ENERGY AND SUSTAINABILITY TRANSITIONS:

THE CASE OF COMMUNITY RENEWABLES FOR OFF-GRID RURAL

ELECTRIFICATION IN NIGERIA WITH EMPHASIS ON *SHAPE* COMMUNITY PROJECT

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Abstract

The transition from one energy system to another has been analysed by many researchers especially in the context of developed countries. Community renewable energy transition in rural areas is largely under-researched, particularly in developing countries. This study developed a model based on indicators from transition theory and concepts to assess the transformative potential of the processes and governance approaches to community renewable energy in accelerating energy and sustainability transition in off-grid communities in Nigeria.

The exploratory research adopted a case study approach and analysed renewable energy planning and decision-making processes as well as evaluated the development of a pilot community renewable energy project in *Shape* rural community in Nigeria. In addition to documentary evidence, the study gathered data primarily by interviewing 24 relevant actors in the Nigerian electricity industry as well as actors involved in the pilot community renewable energy project.

The study reveals that the processes and governance approaches adopted are in line with transition theory and have the potential of contributing to the transformation of the rural electricity provision in Nigeria. However, there is still a long way to go for Nigeria to effectively implement an integrated governance approach capable of accelerating the transition processes.

The study found that community renewable energy is motivated by several determinants including: the lack of energy accessibility; removing carbon emissions; meeting environmental obligations; achieving energy security; and, addressing cracks in the current system of rural electrification. The study further found a lack of local initiatives at the grassroots level that can add pressure to make the transition happen. The study found the establishment of an arena for the identification of the challenges facing rural communities and development of strategies. However, some prominent actors are not involved in both strategic decision-making and the implementation process. Of concern, the study revealed a lack of clearly defined responsibilities with most of the government agencies carrying out renewable energy activities independently. Similarly, the study found several barriers which are classified as: actor; interaction; institutional; infrastructural; and, socio-political that are challenging the successful transition to community renewable energy.

This work contributes to current attempts to operationalise transition theory and concepts to assess on-going transition processes and governance. This is a significant contribution to the literature because it helps in linking theoretical development with sustainability in practice in a developing country context. The study may assist policy makers, communities and other relevant stakeholders in designing an integrated governance framework for renewable energy transition in rural areas.

Keywords: Energy transition, Sustainability transition, Rural electrification, Community renewable energy, Energy transition management, Energy governance

Dedication

To my mother, (late) Hajiya Maryama Ibrahim Butu.

May Allah reward and have mercy on you. Ameen

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List of Abbreviations

DECC	Department of Energy and Climate Change
DISCO	Distribution Company
ECN	Energy Commission of Nigeria
EPSR	Electricity Power Sector Reform
FMEnviroment	Federal Ministry of Environment
FMPower	Federal Ministry of Power,Work and Housing
GENCO	Generation Company
GHGs	Greenhouse Gases
ICREEE	Inter-Ministerial Committee on Renewable Energy and Energy Efficiency
IEA	International Energy Agency
IPP	Independent Power Producers
IRENA	International Renewable Energy Agency
Kw	Kilowatt
Kwh	Kilowatt per hour
MW	Megawatt
NEPP	Nigeria Electricity Power Policy
NERC	Nigerian Electricity Regulatory Commission
NPREEE	National Policy of Renewable Energy and Energy Efficiency
OECD	Organisation of European Countries
REA	Rural Electrification Agency
REF	Rural Electrification Fund
REP	Rural Electrification Policy
REUCS	Rural Electricity Users' Cooperative Societies
SNM	Strategic Niche Management
TM	Transition Management
UNDP	United Nation Development Programme
WHO	World Health Organisation

Chapter One

Research Background and Overview

1.2 Introduction

Energy plays a significant role in improving the standards of living of people as well as promoting economic growth – two key requirements for attaining sustainability in developing countries such as Nigeria (UN/DESA, 2013; Ngosso, 2013; Pearce et al., 1990). Nevertheless, it is estimated that approximately 94 million people do not have access to basic electricity infrastructure in Nigeria (OECD/IEA, 2015). The majority reside in off-grid rural areas and rely on traditional fuelwoods (Gujba et al., 2012; Legros, 2009). The few, who can afford it, generate their electricity using fossil fuel generators (Ley et al., 2015; Charles, 2014).

Using these sources of energy, however, is not without repercussions. The United Nations Development Programme (UNDP) and the World Health Organisation (WHO) have attributed the rising levels of acute respiratory diseases such as pneumonia and lung cancer to the poor indoor pollution resulting from the use of traditional fuelwood (WHO, 2004; Legros, 2009). Reports have shown that about 79,000 people die annually from such diseases in Nigeria (Gujba et al., 2015; Shaad and Wilson, 2009). Similarly, the constant use of the traditional fuelwood has significantly contributed to Nigeria's two most common environmental challenges – deforestation and desertification (Babanyara and Shehu, 2010; Babanyara et al., 2010). Moreover, the rural people especially women and children spend the best part of their productive time on fuelwood gathering (Babanyara and Shehu, 2010; Babanyara et al., 2010). According to the UNDP, these efforts and time could have been better invested in education and income generating

activities that can improve the standard of living of rural people (Legros, 2009).

The effort to address the rural electricity challenges through a national grid extension programme, which started in 1981, has failed to make any significant impact (Madu, 2016; Ohiare, 2015a). Renewable energy has therefore been heralded as a panacea for the electricity infrastructure challenges encountered by off-grid rural communities (Malo, 2016, Sen and Bhattacharyya, 2014; Mohammed et al., 2013; Gujba et al., 2012). Interestingly, Nigeria has initiated several policies, strategies and programmes aimed at transiting to community renewable energy for the electrification of off-grid rural areas (Ley et al., 2015; Emodi and Ebele, 2016).

Some pilot community renewable energy projects including those in *Shape*, Waru and Durumi communities have been implemented (Nebo and Wakil, 2014). However, the pace of the transition process is quite slow due to some alleged governance[1] and institutional-related issues. These include the lack of proper planning and insufficient funding support (Emodi and Ebele, 2016; Ohiare, 2015a; Elusakin et al., 2014), absence of a clear pathway and leadership (Malo, 2016), lack of stakeholder/community engagement (Chikaire et al., 2015) and deep-rooted policy inertia (Agbongiarhuoyi, 2015). Others include unclear roles and responsibilities among the major stakeholders (Otitoju and Diara, 2013; Emodi, and Ebele, 2016) and

[1] Governance is refer here as the, "*institutionalised modes of coordinating societal activities* [relating to policy formulation, implementation, programs, evaluation and feedback mechanisms] *towards collectively binding rules and/or the provision of collective goods for a defined group of people"* (Risse and Lehmkuhl 2007: 20 cited in Benecke, 2010)

inadequate implementation efforts by the government (Emodi and Ebele, 2016).

Although much has been written on the electrification of rural communities in Nigeria, these governance challenges have not been empirically investigated. Underpinned by transition theory and concepts[2], this research aims to assess the transformative potential of community renewable energy processes and governance approaches in accelerating sustainability transition in rural areas. The research adopts a case study approach to empirically investigate community renewable energy planning and decision-making processes as well as to evaluate the development of a pilot community renewable energy project in *Shape* rural area in Nigeria. Data was mainly gathered by interviewing relevant key players in Nigeria's electricity industry as well as the actors involved in the pilot community project.

The rest of this chapter is presented as follows. Section 1.2 gives an overview of the research problem followed by the presentation of the research aim and objectives in Section 1.3. The research questions are provided in Section 1.4. Section 1.5 presents an overview of transition theory and the theoretical approach. Section 1.6 outlines the research methodology. Section 1.7 highlights the significance of the study and finally, Section 1.8 summarises the structure of the thesis.

[2] The transition theory and concepts are presented in Chapter 3 of this work.

1.3 Statement of the Research Problem

The beginning of the current electricity supply trajectory in Nigeria dates back to 1896 when two generating plants were set up in Lagos to serve the then colonial government (Vincent-Akpu, 2012). This was followed by the establishment of the first thermal plant in 1920 and the first hydro station in 1968 (Vincent-Akpu, 2012). The National Electricity Corporation was set up in 1970 with the responsibility of generating, distributing, and selling of electricity in Nigeria (Vincent-Akpu, 2012; Sambo, 2008). The first utility company known as the National Electric Power Authority (NEPA) was established following the merger of the Electric Corporation of Nigeria and Niger Dams Authority in 1972 (Sambo, 2008).

Thereafter, the industry witnessed a dearth of investment in infrastructure, with the one between 1999 and 2007 translating into disproportionate outcomes (Ezirim et al., 2016; Sambo, 2008). This had led to the structural downturn of the industry (Sambo, 2008), resulting in a shortfall in generation and transmission, leaving about 86,785 communities without access to the grid (Ojosu, cited in Ngala et al., 2007). Thus, it became apparent that the public controlled electricity system was failing to provide for the electricity needs of Nigerians (Ezenekwe et al., 2014). The situation is even more severe in rural areas, where people live at distance locations to the grid infrastructure (Pachauri et al., 2012; OECD/IEA, 2015).

To address the challenges faced by the electricity industry, Nigeria has strengthened its commitment to liberalise the electricity market through the Electricity Power Sector Reform (EPSR) Act, 2005. Consequently, by the end

of 2013, the generation and distribution segments of the industry were privatised and handed over to commercial developers (Joseph, 2014).

The reform described above showed the attempts made to overcome the electricity challenges especially in urban areas; the rural communities were often neglected by such transformation (Madu, 2016; Sreekumar, 2008; Byrne and Mun, 2003; USAID, 2002). To ensure an even development across the urban and rural areas, Nigeria adopted several other strategies and policies aimed at transiting to community renewable energy for off-grid rural electrification (Emodi and Ebele, 2016; Ley et al., 2014). However, the appropriate settings capable of attracting private investors, as well as distribution companies and communities into the full-scale transition to community renewable energy in Nigeria have not been realised.

It was posited that transition such as that in the electricity industry does not occur easily. The reason is that the infrastructure is regarded as a socio-technical system that comprises a complex set of technology artefacts, market structures, user practices, regulatory regimes and scientific knowledge, which are difficult to change (Geels, 2005a; Verbong and Geels, 2010). Nevertheless, many studies have shown that the transition pace can be influenced or accelerated to achieve the desired set of objectives (Valkenburg and Cotella, 2016; Björn and Turnheim, 2015; Foxon et al., 2013; Hillman et al. 2011; Verbong and Geels, 2010; Kern, 2009).

According to Lockwood (2013), to accelerate the pace of energy transition, radical innovation is required not only in technologies but also in the

institutions, infrastructure, business models and services. Changing to a new system, therefore, requires a sound intervention to manage these innovative activities. Lockwood (2013:2) indicated that effective intervention for *energy* transition, "*lies with the way that radical innovation is governed".* In other words, how actors[3] make and enforce a collective decision to accelerate the development of innovation. Abdo (2014) and Bazilian et al. (2014) noted that this involves among other things, how actors acquire and use their power to set agendas, negotiate, implement, monitor and enforce rules related to innovations in the energy industry.

A number of studies were conducted to examine transitions from one system to another. For example, Geels (2005b) examined the dynamics of transitions from horse-drawn carriages to automobiles. Similarly, Geels (2006) studied the hygienic transition from cesspools to integrated sewer systems in the Netherlands. However, both Geels (2005b) and Geels (2006) looked at how transitions in the past occurred. In another perspective, Belz (2004) investigated the ongoing transition from industrialised agriculture to organic and sustainable agricultural practices in Switzerland. In the same way, Geels (2012) investigated the dynamics of transition in the transport industry. The study assessed the barriers, new pathways and the factors driving low-carbon transitions in the transport sector. Whereas Belz (2004) and Geels (2012) studied ongoing transition, they felt short of considering how governance can affect the transformations.

[3] The key actors in energy governance include the policy maker, regulators, civil society groups, NGOs, corporations, communities and other institutions. Refer to Foxon (2011a) and Bazilian (2014).

Smith et al. (2005) studied the governance of socio-technical transition and examined how power and agency affect system's transformation. The study concluded that membership, distribution of resources and expectation determined how power can affect changes to current trajectories. Similarly, Upham et al. (2015) studied the transition in Finland's transport sector and argue that the use of public opinion in transition policy may help in creating legitimacy for the socio-technical transition. Likewise, Konefal (2015) examined how governance affects sustainability transitions in the agricultural sector. The study found that membership selection, access to resources and decision-making procedures affect the development of sustainability metrics and their subsequent implementation. Even as Smith et al. (2005) and Upham et al. (2015) and Konefal (2015) studied the governance of socio-technical transition, there were not specific to energy provision.

Regarding the governance of transition in the energy sector, Verbongs and Geels (2007) investigated transition in the electricity industry with a focus on large-scale electricity production. The study provides lessons on socio-technical dynamics, challenges and opportunities for transition to sustainable electricity production and consumption. Likewise, Bagherian, (2016) examined the role of offshore wind development in the transition to a low-carbon society in the UK. The study discovered new interactions between socio-technical elements of the system in the UK's large-scale electricity provision which led to different low carbon pathways. Both Verbong and Geels (2007) and Bagherian, (2016) looked at transition in the context of large-scale electricity provision.

Recent studies such as Strachan et al. (2015) examined community-scale renewable energy transition in the UK. The study examined the role of community-scale energy in corporate energy provision. Equally, Viétor et al. (2015) examined the factors that block the uptake and transition of decentralised CHP in the German Ruhr area in Germany. Despite the fact that these studies examined governace of community-scale energy transition, they were not specific to rural electrification.

Regarding transition in a rural set-up, Li et al. (2013) examined the success factors in the implementation of community-owned renewable energy projects in a rural area of Freiamt (Black Forest, Germany). The case study shows amongst other things that participative and bottom-up planning processes are crucial for the implementation of the project in rural settings. In the same way, Kaphengs et al. (2014) assessed energy transition processes in rural communities of Rhön-Grabfeld district in Northern Bavaria (Germany). The study was conducted to understand the participation of relevant actors and the role of energy cooperatives in initialising transition processes. While the aforementioned studies looked at transition in the rural settings, they were conducted in developed economies where the institutions, as well as the economic structure, are different with that of rural locations in developing countries.

Fewer thoughts are focused on examining community renewable energy transition dynamics and governance approaches in developing countries including Nigeria (see Bazilian et al., 2014). The existing literature on Nigeria focuses on issues such as assessing the potentials of renewable

energy in providing a solution to the electricity challenges facing rural communities (Yamusa II and Ansari, 2015; Shaaban and Petinrin, 2014), the economic feasibility of harnessing renewable energy for remote locations (Ileberi, 2015), and the techno-economic assessment of hybrid system for off-grid rural areas(Olatomiwa et al., 2015; Tijani et al., 2014).

None of the studies mentioned above looks at the process and governance approaches to community renewable energy.

Although studies (for example: Utuk, 2014; Adesida and Okunlola, 2015) have been conducted in Nigeria to understand how local community are engaged in rural infrastructure projects such as water supply, sanitation, health, education facilities and construction of rural roads. Apart from being short of looking at participation from the wider perspective of engaging other key stakeholders, the studies were not conducted on the provision of energy.

This research offers a new contribution to the body of research on this topic by exploring the processes and governance approaches through which community renewable energy is determined, planned and implemented to achieve off-grid rural electrification. Based on the preceding discussion, the aim and objectives of this study are developed in the next section.

1.4 Research Aim and Objectives

The aim of this study is to assess, through the use of case study research, the transformative potential of the processes and governance approaches to community renewable energy in accelerating sustainability transition in

off-grid rural areas. To realise this aim, the study is guided by the following objectives stated in Table 1.1.

Table 1.1 Research Objectives

	Research Objective	Related Chapter
(1)	To critically evaluate the Nigerian electricity landscape within the context of community renewable energy and transition theory concepts.	Chapter 2
(2)	To formulate a transition theory model to assess the determinants of community renewable energy transition in Nigeria.	Chapter 3 and 5
(3)	To use the model to assess the transition planning processes and implementation strategies of community renewable energy in Nigeria.	Chapter 5
(4)	To use the model to investigate the barriers inhibiting the successful transition to community renewable energy for off-grid rural electrification in Nigeria.	Chapter 5
(5)	To provide a series of critical recommendations to assist policy-makers, community and other actors in nurturing, developing and expanding community renewable energy in Nigeria.	Chapter 7

Source: Generated by Author

The following section presents the research questions developed from the above objectives

1.5 Research Questions

To achieve the stated objectives, the study sets the following research questions outlined in Table 1.2.

Table 1.2 Research Questions

	Research Questions	Related Objectives	Methods
(1)	What are the challenges of Nigeria's electricity sector and how can community renewables contribute to solving these challenges?	(1)	Critical review of literature
(2)	What are the factors determining community renewable energy transition in rural electrification?	(2)	Interview and analysis of data
(3)	What are the strategy and processes involved in the planning and implementation to community renewable energy in off-grid rural electrification?	(3)	Interview and analysis of data
(4)	What are the barriers inhibiting the transition to community renewable energy in off-grid rural electrification?	(4)	Interview and analysis of data

Source: Generated by Author

1.6 Theoretical Approach

To assess the transformative potential of the processes and governance approaches to community renewable energy in accelerating sustainability transition in rural areas, this study turns to transition theory. The study developed a theoretical model based on the transition theory and concepts. The theory views the transformation from one system to another as, "*a gradual, continuous process of change where the structural character of society (or complex sub-system of society) transforms*" (Rotmans et al., 200: 16). It occurs because of the interactions and forces on three different levels – landscape, regime and niche. Transition scholars utilised this understanding as the basis for developing the Multi-Level Perspective (MLP) (Rotmans and Kemp, 2003) which is often used to understand the determinant forces or reasons of why transition occurs.

Furthermore, a transition can be categorised into two classes. The *natural* transition has limited coordination and only transpires through principles similar to evolution. But the *guided* transition occurs through high level of interactive and iterative coordination between actors to achieve a pre-set objective (Kemp and Rotmans, 2004). While the former is outside the scope of this work, the latter is the basis for developing the Strategic Niche Management (Kemp et al., 1998; Hoogma et al., 2002) and Transition Management (Loorbach, 2007; Loorbach and Rotmans, 2006). Both Strategic Niche Management (SNM) and Transition Management (TM) represent a governance framework for steering a socio-technical transition such as the one envisaged for this study.

The concepts are suitable for this study because they provide theoretical underpinnings for the multi-level, multi-actor, and multi-stage processes that are involved in a transition process such as that of electricity. Similarly, the shift envisaged in off-grid community renewable energy transition is not only multifaceted but also influenced by many actors. Although the MLP, SNM, and TM have often been utilised individually by scholars, the issues raised in this research cannot be addressed by any one of them in isolation and, therefore, a combination of the elements of the three concepts is required. Thus, this study attempts to make a new contribution by bringing together elements from the three concepts in one theoretical model. A detailed discussion of transition theory and the research's theoretical approach is provided in Chapter 3.

1.7 Research Methodology and Methods

This study explores the opinions of key stakeholders in the Nigerian electricity industry on the process through which community renewable energy is being developed. It is, therefore, believed that qualitative research is the most suitable approach to studying these issues. Thus, a qualitative research approach was chosen over quantitative research. Guest et al. (2012) considered quantitative research too rigid to allow for a detailed investigation of complex social phenomena such as the one involved in a system transition. Further, in line with the recommendations of Yin (2009), a case study research approach has been employed, and data was collected from a group of key stakeholders including regulators, policy makers, development agency, community members and research organisations.

The study administered face-to-face semi-structured interviews. The interview schedule which is presented in Appendix I was developed based on the theoretical model developed in Chapter 3. Data was analysed using thematic analysis with the aid of computer-aided software – NVivo. Themes and categories that emerged from the analysis were interpreted, explained and presented. Ultimately, findings were compared with the literature to ascertain consistencies or contradictions. Further detailed discussion of the methodology employed is provided in Chapter 4.

1.8 Significance of the Study

Transition theory has been applied in various sustainability studies, for example, the transition to organic food and eco-housing (Smith, 2006; Smith 2007) and transition to electric vehicles (Van Bree et al., 2010; Geels,

2012; Hickman, 2013). Recently, the theory has been used in studies on the transition to low-carbon energy in the UK (Foxon, 2013) and transition to community renewable energy in the corporate energy world, with a focus on the UK (Cowell et al., 2016; Strachan et al., 2015).

While studies have suggested that countries are the appropriate delineation for understanding sustainability transition as evidenced in some case studies (Raven et al., 2012), developing countries particularly Sub-Saharan Africa, have mostly not been considered. Fischer (2003a; 2003b) elucidates that the fundamental issue in understanding how changes come about has to be rooted in a thorough contextual analysis of the circumstances of that particular case (see also Cowell et al., 2016). As such, this study highlights new findings regarding a transition to community renewable energy in the context of Nigeria, where transition lies between increasing energy access and pursuing a low-carbon energy trajectory.

Previous studies have also focused on transition theory as an approach that was developed, "*to understand and influence the early adoption of new technologies with high potential to contribute to sustainable development*" (Schot and Geels, 2008: 1). However, community renewable energy is not centred on technology alone but also covers a broad range of innovative socio-technical arrangements. These include the participation of local people in resource exploitation, a new ownership arrangement that involves local communities in decision-making and a new deployment model that supports renewable technologies at a community level. Thus, this study further extends transition theory to both innovative technologies as well as the governance approach through which renewable energy technology is being

implemented in developing countries. The study serves as a guide for policymakers, communities, and regulatory agencies on how they can interact with stakeholders to develop an efficient and effective tailored programme to address the electricity access challenges facing off-grid communities.

1.9 Synopsis of the Thesis

This chapter has positioned the research within geographical, theoretical and methodological contexts and has outlined the purpose and significance of pursuing the research. Chapter 2 provides a general overview of rural electrification and the challenges facing electrification of off-grid rural communities in Nigeria. The chapter also presents an extensive review of community renewable energy and its potential in contributing to the sustainable electrification and development of rural communities. In the end, the chapter reviews the policies and strategies aimed at governing the transition to community renewable energy in Nigeria

Chapter 3 presents a critical and detailed overview of the transition theory and the theoretical model based on which this thesis analyses how the shift to community renewable energy in rural areas is determined, planned and implemented. The chapter begins by reviewing the literature on transition theory and concepts – MLP, TM, and SNM, and developed a theoretical model to analyse the processes through which community renewable energy is developed. The methodology used in this study is presented in Chapter 4. It starts by explaining the reasons for the adoption of an interpretative

research paradigm for this study and subsequently outlines arguments for selecting a qualitative research approach and the choice of the case study as the research strategy for the study. The chapter also presents the method employed for data collection as well as the method for data analysis.

Chapter 5 provides a comprehensive breakdown of the empirical data. It critically explains the findings of the processes of how community renewable energy is being determined, planned and implemented for off-grid rural areas electrification in the national context of Nigeria. Thus, providing a critical evaluative approach to the result gathered from key stakeholders. This is further developed in Chapter 6, which presents a discussion and interpretation of the key findings. It involves analysing data according to themes, synthesising, and evaluating the data with the theoretical model and relevant literature on socio-technical transition and community renewable energy. Having presented and analysed data in Chapter 5 and 6. Chapter 7 provides the conclusion of the study by responding to the questions set in Chapter 1 and pointing out the theoretical and practical contributions to knowledge. The implications for practice and suggestions for further studies are also presented in the chapter.

Chapter Two

Rural Electrification, Community Renewable Energy and Transition Governance in Nigeria

2.1 Introduction

It is universally accepted that electricity is one of the most vital inputs for powering economic growth and human development (Sovacool and Drupady, 2016; Bhatt and Kumar, 2012). However, four out of five people in developing countries live in remote rural locations without access to basic electricity services (Pachauri et al., 2012). It is against this backdrop that this chapter begins by providing a general overview of rural electrification and the challenges facing electrification of remote rural communities in Nigeria. This is then followed by an extensive review of community renewable energy and its potential to contribute to the electrification and sustainable development of off-grid communities. The chapter ends with a discussion of the policies and strategies aimed at governing the transition to community renewable energy in off-grid rural areas in Nigeria.

2.2 Rural Electrification

The term rural electrification refers to the process by which access to electricity is provided to rural communities that are located in isolated or remote areas of a country (Niez, 2010). It is worth stating that the term 'rural' is ambiguous and varies considerably across countries (see for example: Hart et al., 2005). However, Cloke (2006) and Novotný et al. (2015) do outline that a rural area could be understood by the following features:

- Extensive land use practices, typically agriculture and forestry;

- A cohesive local identity;
- Small settlements with a relatively low population;
- Relatively small local markets;
- Relatively low levels of education; and,
- Much of the population is generally unskilled.

In terms of population, Bollman and Clemenson (2008) referred to rural locations as places with a small population of below 1,000 people located outside towns and cities. In other places, it may be up to 50,000 people (Pachauri and Spreng, 2012).

