companies, should be considered when formulating policies. They need to be included in the conversations to understand the effects of policies on their industry and provide advice and directions on what can make for an effective policy to encourage the development of renewable energy technologies in the country. Also, financial institutions and other investment groups should be categorised as crucial stakeholders. They are essential to provide the funds required to develop the technology and, hence, should be included in policy formulations. The technology providers and financiers should be considered partners in this area.

8.5.2 Recommendation to Improve the Governance and Management of Transition for Grid-Based RE Deployment.

The study's findings imply that the Nigerian government is the focal point for the energy transition process related to the grid. As such, applying the TM to this context, the government is responsible for aligning various stakeholders in the transition arena. However, findings suggest that various factors, such as lack of government continuity and synergy, political will and commitment, including vested interests in the current electricity systems, inhibit objectiveness. This is summarised by Table 27 below.

Table 27: Recommendation to improve the governance and management of transition for grid-based RE deployment

Steps by TMF	Conceptualisation in an ideal electricity system	Summary of findings	Challenges of applying TMF to Nigeria	Recommendation
Transition planning and arena formulation	This phase involves defining the transition problem through envisioning in transition team and frontrunners. This phase of the transition constitutes two steps. The first step is the establishment of a transition team and arena and identification of existing challenges.	Two arenas were established for the purpose of envisioning. The transition arena comprises international and national arenas, inter-ministerial and Nigerian National Council on Power. Government initiated and coordinated the affairs of this arenas through the Ministry of Power, which was part of the transition team. The result of the study suggests that persistent societal problems was recognised and shared among actors. These problems are low energy access, lack of sufficient power supply, growing energy demand, climate	The findings from the study imply that the Nigerian Government is the focal point for the energy transition process as it relates to the grid. As such, applying the TM to this context, the government is responsible for aligning various stakeholders in the transition arena. However, findings suggest that various factors such as lack of government continuity and synergy, political will and commitment, including vested interests in the current electricity systems, inhibits objectiveness exerted.	An independent agency should be established to handle all grid renewable energy development affairs. Also, the agency will be able to form a strong coalition of pro-renewable energy and incumbent fossil fuel stakeholders as there are resistance and sabotage from current energy producers. The agency will be held accountable for the actualisation of the grid RE strategy and will promote transparency in the sector through dissemination of information and introduction of right to know initiative where the society can hold the agency accountable.

		change challenges and sluggish economic growth. Barrier to grid RE development are multifaceted.	There is lack of accountability and transparency.	
Transition design	This phase involves developing a transition pathway, defining the agenda of transition and the target or objective of transition. Long-term vision necessitates the creations a visionary image for transition.	A long-term vision was formulated, which is aimed at achieving a 30GW of renewable energy electricity generation by 2030 and 30% from renewable energy sources. There is a lack of legal framework enforced. Support mechanism for grid renewable energy development is not yet implemented.	The existing targets are in line with long term vision; however, they are considered an ambitious target, as 2015 and 2020 milestones targeted to generate 117 MW and 1343.17 MW, PV and solar thermal and 50 MW and 57.40 MW wind power, respectively, in the same timescale were missed. There are existing challenges with reaching a Purchasing Power Agreement (PPA) and a feed-in tariff agreement between the government and the Independent Power Producers (IPPs).	There should be a review of the existing renewable energy electricity generation targets and various stakeholders beyond stakeholders at the international and national arena involved in the deep-thinking processing policy and strategy formulation. The targets need to be reviewed and evaluated with legal framework enforced. Support mechanism for grid renewable energy development needs to be implemented and new mechanism introduced, such as green certificate. Transition agenda formation should be an open process with inclusion