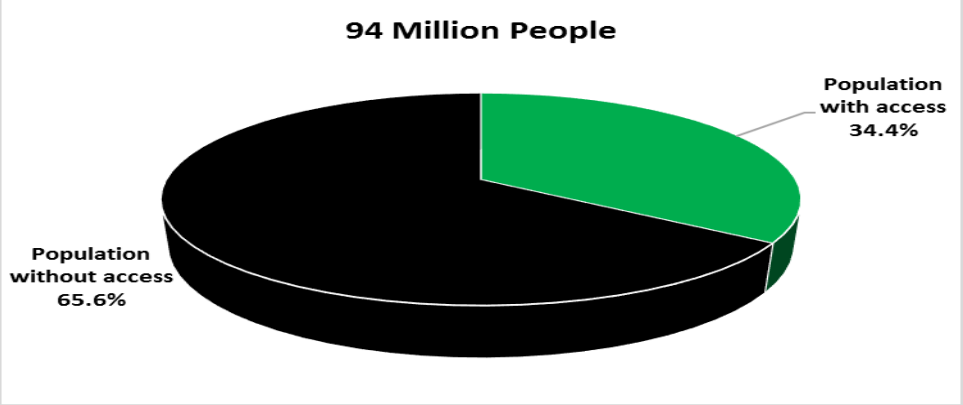
In the national context of Nigeria, a rural area is defined as a place located more than 10 km away from the borders of an urban area or city (NERC, 2012). Further, the average population is below 20,000 people or the population density below 200 people per square kilometre. Also, rural areas are located at least 20 km from the nearest 11 kV grid line (NERC, 2012; Ley et al., 2014).

Irrespective of definitional issues, the electrification of rural communities is necessary for meaningful economic and social development. For instance, the electrification of rural communities fosters productive activities such as mechanised farming, grinding, storage and preservation of farms and health products (Khandker et al., 2012; Barnes, 2007). Niez (2010) and Pachauri et al. (2012) argued that the development and growth of such activities using electricity subsequently gives rise to the demand for more energy usage, leading to a whole cycle which profits both rural communities and electricity providers. Similarly, rural electrification confers social benefits

that are derived from the services electricity provides to individual households (Khandker et al., 2012).

In many developing countries such as India, Bangladesh, Nepal and Nigeria, the extension of the centralised national grid dominates their rural electrification strategies (Niez, 2010; Bhattacharyya and Ohiare, 2012). With Nigeria, rural electrification started with the country's rural electrification programme in 1981 (ESMAP 2005). The aim of the programme was to provide electricity access through national grid expansion (ESMAP 2005). Despite the apparent achievement of the programme in connecting some major towns to the grid, the programme had fallen short of making a significant impact, leaving more people without access to electricity now, than in 1981 when the programme started (Achugbu, 2013). According to World Bank data, about 94 million of 182.2 million Nigerians, live in rural areas, with only 34.4% of people having access to grid electricity as indicated by Figure 2.1.

Figure 2.1 Rural Electrification Rate in Nigeria



World Bank (2015: Online)

Moreover, the majority of rural areas in Nigeria are geographically isolated, with scattered and relatively small population densities or a low potential demand of electricity to justify the extension of the grid (see Narula et al., 2012; Crousillat et al., 2010). Rural electrification using grid extension also faces a myriad of other challenges, which are discussed in the following section.

2.3 Challenges of Rural Electrification in Nigeria

Nigeria generates its electricity primarily from centralised thermal power stations which extend to some rural areas through transmission lines and distribution infrastructure (Ley et al., 2015; ESMAP 2005). This infrastructure faces several challenges including: low generation capacity; inadequate and weak transmission and distribution infrastructure; vandalism and acts of sabotage; insufficient investment; inadequate maintenance; and, poor tariff regime (Oseni, 2015; Emodi and Yusuf, 2015; Oni, 2014; Shaaban and Petinrin, 2014; Oyadongha, 2014; Makwe et al., 2012). The following sections review some of these difficulties.

2.3.1 Inadequate or low generation capacity of the centralised stations

Nigeria generates its electricity principally from gas plants, a small number of large-scale hydro projects, and some newly independent power projects spread across the country (see Appendix D and E for locations of the plants). As previously noted Nigeria has one of the highest gas reserves in the world but the lack of gas infrastructure, poor utilisation of existing infrastructure, and frequent maintenance downtime makes reliable electricity generation from gas a challenge (Oni, 2014). Similarly, the few hydro plants in

operation are old and do not function at full capacity (Emodi and Yusuf, 2015). Finally, overall installed electricity generation capacity in Nigeria stands at only 5,700MW as of 2016 (FGN, 2016). This is considered grossly insufficient even for existing on-grid electricity demand (FGN, 2016). Thus, capacity related issues mean that rural electrification using the existing grid is not currently a feasible option.

2.3.2 Inadequate and weak transmission and distribution infrastructure

Much of Nigeria's electricity infrastructure was built in the 1950s with low transmission and distribution voltages, typically 330kV and 132kV (Makwe et al., 2012). At that time demand for electricity was minimal and the infrastructure that was built was able to meet the country's electricity needs (Makwe et al., 2012). However, as Nigeria's population increased and industrialisation set in, demand for electricity increased without commensurate investment in infrastructure to upscale power supply (Makwe et al., 2012). This, coupled with ageing infrastructure, has put pressure on existing electricity systems and has led to overload in the transmission and distribution network (Aliyu et al., 2013; Makwe et al., 2012). The transmission and distribution system is now subject to double-digit losses – sometimes amounting to about five to six times more of what is usually reported in an efficient transmission and distribution system (Shaaban and Petinrin, 2014; Makwe et al., 2012). Thus, while the system is grappling with inadequate capacity, the available capacity is unable to generate enough reliable electricity. Although the management of the transmission sector has been awarded to a private consultant, it has continued to lack

new expansion and operates with limited capacity and decades-old transmission facilities (Oni, 2014).

2.3.3 Vandalism and acts of sabotage

Extending the centralised electricity to rural areas has also been challenged by the frequent and deliberate destruction of electricity equipment by vandals (Makwe et al., 2012). Electricity transmission equipment such as cables that connect electricity supplies to hinterlands are often destroyed, and some valuable equipment carted away which results in disruption of electricity supply for days (Oyadongha, 2014).

The substantial load shedding experienced in the country has often been attributed to the destruction of pipelines that supply gas to the thermal stations (Amanze-Nwachuku and Alike, 2015, Okafor, 2015). Electricity distribution transformers, insulation oil, feeder pillars and cables that supply electricity to the point of consumption are being targeted especially in less affluent and congested settlements (Oyadongha, 2014). In addition to the deliberate destruction of electricity infrastructure, illegal connections to the distribution and transmission lines often result in power surges that sometimes destroy household and industrial appliances (Oyadongha, 2014). These acts have continued to cause serious disruption in electricity production and threatened the efficient delivery of electricity to the rural parts of the country using grid extension.

2.3.4 Corrupt practices

Like other industries in Nigeria, fraudulent activities are widely reported in the electricity sector (Shaad and Wilson 2009; Aliyu et al., 2013). This

affects almost every aspect of the industry, from generation and transmission to regulations, thereby raising concern about transparency and accountability. Such fraudulent practices include offering bribes to government officials to obtain licences or secure contracts for building new electricity generation plants as well as the syphoning off of public funds meant for the construction of electricity infrastructure (Anyanrouh, 2013). At the lowest level, these unethical practices are also being witnessed at the metering, billing and collection points (Oseni, 2015). Scholars believe that although such acts at this lower level are insignificant, their widespread nature is capable of bringing large utility companies to bankruptcy (see Gulati and Rao, 2007).

2.3.5 Inadequate investment

Inadequate investment in new electricity generation and maintenance of existing infrastructure constitutes another challenge facing the Nigerian centralised electricity industry (Oseni, 2011). According to the Presidential Task Force on Power (PTFP), and the Bureau for Public Enterprises (BPE), the Nigerian electricity industry requires a yearly investment of US$3.5 billion to increase the generating capacity to 40,000MW by 2020 (Makwe et al., 2012). Similarly, significant investment is also required for the transmission network which is considered too low to accommodate even the current on- grid electricity demands (Emodi and Yusuf, 2015).

2.3.6 Poor tariff

The tariff is the price of generating electricity that covers gas purchase, generation, transmission and distribution charged per kilowatt-hour (Fashola quoted in Alohan, 2015). Joseph (2014) maintained that an

efficient pricing or tariff for electricity is crucial for a well-functioning electricity industry because it is critical for cost recovery and, therefore, guides investment decisions. According to Ohunakin et al. (2014), the current electricity tariff in Nigeria is not market-reflective for profitable investment. Attempts to increase the electricity tariff to reflect market conditions have often been resisted by electricity consumers, labour unions and civil organisations (Ebosele, 2015; Suleiman, 2016). The reason for this action could be explained by the lock-in provided by past regulatory pricing and the perceived view of electricity provision being the responsibility of government. Similarly, the low gas tariff is also affecting investment in gas supplies to Nigeria thermal electricity plants (Alohan, 2015).

Thus, given the challenges mentioned above, providing electricity access through other alternatives is necessary for remote rural communities. Barnes (2011) argues that achieving electrification of remote rural communities through other options has proven difficult. This may be because firstly, a lack of agreement on methods to transform the existing policies and institutions to support alternative rural electrification programmes and secondly, the reluctance of electricity providers to support other alternatives due to the relatively small load demand and customer base in rural locations.

Niez (2010) states that the choice of alternative energy for rural electrification depends on issues such as resource availability, technology availability and maturity, economic viability, as well as a viable framework through which electricity will be provided and made useful to rural

communities (Niez, 2010). In this regard, community renewable energy has been presented as an option for the electrification of remote rural communities (see for example: Chmiel and Bhattacharyya, 2015; El Bassam et al., 2013; Yadoo and Cruickshank 2010). The following section presents a review of community renewables.

2.4 Community Renewable Energy

There is no single universally accepted definition of community renewable energy (Seyfang et al., 2013). The term "community renewable energy" is a combination of the words "community" and "renewable energy." Just as there is no one-size-fits-all definition of community renewable energy, there is no one single definition of community (Strachan and Jones, 2012). However, in the context of this thesis, a community is referred to as a group of people who are located close to and affected (in terms of sound and vision) by a proposed project installation (see for example: Strachan and Jones, 2012). Moreover, it can be said that the spatial extent of such localities has no clear boundary (CSE, 2005; Munday et al., 2011; Cowell et al., 2012) and who is affected by project installation and proximity is debated in both policy-making and academic circles (see CSE, 2005). Renewable energy, on the other hand, refers to energy sources from alternative and sustainable means, for example, solar, wind, hydro-geothermal and biofuel energy.

In understanding what the combination of the terms means, two key dimensions emerged from the studies of Walker and Cass (2007), Walker and Devine-Wright (2008). First, concerning the process perspective,

community renewable energy depends on who develops and manages a project, who participates in the project, and who has an impact on the project. On the other hand, an outcome perspective is based on who the project is for, in other words, whom it benefits particularly in social and economic terms. Both perspectives clearly portray how governance is being structured, through which a given renewable technology is being implemented and made useful (Walker and Cass, 2007).

Arising from these perspectives, Walker and Simcock (2012: 194) refer to community renewable energy in general terms as:

> "…[energy] *production on a small, local scale that may be governed by or for local people or otherwise capable of providing them with direct beneficial outcome*."

The definition above highlights an innovative approach that includes the participation of the local community in the governance of energy provision. The question being asked is why communities should get involved in the governance of energy provision?

Community involvement in energy provision is seen as the procedure of making better decisions that include the concern and interest of all those that stand to be affected by the decision (Smith, 1983; Brown and Wyckoff-Bard, 1992). Therefore, community participation was described as, "*any of the several mechanisms intentionally instituted to involve the lay public or their representatives… in decision-making*" (Beierle and Cayford, 2002: 6). It is also described as any group of procedures that inform, consult, involve, collaborate and empower the local communities in the development and management of natural resources (IAP2 2007). Thus, the participation of

the people requires the intentional involvement of the local people in contributing to the development effort of projects. Laah et al. (2014) and Aref and Redzuan (2009) stated that this could be achieved by allocating equal benefits, a shared responsibility in planning decision making and setting goals, as well as in formulating policies.

Although the idea of community participation is new to the renewable energy industry, it has long been utilised in different resource development and management areas. For instance, its importance has been recognised in freshwater resource management (Cavalcanti et al., 2010), tourism (Tosun, 2006) and forestry (Kamoto et al., 2013). Community participation in the development and management of energy provision has been elusive, even though local communities are stakeholders who determine the success or otherwise of a project as well as absorb the impact of the management and development of projects (Wright, 2012). Various arguments have been advanced to substantiate the need for community participation in resource development and management. However, in the context of renewable energy, a typical reason for community involvement is to increase public acceptance, which is one of the key variables for successful large-scale diffusion of renewables (Evans et al., 2011; Wright, 2012). Results of pre and post participation studies revealed a positive correlation between increased public involvement in the planning process of renewable energy development and a high level of social acceptance (Devine-Wright, 2005).

From a different perspective, community participation is seen as the right of the locals who host the renewable energy project. This view was supported

by both the World Commission on Environment and Development (WCED) and UN Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Johnson and Dagg, 2003). Furthermore, advocates of this view see community participation as a means of ensuring trust, reducing conflict and facilitating justification in decision-making, the lack of which contributes to public scepticism, mistrust and opposition (Bell et al., 2005 cited in Devine-Wright, 2011b). Similarly, community participation is seen as a mechanism that allows for bottom-up solutions to economic, social and environmental problems more effectively (Bergman et al., 2010). This opposed the top-down measures which according to Agrawal and Gibson, (1999) are often characterised by faulty designs, inefficiencies, and sometimes corrupt practices.

Sorensen et al. (2002) identified three different approaches to community participation: information dissemination; involvement in decision-making; and, financial involvement. O'Faircheallaigh, (2010) described the first as the most widely adopted and passive in nature. Here the communities are involved as recipients of information with decision makers providing them with details of proposed projects, project timing and expected impacts on particular groups and localities. The information provided is critical in allowing affected parties to prepare for project impact and assists in securing a hitch-free implementation of projects (O'Faircheallaigh, 2010). The second approach involves the participation of local people in decision-making. In such cases, project impacts can be adequately addressed and conflicts reduced (Sorensen et al., 2002). Simon and Wustenhagen (2006) and

Sovacool (2013) observed that direct participation and local community contribution of their time, land and or resources, accelerates social acceptance of renewable projects.

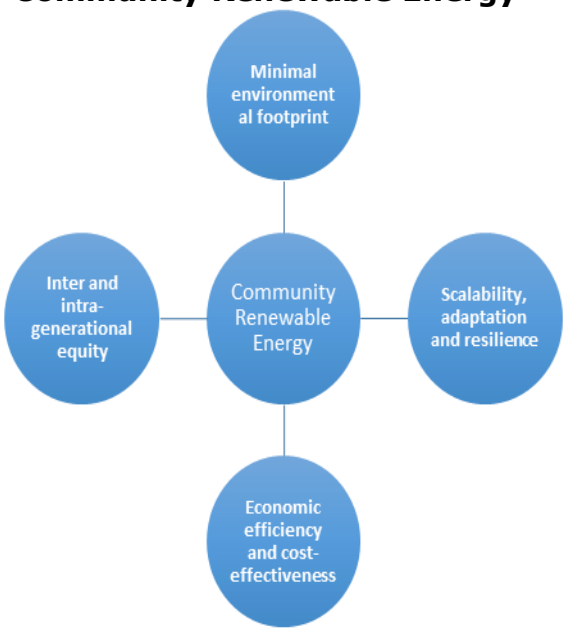
The third approach is the financial involvement method. In this approach, the communities are involved by having a direct financial stake in a project (Szarka et al., 2012; Warren et al., 2012). In most developing countries, the participation of locals in renewable energy initiatives involves mainly initial consultation of community members to assess the demand for energy and solicits the help of the communities in the construction of projects (Gollwitzer, 2014). There is limited evidence of a community renewable energy project that is designed, financed, built, maintained and operated by a local community in developing countries. However, having a financial stake in community renewable energy projects has gained the attention of researchers, and this informed one of the key focal points of this thesis.

2.5 Community Renewable Energy and Sustainability

The electrification of remote rural communities using community-scale renewable energy is crucial to any discussion of sustainability transition in rural areas. This is because of the link it has to all the components of sustainable development pillars – economic, environmental and social sustainability (see Munasinghe, 2002a:2002b). Deshmukh et al. (2014) also believe that community-scale renewable energy appropriately addresses the concerns of the different dimensions of energy for the sustainable development of any location including rural areas. These values, as depicted in Figure 2.2, and explained in the next sections include minimal

environmental footprint, scalability, adaptation and resilience, inter and intra-generational equity as well as economic efficiency and cost-effectiveness.

Figure 2.2 Socio-Economic and Environmental Benefits of Community Renewable Energy



Source: Compiled by Author

2.5.1 Minimal environmental footprint

It is acknowledged that both global production and consumption of goods and services are increasing to meet the requirement for better quality of life of the growing population (Panwar et al., 2011). Whereas fossil fuels provide a substantial part of the energy needed for this increasing production and consumption (OECD/IEA 2015), Panwar et al. (2011) argue that they are unsustainable. The reason is that as fossil fuel use not only intensifies the degree to which the natural stock of fossil fuel reserve depletes, but is accompanied by significant adverse effects on the environment and energy security.

Conversely, community renewable energy provides an alternative energy solution whose source is non-exhaustible, making it available for both present and future generations. Additionally, community renewable energy is based on non-fossil fuel sources, which are virtually free of carbon and other greenhouse gas emissions (Panwar et al., 2011). Climate and environmental risks such as large-scale oil spills, mining accidents, gas explosions and nuclear meltdowns that are linked to hydrocarbons and nuclear energies are negligible with community renewable energy (Martin, 2011). Fossil fuel exploitation also produces a substantial part of today's global waste (Olivier et al., 2013) which is traditionally disposed of through incineration, landfill or discarded into ocean waters (Tyagi and Lo, 2013; Wolsink, 2010).

Such actions according to Tan et al. (2014) are harmful to the environment, marine life and human health. Community renewable energy, on the other hand, produces less or zero secondary waste (Panwar et al., 2011). Martin (2011) also posits that there are possible environmental risks associated with renewable energy, such as emissions during life-cycle construction of technology, or environmental interruptions caused by large wind farms. It is argued that these risks are in no way as threatening as the risks from fossil fuel supply or nuclear power breakdown; where a significant number of people can be affected by a single accident such as the Fukushima nuclear incident. More so, the decentralised nature of community renewable energy also limits the impact of environmental accidents (Verclas, 2012; Edenhofer et al., 2011).

2.5.2 Scalability, adaptation and resilience

The ability to generate electricity on this smaller scale offers the most cost-efficient approach to extending energy access in areas where grid infrastructure has not yet reached, particularly remote and poor rural areas (Edenhofer et al., 2011). This scale advantage also allows community renewable energy to integrate and adapt to available energy infrastructure (Bolinger et al., 2001a:2001b). Many scholars consider the ability to integrate renewable energy with available energy infrastructure as crucial for a sustainable energy system (Gibson, 2006).

Community-scale renewable energy also has advantages regarding system resilience[4]. Energy system resilience characterises a system's ability to cope with adversities that may arise from system complexity, unavailability of resources, diversity of energy supply, political disruption or terrorist attack (O'Brien and Hope, 2010). Community renewable energy contributes to building a resilient energy system not only by its scale but also by the unending availability of resources. In this regard, IRENA (2015) posits that renewable energy can be used in developing countries to improve energy system reliability, prevent power blackouts due to deliberate attacks and natural catastrophes. Kempener et al. (2015) also support the idea that community-scale renewable energy can be developed as an option to evade power shutdowns occasioned by undersupply of resources and natural events that sometimes obstruct electricity production. Likewise, the vulnerability due to the effects of grid system losses, grid congestion and

[4] Resilience here refers to the ability of a system to respond to shocks and still essentially maintain the same functions (Holling, 1973)

destruction could be minimised by having clusters of community-scale electricity generation stations close to points of consumption. Community renewable energy also helps to create a foundation for the promotion of behavioural change (Heiskanen et al., 2010), which is a significant step towards building community resilience (Plodinec, 2009).

2.5.3 Inter and intra-generational equity

The concept of equity reflects a variety of ethical beliefs (Lamorgese and Geneletti, 2015). It connotes the search for a fair and equal ratio between common goods and individual rights (Glasser, 1999). Intergenerational equity is built on the premise that the natural resources of the earth are common goods for both present and future generations (Weiss, 1990). Thus, intergenerational equity advocates fairness in the distribution of these natural resources among both current and next generations. This type of equity was stressed in the Brundtland definition of sustainable development: ''*Development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs*'' (WCED, 1987: 43). Weiss (1990) and Anderson (1997) maintain that as the beneficiary of the earth's natural resources, the present generation should pass down the earth's natural resources as inherited to the future generation.

Similarly, sustainability requires intra-generation equity within and between nations such that distribution of resources between nations and within a nation is made to allow a fair distribution of resources (Vojnovic, 2014). In this regard, Elkin et al. (1991) and Avilés (2013) emphasise the relevance

of not only assuring fair access to natural resources between current and future generations but also within current generations especially considering the needs of the poor. Based on the discussion above, Park, (2012) posited that the participation of the people in the development of common resources not only ensures a fair distribution among the generations but also on how the resources are provided and made useful (See also Johnson and Hall, 2014).

2.5.4 Economic efficiency and cost-effectiveness

Community-scale energy is described as more energy efficient than centralised electricity grids because as electricity is transmitted through long high-voltage transmission and distribution networks, a portion of it is wasted by various factors (Verclas, 2012). The longer the distance, the greater amount of electricity losses (Verclas, 2012). Conversely, by having clusters of community-scale renewable energy projects in different locations, the energy that will be required to compensate for transmission losses is avoided (Alanne and Saari, 2006). Similarly, investment in transmission and distribution networks will be substantially reduced, as a community-scale energy system does not depend on expensive infrastructure that a large-scale power system requires to generate and transmit electricity (Greenpeace, 2005). Furthermore, large-scale fossil fuel plants are characterised with externalities such as emissions, costs related to system failures, the risks of fuel price volatility and supply shortages. Community renewable energy will be at a higher competitive advantage to centralised fossil fuel energy when these are monetised and factored (Sener and Fthenakis, 2014).

Furthermore, the supply chain of a centralised electricity system typically involves complex, large-scale infrastructure systems, various jurisdictions, institutions, and a large number of customers. This structure provides a breeding ground for high profits and rent-seeking behaviour that sometimes leads to corrupt practices in the industry (Mathias, 2002). On the other hand, community renewable energy is usually on a small scale with less institutional and bureaucratic involvement as well as relatively fewer customers (Gollwitzer, 2014). Such configuration reduces the chances of rent-seeking behaviour, and therefore, reduces the chances of corrupt practices, which increase the cost of centralised electricity. Moreover, community renewable energy such as in cooperatives is usually based on democratic principles (Richter, 2013) and, therefore, is more open to transparency and accountability mechanisms and processes that again make them less prone to corruption.

Unlike a centralised electricity system that requires large-scale investment, community renewable energy for rural electrification can be operated with a relatively small investment, making it possible for not-for-profit organisations such as cooperatives to participate (Gollwitzer, 2014). More so, once community renewable energy projects are set up, they can be upgraded to meet growing demand with relative simplicity (Venkataraman and Marnay, 2008).

Having explored the benefits of community renewable energy, the following section appraises the different models through which community renewables can be implemented.

2.6 Different Models of Community Renewable Energy

There are some applicable models for community renewable energy. A community project can be wholly community-owned (Walker, 2008), or may be jointly owned by commercial developers (Strachan et al., 2015). Different model categories of community renewable energy projects have been adopted in several places including: cooperatives; community development trusts; joint ownership arrangements; and more general community benefits provision. Some of the more popular models are explained in the following sections.

2.6.1 Cooperatives

In recent years, cooperatives have been the main vehicle of community ownership of renewable projects notably in Canada, Denmark, Germany, the UK and the USA (Viardot, 2013). Cooperatives are independent associations of people who willingly come together and enter into a contract agreement to meet their common social and economic needs through mutually owned and democratically controlled businesses (Mendonça et al., 2009; Viardot, 2013). In a cooperative model, local citizens willingly become members of the cooperative and subscribe shares to finance a renewable energy project (Walker, 2008; Haggett et al., 2014). Holders of cooperative shares are entitled to a certain percentage of the profits made from the energy projects (Haggett et al., 2014). Such profit may be distributed amongst the members who subscribed for the shares, or it might be put into other charitable works (Haggett et al., 2014).

Cooperatives operate according to the core principles and values enumerated by the International Co-operative Alliance, which include: economic participation by members; voluntary and open membership; democratic member control, autonomy and independence; education; training and information; cooperation among cooperative members; and, concern for the community (MacPherson 1995). A study by Subbarao and Lloyd (2011) showed that successful community renewable projects are usually run by community cooperatives.

2.6.2 Community development trust

This model usually takes the form of charitable associations that offer or manage facilities or equipment for a community including providing services such as energy provision (Walker, 2008). Charitable associations have restrictions on trading and need to ensure that risks from trading are kept separate from the charity. Thus, usually a trading subsidiary is set up to manage the investment in energy generation.

2.6.3 Joint ownership

Literature indicates that community energy can be fostered in a symbiotic or hybrid relationship (Strachan et al., 2015). This takes the form of joint ownership between the commercial developer and any of the local outfits (cooperatives or development trust). Overall, joint ownership gives commercial developers the ability to tap into local resources, address local concerns and gain public acceptance (Strachan et al., 2015). Further, the ownership style also gives the community the benefit of the developer's expertise in areas such as in negotiating complex legal and market

agreements, as well as securing wider financial support for the initial project development (see Strachan et al., 2015; Fermanagh Trust, 2012).

From the perspective of communities, joint ventures are seen as less risky than undertaking wholly owned community projects, because the joint-partner brings in funding, skills and experience that are often not available in the community to start a project. However, when a local community is the minority partner in a joint venture, they may have limited control and participation (Gubbins, 2010). Similarly, it is often difficult to access public grants and loans for communities with a minority shareholding in a joint venture because most public fund providers prefer to see the community having control and ownership of project assets (Gubbins, 2010).

2.6.4 Community benefits

This model represents a rather passive financial involvement of communities in renewable energy projects. It arises where the energy developer offers a financial package to a community trust fund for spending on local projects (Strachan and Jones, 2012; Cowell et al., 2011). Community benefits provision is more popular in the UK (see DECC, 2014a). Docherty Consulting (2012) mentioned several methods in which financial contributions from developers can be provided to the communities. This include:

- An annual sum paid per generation output. This gives an expected level of income for the community, which is tied to the size of the development. These annual payments are usually index-linked.

- A variable annual payment per generation output - here payment is tied to profit or productivity measures. It might be higher or lower dependent on the project output;
- A Lump sum, typically an initial one-off payment; or
- A blend, of two or more of the described methods.

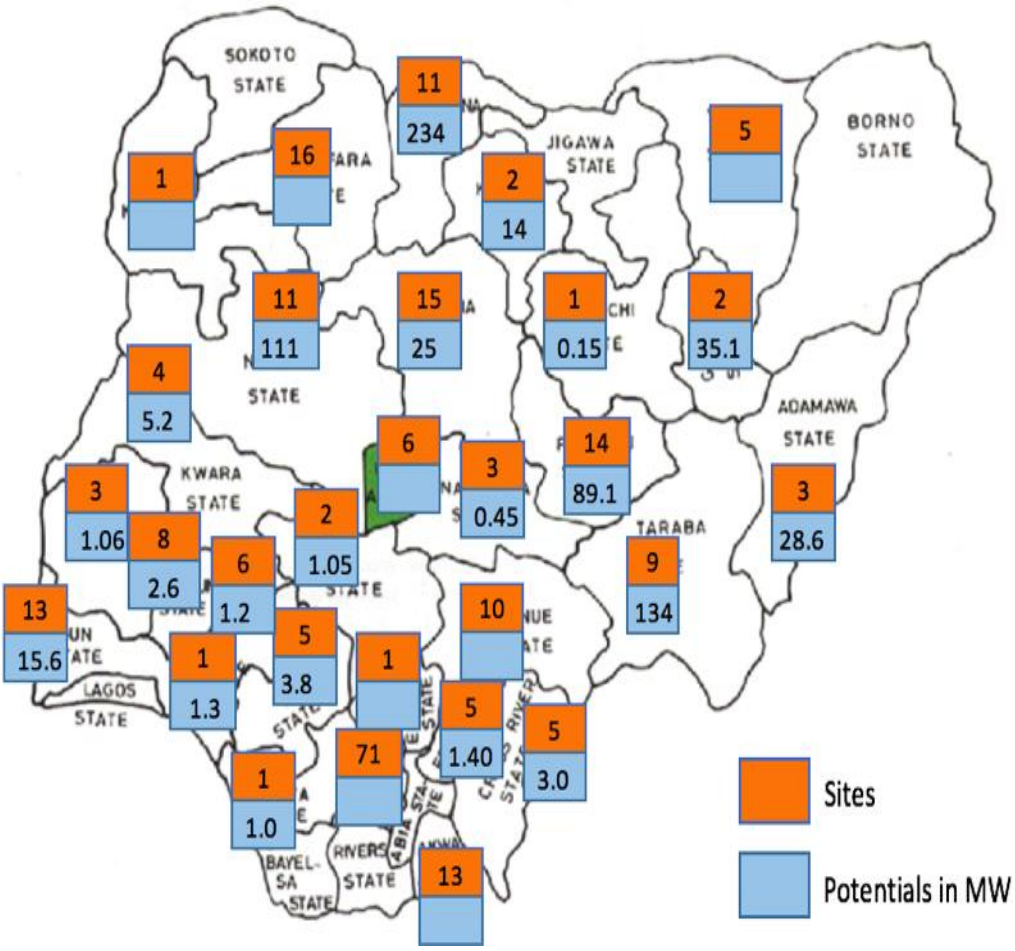
The community benefits model is being applauded as a way of administering financial benefits that are linked to the performance of a project and also as a way of sharing the benefit with a larger population of a local community (CSE, 2007). However, criticisms exist where funds are not adequately put to use in ways that benefited the local community as well as when payment was seen as compensation, which implied causing some harm (Cowell et al., 2011). It is also criticised because communities are left with limited control and rights to participate in project decision-making (Walker, 2008; Cowell et al., 2011).

2.7 Potential for Community Renewables in Nigeria

It has been identified in many studies that Nigeria has considerable untapped renewable energy resources that can support community renewable energy deployment to meet its rural electrification challenges (see Kempener et al., 2015; Charles 2014; Elusakin et al., 2014; Shaaban and Petinrin 2014). A recent policy document reported on 10,000MW of large hydro that may be capable of generating 36,000GWh of electricity per year. However, only 15 percent has been harnessed (NREEEP, 2015). The document also shows that Nigeria can generate about 3500MW from small and medium scale hydro (NPREEE, 2015). Only 2 per cent of this is currently being utilised (NPREEE, 2015). Figure 2.5 presents the medium and small

hydro resources in some selected locations that can be exploited for community renewables.

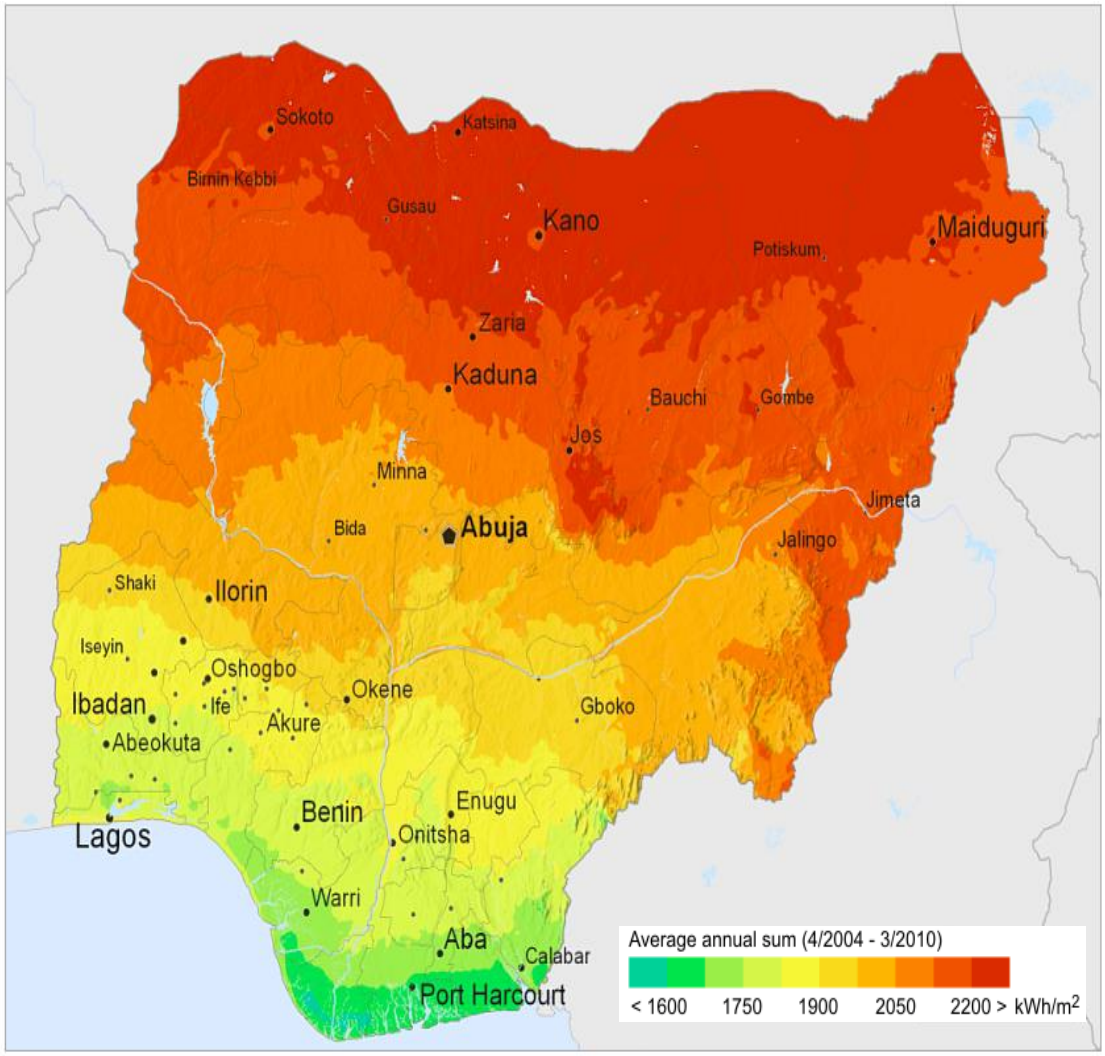
Figure 2.3 Potentials for Small Hydro Energy



Source: Based UNIDO cited in Kela et al., (2012: 3)

Nigeria is geographically placed within a sunny belt area with solar radiation averaging between 3.5 to 7.0 kWh/m2/day (using 0.1% Nigeria's land area. This potential may be used to generate about 4.2 million MWh/day) (REMP, 2009). The figure below depicts the solar radiation across the different regions of Nigeria.

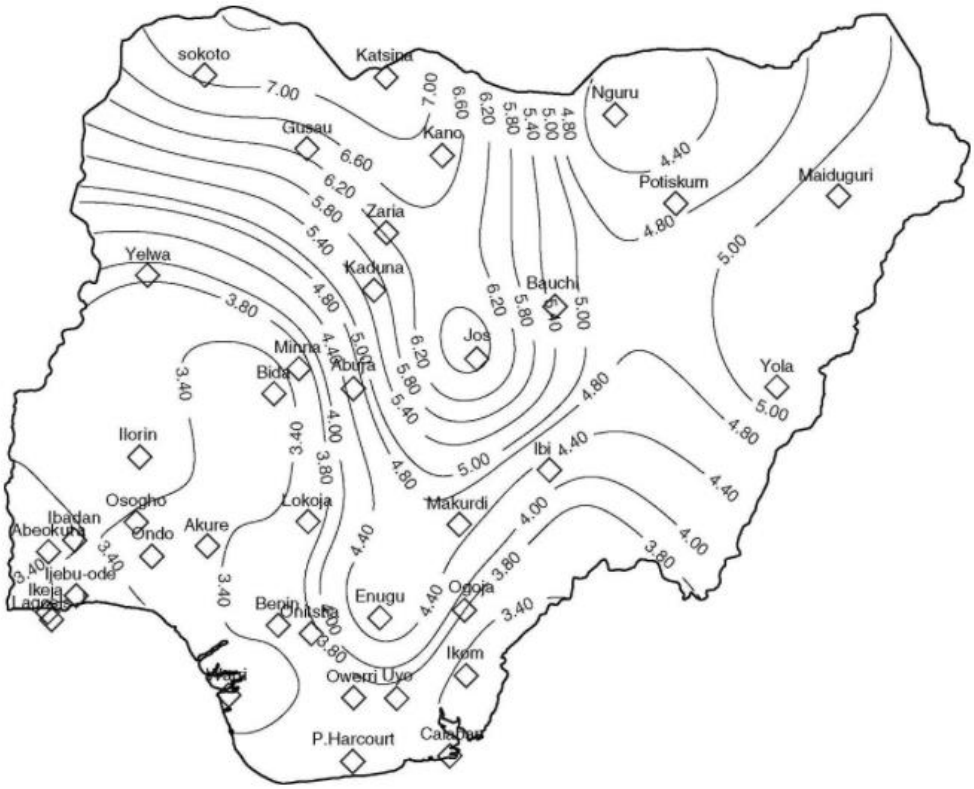
Figure 2.4 Annual Solar Radiation in Nigeria



Source. GeoSun (2016: Online)

In a related development, studies have shown that at the height of 10 meters, Nigeria is endowed with wind speeds that range from 1.4 m/s at the southern part to 8.0 m/s at some higher altitude locations in the northern region (Shaaban and Petinrin, 2014; Charles 2014). Figure 2.6 indicates the distribution of average wind speed spread across some selected places in the country at the height of 10 meters. The figure portrays that wind speeds are weak in the southern part but relatively suitable for electricity generation in some northern regions of the country.

Figure 2.5 Potentials for Wind Energy in Nigeria



Source: Charles (2014: 13)

2.8 Challenges of Developing Community Renewables

Despite the potential and significance of community renewables in solving electricity access problems in rural locations, its wide scale development is being challenged by many factors as reported in several studies. Some of these factors are explained in subsequent sections. They include: limited knowledge and understanding of renewables; the difficulty in raising capital; the limited expertise; the low level of participation; and, local opposition.

2.8.1 Limited knowledge and information about renewable energy

Inadequate information and knowledge of renewable energy technologies are identified as one of the reasons why the rate of community renewable energy deployment remains low (Liarakou et al., 2009; Barton, 2008).

Knowledge, information and awareness of renewable technologies are vital aspects of deploying community renewables (Sathaye et al., 2011). Research has similarly shown that people with no particular knowledge and understanding of renewables are more likely to overestimate their costs, underestimate their benefits, and oppose them in their community (see Sovacool and Ratan, 2012). Lack of knowledge also prevents investors and local communities from getting involved in community projects that may appear complex and unfamiliar to them (Walton 2013), resulting in low participation and continued use of established methods (Assefa and Frostell, 2007).

Negro et al. (2012) and Horbety et al. (2012) found that insufficient knowledge and inadequate access to information have also affected community acceptance of many renewable energy projects. Similarly, Upreti (2004) and Devine-Wright (2011a) have found that low levels of information and awareness contribute to disagreements over siting community renewable energy projects. Conversely, Krohn and Damborg (1999) have identified that communities with a high level of information and knowledge about sustainable energy generation tend to be more positive towards renewable energy.

Disregarding perceptual and informational concerns of community renewable energy affects public acceptance and development of renewable energy technology (Sathaye et al., 2011; Werner and Schaefer, 2007). Previous research has emphasised the need to provide accurate information to create awareness, change behaviour and gain support for renewable

energy. Lorenzoni and Pidgeon (2006) suggest that creating climate change and sustainable development debates in communities will help to raise awareness in communities. Irrespective of the strategies to be used, trust in the source of information plays a significant role in changing people's beliefs (see for example: Walker et al., 2010). Lorenzoni and Hulme (2009) found that information that clashed with people's beliefs and attitudes is likely to be rejected. Thus, they suggested that information should be provided in line with the beliefs and attitudes of local people. Further, Park and Theobald (2013) emphasised the need to adapt renewable energy information in money-making terms in addition to environmental and other benefits.

Prasad and Snow (2014) also argue that: lack of information about technology, performance, cost and planning among investors makes support for renewable energy transition challenging and difficult in many developing countries.

2.8.2 Difficulty in raising initial capital requirement

The UK Department of Energy and Climate Change (DECC) has shown that even where people are knowledgeable about sustainable energy and have indicated interest and willingness to be part of the renewable energy transition, raising initial capital requirement has remained a challenge for the development of community renewable energy (DECC 2013:2014a). Rogers et al. (2008) stated that mobilising communities to finance the initial investment of community renewable energy has been a task that most communities cannot afford. For instance, a resident of Cumbria in the UK in

an interview said, "*Everybody does the talking but, in the end, it costs so much that you are back to square one. You can't raise the sort of money that's needed*" (Rogers et al., 2008: 4220). This is even more complicated in developing countries where most rural inhabitants are relatively poor and have no knowledge of raising capital to participate in energy projects. In addition to the difficulty of raising the capital required for renewable energy, the longer investment recovery period is also affecting renewable energy development especially in rural areas (Nasirov et al., 2015).

2.8.3 Lack of expertise

The success of a community renewable project depends largely on having the right mix of experts. Nonetheless, experience has shown that most projects are initiated by volunteers who do not necessarily have the required expertise, including legal and financial skills (Willis and Willis, 2012). In instances where people with the necessary expertise can be found, they are often limited by how much time they are willing to give without any financial reward, as communities may not be able to offer payment (DECC, 2013). Thus, the lack of available skills in communities presents a challenge to the development of community renewable projects, particularly when it requires complex issues such as seeking permission or negotiating complex contract agreements with other organisations (Haggett et al., 2013; DECC, 2014b).

2.8.4 Local opposition

One acronym that has frequently been used in research studies to explain opposition to renewable energy projects is the NIMBY (Not In My Backyard) syndrome. It is a concept that refers to the support for renewable energy development at the generic level, but resistance to a particular development

within one's own locality (Barton, 2008). Studies have shown that even where people express support for renewable energy projects, they are opposed to siting those projects close to their neighbourhood (Krohn and Damborg, 1999; Burningham, 2000; Wolsink, 2007; Van der Horst, 2007). Although NIMBYism tries to explain local resistance towards the construction of renewable energy, scholars point out that the phenomenon is inaccurate in explaining opposition (Musall and Kuik, 2011; Kemp, 1990 cited in Ellis et al., 2009). Against this background, Devine-Wright (2011a) and Aitken (2010) called for disregarding the concept in explaining local opposition. However, despite this, it continues to gain relevance and remains in academic discourses (Ellis et al., 2009). Little is known in developing countries whether people will be resistant or not to community renewable energy projects.

2.8.5 Low community willingness to participate

Apart from the overt opposition, another challenge is a general unwillingness to take part in community projects. Rogers et al. (2010) argue that though locals value renewable energy, they often show reluctance to take part in such projects. This value-action gap between the values an individual holds and the actual implementation of such values remains an obstacle to community renewable energy development. The results of a survey conducted by Rogers et al. (2008) revealed that while locals seemed to support the deployment of a renewable energy project in their area, there was considerably lower willingness to participate in the planning process. The study found that few respondents showed much interest in active

participation in project development while others showed a willingness to get involved in low-level activities such as accepting energy-related home improvements and consultation (Rogers et al., 2008). Bomberg and McEwen (2012) argued that inaccurate information and knowledge or a feeling that one's actions will not make an impact helps to create a value-action gap for community renewable energy. Thus, given these challenges, it is argued that steering community renewable energy through policy and strategies is necessary to realise the full potential of community renewables in rural areas. In this regard, Nigeria has developed several related policies and strategies that are aimed at governing the transition to renewable energy in rural area electrification. The following sections review some of the key policies and strategies.

2.9 Evolution of Renewable Energy Governance in Nigeria

The policies and strategies of promoting renewable energy were included in energy policy and related documents, such as the National Electric Power Policy (NEPP), 2001; National Energy Policy (NEP) 2003; Electric Power Sector Reform Act (EPSR) 2005; Vision 20-2020, July 2009; Roadmap for Power Sector Reform 2010; and, Rural Electrification Policy (REP) 2009. The following sections outline the development of the governance of community renewable energy by reviewing these policy and related documents including the recent National Policy on Renewable Energy and Energy Efficiency (NPREEE), 2015.

2.9.1 National Electric Power Policy (NEPP), 2001

This policy document set the scene for the transformation of Nigeria's electricity sector from being one that was entirely controlled by the government to a privately driven industry. The NEPP 2001 was initiated following consultations of the Electrical Power Implementation Committee (EPIC) that was responsible for coordinating and monitoring all the activities relating to Nigeria's electricity reform exercise (Ley et al., 2015). The NEPP 2001 stipulated several objectives for the Nigeria's electricity industry that included the following:

- Ensuring that the power sector attracts private investment both from Nigeria and from overseas;
- Developing and enhancing indigenous capacity in the power sector;
- Developing a transparent and efficient regulatory framework for the electricity industry;
- Promoting competition through the full liberalisation of the electricity market;
- Ensuring that the Government divests its interest in State-owned entities and entrenching the key principles of restructuring and divestiture in the electric power sector; and,
- Reviewing and updating electricity laws in conformity with the need to introduce private sector operation and competition into the industry.

According to Otitoju and Diara (2013), the NEPP had three major phases for achieving its objectives. The first phase was intended to transfer the vertically integrated public utility company to private firms and then

introduce the Independent Power Producers (IPPs). The second phase emphasised increasing competition among market participants while the last stage focuses on strengthening market competition through full cost pricing and competitive market trading (Otitoju and Diara, 2013). Although the NEPP 2001 set the scene for the transformation of the electricity industry through liberalisation, the document is silent on the utilisation of renewable energy.

2.9.2 National Energy Policy (NEP) 2003

The NEP came into being following the approval by the Federal Executive Council (FEC) of the draft energy policy document developed by the Energy Commission of Nigeria in 2003 (Ley et al., 2015). This policy document established the groundwork for the sustainable utilisation of natural resources in Nigeria as well as articulating for the first time, the inclusion of renewable energy sources in the national energy mix in Nigeria. The document also sets the following energy policy objectives:

- To ensure the development of the nation's energy resources, with a diversified energy resources option, for the achievement of national energy security and an efficient energy delivery system with an optimal energy resource mix;
- To guarantee adequate, reliable and sustainable supply of energy at appropriate cost and in an environmentally friendly manner, to the various sectors of the economy, for national development;
- To guarantee the increased contribution of energy productive activities to national income;

- To guarantee an efficient and cost effective consumption pattern of energy resources;
- To promote increased investment and development of the energy sector industries with substantial private sector participation;
- To accelerate the process of acquisition and diffusion of technology and managerial expertise in the energy sector and indigenous participation in energy sector industries, for stability and self-reliance;
- To ensure comprehensive, integrated and well-informed energy sector plans and programmes for effective development;
- To foster international cooperation in energy trade and project development in both the African region and the world as a whole; and,
- To successfully use the nation's abundant energy resources to promote international co-operation.

Regarding renewable energy utilisation, the policy acknowledges the importance of full utilisation of natural resources for economic development by making provision for the effective exploitation of all forms of energy including renewable energy (see Otitoju and Diarra, 2013). The policy specifies the following measures to support renewable energy development in Nigeria:

- To fully harness Nigeria's hydropower potentials for electric generation;
- To pay full attention to the development of a mini and micro hydropower scheme that would allow private sector participation;

- To extend electricity to rural and remote areas, through the use of mini and micro hydropower schemes;
- To aggressively pursue the integration of solar energy into the nation's mix while learning from solar development technologies across the globe;
- To promote and develop the nation's wind energy research and integrate wind power generated electricity into the energy mix including rural areas; and,
- To promote efficient biomass conversion technologies for energy uses.

2.9.3 Electric Power Sector Reform (EPSR) Act 2005

The EPSR Act 2005 evolved from the NEP 2001 and is described as the catalyst for the recent restructuring of Nigeria's electricity sector (KPMG, 2013). The Act set the foundation for the legal framework under which private entities can get involved in the generation, transmission and distribution of electricity in Nigeria. According to KPMG, (2013), the EPSR Act provides for, inter alia the:

- Establishment of a holding company for the assets and liabilities of the then government own public utility;
- Unbundling of the holding company through the formation of several companies to take over the assets, liabilities, functions and staff of the holding company;
- Establishment of an electricity regulatory agency that will serve as an independent watchdog for the Nigeria's electricity industry;

- As a basis for the determination of customer rights, tariffs, obligations and other related matters; and,
- Development of a competitive electricity market.

The EPSR Act 2005 further provides for the creation of the Rural Electrification Agency (REA) and the Nigeria's rural electrification support fund the REF. The Act also provides for the creation of a consumer assistance fund to assist underprivileged electricity consumers.