			Some stakeholders were not involved in the whole process of the grid renewable energy policy and strategy formation.	of all necessary stakeholders. There should be dissemination of information on participants' selection process, meetings and outcomes.
Operationalising transition	This involves the execution of pilot projects and experiments to obtain learnings from the system before expansion.	The result of the current study found that no renewable energy technology project relating to the grid has been executed. However, respondents indicated there are notable off-grid projects ongoing, including projects that feeds into the 11KVA distribution lines, but the capacity is too small.	14 IPPs are experiencing difficulty obtaining financing of grid RE projects due to lack of Partial Risk Guarantee (PRG) not being issued by the Federal government. Hence, financial closure has not been reached. These projects would have served as experiments from which learnings can be observed. These 14 IPPs were not selected through a bidding process system.	Introduction of renewable energy initiative, programmes and projects sponsored by the government. This will be small-scale RE projects that relates to the grid from which learnings can be obtained. Also, learnings from the decentralised RE projects can be leveraged in the introduction of grid RE experiments. Introduction of accountability and transparency through competitive bidding system. Information about the status and state of the project should be

				published regularly and disseminated to the public.
Transition process, review and enhancement	The phase obtaining learning from monitoring, reviewing and evaluating the experiments and implementation process, actors, targets and agenda. Learning phase involves a reflexive process.	Information on learnings were not obtained as there are no projects executed that are connected to the grid yet. However, IR07 indicated that there is no follow-up regarding implementation of the renewable energy policies and targets.	No projects have been implemented.	The process should be monitored, reviewed and critically evaluated to identify what this should involve (system and actor analysis), i.e., the target and agenda. Learnings should be published and lead to revision of the existing transition process and plan with the previous transition process and include new learnings to the new plan.

8.5.3 Recommendation to Improve Accountability and Transparency of the Strategic Planning Process and Implementation of Grid-Based RE in Nigeria.

1. **Enforcement of current legal framework and establishment of a singular agency responsible for grid renewable energy projects and initiatives.**

   Moreover, as highlighted in the literature and interviews, the level of transparency and accountability in the energy sector is below standard, even though these are requirements for good governance and encourage the transition to the grid renewable energy. Therefore, there is a need to enforce current legal frameworks to ensure everyone is accountable and takes responsibility for their actions and inactions. Also, improved and responsible leadership is required; establishing a singular agency responsible for grid renewable energy projects and initiatives will encourage transparency and accountability in the sector.

2. **Implementation of better monitoring and audit process and robust societal engagements.**

   Furthermore, more work must be put in place to ensure a better monitoring and audit process. The encouragement of robust societal engagements and influence through participation in the audit processes of the grid renewable energy initiatives and projects and demand or request for information and updates will boost transparency and lead to accountability of the entire process.

3. **Introduction of hybrid accountability.**

Also, there is a need to embrace “hybrid accountability” by introducing top-down and bottom-up mechanisms. These can be through appropriate metering of all customers and introducing a competitive bidding system.

8.6 Originality and Generalisation

The originality of this study is the contribution to the field of energy transition studies, especially in developing countries, by contributing to the growing literature on energy transition, strategic planning and governance. Existing research has given more consideration to the policy, economic and technical aspects of the energy transition, focusing more on off-grid renewable energy, such as community and rural electrification. However, little attention has been paid to the Nigerian grid-based electricity generation systems' renewable energy planning process and governance. This study assesses the RE planning process and governance, emphasising the accountability and transparency of implementing strategies for grid-based RE electricity generation in Nigeria for sustainable development.

A major contribution of this study is developing a framework for effectively managing energy transition in Nigeria, as there is little or no attempt at introducing a framework that contains modules for the successful transition of grid-based renewable energy generation in Nigeria. This study demonstrates originality by providing a roadmap for actualising the RE strategies on the grid. This roadmap contains key elements for grid-based RE generation strategies implementation in Nigeria. Another originality of this study in the field of energy transitions is the integration of transition studies with transparency and accountability concepts.

Furthermore, this study contributes to the accountability and transparency domain by building on the debate of accountability design that factors in the specificities of the context of accountability by applying this study to the context of the Nigerian electricity sector.