Regarding renewable energy, the EPSR Act 2005 encourages the inclusion of electricity generated from all sources of energy including renewable energy by mandating the regulatory agency to provide equal opportunity for all energy sources in Nigeria's electricity market (Otitoju and Diarra, 2013). The policy was also instrumental in the creation of the REA and stipulated under section 88(9) of the Act, the development of isolated and mini-grid systems, and renewable energy electricity generation (EPSR Act, 2005).

2.9.4 Vision 20-2020, July 2009

Unlike the other policy documents reviewed, the Vision 20-2020 was a long-term development document designed and approved in 2009 to guide the overall economic development of Nigeria by the year 2020 (NPC, 2009). The goal of the Vision 20-2020 is to drive Nigeria’s economy to the top 20 economies of the world (NPC, 2009). To realise this ambition, the policy document recognised the optimal utilisation of Nigeria’s endowed energy resources as necessary to meet future energy demand (NPC, 2009). Previous national development plans fell short of detailing strategies and

initiatives to drive the development of alternative sources of energy, and this is a significant loophole that the vision 20-2020 sought to address. The Vision defined five strategic priorities for the energy sector, which include:

- To provide necessary commercial and market incentives to attract private investments (local and foreign) required to facilitate the necessary energy capacity expansion in a rapidly growing economy;
- The consolidation of on-going structural and economic reforms targeted at establishing effective institutional and regulatory frameworks in the energy sector;
- Achieving energy supply security by utilising the nation's renewable energy resources (including wind, solar, hydro and biomass) to diversify the energy consumption mix;
- Development of efficient and sustainable energy generation and consumption patterns; and,
- The consolidation of the on-going local content campaign by expanding linkages to other sectors of the economy.

Vision 20-2020 recognises the importance of Nigeria's renewable energy potential in meeting national electricity targets (NPC, 2009). Therefore, it called for various measures and strategies as contained in the document to support the integration of renewable energy generated electricity into the energy mix of the country. The Vision 20-2020 has the following objectives (NPC, 2009):

- To fully harness the hydropower potential available in the country for electricity generation;

- To commercially develop the nation's wind energy resource and integrate with other energy resources for off-grid electricity supply to rural areas;
- To harness the nation's solar energy resources for electricity generation, especially to rural and remote areas; and,
- To integrate biomass energy resources, including agricultural residues, animal and human wastes, with other energy resources through the adoption of efficient conversion technology.

To deliver the Vision 20-2020, strategies were set out including (NPC, 2009):

- To utilise mini and micro hydropower schemes to extend electricity to rural and remote areas; create an enabling environment (fiscal, administrative and regulatory) to attract private investment in establishing and operating hydropower plants;
- Utilise wind power plants to extend electricity to rural and remote areas; aggressively drive to optimise the components of wind water pumping and electricity generation and - to de-emphasize diesel powered water pumps wherever the wind speed will allow wind water pumping;
- Support demonstration and pilot projects to ensure that the general public is aware of the potential of solar energy technologies that will assist in the creation of markets for solar energy systems;
- Create an enabling environment to attract private investment in manufacturing, establishing and operating solar energy systems;
- Continuous active support of research and development activities to cater for site specificity of designs for all parts of the country;

- Develop extension programmes and establish pilot projects to facilitate the general use of new biomass energy technologies;
- Create a sustainable legal, institutional and commercial framework that encourages public, private sector investment in the industry;
- Create an enabling environment to attract private investment in biomass–to- power projects;
- Ensure local workforce development by establishing effective training institutions and programmes as well as enforcing minimum local content components of the power sector development and operational activities; and,
- Provide incentives to encourage local manufacturing and production of consumables used in the electricity sector such as conductors, insulators and cables.

2.9.5 The Roadmap for Power Sector Reform (RPSR) 2010

Widely regarded as the blueprint for the implementation of the reform of the Nigeria's electricity sector, RPSR 2010 specified plans to fast track the pace of activities envisaged by the reforms in the power sector (Otitoju and Diarra, 2014). The RPSR, which built on the foundation laid by the NEP 2001 and the EPSR Act 2005, heralded the final and critical stage of the privatisation of Nigeria's electricity sector (Ley et al., 2015: 2014). The key objective of the RPSR 2010 was to ensure that all the necessary changes to the ownership structure as well as regulation of the sector envisaged by the EPSR Act are realised. The policy document intends to accelerate these structural reforms by firstly removing hurdles to private sector investment; secondly clarifying the government strategy on the divestiture of the public

own successor companies; and finally transforming the fuel to power sector (RPSR, 2010).

According to the document, each of these strategies would be facilitated by various measures. For instance, to remove investment hurdles, the roadmap advocates for the establishment of an appropriate pricing regime, the establishment of a bulk purchaser, and the clarification and strengthening of the licensing regime. The other measures include the strengthening of the Nigerian Electricity Regulatory Commission and the contracting out of the management of the transmission segment to a private company that has both the requisite project management and technical expertise.

2.9.6 Rural Electrification Policy (REP) 2009

In recognition of the significance of reliable and affordable electricity in rural economic development, the Nigerian government approved the REP in 2009. The policy document seeks to establish the framework for the rural electrification programme. The REP 2009 as stipulated by REA, (2014) has the following key objectives:

- Promote agriculture, industrial, commercial, and other economic and social activities in rural areas;
- Raise the living standards of rural populations through improved water supply, lighting and security;
- Promote the use of domestic electrical appliances to reduce the drudgery of household tasks typically allocated to women;

- Promote cheaper, more convenient and more environmentally-friendly alternatives to the prevalent kerosene, candle, and vegetable oil lamps and fossil fuel-powered generating sets;
- Assist in reducing migration from rural to urban areas; and,
- Protect the nation‘s health and the environment by reducing indoor pollution and other energy-related environmental problems.

The policy has an ambitious target of 75 per cent rural electrification by 2020. Regarding renewable energy, the policy paper sets a target of generating 10% of renewable energy by 2025 (REA, 2014).

2.9.7 National Policy on Renewable Energy and Energy Efficiency (NPREEE), 2015

The NPREEE 2015 was developed and approved in response to calls for a coherent and all-encompassing policy framework to drive reform of the EPSR Act 2005 in rural areas electrification. The RPSR (2010) addresses the concern of the large-scale supply of electricity especially to urban areas by giving emphasis essentially to the development of grid-based electricity. The NPREEE (2015), on the other hand, serves as a framework for the sustainable development and efficient utilisation of renewable energy resources for both on-grid and off-grid electricity supply (NPREEE, 2015). The NPREEE, (2015) has the following key objectives:

- To ensure the development of the nation's energy resources, with diversified energy resources options, for the achievement of national energy security and an efficient energy delivery system with an optimal energy resource mix;
- To guarantee an adequate, reliable, affordable, equitable and sustainable supply of renewables at cost-reflective and appropriate

cost in an environmentally friendly manner, to the various sectors of the economy, for national development;

- To accelerate the process of acquisition and diffusion of technology, managerial expertise and indigenous participation in the renewable energy and energy efficiency sector industries, for stability and self-reliance;
- To guarantee efficient, a location-specific and cost-effective consumption pattern of renewable energy resources and improved energy efficiency;
- To promote increased investment and development in the renewable energy and energy efficiency sector, with substantial private sector participation;
- To ensure a comprehensive, integrated and well informed renewable energy and energy efficiency sector, with plans and programmes for effective development;
- To develop the nation's renewable energy and energy efficiency resources through the establishment of an appropriate financing mechanism that supports private investment in the sub-sectors;
- To ensure effective coordination and collaboration among all players in renewable energy and energy efficiency activities in Nigeria;
- To ensure the provision of electricity to all remote and off-grid areas of Nigeria as well as increasing the energy mix of grid-supplied electricity in line with regional policy and targets;
- To provide a reliable and stable power supply to consumers, especially to industries in remote and off-grid areas and productive use;

- To ensure the removal of bottlenecks to the development of off-grid electricity in Nigeria; and,
- To attract investment capital, both foreign and domestic, for the development of renewable energy for both on and off-grid projects;

The policy document pinpointed some steps and strategies to be implemented to realise its objectives. Some of these strategies include:

- Commencement of feasibility studies on using renewable electricity power generation for remote and off-grid areas to be carried out by the REA;
- Commencement of feasibility studies for small community renewable electricity solutions for off-grid areas, including home-based wind and solar, mini, micro and Pico hydro, tidal energy and biomass;
- Support the establishment of basic engineering infrastructure for the local development of solar energy equipment, devices and materials;
- Encourage research and development in the generation and distribution of electricity from renewables that will be used in mini-grids;
- Develop and implement a programme for the participation of the private sector in the remote and off-grid sectors of the electricity Industry;
- Intensify the national effort in training, research and development to (or "intending to") generating electricity using solar, wind, biomass and other renewable resources to conserve our fossil fuels;
- Provide appropriate incentives to entrepreneurs to ensure adequate returns on investment in power generation from renewable energy sources;

- Provide appropriate financing facilities to support indigenous investment in renewable electricity power generation for remote and off-grid sectors areas; and,
- Encourage off-grid generation and supply of power in remote locations.

Further to the development of the policies and strategies discussed above, some pilot community renewable energy projects have also been undertaken by different organisations. For instance, the Energy Commission of Nigeria (ECN) and the Federal Ministry of Power (FMpower)[5] have initiated and developed several community projects in Nigeria. Most of these projects, which include both stand-alone, and mini-grid systems were for either residential, irrigation or cooling purposes (see JICA 2007). Recently, the Rural Electrification Agency (REA) and the Federal Ministry of Environment (FMEnviroment) participated actively in the development of pilot community renewable energy projects in some parts of the country. The Federal Ministry of Power in 2014, commissioned the pilot community renewable energy projects in *Shape*, Waru and Durumi under the Ministry's Operation Light-up Rural Nigeria programme (Nebo and Wakil, 2014). The aim of the programme was to test if community renewable energy could be a panacea to electrify rural communities in all parts of the country.

Although relative successes have been recorded in some of the pilot community renewable energy projects, the settings capable of attracting

[5] The Federal Ministry of Power (FMPower) represents the Federal Ministry of Power, Work and Housing's organ that is charge with electricity related activities.

private investors, distribution companies and communities into the full-scale development and expansion of community renewable energy appear not to have been realised in practice. This raises questions on how community renewable energy policies and strategies should be developed and implemented to ensure transition in rural areas. As mentioned in Chapter 1 the transition to community renewable energy in Nigeria's rural areas appears not to be a simple task. The system is deeply rooted in a complex societal structure, presenting many challenges. Overcoming such challenges requires sufficient understandings of the dynamics, that is, the causes, rate and direction of community renewable energy, and appropriate governance system to speed or steer the transition. The understanding of the dynamics and governance approach of community renewable energy in Nigeria has not received sufficient attention from other researchers to date. This is the principal gap in knowledge that this thesis aims to address.

2.10 Summary

To date attempts to electrify rural communities in Nigeria have been predominantly undertaken by the extension of the centralised national grid. Nevertheless, the majority of rural areas in Nigeria are geographically isolated, with relatively low electricity demand to justify or motivate new commercial owners to invest in grid extensions. Thus, providing electricity access through other options is necessary for remote rural communities. Several relevant policies and strategies have been enacted to promote the use of community renewables. Nonewithstanding this, a setting capable of attracting investors and communities in developing community renewables

has not been realised principally because of governance and institution challenges.

The chapter concludes by arguing that the governance and institutional approaches through which community renewables is being determined, planned and developed in Nigeria has not been sufficiently researched by scholars, therefore providing a gap in the extant literature, which this study aims to address.

Chapter Three

Transition Theory and Theoretical Approach

3.1 Introduction

The previous chapter reviewed recent policy developments and the literature on community renewable energy. This chapter will now review the rich and expanding literature on transition theory. Transition theory concepts such as the Multi-Level Perspective (MLP), Transition Management (TM) and Strategic Niche Management (SNM) are critically appraised. These concepts are used to develop a new theoretical model that will be employed in exploring the processes and governance approaches through which community renewable energy is being determined, planned and implemented for off-grid rural electrification. This model will significantly add to the existing extant literature by linking and operationalising theoretical developments with sustainability in practice in a developing country context.

3.2 Transition Theory

Transition literally means, 'a movement, development or evolution from one form, stage, or style to another' (Merriam-Webster 1976: 1241). In the field of socio-technical transition studies, a transition has been defined by scholars in many different ways. Table 3.1 provides examples of such definitions.

Table 3.1 Definitions of transition by various scholars

Scholars	Definition
Rotmans et al. (2001: 16)	"… as a gradual, continuous process of change where the structural character of society (or a complex sub-system of a society) transforms."
Elzen and Wieczorek (2005: 651)	"… a long-term change in an encompassing system that serves a basic societal function (e.g. food production and consumption, mobility, energy supply and use, communication, etc.)"
de Haan and Rotmans (2011: 92)	"… a fundamental change in the structures, cultures and practices of a societal system, profoundly altering the way it functions."
Frantzeskaki and de Haan (2009: 594)	"A transition is understood as having occurred when the societal system functions in a different way for which the composition of the societal system had to change fundamentally."

Source: Author Compiled

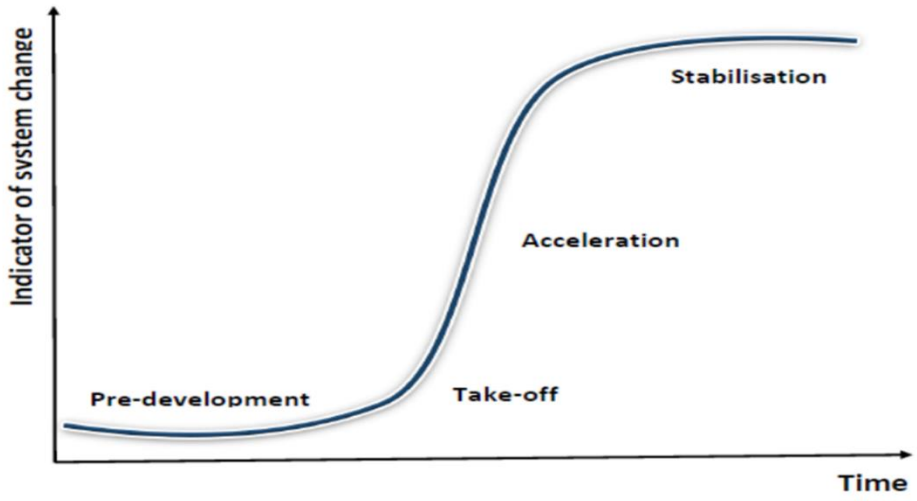
Despite difference in definition, a socio-technical transition has three main characteristics. One, the transition occurs because of the interaction between several factors - cultural, technological, economical, environmental and institutional, that brings about changes in existing techniques, artefacts as well as rules, practices, and networks (Rip and Kemp, 1998; Elzen et al., 2004; Rotmans and Kemp, 2003). Secondly, a socio-technical transition is a long-term process and usually transpires within at least one generation (normally between 25–50 years) (Rotmans and Kemp, 2003). Lastly, changes that occur are aimed at fulfilling a societal need, such as food,

health, mobility, energy and water (Yücel, 2010). The phases in which transition occur are conceptualised in four stages as presented in the next section.

3.3 Stages of Socio-Technical Transition

Rotmans et al. (2001) distinguish between four different phases or stages of socio-technical transition – pre-development, take-off, acceleration and stabilisation. These stages are presented in an S-curve shape in figure 3.1. This represents the non-linear pattern of the interactions between short-term fluctuations and long-term waves with alternative forms of rapid change in the take-off and acceleration stages. And then a period of slow change in the pre-development and stabilisation stages of the transformation process (Rotmans 2005).

Figure 3.1 Stages of Transition



Source: Adapted from Rotmans and Kemp (2003: 11)

At the pre-development phase, small-scale uncoordinated innovative initiatives start to build up which completely alter the existing paradigm. However, the existing status quo remains without any visible changes

(Rotmans and Kemp, 2003; Laes et al., 2014). Developments for finding solutions to the complex problem predominantly take place on an individual level (Laes et al., 2014).

The take-off stage is where the transformation process begins to set in because some innovative practices break out and start to challenge the existing status quo (Rotmans et al., 2001). The take-off phase represents the period where structural transformation resulting from socio-cultural, ecological, economic and institutional changes begins to show a clear process of change (Bergman et al., 2008). The actors involved are jointly linked and reinforce each other through a synchronised network, and the dominant model of the innovative practice they are developing emerges and rapidly improves (Rotmans and Kemp, 2003; Bergman et al., 2008). The acceleration stage, on the other hand, represents the breakthrough phase of socio-technical innovation (Rotmans et al., 2001). Changes that occur at the acceleration stage are transformed into the mainstream practice of various actors (Laes et al., 2014). New system equilibrium is established at the stabilisation phase. This new equilibrium represents a new socio-technical system where innovative practice becomes the dominant practice (Rotmans et al., 2001). The speed of change stabilises and a new circle is reached at the stabilisation stage in a dynamic process (Laes et al., 2014).

It is important to note that the terms ‘speed' and ‘acceleration' are relative because transition contains both periods of slow and fast developments which can be caused by both positive and negative feedback (Rotmans 2005). A socio-technical transition can be accelerated by a one-time event

such as war or a large accident (e.g., the Fukushima nuclear accident or the oil crisis of the 1970s) (Kemp and Rotmans, 2005). Yet, a transition cannot be caused by one single event (Kemp and Rotmans, 2005). The processes through which socio-technical transition occur are conceptualised in the Multi-Level Perspective (Geels, 2002; Elzen et al., 2004) which is presented in the subsequent section.

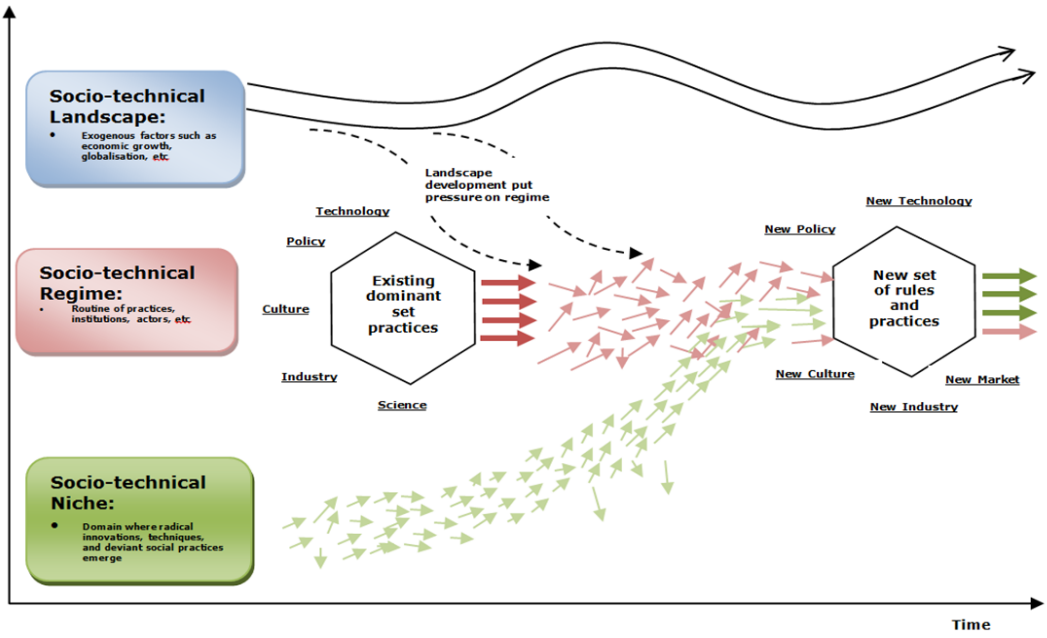
3.4 Multi-Level Perspective (MLP)

The fundamental principle behind the MLP is that technological innovation does not exist as a discrete entity but rather evolves and develops from a system of social and technological factors that are mutually dependent (Geels, 2004). These mutually dependent events occur when trends and developments reinforce each other on three distinct functional socio-technical levels: landscape, regime and niche (Rip and Kemp, 1998; Geels, 2012).

As depicted in Figure 3.2, socio-technical landscapes are macro-level developments that represent an exogenous environment within which deep structural trends are entrenched (Elzens et al., 2004; Rothmans, 2005; Geels and Schot, 2007). This setting embodies wider social, political, cultural values and the institution of a society that exerts pressure on the socio-technical configuration (Foxon et al., 2009; Foxon, 2013). Determinants from the socio-technical landscape can include a wide variety of phenomena. This may include demographic development (e.g. ageing population), socio-political factors (e.g. the economic crisis, globalisation, or urbanisation), an ecological phenomenon (e.g. climate change), or socio-technological revolution (e.g. the ICT-revolution) (Avelino et al., 2014).

Changes at the landscape level are beyond the influence and control of actors in a socio-technical transition. Nevertheless, it is this level that often wields pressure on the existing system (Geels and Schot, 2007; Viétor et al., 2015).

Figure 3.2 Socio-technical transition process



Source: Adapted from Geels (2002: 1263)

On the other hand, the socio-technical regime is built on Nelson and Winter (1982) version of a technological regime (Elzens et al., 2004; Geels and Schot, 2007). It represents the dominant set of routines or practices, actors and institutions that establish and pattern a particular technological system (Foxon, 2013). The socio-technical regime accommodates a broader community of social groups that shape and stabilise a particular technology along an existing trajectory (Geels and Schot, 2007). Actors in a socio-technical regime include firms, industries, policymakers, politicians,

consumers, civil societies, engineers, researchers, scientists, users, communities and special interest groups (Geels, 2012).

Over time, the factor of interdependency in the socio-technical regime locks in society, such that it follows an established dominant pathway (Unruh 2002:2000; Bergman et al., 2008). According to Geels (2004) and Geels and Schot, (2007), lock-in[6] to a particular path occurs in two ways. First, when society tends to build an assumption, belief, habit, and knowledge about a possible and legitimate technological solution, and secondly when market entry of new technology is prevented by the existing technology's economies of scale. Attempts to unlock the system by the introduction of new technology or pressure from the surrounding levels are often neutralised by system improvements to existing structures (Viétor et al., 2014; Geels, 2004). However, when the regime succumbs to these pressures, a window of opportunities is created for niche innovations to intrude (Geels and Schot, 2007).

In contrast, the socio-technical niche level represents the domain within which individual actors or technologies are more prone to deviate from the norm than the other two levels (Rotmans et al., 2001). At this point, radical innovations, techniques, or deviant social and institutional practices, facilitated by learning processes, price improvements, performance enhancements, and support from powerful groups tend to gain trust (Geels, 2002; Geels and Schot, 2007; Geels, 2011). The Niche level provides an

[6] Lock-in refers to choices made in the past that prevent the introduction of new opportunities now (Klitkou et al., 2013; Unruh, 2002)

"incubation room" where socio-technical innovations are safeguarded against the mainstream market forces and are facilitated by the development of innovation support systems (Kemp et al., 1998; Geels, 2002; Geels and Kemp, 2007). Most often, niche innovations emerge as a result of deficiencies that are set within the existing dominant regime (Smith and Raven, 2012; Seyfang et al., 2013) and are usually built and developed by a small group of dedicated actors, often *outsiders* or border actors (Geels and Schot, 2007).

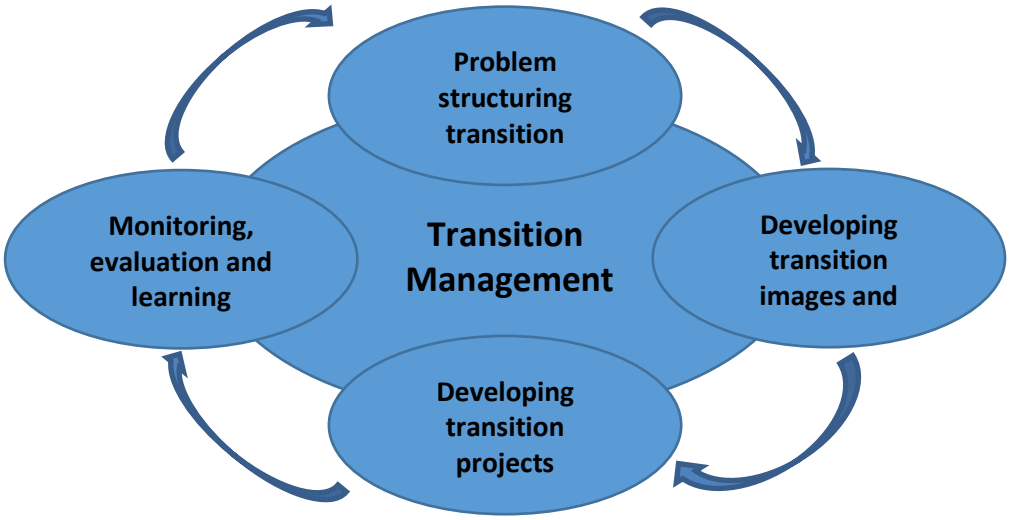
Kemp and Rotmans, (2004) emphasise that transition can be self-evolving, that is, there is limited coordination among actors and transition transpires through a principle similar to natural evolution. It can also be a target-oriented transition, where there are high levels of interactive and iterative coordinations between actors, in order to achieve a pre-set objective. Guided or target oriented transition perceives rules, policies and regulations as part of a larger co-evolutionary process of a socio-technical transformation, which can be purposefully managed and driven by a group of stakeholders (Rotmans, 2005). This understanding is the basis for the development of the transition theory concepts - Transition Management and Strategic Niche Management. Both represent a framework for governance that aims to stimulate, direct, and control transition to the desired objectives (see for example: Loorbach, 2004; Caniëls and Romijn, 2006; Loorbach, 2007; Loorbach, 2010; Schot and Geels, 2008).

3.5 Transition Management (TM)

Transition Management represents a governance model that begins from a strategic level, making an exhaustive analysis of different approaches from

a long-term perspective (Loorbach and van Raak, 2006). The process consists of problem structuring and development of long-term vision, establishing a transition arena and agenda, initiation and execution of transition projects as well as monitoring, evaluation and learning (Loorbach, 2010; Smith and Stirling, 2008). This cycle of governance activities is presented in Figure: 3.3 and explained below.

Figure 3.3 Transitional Management Cycle



Source: Adapted from Loorbach (2007: 115)

3.5.1 Problem structuring and development of transition vision

Problem structuring and long-term visioning start with the convening of a multi-actors forum, where actors deliberate over the challenges associated with the existing socio-technical regime (Smith and Stirling, 2008). Actors debate on possible alternative solutions as well as develop a long-term vision which, in turn, is the basis for the development of transition pathways and projects (Smith and Stirling 2008; Loorbach and Rotmans, 2006).

The long-term shared visioning process functions as a guide for formulating transition programmes and objectives (Loorbach and Rotmans, 2006). Although actors come with different backgrounds, competencies and interests (Loorbach, 2010), prominence must be given to mutual learning, accord building and the development of joint problem perception (van der Brugge and van Raak, 2007). Hence, Raven (2007: 2392) posits transition as, "a *collective strategy rather than an individualist's strategy*". Long-term vision must be appealing and imaginative to be able to be supported by a wide range of actors as well being able to stimulate and direct short-term activities (Rotmans et al. 2001). Following the development of long-term vision, a short-term goal is developed through backcasting: a process that first defines the desirable future sought and then works backwards to identify short-term goals and objectives (Quist, 2007; Quist and Vergragt, 2006).

3.5.2 Developing transition images and pathways

The TM process is followed by developing a transition agenda and pathways in, "*an open and dynamic network, in which different perspectives, different expectations and different agendas are confronted, discussed and aligned*" (Loorbach, 2007: 132). The basis for developing and supporting transition projects is provided by the formulation of transition images and pathways (Smith and Sterling, 2008). Actors select the most feasible, innovative and promising pathways in the transition process (Loorbach and Rotmans, 2010). Such images and pathways must also be, "*appealing and imaginative so as to be supported by various actors*" (Rotmans et al., 2001: 23).

3.5.3 Developing transition projects

After the transition images and pathways are drawn in a participatory process, transition pilot projects are initiated to translate the images and pathways into action with the aim of deepening, broadening, and scaling-up through learning processes (Rotman and Loorbach, 2008; Loorbach, 2010). Scholars have highlighted that the development and execution of transition projects should be done through the prevailing networks of actors in the arena to ensure the direct participation of forerunners in the development process (Kemp and Rotmans, 2004; Loorbach and Rotmans, 2006). It is vital to frame a sound condition for selecting a transition project that is mutually accepted by all actors (Rotmans and Loorbach, 2009). The feasibility and running time of the transition project may be challenged when the transition project lacks mutual understanding and unity among the participants (Rotmans, 2006).

3.5.4 Monitoring, evaluation and learning

Constant monitoring and evaluation of a transition process are critical in transition management (Smith and Stirling, 2008). This involves monitoring all the activities as well as the transition process itself (Loorbach and Raak, 2005). Monitoring takes place at different levels of the transition process (Looback and Raak, 2005). This includes monitoring the changing exogenous landscape developments, the behaviour of actors within the transition arena, networking activities, alliance forming and responsibilities (Loorbach and Rotmans, 2006; Looback and Raak, 2005). Similarly, transition managers must also ensure that the transition process itself is continuously monitored including its rate of progress, the barriers and points to be enhanced (Smith and Stirling, 2008).

The purpose of monitoring is to permit the documentation of outcomes, experiences and processes that serve as the basis for evaluation (Bussel et al., 2013; Van Mierlo et al., 2010). Transition scholars stress the importance of reflexive monitoring which focuses on learning through a participatory process that is required for instigating both first and second order learning (Bussels et al., 2013; Van Mierlo et al., 2010). Kemp and Rotmans (2005) further state that it is difficult to monitor and document this kind of learning process because reflexive social learning is for many, still in an abstract form that cannot be translated into monitoring. Scholars suggest formulating explicit learning goals against which transition learning processes should be evaluated. Kemp and Rotmans, (2005) theorise that the purpose of the evaluation is to assess whether goals have been realised and if not, questions whether any external or unexpected social developments were not taken into account or whether any actor has not complied with the agreements that were reached are being raised. Once these questions are resolved, a new transition management process begins (Kemp and Rotmans, 2005).

3.6 Strategic Niche Management (SNM)

In light of the transition perspective, scholars developed the Strategic Niche Management to serve the governance of a particular type of transition project (Schot and Geels, 2008). Caniëls and Romijn (2006), Mourik and Raven (2006) and Balkema et al. (2010) assert that SNM is an analytical tool which guides the nurturing, development and expansion of new technologies through societal experimentation. The SNM claims that when innovations emerge, they are often characterised by low performance, high

costs, and absence of an established network to support and move the innovative project forward (Hoogma et al., 2002; van den Bosch and Rotmans, 2008). Consequently, new projects are deprived of competing with existing regimes that are favoured by path dependence and lock-in (van den Bosch and Rotmans, 2008; Hoogma et al., 2002). The starting point of SNM is that innovative projects are facilitated by moderating them in technological niches, that is, protected spaces that allow nurturing and developing of innovative technology, the co-evolution of user practices, and regulatory structures (Hoogma et al., 2002; Schot and Geels, 2008).

Mourik and Raven (2006) argue that SNM is particularly aimed at organising transitional projects with uncertainty in terms of the technological specifications and users' context. This is because both the technology is significantly different from existing technologies and the market is not yet certain. Previous studies on SNM had distinguished transitional projects from other innovative or market projects (see Table 3.2) and conceptualised the SNM approach as a bottom–up process, in which innovations emerge in technological niches, develop, and ultimately replace the existing regime (Schot and Geels, 2008).

The question arising here is how and under what conditions can a transition project be developed and expanded successfully. The term successful used here refers to the transformation process of niche building and intrusion into a market dominated by an existing regime, either because the regime started to adopt elements from the niches or because the niche competed head-to-head with the existing regime (Hoogma et al., 2005).

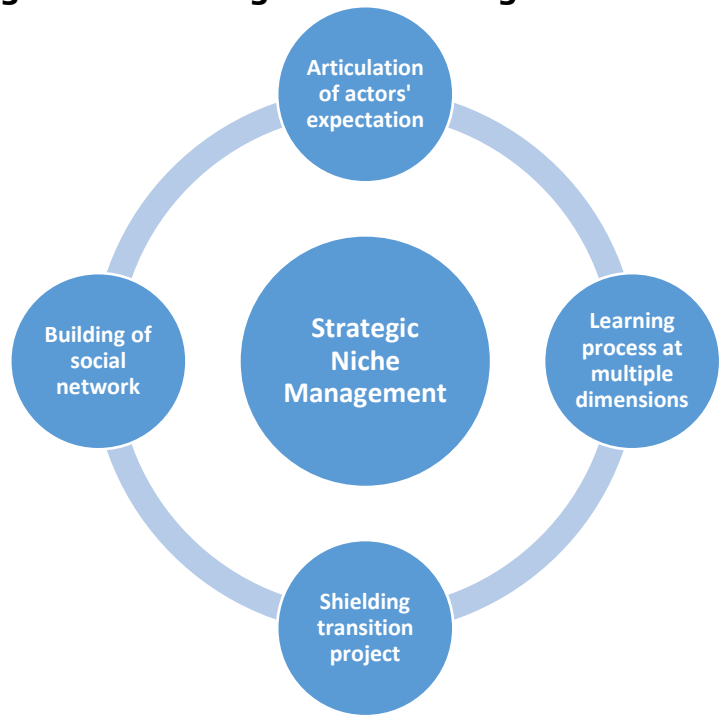
Table 3.2 Differences between transitional and innovative experiment

	Transitional Project	*Innovative/market Project*
Starting Point	Solution to persistent societal problem	Solution to market or technical problem
Problem nature	Uncertain and complex	Well defined and structured
Objective	Contribution to structural societal change (Transition)	Identification of satisfactory solution (Innovation)
Perspective	Medium and long term	Short and medium term
Method	Exploring searching and learning	Testing an Demonstration
Learning	Mainly 2nd order (reflexive), multiple domains and collective social learning	Mainly 1st order, single domain and individual
Key Stakeholder	Cross organisational and multi-actor alliance	Specialised members of single organisation
Project context	Real life context	Partly controlled context

Source: Adapted van den Bosch and Rotmans (2008: 23)

Figure 3.4 shows the four major procedures of SNM. This includes the articulation of actors' expectation, building of social networks, facilitating learning processes in multiple dimensions and shielding transition project(s) (see for example: Elzen et al., 1996; Kemp et al., 1998; Weber et al., 1999; Mourik and Raven, 2006; Schot and Geels, 2008; Sterrenberg et al., 2013). These procedures represent the process through which a transition project can be developed and expanded to ensure the successful transition to new innovative practice. The following sections explain the procedures in detail.

Figure 3.4 Strategic Niche Management Process



Source: Based on Kemp et al. (1998: 186)

3.6.1 Articulation of actors' expectation

Business organisations, policymakers, entrepreneurs, users and other relevant stakeholders partake in niche development based on their expectations (Raven et al., 2010). SNM scholars have established that articulating the expectations of actors is crucial for the successful development of a transition project (Kemp et al., 1998). This process involves articulating technical problems, user requirements and experiences, and identifying ways in which technology diffusion barriers can be solved, and society could benefit from the innovation (Kemp et al., 1998). When expectations are robust, precise, and shared by many actors, they can legitimise actions, and act as the driving force in social interactions as well as reduce the uncertainties actors have about innovation (Kemp et al., 1998; Mourik and Raven, 2006; Sterrenberg et al., 2013). Articulating

actors' expectations, therefore, facilitates the creation of a shared agenda and attracts actors' knowledge as well as their financial and managerial resources for niche project (Mourik and Raven 2006).

3.6.2 Building of social networks

Building a social network and its analysis are useful in learning about actors' expectations (Mourik and Raven 2006). A social network is capable of leading to a successful project development and the expansion of a transition project. Transition scholars argue that in order to achieve this task, such a network must fulfil the following conditions. One, the networks must be comprehensive, that is, several kinds of actors such as the policy makers, user, researchers, regulators and other stakeholders from both within and outside the existing regime are involved. Two, the actors can present the outcomes of a transition project and able to inspire the people within and outside their organisations (Elzen et al., 1996; Hoogma et al., 2002 cited in Schot and Geels, 2008; Loorbach, 2007; Raven et al., 2010).

Weber et al. (1999) state that actors with a stake in the existing regime technology might not necessarily be interested in stimulating a new competitive technology. Given this argument, Bos and Brown (2012) suggest that key actors who advocate and influence transition should purposely be involved in the network of transition project actors.

3.6.3 Facilitating learning processes in multiple dimensions

The purpose of developing a transition project is to change the perspectives of the actors that are involved. In SNM, learning is seen as a socially interactive process of gaining new knowledge, norms and values or

competencies (van den Bosch and Rotmans 2008). Learning allows adjustments to technology that permits social embedding required for successful diffusion of innovations (Raven et al., 2010). The aim of learning is to contribute towards transition by, for instance, provoking necessary changes in the existing structure, practices and culture (van den Bosch and Rotmans 2008; Pahl-Wostl, 2009; Bos and Brown, 2012). Sterrenberg et al. (2013) stress the importance and role of learning within and between transition projects. The scholars argue that learning practice would lead to successful niche development and up-scaling if they are not only targeted at the gathering of facts and data but also when they can provoke changes in the perception and expectations of the actors involved.

Bosch and Rotmans (2008) emphasised that for successful niche development and up-scaling, learning processes should be aimed at the following. One, understanding the innovation and the direct context of the transition project in terms of the regime and landscape events, and what changes would be needed for the innovation to become mainstream practice. Two, extending transition project to different contexts and linking it to other functions or domains and, therefore, expands its influence and stability. Lastly, scaling transition project to mainstream activities. The scaling up of a transition project is distinguished from scaling up market, the latter referring to scaling up products, services, or users; the former includes scaling up perceptions, routines, rules, and institutions (van den Bosch and Rotmans, 2008). It involves expanding activities toward the embedding of the transition experiment to the thinking, culture and practices of society at a higher scale level (Raven et al., 2010).

3.6.4 Shielding transition project(s)

Lastly, successful transition project development is facilitated when a favourable space for learning and reflection is provided through shielding the transition project from the mainstream selective environment (van den Bosch and Rotmans, 2008). SNM literature conceptualised this as building a temporary 'protected space', whereby transition projects are protected from the mainstream selection environment to prevent them from premature failure (Kemp et al., 1998; Weber et al., 1999; Sterrenberg et al., 2013). van den Bosch and Rotmans (2008) and Sterrenberg et al. (2013) highlight that such protection could be either in financial form (e.g., subsidies, investments, grants), geographical (e.g., specific location), institutional (e.g., exemptions from taxes, rules, legislation) or political (e.g., commitment of powerful actors).

Having elaborated on the different processes involved in the TM and SNM, it is important to state that the objective of both TM and SNM is to align the processes that are involved in a combination of a network of governance, self-organization and process management (Kemp et al., 2007). It is also important to state that both TM and SNM processes are conceptualised in three levels of activities - strategic, tactical and operational activities.

The strategic level covers activities defining societal problems, the formulation of long-term vision and the development of short-term goals (Kemp et al., 2007; Falcone, 2014). Tactical level activities, on the other hand, are related to activities of developing coalitions and the creation of transition agendas as well as the formulation of transition pathways

(Falcone, 2014; Loorbach, 2010; Spekkink et al., 2013). The third level activity of the transition process is devoted to operational activities that centre on the implementation of transition experiments as well as the mobilisation and widening of the networks of actors (Spekkink et al., 2013).

3.7 Critics of Transition Theory

Despite the attempt by transition theory and concepts to theorise socio-technical transition, some criticisms have been levelled against them. The first, being the difficulty and lack of consistency in applying the theory. This problem arises due to giving meaning to the theoretical concepts in the field. For instance, in a survey of the transition literature, Raven et al. (2010) found five different meanings of the concept of the regime, six different meanings of niche and four different meanings of the landscape. Similarly, the unit of analysis is not adequately defined (Walker and Shove 2007). There is the problem of drawing boundaries and defining the topic of analysis (Geels 2011). For instance, critics argue, "*what looks like a regime shift at one level may be viewed merely as an incremental change in inputs for a wider regime at another level*" (Geels 2011: 31). Geels (2011) suggests that to minimise these shortcomings, a researcher must prior to any research undertaken clearly define the unit of analysis so that conclusions can be interpreted accurately. This study took into consideration these shortcomings and minimised the impact by strictly following the widely accepted definition of transition concepts. The research also stated clearly in Chapter 1 that this study focuses on examining community renewable energy transition processes and governance approaches. Therefore any metric apart from the transition processes and governance approaches are considered outside the scope of this study.

The study could have benefited from other theories such as Innovation Diffusion Theory (IDT). Though the IDT focuses on what influences individuals to accept or adopt an innovation, wide-scale diffusion of new technologies is beyond the acceptance of individual. Rather it is a change in the configuration of institutions, techniques, and artefacts, as well as rules, practices, and networks that define the normal development and use of innovation such as community-scale energy (see Verbong and Loorbach, 2012; Geels, 2012; Foxon, 2013). The focus of this study is to understand how this configuration of institutions, techniques, and artefacts, as well as rules, practices and networks interact to nurture, develop and expand innovation. Transition theory provides the most appropriate framework for understanding these multi-actor and multi-dimensional processes.

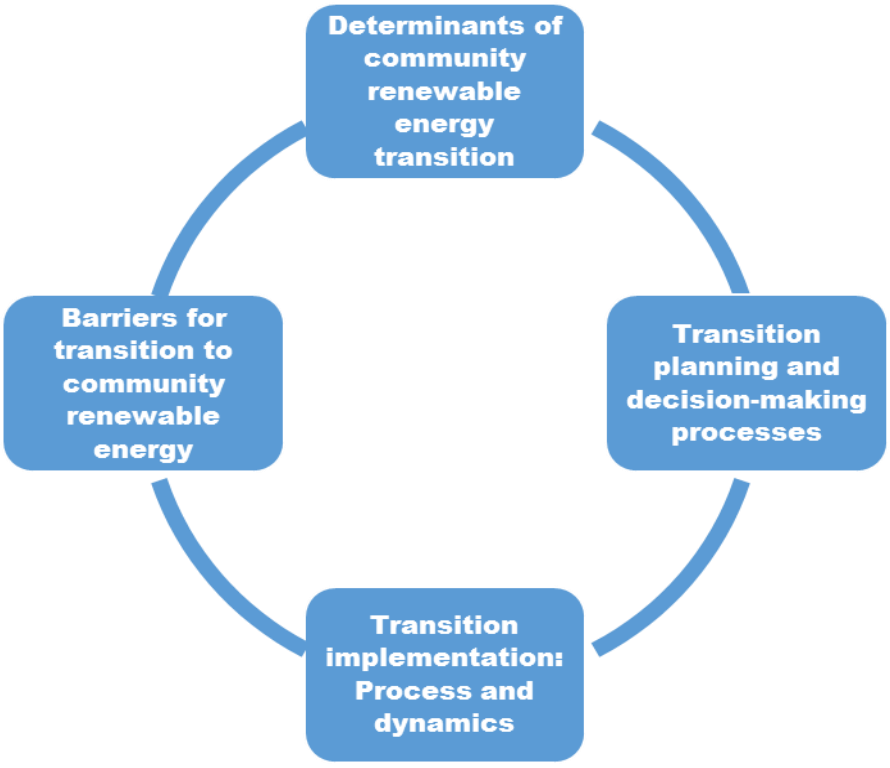
3.8 Theoretical Model of the Research

Building from the integration of literature and theoretical insights addressed above this study developed a model through which the research problem identified in the previous chapter will be analysed and addressed. The model, which is presented in Fig 3.5, will be used to assess the transformative potentials of community renewable energy process, planning and implementation in accelerating sustainability transition in off-grid rural areas.

This makes a novel contribution to the development of a model for the assessment of on-going transition processes and governance approaches. The model begins by analysing the determinants of community renewable energy. The idea is to have an understanding of the factors that drive the

transition at the beginning. This is followed by examining the strategy and processes involved in transition planning and decision-making. The reason is to determine whether the factors discovered in the first stages of the assessment is given consideration at the planning and decision-making stage. The model's next stage is assessing the implementation processes and dynamics. This is to assess whether the implementation of the transition projects is carried out according to the rules set out at the planning stage. Lastly, the identification of the barriers inhibiting the transition follows which offer the opportunity to comprehend existing challenges. The process may be repeated after some time to assess what may have changed over a period regarding the processes and approaches to governance. The model is further explained in the following sections.

Figure 3.5 Model for Assessing Transition Processes and Governance Approach



Source: Generated by Author

3.8.1 Determinants of community renewable energy transition

Community renewable energy transition determinants will be studied based on the following categories: (a) Landscape development; (b) Current electricity regime development; and, (c) Bottom-up developments.

3.8.1.1 Landscape developments

The transformation of community renewable energy for the electrification of off-grid rural areas such as the one envisaged in Nigeria can be regarded as a socio-technical transition (see Jolly et al., 2012; Ulsrud et al., 2011). This is because the processes envisaged for Nigeria's shift to community renewable energy in off-grid rural areas involved multi-actors and is a multi-dimensional transformation by which the existing national grid extension systems of rural energy provision and consumption shift to a more sustainable system.

As described by the MLP (see Section 3.4), the transformation process of a socio-technical transition follows a pattern with landscape building selective pressures that exert influence on an existing system. These pressures embody wider socio-economic, political and cultural developments. The pressures usually give rise to problems, which the system cannot resolve.

System optimisation similar to the unbundling and privatisation exercise in Nigeria's electricity sector may be used to solve these problems, although it may not be enough to withstand the pressures (see Viétor et al., 2015; Geels and Schot, 2007). Therefore, a window of opportunities is created for socio-technical innovations such as a community renewable energy system

to compete or replace the centralised grid system in the area of off-grid rural electrification (see Geels and Schot, 2007; Viétor et al., 2015).

A number of studies applied transition theory and discovered a number of factors that determined transition from one system to another (Grin and Van de Graaf, 1996; Foxon et al., 2008a; Jia-Hai, 2014; Viétor et al., 2015). For example, Grin and Van de Graaf (1996) found the rising oil price occasioned by the 1970s oil crisis as the landscape pressure driving wind energy transition in Denmark. In the same way, Foxon et al. (2008a) discovered government commitment to national and international targets for carbon reduction as the dominant landscape pressure driving low-carbon energy transition in the UK. The study also found concerns for the security of energy supply as the second most important factor driving low-carbon energy transition in the UK.

However, the application of the transition theory concept by Jia-Hai (2014) in China's super smart grid development revealed industrialisation, rapid urbanisation as well as increasing income as the landscape factors driving smart grid transition. Other landscape factors found by the study included increasing pressure on China to cut GHGs, concerns over primary energy security, government commitment to reduce emissions, concern over fuel poverty and affordability. In addition, the application of transition theory by Viétor et al. (2015) found increasing aspirations by citizens and local companies to local investment as well as increasing energy prices as the landscape factors driving the transition to decentralised CHP in the German Ruhr valley. Furthermore, Bosman et al. (2014) found decarbonisation,

secure energy supply and energy affordability as the drivers for the sustainable energy transition in the Netherlands. Most of these studies conducted in this area concentrated on developed economies where the institutions, as well as the economic configurations, are well established.

3.8.1.2 Current electricity developments

Similarly, disturbances or internal structural problems from within Nigeria's national grid system may add to the exerting of pressure(s) on the current centralised grid system (see Turnheim and Geels, 2012; Verbong and Loorbach, 2012). Internal pressures resulting from either technical, social or other problem intrinsic to the current system can be responsible for the sustained performance and structural problems of Nigeria's centralised grid systems. Sometimes these pressures may lead to systemic failures that eventually result in declining commitment and subsequent destabilisation of a regime (Turnheim and Geels, 2012). Frantzeskaki and van Daalen (2007: 4) pointed that, "*systemic failures include systemic inefficiencies, ineffectiveness as well as inadequacy between demand and supply of [a] system*". They refer the ineffectiveness of a system to a system's inability to meet the objective it was designed to achieve.

The inefficiency of the system, on the other hand, is referred to as the "*misallocation of resources and the mis-utilization of resources for needed functions of [a] system*", while the inadequacy of a system is referred to as the inadequacy of a system to fulfil the promises for which it was set (Frantzeskaki and van Daalen, 2007: 4). Further, concerning internal regime pressure, Turnheim and Geels (2012) who studied coal transition found slow mechanisation, weak international competitiveness and low-level

productivity as part of regime internal drivers that triggered transition in the transport sector.

3.8.1.3 Bottom-up developments

In addition to a systemic failure of the centralised grid system to meet the energy needs of rural people, momentum from innovative activities at the bottom can also create pressure. These determinants can lead to a shift from rural electrification by means of grid extension to a decentralised system (see Smith and Raven, 2012). The determinants or formation forces as referred to by Frantzeskaki and van Daalen (2007) include the 'creation of local initiatives', the 'creation of new demand', and the 'introduction of a new functioning' (Frantzeskaki and van Daalen, 2007). The creation of local initiatives or niche starts when a group of actors adopt a new practice or new technology such as the creation of an association or movement that embraces or promotes the use of innovation (Seyfang and Hexaltine, 2012; Seyfang et al., 2010).