The framework for effective energy transition management cannot be generalised to developing countries as the sample size of 31 participants is small. The study focussed on the Nigerian renewable energy sector as a case study. However, the findings of this study can be duplicated by other countries with similar techno-economic, socio-technical and political considerations to Nigeria and serve as a basis of research for other countries.

8.7 Limitations and Future Research Directions

There was high agreement among interviewees on the existence of barriers, drivers and enablers to the transition and development of grid renewable development including the need to improve the level of transparency and accountability. However, the degree of agreement varied across the nuance of analysis as presented in Chapter 5, 6 and 7. Future study could explore how the various actors background influences their perception and perspective on the phenomenon under study.

This study is based on a qualitative approach through 31 semi-structured interviews and could be complemented by other data collection techniques, such as a survey. However, this research provides rich information on the barriers, enablers and drivers of transition, planning and governance of renewable energy in Nigeria and accountability and transparency. As such, the qualitative data provided a basis for developing a conceptual framework for the effective management of grid renewable energy and developing a roadmap for the actualisation of grid renewable energy strategies in Nigeria.

This research recommends that future research should focus on a larger sample size and adopt data triangulation in the research design. This will provide a well-rounded and holistic perspective on energy transition in Nigeria. Furthermore, the conceptual framework for effective management of grid renewable energy and development of a roadmap for the actualisation of grid renewable energy strategies can be applied to other countries with similar techno-economic, socio-technical and political considerations to Nigeria and serve as a basis of research for other countries to test the extent to which the elements are consistent with other countries. It can also be applied to the off-grid renewable energy space, and this will develop the domain of energy transition literature in Nigeria. Furthermore, this study focused only on solar and wind technologies. However, it provides the opportunity for assessing other forms of renewable energy contained in the Nigerian Renewable Energy and Energy Efficiency Policy documents, such as biomass and hydro technologies.

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APPENDICES

Appendix 1

Lead Questions

What are the drivers and enablers for the development of renewable energy on the Nigerian national grid?
What do you think are the inhibitors/barriers of renewable energy development on the national grid?
What are the objectives and visions for introducing renewable energy on the grid?
What is the strategy or pathway for their actualisation? In your opinion, what strategy or pathway can be adopted to achieve renewable energy on the grid?
How do Nigerians perceive this energy mix initiative? What is the outlook of Nigerians towards this plan?
Who are the major actors/stakeholders in renewable energy governance relating to the grid?
Which stakeholders are involved in implementing the strategy of grid renewable energy?
What role does the government play in facilitating stakeholder alignment, and how is this done?
What support mechanisms are you aware of for grid renewable energy development?
How effective are these support mechanisms in fostering development?
In your view, what support mechanisms should be introduced?
What are the determining factors for the successful planning process of grid-based renewable electricity generation?
What are (or should be) the procedures for the implementing renewable energy on Nigerian national grid and how is/should this have been enforced?
What are the renewable energy planning process and governance for sustainable development in Nigeria?
In your view, what should the process of planning for renewable energy on Nigeria national grid entail?

Who are the major actors/stakeholders in the planning of renewable energy on the grid?
In your opinion, which important stakeholders were excluded in the process of planning for grid renewable energy?
What role(s) does the incumbent energy generating players play in the development of grid renewable energy?
Are you aware of any ongoing renewable energy projects or experiments on the grid?
What can you say about the direction of the projects/experiments?
Who are involved in this projects/experiments? key actors or stakeholders?
In your view, what is (or should be) the process of monitoring and reviewing these projects/experiments? Is the learning from these processes effected or how can it be effected?
How accountable are the processes?
What is your view about the level of transparency in planning, governance or implementation of renewable energy on the national grid?
In your opinion, what role does transparency play in actualising the goal of renewable energy on the grid?
Who should be responsible for ensuring the entire process is transparent?
What can be done to ensure the process is more transparent?
What are the similarities and differences in the comparison of on-grid and off-grid generations?
Are the challenges of introducing renewable energy on the national grid similar to the off-grid issues?
Is the planning and governance of renewable energy on the national grid similar or dissimilar to the off-grid process?
How do the stakeholders/actors’ involvements compare with the off-grid and grid-based electricity generation projects?
How does the societal acceptance of renewable energy on the national grid project compare to the off-grid project?
In your opinion, what could be the impact of the Covid-19 pandemic on RE development in Nigeria?