The creation of new demand arises when society begins to agitate for a new innovative product such as an environmentally friendly product or low-priced products (Frantzeskaki and van Daalen, 2007). The introduction of new functioning, however, refers to the development or emergence of innovative functioning that results from either a technical development or a merging (hybrid) of existing functioning (Frantzeskaki and van Daalen, 2007). Development of community renewable energy for rural areas electrification in Nigeria can be regarded as the development of new functioning.

On bottom-up pressure, Grin and Van de Graaf (1996) found the introduction of new designs of wind turbines and the creation of local initiatives to improve small wind turbine designs as determinants for a socio-technical transition. The scholars found increased collective interest to increase the wind turbine share in the Danish electricity generation mix as other determinant driving the decentralised energy transition in Denmark. Thus, it is observed that in any given situation, the presence of pressures from the regime and landscape levels as well as successful innovative activities at the bottom are essential for a successful transition to a new system. From this, it can be argued that there is, 'no single cause or driver' for the transition to community renewable energy in off-grid rural electrification in Nigeria. But rather there may be multiple factors that act within and between the three levels (see Geels 2011: 29).

Understanding the typology and sources of these multi-dimensional forces driving community renewable energy transition is important for a number of reasons. First, it can help to prevent future lock-in to a system configuration. As Barnes et al. (2004) argued that it can be useful on an informational basis for strategy and policy intervention in steering transition to achieve desired objectives. Second, it is also beneficial to provide support for alternative sustainable options that are in tandem with the pressures within the existing socio-technical system (Smith et al., 2005; Patwardhan et al., 2012).

Most of the studies (for example: Foxon, 2013) that try to understand actors' perception of the factors determining on-going socio-technical

transition were conducted on developed economies. However, as earlier mentioned, the typology, timing, and influence of socio-technical transition differ according to the context within which the transition takes place (Cowell et al., 2016; Viétor et al., 2015; Bridge et al., 2013; Coenen et al., 2012; Geels 2002). For this reason, this study argues that identifying the contextual determinants of community renewable energy transition is important before any attempt to plan and manage a transition.

One of the key problems in Nigeria is that there seems to be a disregard for studying and aligning policy or practice with the pressures that are driving energy transition. Related studies of factors driving energy transition were conducted based on desktop research (For example: Ohunakin et al., 2014). Thus, there is limited empirical evidence of the factors driving community energy transition in rural areas. The research undertaken in this thesis is primarily based on empirical data.

3.8.2 Transition planning and decision-making processes

The second element of the theoretical model is centred on transition planning, policy and decision-making processes. This will be discussed under the following headings: (1) Participatory planning and envisioning; (2) Strategies and pathways development; (3) Stakeholder engagement; (4) Local community participation; (5) Setting renewable energy targets; and (6) Community ownership and cooperative societies.

3.8.2.1 Participatory planning and envisioning

Participatory planning and policy-making are seen as important in socio-technical transition management (see for example: Foxon et al., 2008b:

20). Transition scholars theorise that an important part of operationalising this process is the formation of a 'transition arena' where actors with interest in innovation engage themselves in a participatory process to understand societal problems and explore possible future solutions (Kemp and Loorbach, 2006; Van de Kerkhof and Wieczorek, 2005).

A transition arena can be instigated by a group of innovative individuals or by government. This is done by assuming the leading role or acting as transition manager, not necessarily to force changes, but to stimulate the needed mutual learning process (Kemp et al., 2007). For instance, EZ, 2004 cited in Kern and Smith (2008) described the Dutch Ministry of Economic Affairs as the transition manager of sustainable energy transition in the Netherlands. The Ministry of power (FMPower) can be regarded as the transition manager of the community renewable energy transition in Nigeria. Thus, the vital function of the FMPower is to organise and facilitate the formation of such an arena or platform where actors will come together under one platform.

Although the Ministry can start to initiate a transition it will not have adequate capacity on its own to constitute the transition arena (see Smith et al., 2005; Lopolito et al., 2011a:2011b; Kern et al., 2013). This is because actors in a transition arena depend on each other for important resources that are required to guide a socio-technical transformation like community renewables (see for example: Rohracher, 2006; Ceschin, 2014).

A sequel to establishing the transition arena, the first activity of transition planning (as outlined in section 3.3), is the participatory understanding of the problems of society and the development of a long-term vision of a preferred future (spanning at least 25 years or more). Developing a shared long-term vision is a significant step in knowing that everyone is linked to a common path in the transition arena process. Thus, problem structuring, visioning and pathways formation are fostered by the interaction between the different actors who hold different views, interest, and experiences (Loorbach, 2007; Twomey and Gaiuolusoy, 2014).

Over the past decade, several countries and cities facing different societal problems have developed various shared long-term visions to guide their sustainability transition. For instance, Ferguson et al. (2012) discovered a 50-year long-term vision for the water sensitive city transition in Melbourne. Similarly, Auvinen and Tuominen (2014) reveal a safe and secure Finnish transport system by 2100 as the shared long-term vision for a sustainable transport system in Finland. Other countries desiring sustainable transition (such as Belgium and France) have developed shared long-term visions up to 2050 (Pisano et al., 2014).

3.8.2.2 Strategies and pathway developments

As described in Section 3.5.2, the development of a long-term vision is followed by the development of strategies or pathways for realising shared long-term vision. This process is realised through backcasting. Backcasting from the vision generates alternative transition paths that link the future with the present (Vergragt and Quist, 2011; Quist 2007; Quist and Vergragt, 2006). For instance, the UK has set a number of pathways in order to realise

its sustainable long-term vision. This includes: increasing renewable energy capacity; better insulation in buildings; reducing household energy demand; and, increasing efficiencies in the transport sector (HM Government 2011).

Similarly, the Danish government has set a long-term development vision of fossil fuel independence by 2050 (OECD/IEA, 2011). It intends to achieve this vision by increasing the use of renewable energy and energy efficiency improvements which is expected to reduce fossil fuel use in the energy sector by 33% by 2020 (OECD/IEA, 2011). Pisano et al. (2014) posit that when designing or implementing transition pathways, it is crucial to state in clear terms the role or responsibility required of each of the actors involved and how their activities will be co-ordinated to ensure learning. Mehlwana (2004) reiterated that one key challenge of renewable energy transition in developing countries is the existence of several uncoordinated programmes and demonstration projects. So far, no evidence is available to demonstrate that Nigeria has set pathways with which transition to electrification by community renewables in off-grid rural areas will be realised. Based on the above-mentioned points, this study also seeks to explore transition strategy and processes.

3.8.2.3 Stakeholders engagement

Whilst the interaction of actors is crucial in transition planning and policy-making, the composition of actors must also be all-encompassing to allow for learning to take place (Fischer and Newig, 2016; Smith and Stirling 2008). Thus, the participation of actors such as regulators, policy makers, incumbent utilities, communities, politicians and investment communities in

the transition planning of community renewables is important. The non-involvement of key actors is capable of resulting in low legitimacy and unavailability of resources required to support the transition from the centralised grid extension system to the community scale (see for example: Geels, 2012).

Loorbach and Rotmans (2006) assert that transition managers, as part of their responsibilities have to ensure a balanced representation of actors from the heterogeneous groups of stakeholders. Kemp and Loorbach (2006) maintain that although a transition arena could be started with a relatively small network, as the process expands there would be a need to involve other actors such as civil society groups, non-governmental organisations and private investors who are considered crucial in creating legitimacy and finance for any socio-technical transition. Loorbach and Rotmans (2006) believe that as the transition process progresses arena participants may need to be replaced by new participants. With new expertise and perspectives. In such a case, transition managers must ensure that the replacement process does not interrupt the balance in the arena (Loorbach and Rotmans, 2006).

In a study of sustainable transport system transition in Europe, Lindenau and Böhler-Baedeker (2014) found that planning involved a range of actors: motorist associations, public transport providers, non-governmental organisations, and local companies. Their research, however, found that the level of involvement significantly varied between cities. They also found that actors are mostly involved in the first stage of the process - identification of

transport and mobility problems, but few cases involved actors at other stages of the process (e.g. in envisioning and in identifying possible alternative pathways). While this particular study was conducted in Europe, it is important to know if it can be applied to other national contexts such as Nigeria. Research on the composition of actors in transition planning, policy and decision-making are rarely conducted in developing countries. This study aims to bridge this gap in knowledge and understanding.

3.8.2.4 Community participation

Similarly, as described in Section 2.4, the involvement of local communities in community renewable energy transition planning and decision-making is considered crucial. This is because local communities provide the means by which to raise awareness and acceptance of new projects (Quist et al., 2013). In addition, participation of local communities in transition planning broadens new frontiers that allow individuals to reflect on their own behaviour in a wider societal context (Quist et al., 2013). Iacovidou and Wehrmeyer (2014) found the participation of local communities in transition planning key to achieving successful outcomes.

But in Nigeria, most developments affecting rural areas have been undertaken without regard to the involvement of the community in the planning and decision-making process (Abdullahi et al., 2014). Despite repeated calls for community participation in local development projects (see for example: Abdullahi et al., 2014) there is no known investigation into local community involvement in renewable energy planning and policy decision-making in Nigeria. Thus, this study aims to contribute to addressing the gap in knowledge and understanding of current practice.

3.8.2.5 Community ownership and cooperative societies

In both Denmark and Germany ownership of renewable energy projects by local communities has been instrumental to the success of community renewable energy deployment (Richter, 2013; Kaphengst and Velten, 2014). Additionally, different business models have allowed local citizens to participate in the ownership of community renewable energy. Cooperatives, for example, have become an important ownership style (Kaphengst and Velten, 2014). Countries such as Germany have also enacted laws that mandate energy developers to engage local communities and cooperatives in the ownership of projects sited within their communities (Richter, 2013). However, there are currently no known empirical investigations into community ownership and cooperative societies as models for community renewable energy in Nigeria.

3.8.3 Transition project implementation: Process and dynamics

Transition project implementation is the third element of the model. This is now discussed under the following categories: (1) Project objectives and design; (2) Stakeholders involvement and networking; (3) Community involvement; (d) Monitoring, communication and learning outcomes; and (e) Market support and business models

3.8.3.1 Transition project objectives and design

As described in Section 3.5.3, steering transition to achieve the desired objectives is supplemented by physical piloting or experimentation to explore the socio-technical pathways developed in an arena or platform setting (Voß et al., 2009). Based on this, it can be contended that the development of the *Shape* community renewable energy project is to familiarise socio-technical innovation to a real-world situation (see Lee,

2001). It is considered as a means of trialling socio-technical innovations to facilitate understanding of the interactions between the innovation and the real-world context (see Raven 2007). Hellsmark (2010), Karlström and Sandén (2004) and Raven (2005) identified different aims of a transition pilot project, which include:

- To facilitate the formation of knowledge networks;
- To facilitate learning that can be instrumental in decisions on technology choice;
- To create public awareness of technology;
- To explore user preferences and possibilities for changing the innovation, as well as learn about how future experiments should be set up;
- To stimulate debate and try the feasibility of innovations in different environments;
- To showcase innovation to potential adopters; and,
- to publicise tested techniques, methods, or models through replication.

Raven (2005) posits that transition projects such as *Shape* are also important in creating niches capable of transiting from one system to another because they reflect upon the different important aspects of niches. Accordingly, a transition project such as the one under review is supposed to offer the avenue for the interaction between technology, society and other structural agents (Raven 2005). A pilot project also contributes to integrating different concerns of actors into the design of the transition project (Raven 2005).

3.8.3.2 Stakeholders involvement and networking

One requirement for the *Shape* community renewable energy project to be transformed into a niche is the adequate presence of a stable network of actors; who represent the required drive to support the development of learning by doing and learning by interacting (Schot and Geels, 2007). Given the fact that a niche is a, "small network of dedicated actors" (Geels and Shot 2007: 400), scholars state that it is critical that powerful actors are carried along in the network during both the design and development of the transition project (Lopolito et al., 2011a, 2011c; Meroni 2008). Ceschin (2014) outlines that such powerful actors might include: regime *outsiders* and *insiders*.

In the case of the community renewable energy transition, *outsider* actors are, for example, firms, civil society groups, scientists, non-governmental organisations and societal pressure groups. These actors are required in a transition project network because they do not share the existing institutions and practices and therefore, may protect the innovation (Ceschin 2014). *Insider* actors, on the other hand, are, for instance, the Nigerian Electricity Regulatory Commission, the Energy Commission of Nigeria or the Rural Electrification Agency who are needed to provide support for scaling up the new practices and institutions (Ceschin 2014). *Insider* actors may also include existing regime players such as the generation (GENCOs) and distribution (DISCOs) companies. However, the dominance of these agents in the socio-transition project is often criticised because of their tendency to influence the trajectories in support of vested interests (Coenen et al., 2010; Coenen and Lopez, 2010; Smink et al., 2015).

Similarly, in community-scale energy transition such as the one in Nigeria, other *insider* actors may include local authorities that can play a prominent role in building support for socio-technical innovation (Fudge et al., 2015). Gouchoe and Larsen (2001) argue that such actors are important stakeholders in transition projects. They believe that not only are local governments in close contact with local people, but local authorities can act as educators, customers, regulators, financiers, and investment partners in localised energy provision.

3.8.3.3 Local community participation

Furthermore, Meroni (2008) emphasises the engagement of a local community not only in the development of a transition project but also in the design of the project from the onset. This line of argument is further supported by Cheschin (2014) who posits that when designing a transition project, it is not only important to engage actors who can create the settings necessary to protect and support the project through a top-down process, but also those actors from the bottom who can bring about system change.

In Nigeria, many rural communities still hold the view that community development projects such as renewable energy are exclusively the responsibility of the government (Abiona and Bello, 2013). On the government's part, community participation tends to be top down in the form of communities receiving information via consultation (Laah et al., 2014). Abiona and Bello (2013) have concluded that rural community projects have been designed and implemented without truly involving local

communities. Such projects then fail because they lack commitment on the part of local people.

Therefore, both *insider* and *outsider* actors are required for providing the financial investment and technical expertise required (Smith et al., 2010; Späth and Rohracher, 2010a:2010b). Their involvement is also required for increasing social legitimacy through conventionalizing its value by means of various forms of support (Smith et al., 2010; Späth and Rohracher, 2010a:2010b).

As mentioned in Section 1.2, even as studies have been conducted in Nigeria to understand local community participation in rural infrastructure projects such as water supply and sanitation, health and education facilities and rural roads (Utuk, 2014: Adesida and Okunlola, 2015), these studies focused on local community participation in infrastructure projects. Apart from being short of looking at participation from the wider perspective of engaging other key stakeholders, these studies have not conducted on the provision of energy.

3.8.3.4 Learning outcomes, monitoring and communication

Another requirement for the success of the *Shape* project is ability to instigate social learning (Schot and Geels, 2008). This is because the social learning experienced through experimentation is regarded as crucial in overcoming path dependence and system lock-in (Raven et al., 2010). It is posited that a transition project provides an avenue within which social learning can effectively be conceived (see Bos and Brown, 2012; Loorbach, 2010; Foxon et al., 2008c). The learning-by-doing process that augments

available knowledge is initiated once a transition project commences (Morone and Lopolito, 2010).

Additionally, knowledge gained will typically be shared among the actors partaking in the innovation project for the further improvement of the innovation through a learning-by-interacting process (Morone and Lopolito, 2010). Thus, both learning-by-doing and learning-by-interacting are likely to be crucial in helping the *Shape* community renewable energy project reduce the uncertainties that characterise new socio-technical innovations, and therefore create opportunities for the project to develop further. This process according to Morone and Lopolito (2010) is the last stage of generating a socio-technical niche capable of replacing an existing regime.

However, effective social learning must follow a reflexive monitoring and evaluation of the outcomes of the project in terms of activity, process, progress and impact (see Bussel et al., 2013). van Mierlo et al. (2010) posit that monitoring is used to document the inventory of the result of the experimentation project that allows project actors to learn from them. They suggest that it is important to start monitoring the project as soon as the first activities are undertaken regardless of their success. The authors further suggest that monitoring should reflect on four key aspects and their relationships: the current state of the project; the objectives already achieved; opportunities and barriers; and, the extent to which activities and results contribute to the objective of inducing a change in practice and institutions.

Keeping an inventory of data through monitoring is considered by Bussels et al. (2013) as the basis of information upon which an evaluation can be made. Rotmans and Kemp (2003) pointed out the importance of sound and transparent communications amongst parties. Therefore, it is also crucial that the outcomes of project monitoring and evaluation be reported or communicated to all the relevant actors to keep them abreast of what is happening at each stage of the transition project. In Nigeria, there is often a disregard for monitoring, evaluating and communicating outcomes of rural community development projects. As such this study also aims to contribute to understanding these aspects of community project implementation.

3.8.3.5 Market supports and business models

If left to the current regime, community renewable energy may face a number of pressures. Pressures, for instance, from established industry structures. Thus providing a hostile environment because of say existing network relationships, strong producer-user interactions, shared routines or existing resource allocation procedures (Smith and Raven, 2012). Therefore, any attempt to gain market entry by community-scale renewable energy may be rejected because it does not conform to existing industry structures and decision-making processes (Smith and Raven 2012).

For this reason, Foxon (2011) states that for any socio-technical transition to manifest, both the technology and institutional set up must not only coevolve but this should happen simultaneously. Foxon (2011: 2262) indicates that the coevolution of technology and institution can occur in two ways, "*by altering selection criteria, e.g. a new incentive in the institutional structures…increases the likelihood of renewable energy technologies being*

adopted, or by changing the replicative capacity of individual entities, e.g. by [by adopting] new business strategy [or model] *to increase investment in renewable energy innovation*".

Given this argument, Hannon et al. (2013) and Bidmon and Knab (2014) noted the significance of institutional incentives and business models as the key co-evolving systems required to support any socio-technical change such as the one under study here in this thesis.

The activities designed to support system change are being framed in socio-technical transition literature as "protection" or "shield" for socio-technical innovation (see for example: Smith and Raven, 2012). Protecting or shielding socio-technical innovation can be passive in nature where protection exists without any deliberate mobilisation by actors – such as geographic space (Smith and Raven 2012). Active protection represents the deliberate attempt and the establishment of strategies aimed at shielding or protecting socio-technical innovation from mainstream pressures (Smith and Raven, 2012). Foxon (2013) argued that central government should play a major role in facilitating active protection for innovation. This can be achieved through the provision of incentives to encourage local community involvement, and the development of new business models aimed at supporting local investment (Hannon et al., 2013; Smith and Raven, 2012).

Incentivising socio-technical innovation follows Kemp et al. (1998) who suggested supporting innovation through changes in the structure of

institutions in which market forces operate. An incentive is regarded as the most influential factor in attracting investment communities, which Kern (2012) referred to as the most powerful actors in socio-technical transition. In community renewable energy transition for rural areas electrification, incentivising may take the form of policy changes in the arrangement and mode of providing economic motivation to one that rewards renewable energy innovation in the rural areas. However, Kemp et al. (1998) warned that once innovation reaches maturity, incentives may then need to be withdrawn but this should be done in an orderly way so as not to be harmful.

A review of the literature revealed different instruments for incentivising community renewable energy. These can be classified into three broad types of instruments: fiscal; regulatory; and, financial instruments (IRENA, 2012a; Abolhosseini and Heshmati, 2014). Financial instruments are the central instrument for incentivising renewable energy developments and include government grants and loans from development banks and other finance institutions (Hussain, 2013). Mohiuddin (2006) questioned the use of grant-based instruments due to what he referred to as uncertainties associated with government grants. Regulatory incentives, on the other hand, refer to any incentive that is offered and the responsibility of implementation assigned to an energy regulator (Bjork et al., 2011). Regulatory incentives may include a feed-in tariff, quotas and guaranteed access that are instituted to support the renewable energy transition in many countries. A fiscal incentive such as tax reduction and exemptions is also being used to attract community renewable energy investment (IRENA, 2012a). Experiences in Europe and some developing countries demonstrate

that instruments such as feed-in tariffs, quotas, tax credits, capital subsidies, tradable renewable energy certificates, and loans have so far been used as the tools for incentivizing renewable energy transition.

Azuela and Barroso, (2012) stressed that despite the large body of literature that explores the experience of countries about the use of different types of instruments to incentivise renewable energy transition, most of this literature concentrates on developed countries such as in the OECD. Liming (2009) also explores and compares financing instruments for rural renewable energy in China and India. Incentivising community renewable energy for rural electrification in Nigeria is an area that has not been given any significant attention in the literature. Thus, this study aims to contribute to the literature by exploring the availability and effectiveness of incentive instruments for community renewable energy transition in off-grid rural areas electrification.

In addition to incentivising innovations, Johnson and Suskewicz (2009) and Nidumolu et al. (2009) have stressed the importance of developing and integrating new business models into strategies aimed at supporting socio-technical transition. Bidmon and Knab (2014: 4) see a business model as, "…*how a firm creates and captures value in a value network, which transcends the boundaries of the focal firm. It is both, a market device to commercialise innovative technology and subject to innovation*."

A business model responds to questions which identify its nature in terms of: "who is the customer?"; "what does the customer value?"; "how do we make money in this business?"; and, "what is the underlying economic logic

that explains how we can deliver value to customers at an appropriate cost?" (Magretta 2002: 4). In addition: what is the value attached to the innovation?; who are the partners and channels through which the value is produced and delivered?; and, what is the flow of revenue in relation to the cost stream (Doganova and Eyquem-Renault 2009).

According to Bidmon and Knab (2014), a business model serves as a point of illustration among various actors promoting socio-technical transition. Other scholars argue that the business model not only strengthens learning processes and the formation of social networks but also attracts actors' financial commitments to socio-technical innovation (Doganova and Eyquem-Renault 2009; Massa and Tucci 2014) and increases the protective space for socio-technical innovation (Parrish and Foxon, 2006).

Chesbrough and Rosenbloom (2002: 533) note the following functions of a technology business model:

- It helps in articulating the value proposition, that is, the value created for users by an offering based on the technology;
- It also helps in identifying a market segment and specify the revenue stream and mechanism by which an organisation will be paid for the offering - that is, the users whom the innovation is useful to, how they will pay, how much to charge and how the value created would be distributed;
- It also helps to define the value chain structure as well as the complementary assets required to create and disseminate the innovation and;

- Lastly, it helps in estimating the cost structure and the margin given the value proposition and the value chain structure selected.

Despite the importance of a business model in accelerating the transformation of innovation, potential socio-technical innovation such as community renewable energy in Nigeria often has no clear business model, and in such a situation actors must produce an appropriate model to be able to capture value from that innovation (Chesbrough, 2010). Such a business model must not only differ from the existing business model in terms of technology but also in the content, structure, and governance of how technology services are being provided to customers (Hannon, 2012).

Realising a sustainable business model for community-scale renewable energy is a daunting task (Dhakal et al., 2013). According to Amit and Zott (2001), the difficulty arises because of the wide difference between the business model established for the existing set-up, and the anticipated requirements needed to exploit the evolving socio-technical innovation. Also, because new business models often have no clear market value, returns for established models are initially higher than emerging ones and this may influence investment communities to favour the incumbent system and, therefore, starve innovation of resources (Chesbrough, 2010).

Developing business models may be even more challenging for participatory energy provision because there is no one-model-fits-all situations. According to Greenpeace (2013), business models vary with the topography of a region, institutional settings, demographic features, the nature of stakeholders, available technology and the economic activities of the region

or locality. However, Kaphengst and Velten (2014) have shown that in addition to being an appropriate model for community renewable energy, cooperatives offer the most successful model for participation and involvement of local communities in renewable energy investment.

Irrespective of the business model being sought, establishing a legal or regulatory framework for the innovative business undertaken is a major step in institutionalising business models for socio-technical innovation (see Greenpeace, 2013). The legal or regulatory framework for community-scale renewable energy is still in its infancy in most developing countries (IRENA, 2016; Wouters, 2015). Ohiare (2015b) identified several business models for application in Nigeria's rural electrification. But no known study has explored the implementation of such business models and their appropriateness to community renewable energy transition in Nigeria.

3.8.4 Barriers to transition

Changing energy systems such as the shift to community renewable energy for off-grid rural electrification can be a challenging task because over time technology, economic, institution and cultural factors have converged to locked-in existing systems (Unruh 2000:2002). Viétor et al. (2015) maintain that it is challenging to develop and replace existing systems. Socio-technical transition can encounter many barriers that hinder innovation from developing and expanding (see also Wieczorek and Hekkert, 2012; Kieft et al., 2015).

Transition scholars have referred to the barriers faced by new socio-technical system in different ways including system failure, blocking

mechanisms, and systemic problems (Chaminade and Edquist, 2010; Kieft et al., 2015; Bergek et al., 2008; Foxon et al., 2005; Steinhilber et al., 2013; Farla et al., 2010). They have effectively demonstrated that promising socio-technical transition can be challenged by a range of barriers at any stage of its developmental process – pre-development, take-off, acceleration and stabilisation stages. Twomey and Gaziulusoy (2014) point out that identifying the challenges that hinder a shift to a new system and categorising them in terms of how they affect the transition is essential for designing a programme aimed at accelerating the transition process.

Bergek et al. (2008) and Hekkert et al. (2007) for example identified and classified transition barriers based on the functional activities or processes that support socio-technical system transition. On the other hand, Wieczorek and Hekkert (2012) classified barriers into four structural dimensions, namely, actors, institutions, interaction, and infrastructure. This study aims to critically identify the barriers, as they exist in Nigeria's community renewable energy transition based on the structural dimensions as conceived by Wieczorek (2014). The next section explores in detail these structural barriers.

3.8.4.1 Actor related barriers

Actor problems or barriers are challenges that constrain users or any other actor (e.g., civil society, companies, research centres, technology institutes, governments, NGOs, legal organisations and financial institutions) from performing their functions as agents of change (Twomey and Gaziulusoy, 2014). These barriers may result from inadequate resources or knowledge of the actors to act (Wieczorek and Hekkert, 2012). For example, the limited

individual financial capacity identified by Ballesteros et al. (2013) can be classified as one of the actor barriers for concern, when considering renewable energy transition especially in low-income rural areas similar to rural communities in Nigeria. In support of this position, Omer (2007) further claims that successful renewable energy transition rests on the ability of users to pay for the electricity services provided by renewable energy technologies.

Similarly, lack of awareness can be considered as another actor barrier because the ability of the different actors including policy-makers, to shift to new norms and behaviour relies on the level of their awareness and experience on the use and application of socio-technical innovation. This view is supported by Blenkinsopp et al. (2013) who find that absence of awareness and understanding of renewable energy technologies hinder the uptake of small-scale renewable energy in the rural communities of India's Maharashtra.

Furthermore, a socio-technical transition can be constrained by the lack of required skills among actors to operate and develop a new socio-technical system. This assertion is supported by some studies that found that insufficient skills to run effectively and maintain or rally financial support for community energy as a major actor related barrier to community renewable energy transition (Bhattacharyya et al., 2014; Haggett et al., 2014).

3.8.4.2 Institutional related problems

The transition to a new socio-technical system such as that of community renewable energy in Nigeria can be challenged by institutional barriers that may result from incapacity or weak institutional settings, which as a

consequence favour the incumbent system or hinder socio-technical transition to transformation (Wieczorek and Hekkert, 2012). An institutional setting comprises laws, rules, standard procedure, protocols as well as accepted norms that guide socio-technical transition (Hoffman et al., 2002; Twomey and Gaziulusoy, 2014).

Regarding institutional and related barriers, Glemarec et al. (2012) found a lack of clarity in institutional responsibilities as a major institutional factor challenging renewable energy transition in Mauritius. IRENA (2012a) stated that the insufficient institutional and individual capacity that is required to drive energy transition is a major issue of concern in most developing countries.

3.8.4.3 Interaction related barriers

Transitions can be greatly influenced by complex interaction barriers. Interaction in socio-technical transition refers to how parties in the system relate to one another at the strategic, tactical and operational level of the transition process. Thus, the nature of interaction barriers lies in structural relations and these can be analysed at the level of both the system network and individual contacts (Wieczorek and Hekkert, 2012; Twomey and Gaziulusoy, 2014). Several factors such as non-participation or a communication gap can inhibit the smooth interaction of actors and therefore, affect the pace of socio-technical transition.

3.8.4.4 Infrastructure related barriers

Infrastructure challenges can also constrain a socio-technical transition. These challenges occur because of the absence or insufficient presence of

knowledge, material and/or financial infrastructure to support a system transition (Bolton and Foxon, 2015; Wieczorek and Hekkert, 2012). These infrastructures are needed for a shift to occur because innovation may not be compatible with the existing stock of infrastructures (Hanseth, 2004).

Hanseth (2004) posits that new knowledge, material or financial infrastructure will not encourage transition until there is an accumulation of critical mass that is compatible with it. Flavin et al. (2004) maintained that lack of baseline data required in transition planning is a significant infrastructure related barrier for renewable energy transition. The scholars found the lack of this data is affecting the transition to renewable energy in Latin America and the Caribbean. Ohunakin et al. (2014) claimed that deficiencies in national quality standards constituted another infrastructure barrier. The difficulty in accessing land for siting renewable energy projects may constitute another infrastructure barrier, typically affecting renewable energy transition in developing countries (see Nasirov et al., 2015).

Finally, this study aims to critically analyse the challenges affecting community scale renewable energy in Nigeria and will utilise concepts arising from the preceding discussion to conduct an investigation of the barriers to community renewable energy transition.

3.9 Summary

This chapter has outlined the rich literature on transition theory with a number of different approaches having been critically assessed.

Arising from this literature review, a theoretical model has now been developed, and this will be utilised to analyse the governance and processes through which community renewable energy is determined, planned, and implemented. Specifically, the model will be used to investigate the determinants of community renewable energy transition for off-grid rural electrification. And also the processes and approaches involved in the implementation of the *Shape* community renewable energy project. Furthermore, the model will be used to critically assess the availability and effectiveness of incentive instruments and business models. Finally, barriers compromising the transition to community renewable energy will also be investigated.

The next chapter presents the research methodology and methods that underpin this study.

Chapter Four

Methodology and Methods of the Study

4.1 Introduction

This chapter begins by briefly reviewing the aims, objectives and research questions of the study before presenting an overview of two different research philosophies. Within this discussion, a thorough justification for the choice of research methodology is provided. The chapter then turns to the research strategy employed and discusses the sample and the data collection methods. Ethical issues attached to the research are also outlined.

4.2 Overview of the Research

To recap, the aim of this study is to assess, through the use of case study research, the transformative potential of the processes and governance approaches to community renewable energy in accelerating sustainability transition in off-grid rural areas. To achieve this aim, five key research objectives were identified in Chapter 1.

(1) To evaluate the Nigerian electricity landscape – challenges, institutional approaches, strategies and policies – and to consider this within community renewable energy and transition theory concepts.

(2) To formulate a transition theory model to assess the determinants of community renewable energy transition in Nigeria.

(3) To use the model to assess the transition planning processes and implementation strategies of community renewable energy transition in Nigeria.

(4) To use the model to investigate the barriers inhibiting the successful transition to community renewable energy for off-grid rural electrification in Nigeria

(5) To provide a series of critical recommendations to assist policy-makers, community and other actors in nurturing, developing and expanding community renewable energy in Nigeria.

To achieve the stated objectives, the study is being guided by the following four questions:

(1) What are the challenges of Nigeria's electricity sector and how can community renewables contribute to solving these challenges?

(2) What are the factors determining community renewable energy transition in rural electrification in Nigeria?

(3) What are the strategy and processes involved in the planning and implementation of transition to community renewable energy in off-grid rural electrification in Nigeria?

(4) What are the barriers inhibiting the transition to community renewable energy in off-grid rural electrification in Nigeria?

4.3 Selecting the Research Methodology

This study began by carefully reviewing different methodological approaches with it taking some time to identify an appropriate research approach that would allow the research aims, objectives and key questions to be addressed. To provide an insight into how the research methodology was chosen and following Bryman (2007a) and Agarwal (2011) the philosophical

framing of research design, the suitability of different methods and then existing research approaches adopted by similar research studies, is used to structure the following discussion.

4.3.1 Philosophical framing of the research design

It is acknowledged that the philosophical paradigm of a research project impacts on the way knowledge is studied and interpreted. The choice of paradigm sets down the intent, motivation, and expectations of research (Bryman, 2012). Additionally, the subsequent selection of methodology, methods or research design is based on the philosophical paradigm in which a researcher is situated (Mackenzie and Knipe, 2006). Thus, understanding a philosophical research paradigm from the outset helps a researcher to ensure that his ontological views, epistemological positions and methods for data collection and interpretation are closely integrated (Bracken, 2010). Doing so clearly offers the researcher the ability to reflect iteratively upon, and guide how best to conduct the research.

Research philosophy is referred to in the literature, "*as a loose collection of logically related assumptions, concepts, or propositions that orient thinking and research*" (Bogdan and Biklen 2007: 24). It also regarded as the, "*patterns of beliefs and practices that regulate inquiry within a discipline by providing lenses, frames, and processes through which investigation is accomplished*" (Weaver and Olson, 2006: 460). Despite the significance of the philosophical paradigm Goulding (2002) acknowledges that framing a philosophical position is not an easy task. It requires a thorough understanding of the different possible paradigms and the evaluation of oneself as a researcher in terms of convictions, beliefs, and interests. There

are many philosophical research paradigms including positivist, interpretivist, transformative, and pragmatist (Mackenzie and Knipe, 2006). In most social science research, however, two major research philosophical paradigms are often considered - *positivist* and *interpretivist* paradigms.

Positivism is a philosophical research stance that advocates the application of the natural science method in the study of social reality (Bryman and Bell, 2015). The positivist paradigm posits that a researcher can apply a natural science method to study the social world based on the impression that, "*the social world is value-free, and that explanations of a causal nature can be provided*" (Mertens, 2005: 8). The positivists also believe that to reveal the truth about not only the nature of science but also about the nature of human behaviour, once outside conditions are systematically controlled and monitored, that nature can be subjected to experimental testing (Bracken, 2010). Thus in positivism, the aim of the researcher is, "*to test a theory or describe an experience through observation and measurement in order to predict and control forces that surround us*" (O'Leary, 2004: 5).

In contrast, interpretivists argue that the distinguishing characteristics of the social world require a different reasoning that reflects such distinctiveness of the social world against natural science (Bryman and Bell, 2015). This understanding stemmed from researchers who are not content with the application of the scientific methods in studying the social world (Bryman and Bell, 2015). Such researchers believe that social phenomena can best be understood through the interpretation or meaning assigned to

it by research participants. Table 4.1 summarises the difference between the positivist and interpretivist philosophical positions.

Whilst both paradigms are applied in social science research, Guba and Lincoln (1994) suggest that choosing between these paradigms largely depends on the two major research stances: the *ontological* and *epistemological* stances. Ontology refers to the nature of the social world. Briefly defined, it is concerned with 'being' and questions the nature of reality as something imagined or existing outside of an individual (Bryman and Bell, 2015). Positivists, therefore, hold the view that reality can be detached from people's beliefs and imagination (Denscombe, 2002), whereas, from an interpretivist paradigm, the world is a collection or construction of peoples' minds rather than a single reality (Burell and Morgan, 1979). Thus, a reality in the interpretive paradigm is the meaning given to it by research participants (Easterby-Smith et al., 2002). Therefore, the interpretive paradigm embraces multiple truths and realities as evident in the multiple forms of themes emerging from research participants' views being studied (Creswell, 2013a).

In this study, the author believed that knowledge is an innate part of humans which cannot be detached and is therefore explained or understood through the meaning ascribed to it by the people. This position aligns the author to the interpretive ontological stance.

In addition to the ontological stance of a researcher, choosing a philosophical research position is also influenced by a researcher's epistemological stance

Table 4.1 Summary of the differences between Positivist and Interpretivist research paradigm

	POSITIVISM	INTERPRETIVISM
Independence	The observer is independent of what is being observed.	The observer interacts with the subject being observed.
Value-freedom/ Value-laden	The choice of what to study, and how to study can be determined by objective criteria rather than by human beliefs and interests	Inherent bias in the choice of what to study, and how to study it as researchers are driven by their interests, beliefs, skills, and values.
Causality/No causality	The aim of social science should be to identify causal explanations and fundamental laws that explain regularities in human social behaviour.	The aim of social science is to try to understand what is happening.
Hypothetico-deductive/ No Hypotheticodeductive reasoning	Science proceeds through a process of hypothesising fundamental laws and then deducing what kinds of observations will demonstrate the truth or falsity of these hypotheses	Develop ideas through induction from evidence; mutual simultaneous shaping of factors
Operationalisation	Concepts need to be operationalised in a way that enables facts to be measured quantitatively; static design – categories isolated from the study.	Qualitative methods – small samples investigated in depth or over time; emerging design – categories identified during research process
Reductionism	Problems as a whole are better understood if they are reduced to the simplest possible elements	Problems as a whole are better understood if the totality of the situation is looked at
Generalisation	To be able to generalise about regularities in human and social behaviour, it is necessary to select samples of sufficient size; the aim of generalisations is to lead to prediction, explanation, and understanding.	Everything is contextual; patterns identified – theories then developed for understanding
Research Language	Formal, based on set definitions; impersonal voice; use of accepted quantitative words.	Informal, evolving decisions; personal voice; use of accepted qualitative words. Research

Source: Easterby-Smith et al. (1991), Hussey and Hussey (1997), Creswell (1994), Remenyi et al. (2000) as compiled by Holden and Lynch, (2004: 9)

The term epistemology is derived from a Greek word epistêmê, which refers to the assumption of how to study the world or how we come to know about our social world (Krauss, 2005). Krauss (2005: 79) posits that epistemology asks the following questions:

- "*What is the relationship between the knower and what is known?*
- *How do we know what we know*?
- *What counts as knowledge*?"

The positivist holds the view that, "*one observable social reality and that the end product of such reality can be law-like generalisations similar to those produced by the physical and natural scientists*" (Remenyi et al., 1998: 32). In the interpretative paradigm, reality is assembled through the subjective experience of research participants, and the researcher tries to get as close as possible to the research participant being studied (Creswell, 2013a).

This research is exploratory and explanatory in nature. Therefore, it recognises the 'real world' as constructed based on the experiences and collective meaning given to it by research participants involved. To gather these constructive meanings as attached by the participants, the researcher get himself close to them to have a more rounded feel of their narratives. This attempt places the author to the interpretive epistemological stance. Nevertheless, to ensure credibility and validity the researcher as much as possible is detached from the data during the interpretation and analysis stage of the research process.

In addition, because this study is exploratory and explanatory, the flexibility to adjust to new constructs as they emerge is significantly important.

4.3.2 Suitability of a particular approach to addressing the research issues

Bryman (2007ab) argues that the appropriateness of a research approach to addressing a research problem plays a significant role in selecting a research method. Research approach shapes the decisions about research design and methods that are applied to find answer. This corroborates the position of Cavaye (1996) who states that the methodology chosen depends on what a researcher is trying to do rather than a particular paradigm to which a researcher is committed. This understanding points to a departure from early researchers' position on ontological and epistemological stances as the critical factors in choosing a research methodology, with some researchers questioning the suitability of the approach in social science research (Agarwal, 2011).

Denscombe (2002) claims that holding on to a particular philosophical position in selecting a research method has its shortcomings. Therefore, social science researchers' should embrace more pragmatic and triangulated approaches that fully address the research problem without given preference to any philosophical stance. Based on these arguments, Clough and Nutbrown (2012: 21) state that the, "*purpose of a methodology is to show not how such and such appeared to be the best method available for the given purposes of the study, but how and why this method was unavoidable – as required by - the context and purpose of the particular enquiry*."

Given this discussion and the exploratory and explanatory nature of this research, it is evident that it requires an in-depth investigation which can more appropriately qualitative research approach.

4.3.3 Existing practices in similar areas of study

A search of the literature identified some studies conducted on the issue of community renewable energy transition. These previous studies were examined to evaluate the methodologies utilised in order to consider them in the context of this study.

Haggett et al. (2013) explored the social factors that influence the success of community energy projects at different stages of development from conception to operation in Scotland. Her study drew predominantly on documentary sources of data and is aimed at providing critical analysis and recommendations to support the Scottish Government in upscaling community projects. Arentsen and Bellekom (2014) also explored how local community energy initiatives can be considered seedbeds of innovation and state that such efforts can lead to innovative changes in energy supply. Their research adopted secondary research methods. While these methods were suitable for the contexts and questions, the documentary research approach alone is not adequate for this study because of the setting in which this study was undertaken. Community renewable energy is not established in Nigeria. Therefore, there is not an adequate documentary evidence base on which to base an inquiry. Hence, a more rigorous methodology is required.

Abdullah and Amirruddin (2015) investigated the potential for the transition to sustainable transport system in Brunei. The study aimed to provide understandings into the expectation, challenges and a way forward for sustainable transportation in Brunei. A questionnaire survey and semi-structured interviews provided both quantitative and qualitative data for the

study. Whilst this research work utilised qualitative semi-structured interviews, the use of a questionnaire survey or any quantitative method is not suitable for this study. This is because as Geels (2011 and 2012) argue, any rigorous quantitative analysis may only be appropriate for a relatively stable socio-technical situation where the parameters are well established. However, community renewable energy is not well established in Nigeria as previously noted.

Moreover, the electricity system that is the focus of this research comprises many different interrelated and constantly changing aspects. Smith et al. (2010) argued that understanding these multiple and constantly changing realities operating at the various levels of an emerging socio-technical system creates analytical challenges that require reflexivity. Also, research respondents within the local community may not have sufficient levels of literacy to respond to a survey questionnaire. Thus, these contextual features create difficulty for the researcher to use a purely quantitative questionnaire survey. Moreover, the use of a structured questionnaire is inappropriate for the aim of this research as it required to capture the in-depth feelings and perspectives of individual participants. Therefore, a survey questionnaire or any quantitative research method was considered unsuitable.

Of relevance to this study is Hobson et al. (2016) who explored the role of monitoring and evaluation in low-carbon community groups in the UK. Their study aimed to examine the practice of community renewable energy and identify the potential barriers to their use of monitoring and evaluation in community projects. This study drew on qualitative data collected from semi-

structured interviews as part of a Knowledge Exchange programme in the UK. Similarly, Rocholl and Bolton (2016) studied the contestations surrounding the governance and ownership electricity distribution grid in Germany. The study offered new contributions to the debate on urban energy transitions by using 36 semi-structured interviews.

While the semi-structured interview utilised in the above studies provided in-depth narrative accounts and experiences of research participants, it is considered insufficient for this research. Of further relevance to this research is the work of Cowell et al. (2016) who assessed the impact of devolution on renewable energy transition within the UK. The study utilised documentary evidence and semi-structured interviews to conducts its investigation. In the same way, Bolton and Hannon (2016) examined the significance of innovative business models in the transition towards a decentralised sustainable energy system in the UK. The empirical study utilised semi-structured interviews and documentary analysis to offer new understandings into the dynamics and governance of socio-technical transitions.

Equally, Bagherian (2016) employed semi-structured interviews and document analysis to contribute to the debate on offshore wind system and sustainability transition in the UK's energy system. Likewise, Bolton et al. (2016) studied how and factors that influence investment in the transition to low-carbon electricity system in the UK. The study is based on documentary research and semi-structured interviews with the principal actors in the UK electricity systems. Similarly, Warren et al. (2016) assessed the Australian policy relating to sustainability transition and discovered that the inability of the government

to define and articulate a clear narrative is constraining its shift to a low-carbon trajectory. Their study used semi-structured interviews with representatives from different organisations and policy cycles, in addition to the documentary evidence.

In this study of community renewables in Nigeria, the research approach adopted follows Cowell et al. (2016), Bolton and Hannon (2016), Bagherian (2016), Bolton et al. (2016) and Warren et al. (2016). The reason being that documentary evidence provided an insight into the policy issues. Nonetheless, it is short of explaining how and why such decision came into being. Hence, the documentary analysis is augmented by the semi-structured interviews to provide understandings into the decisions based on the perceptions and experience of the actors involved.

4.4 Research Design

This research adopts a case study approach. A case study is considered more appropriate for this research because it offers the researcher the chances to explain holistically and in a real-life context, the processes by which community renewable energy is being developed and expanded for off-grid rural electrification in Nigeria. Case study research has a unique strength in that it tries to explain or analyse contextual issues that a researcher has little or no control over. According to Yin (2009: 13), "*…a case study is an empirical enquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomena and context are not evident*."

Moreover, a case study, as Yin (1994) suggested is more appropriate when the intent is to consider phenomena under its contextual conditions using various sources of evidence. This research relies on multiple sources of evidence from research participant experiences, and as such fits the case study design. Yin (1994) and Kern (2009) suggest that case studies could be utilised to test a theory, formulate a theory or provide a description. Thus, case study research is suitable for this study because the study is not only aimed at exploring and explaining phenomena in a real life context but also aimed at providing rich empirical descriptions of the processes of how community renewable energy is governed.

4.5 Research Population

Different groups of participants were identified as stakeholders for this study. The identification was rooted according to transition theory (see for example Miles and Hubberman, 1994), which states that transition occurs through the dynamic interaction of social and technological factors at different levels, mediated by various actions of actors (Foxon, 2013). These actors that greatly influence energy transition are identified and classified by Foxon and Pearson (2011) into three key stakeholders: policy makers (decision makers and regulatory); market (consumers, financial providers and developers); and, societal actors.

As such, representatives from the Federal Ministry of Power (FMPower), the Rural Electrification Agency (REA), the Nigerian Electricity Regulatory Commission (NERC), Energy Commission of Nigeria (ECN), Federal Ministry of Environment (FMEnvironment), research institutes, commercial developers

and community members were identified as key stakeholders in this study. A brief overview of each of these 'agents' will be discussed in turn.

Federal Ministry of Power (FMPower): The FMPower was selected because it is responsible for ensuring a robust electricity sector that fully supports the socio-economic needs of the nation. The main goals of the ministry are initiating, formulating, coordinating and implementing broad policies and programmes for the development of electricity generation from all sources of energy. FMPower is also charged with the responsibility of developing and deploying electricity-related renewable energy policies in Nigeria. Moreover, the ministry is the initiator of the transition pilot study under review. Thus, the FMPower is a key policy maker in the Nigeria electricity industry.

Federal Ministry of Environment (FMEnviroment): The FMEnviroment was established in 1999 with the statutory responsibility for coordinating all issues related to the environment (Otitoju and Diara, 2013). It is therefore charged with the responsibility of formulating and directing national policies on the protection of the environment, responding to climate change and the use of natural resources (Ley et al., 2015). The FMEnvironment also engages with the public and international organisations on behalf of the Nigerian government on issues relating to the environment such as the international climate change negotiations (Otitoju and Diara, 2013). Further, the FMEnvironment through its unit on renewable energy develops and implements strategies aimed at realising clean, reliable energy supply (Ley et al., 2014). The unit's activities, therefore, centre on three primary areas: secure, safe and reasonably priced

energy; economic growth and development; and, environmental protection (Otitoju and Diara, 2013).

Rural Electrification Agency of Nigeria (REA): The Rural Electrification Agency is an establishment of the Federal Government of Nigeria. REA was established under section 88 (I) of the Reform Act (EPSR Act. 2005) with the responsibility of mobilising capital for sustained private-sector driven investment in rural electrification. REA was chosen for this study because its core function is to promote and coordinate rural electrification projects of up to 1MW capacity in Nigeria and to implement and manage the Rural Electrification Fund.

Energy Commission of Nigeria (ECN): The Energy Commission of Nigeria was established by Act No. 62 of 1979, as amended by Act No.32 of 1988 and Act No. 19 of 1989. The commission was selected for this study because of its statutory mandate for the strategic planning, development, and coordination of national policies in the field of energy in all its ramifications. The Commission serves as a centre for the gathering and dissemination of information relating to national policy in the area of energy and advises the government on issues related to energy policy. The commission is also saddled with the responsibility of preparing, after consultation, periodic master plans for the overall development of energy in Nigeria.

Nigerian Electricity Regulatory Commission (NERC): The Nigerian Electricity Regulatory Commission was established as an independent regulatory agency in 2005 under the EPSR Act (2005). NERC formed part of

this study due to its mandate to licence, monitor and regulate the electricity industry, to ensure compliance with market rules and operating guidelines. The NERC is established with the objectives of creating an efficient industry market environment and ensuring the best utilisation of resources for the provision of electricity services. The Commission also ensures that regulation is fair and balanced for licensees, consumers, investors and other stakeholders. Moreover, the commission is mandated to set a tariff for electricity that is fair for the electricity consumers and also sufficient to allow the licensees to finance their activities and to allow for reasonable earnings in an efficient operation. NERC is expected to ensure that all stakeholders are consulted in decisions related to the electricity market.

Commercial Developers and Funding Organisation: This group of stakeholders was involved in this study based on their investment interest in renewable energy development.

Community leaders and local citizens: Communities were part of the study because of their role as host of community renewable energy projects. As the name suggests, the community formed the nucleus of the community renewable energy project. They are end-users for the off-grid community renewable energy project and therefore, determine the success or otherwise of the projects in their locality***.***

4.6 Sampling

Mason (2010) and Brannen (2012) argue that in qualitative research, one occurrence of an event is potentially as useful as many in understanding a process behind a subject matter. Mason (2010) further elaborates that

frequency is rarely important in qualitative research. This is because qualitative research is concerned with understanding or giving meaning to a phenomenon rather than making a generalisation which quantitative research focuses on (Crouch and Mckenzie, 2006). Glaser and Strauss (1967) posited that if the principle of qualitative research is to take precedence, the sample size in qualitative research must be guided by theoretical saturation.