Appendix 2

Energy planning: is a process or a tool of building and verifying strategies in an energy economy, while taking into account the analysis of energy supply and demand, and the means of implementation to ensure coverage of energy needs in a national and international context (World Energy Council 1992).

Intended Nationally determined contributions: refer to independently determined global effort at reductions in greenhouse gas emissions under the United Nations Framework Convention on Climate Change that each country (UNFCC 2020).

Nationally determined contributions: refer to the ratification of the intended nationally determined contributions by countries.

Governance: all the ways in which groups of people collectively make choices.

Energy governance: refers to the actors, institutions and processes that shape how decisions are made about how to provide energy services (Florini and Sovacool 2009).

Put-Call Option Agreement (PCOA): which allows Solar IPP to put the plants up for sale at an agreed price if the project is failing due to factors outside the IPPs country but within the FG's control, likewise, the FGN can call for the asset to be sold to them if the Solar IPP is not meeting its operational agreement.

Partial Risk Guarantee: in Nigeria aims to increase the country's electricity generation by catalysing private sector investment and commercial financing in the power sector through the provision of PRGs. The PRGs will mitigate the risk of the Nigeria Bulk Electricity Trading Plc (NBET), a Federal Government of Nigeria entity established to purchase electricity from independent power producers (IPPs) (WallAfrica, 2020).

INTERVIEW PARTICIPANTS

Regulatory Authorities	**Nigeria Electricity Regulatory Commission (NERC)**	This is the regulatory agency charged with the function of ensuring uninterrupted electricity, encourage private sector participation, assure consumer protection and enable fair regulation of the electricity industry in Nigeria.
Policy-Making Authorities	**Energy Commission of Nigeria (ECN)**	This is the organisation responsible for energy planning and policy implementation, and encourage diversification of various energy resources, renewable and non-renewable.

Government parastatal	**Department of Climate Change**:	This is the government agency responsible for the coordination of all activities to achieve the Paris Agreement by providing "a sustainable policy framework and enabling environment for climate change action in Nigeria and to regularly update information regarding national greenhouse gas emission, mitigation options, vulnerability assessment and adaptation measures to the impacts of climate change."
	Federal Ministry of Environment:	This is the government ministry solely in charge developing strategies to protect the Nigerian environment through the enforcement of the Environmental Laws and Regulations and taking Climate action to provide a healthy environment.
	Federal Ministry of Power:	This is the ministry responsible for policymaking to provide power in the country.
Research and Development Institute	**Centre for Energy Conservation and Energy Efficiency**:	This one of six research centres of the Energy Commission of Nigeria (ECN) responsible for organising and conducting research and development in energy efficiency and conservation.
Associations	**Renewable Energy Association of Nigeria**:	This is an association comprising of Renewable energy experts and promoters to stimulate private sector participation in the Nigeria's Renewable energy sector with the aim guiding advocacy, formulate polies and encourage investments in the sector and "to promote strategies that will improve the contribution of renewable energy up to forty percent (40%) of the National Energy Mix by 2030.
	Association of Power Gathering Companies:	This is a non-profit apolitical organisation who represents the interests of independent energy stakeholders with special attractions to renewable energy sources for power generation.

Climate Change Movement	**Friends of the Earth in Nigeria**:	This is an international environmental network of individuals campaigning to create an environmentally sustainable and socially just societies with offices in several countries including Nigeria.
NGO	**Ecowas Centre for Renewable Energy and Energy Efficiency**:	This is an ECOWAS sub-regional centre to achieve a regional to achieve sustainable development and environmental conservation for the economic, social and environmental wellbeing of its member states through policies, capacity development, investments and development of projects and programs. The Nigerian centre is located in the Federal Ministry of Power office.
Universities	**Covenant and Landmark Universities**:	These are two (2) of the foremost universities in Nigeria investing greatly in the renewable energy research and widely published.
Electricity Generation Companies	**Kainji Power Station**:	This is the first and largest hydro-electric power station in Nigeria which experience is vital to further renewable energy development in Nigeria.
	Egbin Thermal Power Station:	This is one of the largest gas power station located in Lagos, Nigeria. The technical know-how and experiences of the staff will be utilised for Renewable energy development in the country.
Electricity Distribution Companies	Ikeja Electricity Distribution Company:	This is a representative of the Distribution companies in Nigeria who are important actors in electricity provision in Nigeria. The experiences will be vital to incorporate RE on the national grid.
Electricity Transmission Company	**Transmission Company of Nigeria**:	This is the only company that connects the electricity generation and distribution companies. The experiences will be vital to incorporate RE on the national grid.
Renewable Energy Technology	**Sustainable Use of Natural Resources and**	These projects aim to provide access to finance for RE and EE technologies in Nigeria through offering of loans and technical

Funding Company	**Energy Finance (SUNREF) Nigeria**	assistance for green investments and works in partnership with local (Manufacturers Association of Nigeria, UBA, Access Bank) and foreign (French Development Agency and European Union) stakeholders
	Nigeria Investment Promotion Commission	This is the agency responsible for encouraging, promoting and co-ordinating investments in the Nigerian economy, including RE investments.
Independent Researchers	**Individual Researchers:**	Individuals who have demonstrated research excellence especially in Renewable energy development in Nigeria.
Renewable Energy Businesses	**Nigeria Solar Capital Partners**:	This is a renewable energy company to develop solar projects in Nigeria who has been operating in the country since 2012.
	Terrawatts mbH Company:	This a renewable energy company who has won the tender to erect 37 wind turbines in Nigeria.

Appendix 3: Selected Conferences and Paper Publications

ADEDOKUN, R., STRACHAN, P. and SINGH, A., 2021. Governing the transition of socio-technical grid-based systems: promoting security of supply and accelerating renewable energy innovation in Nigeria. *3rd Network of International Business and Economic Schools Research (NIBES) Session – Sustainability Research in Business and Economics,* Online.

ADEDOKUN, R., STRACHAN, P. and SINGH, A., 2022. Accelerating the transition to a renewable energy powered grid in Nigeria. *All Energy Exhibition and Conference (poster presentation),* Glasgow.

ADEDOKUN, R., STRACHAN, P. and SINGH, A., 2022. Assessing governance of strategic planning for sustainable energy transitions – a sociotechnical approach for grid-based renewable energy development in Nigeria. *Energy and Climate Transformations: 3rd International Conference on Energy Research & Social Science, University of Manchester,* Manchester.

ADEDOKUN, R., STRACHAN, P. and SINGH, A., 2022. Governance of transition: Assessing accountability and transparency of strategic planning for grid-based renewable energy development in Nigeria. *The ETP 11th Annual Conference: A Net Zero Conference for Emerging Researchers,* Edinburgh.

ADEDOKUN, R., STRACHAN, P. and SINGH, A., 2023. Governing the transition to renewable energy: Accountability and transparency assessment of Nigeria strategic planning for grid-based renewable energy development. *RGU Aberdeen Business School Research Seminar,* Online, Aberdeen.

ADEDOKUN, R., STRACHAN, P. and SINGH, A., 2023. Investigating the strategic planning process and governance to promote grid-based renewable energy development in Nigeria. *Science Talks*, *5*, p.100116.

A paper titled "Socio-technical transition; understanding the barriers, drivers and enablers of grid renewable energy uptake in Nigeria" submitted to Energy Policy Journal in July 2023, and under review.