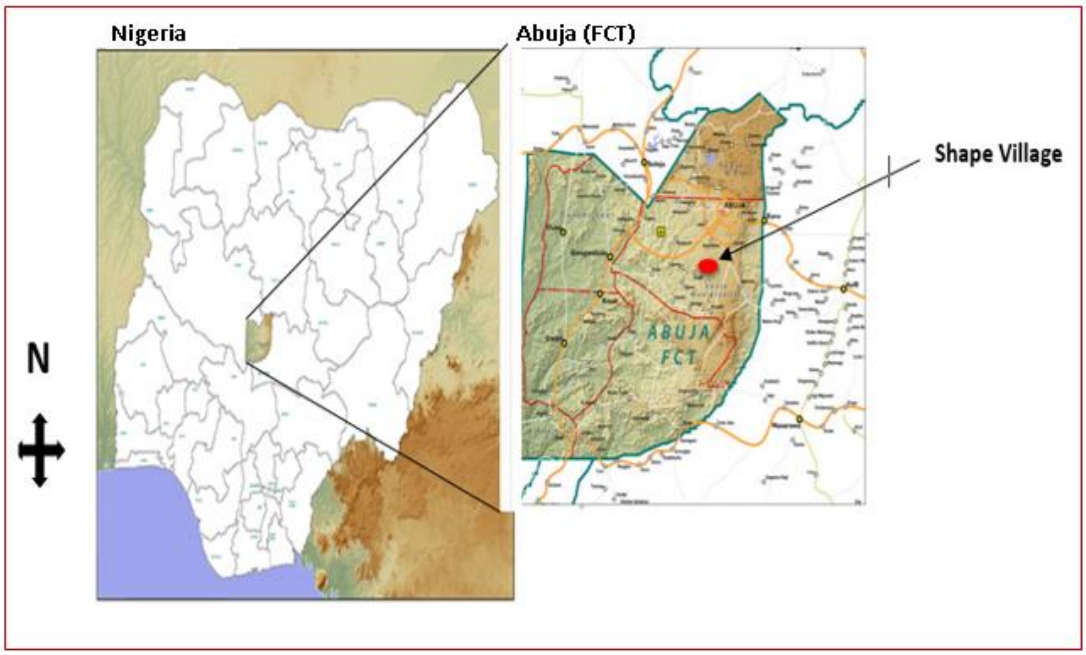
In selecting the research participants, this study employed a purposive sampling technique. The justification for choosing the technique is that it offers the researcher the greatest chance of gleaning valuable information that is capable of addressing the research questions (see for example: Marshall, 1996). Punch (2005) indicated that purposive sampling means sampling in a calculated way, with a purpose or focal point in mind. This technique was then followed by the snowballing technique in order to identify additional participants via previous interviewees. This allowed the researcher to gain access to key individuals who were not considered at the initial stages of the research.

4.7 *Shape* Community Energy Project

The *Shape* rural community is a small village located 7 kilometres away from Apo Mechanic Village located in Kabusa district of the Federal Capital Territory, Abuja (see Figure 4.1 for location). The project was commissioned by Nigeria's president in 2014 to present a paradigm shift in the area of rural electrification. The *Shape* community was one of the three village communities selected for piloting community renewable energy by the Federal Government of Nigeria (Nebo and Wakil, 2014). Local sources (RP023) estimated the population of the rural areas at 1300 with farming as their major occupation (see also NAN,

2014). The project, which has three substations strategically located within the community, transmits electricity to various houses through a mini-grid system and provides 100-kilowatt solar energy for the community (NAN, 2014). The project triggered some small and medium scale businesses such as welding, card retailing shops, barbing and hairdressing salons (Ochayi, 2015). The reason for the selection of this single case is to develop a deeper understanding of the socio-technical complexities involved in the implementation of community renewable energy project in rural areas, which may not be feasible when studying multiple cases. The *Shape* community energy project also represents a unique experience of a renewable energy mini-grid project that is still operating long after its commencement of operation.

Figure 4.1 Map showing the location of *Shape* village



Source: Adapted from www. skaa-geospatial.com (online)

4.8 Data Collection Technique

The data collection approach was two-pronged. Initially, documentary evidence related to rural electrification and community renewable energy was

critically explored through desktop (documentary research). The documentary research provided critical insights into what community renewable energy is and how it can contribute to the electrification and sustainable development of off-grid rural communities. It also provided evidence of the challenges of Nigeria's electricity sector and identified how community renewable projects could contribute to solving the challenges. Secondly, semi-structured interviews were conducted to provide critical perspectives on:

- The determinants on the community renewable energy;
- The strategy and processes involved in the planning of transition to community renewable energy in off-grid rural electrification;
- The processes involved at the implementation level of off-grid community renewable energy transition project; and,
- The barriers to community renewable energy transition in off-grid rural electrification.

The empirical study is primarily based on 24 semi-structured interviews that were conducted on a face-to-face basis. Each interview lasted one hour to one hour thirty minutes. The participants cut across the different actor groups enumerated in Section 4.5. This comprises of members of the Nigerian Energy Commission, Rural Electrification Agency, Nigerian Electricity Regulatory Commission, Federal Ministry of Power, Federal Ministry of Environment, Developers, Community members and Research organisations. The participants are mostly top executive and managerial level officials with two from the community as community leaders. Further description of the research participants is presented in Table 4.3.

Table 4.2 Summary of research participants

Research Respondents	Organisation	Type	Position
RP001	Energy Commission of Nigeria	Policy Making	Executive
RP002	Energy Commission of Nigeria	Policy Making	Managerial
RP003	Energy Commission of Nigeria	Policy Making	Managerial
RP004	Energy Commission of Nigeria	Policy Making	Managerial
RP005	Rural Electrification Agency	Government	Managerial
RP006	Rural Electrification Agency	Government	Executive
RP007	Rural Electrification Agency	Government	Managerial
RP008	Rural Electrification Agency	Government	Managerial
RP009	Renewable Energy Agency	Government	managerial
RP010	Nigerian Electricity Regulatory Commission	Regulatory	Executive
RP011	Nigerian Electricity Regulatory Commission	Regulatory	Executive
RP012	Nigerian Electricity Regulatory Commission	Regulatory	Managerial
RP013	Nigerian Electricity Regulatory Commission	Regulatory	Managerial
RP014	Federal Ministry of Power	Government	Managerial
RP015	Federal Ministry of Power	Government	Managerial
RP016	Federal Ministry of Power	Government	Managerial
RP017	Federal Ministry of Environment	Government	Executive
RP018	Private Developer	Business	Executive
RP019	Private Developer	Business	Executive
RP020	Representative of World Council on Renewable Energy	Research	Researcher
RP021	Societal actor	Community	Community leader
RP022	Societal actor	Community	Community Leader
RP023	Societal actor	Community	member
RP024	Societal actor	Community	member

Source: Author compiled

4.9 Approach to Data Analysis

Cho and Lee (2014) highlight that one strength of interpretive qualitative research is flexibility in applying inductive, deductive or a combination of both approaches for data analysis. This unique strength offers an interpretive qualitative researcher the ability to commence research either by observing specific instances and seeking to establish generalisations about the phenomenon being investigated (Collis and Hussey, 2013). Or by trying to test, confirm or modify existing theory (Gilgun 2013). The inductive approach uses

no initial conceptualisation and themes are only drawn from the data through an open coding process and their categorisation into themes (Gilgun, 2011).

Gilgun (2013) contended that it is difficult to commence research work without preconceived ideas. The deductive approach recognises this and provides guidelines for undertaking qualitative research that begins with an initial conceptualisation that can range from a small model or theory to a rather loose set of ideas (Gilgun 2013). Here codes and categories or themes are derived from prior research, literature or a relevant theoretical model (Kondracki et al., 2002, Gilgun 2013). Essentially the deductive research approach allows researchers to impose their structure or predetermined framework to analyse interview transcripts (Burnard et al., 2008; Williams et al., 2004).

According to Gale et al. (2013: 117), the only distinction between the inductive and deductive approaches lies in how themes are generated. The scholar contended that, *"[I]n the deductive approach, themes and codes are pre-selected based on previous literature, previous theories or the specifics of the research question; whereas in the inductive approach, themes are generated from the data though open (unrestricted) coding, followed by refinement of themes*."

Meheus (2004) argued that both research approaches can be applied in a single research work. Based on this argument, O'Leary (2004) suggests that both inductive and deductive research approaches to data analysis can be observed. This is by allowing both literature-informed themes as well as by allowing new themes to emerge from the data.

To achieve the research aims of this study, it developed a theoretical model that guided the study. Although the steps taken in developing a theoretical model is pertinent to the deductive research approach, initial themes and categories were allowed to emerge from both the data and the theoretical model. Moreover, research participants were given the flexibility and liberty to present their experiences and perspective on how community renewable energy is being governed in Nigeria. Thus, this research applied both inductive and deductive approaches at different stages of the research process.

4.10 Method of Analysis

In parallel with the research approaches adopted in Section 4.9, this research employed thematic analysis as the method of data analysis. Thematic analysis is a method that allows for both the inductive and deductive interpretation of transcript data (Gale et al., 2013). This is carried out by means of a systematic classification process of coding and identifying themes and categories with the aim of drawing descriptive or explanatory conclusions around the identified themes and categories (See Gale et al., 2013, Joffe and Yardley, 2004).

Although this work could also have benefited from content analysis as the method, thematic analysis was chosen for this research study because it gives greater emphasis to the qualitative aspect of the data being analysed. For instance, Joffe and Yardley (2004) observed that in content analysis, a theme might refer to the manifest, recurring or directly observable content of data. However, the authors argued that a theme may also refer to more latent themes. The thematic analysis draws on both manifest and latent themes and even where the focus is on the manifest or recurring themes, the aim of thematic analysis is to understand the latent meaning of the manifest themes

as attached to it by the research participants through interpretation (see for example: Joffe and Yardley, 2004). This investigation aims to be in-depth. Thus, understanding both manifest and latent variables is important.

Data coding was carried out in two stages. In the first stage, the researcher began the initial coding by reading a few interview transcripts line by line and in detail without any theoretical assumptions. This step allowed the researcher to familiarise himself with the data. Recurring and relevant passage or quotes were highlighted and coloured as they become worthy of attention. To become worthy of the research attention, codes could refer to substantive things (e.g. particular behaviour or incidents), values (e.g. those that inform or underpin certain statements), emotions (e.g. frustration or the like) and more impressionistic/methodological elements (e.g. interviewee found something difficult to explain, interviewee became emotional, interviewer felt uncomfortable). This step complies with the coding process suggested by Gale et al. (2013) and Saldana (2009).

Upon further reading of the transcripts, the reiterative process of aligning assigned codes to the highlighted or coloured passages continued. To check if a code was properly assigned, transcripts were compared line by line to see if previously assigned codes reflected the same concept throughout. As the process progressed, the codes became more refined, and some of the initial codes were subsumed by other codes while others were relabelled. The codes developed were subsequently grouped into categories.

In the second stage, all the transcripts were imported into a computer-aided software – Nvivo. The research repeated the same process of coding using the NVivo software. Again as the process progressed, the codes become more refined, and some of the initial codes were again subsumed by other codes while a few new codes emerged. As more passages were reviewed through this process, a conclusion was reached that no new additional code or category was forthcoming, and the final coding sheet developed (see Appendix II). This confirmed the research's point of saturation, and a full coding sheet developed reflecting the experiences of the participants involved.

The development of a coding sheet for this study was significant not only because it served as a tool for organising similar or related text which helped in the interpretation of the data, but also because it demonstrated a clear record of evidence. Having drawn together the final coding sheet, the researcher then applied it to subsequent transcripts using the NVivo software. After exhausting this process, the analysis went to the next stage, which is giving explanations to the data.

4.11 Reliability and Validity

Traditionally, the concept of reliability and validity are common in quantitative research. In recent times, qualitative researchers are being urged to pay attention to reliability and validity so as to increase the rigour of their studies. Reliability connotes the extent to which measures are consistent and free from error and also gives an exact representation of the total population that is being studied (Noble and Smith, 2015; Joppe, 2000). Even as accurate representation is not an issue of much concern in qualitative research, the consistency or repeatability of results has often been questioned. More

recently, this notion has garnered attention amongst qualitative researchers who deem it as vital as it is for quantitative research (Campbell et al., 2013; Zikmund, 2003). According to Joppe (2000), research validity in quantitative research evaluates the accuracy of measurement and the authenticity of the results.

Both concepts of reliability and validity are now being advocated in qualitative research (with some texts referring to concepts such as dependability and credibility). However, the greatest threat to realising reliability or credibility in qualitative research lies in the human centred approach to researching. It is often cited that bias is a natural feature of human cognition and memory, and this may influence the way a researcher conducts himself/herself when researching (Rolfe, 2006; Norris, 1997). For instance, either when developing research questions or during the coding and retrieving process, a researcher may be influenced by his/her pre-existing belief and knowledge (see Franklin et al., 2010). Similarly, qualitative research may be influenced by research respondents' bias such as the tendency to withhold information or give different information (Johnson, 2005).

This research acknowledges the shortcomings associated with qualitative research and tries to increase reliability and validity by staying close to the empirical data and supporting the statements of findings through quoting from the research participants' description of that which is being researched. Similarly, the research tries to improve reliability and credibility by carefully keeping a record of events and demonstrating a clear record of decisions while

at the same time ensuring that interpretations of data are transparent and consistent.

4.12 Ethical Considerations

Ethics is primarily concerned with what is right or wrong for individuals or society. The word ethics was derived from the Greek *ethos, which* means norms and values of life (Sims, 1992). Every institution, discipline or profession has certain rules and values that shape the achievement of its aims and objectives. In the academic field, ethical issues are essential and are required whenever decisions are made at any stage of the research work. For example, in the formulation of the research question, when taking samples, gaining access to data, analysing data, at the writing-up stage, publishing findings, or even when deciding on the population of the study an element of ethical issues is involved (Seale, 2004).

A researcher has a set of moral principles that guides them in their choice of how to conduct themselves during involvement with individuals and society (Bryman and Bell, 2007). A researcher must consider two main ethical responsibilities: the responsibility for the phenomenon that forms the subject of the study (human or animal) and the responsibility to conduct the research honestly and sincerely (Shah et al., 2000). Ali and Kelly (2004) stated that a researcher has the moral obligation to protect research participants from both foreseeable and unforeseeable harm. Harm can take different forms, which according to Diener and Crandal (1978) can include harm to research's participants self, self-esteem or career development.

Furthermore, it is within the realm of ethics for the researcher to protect the research participant's privacy, freedom, dignity and well-being, through good and careful research design and the informed consent of all research participants (Bryman and Bell, 2007). Informed consent also entails the consent, or right, to use data protected by the Copyright Act, the violation of which amounts to ethical misconduct (Data Protection Act, 1998).

In Nigeria, the greatest fear of research participants is the resultant harm that may arise from the disclosure of certain information such as their identity. As a result, participants may not wish to participate or share certain confidential or private information. Thus, to ensure participation, each interviewee was assured that his or her confidentiality would be guaranteed. Moreover, the researcher reassured them that the information provided would only be used for the purpose of this study and as such, their identities would not be disclosed. Likewise, the researcher observed all the requirements of privacy and copyright among others, at every stage (exploration, design, execution and reporting) of the research study and conducted himself within the constraints of ethics and standards set by the Robert Gordon University.

4.13 Summary

The explorative and explanatory nature of this investigation and related studies positioned this study within the qualitative interpretive research paradigm. In total, 24 semi-structured interviews were conducted with key stakeholders in the Nigeria electricity industry as well as actors that are involved in the development of *Shape* community project. This in addition to the analysis of important policy and associated documents. Each interview lasted one hour to

one hour and thirty minutes. The interviews were audio recorded and subsequently transcribed. In the end, the chapter explained the moral principles that guide the research process.

Having provided this overview, the next chapter presents the finding of the research.

Chapter Five

Presentation of Findings

5.1 Introduction

This chapter presents the key research findings arising from the semi-structured interviews. The semi-structured interviews generated a significant amount of rich and deep data. The presentation centres on five major themes namely: views on transition determinants; reflections on planning and decision-making process; perceptions on *Shape* community project development; views on market support and business models; and, respondent opinions on the barriers affecting the transition to community renewable energy in rural areas.

Tables are used to summarise a number of respondent accounts, perspectives or opinions, in order to provide a more rounded feel to the data. Verbatim quotations are also utilised in the main body of the text to illustrate further or provide more detailed viewpoints. For confidentiality reasons codes are used throughout.

5.2 Reflections on Transition Determinants

This section presents research respondents understanding of the factors that influence community renewable energy transition in Nigeria's rural areas. Research respondent statements are categorised under the following key themes: socio-economic and environmental developments; regime related factors; and, bottom-up developments. The purpose of this section is not aimed at comparing the views of the research respondents but rather on listing

what they see as the key drivers or determinants of community renewable energy.

5.2.1 Socio-economic and environmental developments

Respondent statements on socio-economic and environmental factors that drive community renewable energy transition are now presented as follows.

5.2.1.1 Lack of energy access and government commitment

Lack of electricity access in rural areas is one of the key reasons for the current shift to community renewables. It is interesting to note that all the respondents, at one point or another when interviewed, mentioned the lack of access to electricity as the main reason why rural electrification, via community renewables, is now being promoted by the Nigerian government. Indicative examples of the research participant views are presented in Table 5.1.

Table 5.1 Comments showing lack of energy access and government commitment as a determinant for community energy transition

Comments	Research respondent
"*So community renewable energy is embedded in the present striving to bring up energy access in rural areas.*"	Rural Electrification Agency (RP001)
"*...lack of access to electricity by the rural communities…So provision of power is the main driving force that informs the decision by the government.*"	Commercial Developer (RP018)
"*…current development of renewable energy is driven by the interest to increase electricity access by the present government.*"	FMPower (RP014)
"*… the commitment by the government to light up rural areas throughout Nigeria.*"	Local citizen (RP024)
"*…this government has seen the plight of the rural people and is now looking at solving their problem through solar energy.*"	Community leader (RP022)

Source: Interviews

5.2.1.2 Rural economic development

Respondents from the Rural Electrification Agency, Energy Commission of Nigeria and the FMPower were of the view that the current driver to promote community renewable energy is predominantly linked to recent attempts by the Nigerian government to improve economic development in rural areas. Indicative examples illustrating this view are outlined in Table 5.2.

Table 5.2 Comments showing achieving rural economic development as a determinant for community renewable energy

Comments	Research Respondent
"….the level of economic development is dependent on the amount of energy generation per population."	Rural Electrification Agency (RP006)
"…and you and I know that the federal government is trying to improve the economic situation in the rural areas. Hence, the development of community energy to achieve that objective."	Rural Electrification Agency (RP007)
"…so community energy is there to uplift the rural people… [and] *bring about economic development in the rural areas."*	FMPower (RP017)
"…the government is keen on reducing poverty in the rural areas. To do that, you need to provide them with basic electricity."	Energy Commission of Nigeria (RP004)

Source: Interviews

5.2.1.3 Realising carbon reduction and environmental protection

FMEnviroment and the Energy Commission of Nigeria state that carbon reduction and related environmental factors are also key determinants, with this illustrated in Table 5.3.

Table 5.3 Example of comments showing environmental factors as a driver for community renewable energy in Nigeria

Comments	Research respondent
"…remove emission sources…."	FMEnvironment (RP017)
"…have less environmental impact."	Energy Commission of Nigeria (RP001)
***"…** (to be) environmentally friendly."*	Rural Electrification Agency (RP006)

Source: Interviews

The following quotation from respondent RP017 of the FMEnviroment, further stressed the view of environmental factors as the basis for community renewable energy development in rural areas.

> *"So, for us, we want to ensure that we remove emission sources either from kerosene lanterns, fuel-wood or* [fossil fuel] *generators because of the black carbon and particulate matters. We want to replace them with a cleaner source of energy as a better source of electricity or energy sources for our rural areas."*
>
> RP017

In a related development, the necessity to meet international obligations are also a determinant for community renewable energy. This view is perhaps not that surprising given that Nigeria is a signatory to international agreements on climate change. For instance, research respondent RP012 said:

> *"The issue of renewable energy in Nigeria is at the forefront of policy on the diversification of energy sources….First, is that Nigeria being one of the signatories to the Kyoto protocol..."*
>
> RP012

Another research respondent RP017 shared the same view of participant RP012:

> *"Potentially by the 2017 or 2018, Nigeria could become the biggest polluter in Africa. When you have that kind of baggage and going to climate negotiation, you will definitely be in a wrong position to start.*

Hence, the development of community renewable energy as a mitigation option."

RP017

5.2.1.4 Secure energy supply

Views from FMPower and the Rural Electrification Agency indicated securing a long-term and sustainable supply of electricity as another key determinant, with Table 5.4 summarising different perspectives on this important issue.

Table 5.4 Comments suggesting achieving energy security as a determinant for community renewable energy

Comment	Research respondent
"…we want to ensure energy security by diversification."	Nigerian Electricity Regulatory Commission (RP012)
"...broaden the mix to achieve energy security."	FMPower (RP014)
"…currently we rely more on gas for our electricity production, and whenever there is pipeline disruption, the whole country will be affected."	Research Community (RP020)

Source: Interviews

Respondent RP012 further stated that:

"…although we are a country blessed with oil and gas resources, we also want to ensure energy security by diversification. [Nigeria] *has specified that it will pursue a wider and robust energy mix by including renewables in its portfolio."*

RP012

Another research respondent RP014 shared a similar view with respondent RP012 on the need for diversification to ensure energy security.

"And also to increase or broaden the mix in the energy basket to achieve energy security, because presently we use more of fossil energy; and we are blessed with all sources of renewable energy: solar; biomass; small hydro; and Wind."

RP014

5.2.1.5 Utilising naturally endowed resources

Additionally, a number of respondents were of the view that Nigeria should better utilise its renewable energy resources, with this illustrated in Table 5.5.

Table 5.5 Comments indicating the need to utilise natural resources as a determinant for community renewable energy in Nigeria

Comment	Research Respondent
"…to utilise the (renewable energy) resources we have…"	Research Community (RP020)
"…we have abundant renewable energy resources that ought to be put to use."	Local citizens (RP024)
"….because we have many renewable energy resources like solar, wind and other resources."	Rural Electrification Agency (RP006)
"…we have a very massive solar potential…"	Community leaders (RP021)
"And with the abundant energy potential in the country, the government is now interested in harnessing renewable energy."	Commercial Developer (RP018)

Source: Interviews

The following quotation further highlights the views presented in Table 5.5.

> *"The focus on the development of community renewable energy in Nigeria is to utilise the natural resources that are available within the localities. We aim to explore and utilise these natural resources with the aim of bringing economic activities that will create jobs and empower the people."*
>
> RP013

5.2.1.6 Global appeal for renewables

From another perspective, one respondent sees the trend for 'going green' as another factor influencing the drive for community renewable energy

development. According to respondent RP006, almost every nation is going green. Therefore Nigeria sees the need to also go green:

> **"***It is a world practice now with so many nations now deviating to renewable option."*
>
> RP006

RP018 shared a similar view to respondent RP006:

> *"So the government itself has realised that rural electrification using renewable energy because of its global trend is a positive aspect on its own to bring an end to the problems of power within the country."*
>
> RP018

The views of research participants RP006 and RP018 presented above indicate that Nigeria is also interested in promoting renewable energy in rural areas because of the global appeal for renewables.

5.2.1.7 Topographical reasons

In another development, some respondents believed that the scattered nature, terrain and geographical distance of some rural locations are motives for community renewable energy transition in Nigeria, with this illustrated in Table 5.6.

Table 5.6 Comments indicating the need to utilise natural resources as a determinant for community renewable energy in Nigeria

Comments	Research respondent
"Some places are not even motorable."	Nigerian Electricity Regulatory Commission (RP010)
"...due to the terrain, getting to them is an issue."	Rural Electrification Agency (RP005)
"…areas in the creeks where it is difficult to extend the grid energy sources."	Rural Electrification Agency (RP008)

Source: Interviews

The following quotation from respondent RP010 further highlights this view:

> *"Some places are not even motorable, how do you extend the grid to them? It is impossible. So off-grid community renewable energy remains the only solution."*
>
> RP010

Other respondents shared the same view:

> *"You have remote rural areas that are isolated either due to the terrain to get to them is an issue. For instance, take the case of the South-South where the creeks don't allow you to reach them; or the Central region where there are mountainous places that you cannot access them. Then there are communities up the North, desert communities, far off from the nearest grid."*
>
> RP005

Essentially, therefore, the respondent's' views presented above show that community renewable energy in Nigeria is also influenced by physical features - the scattered nature and terrain of some of the rural location that makes community-scale renewable energy the only viable option for creating energy access.

It is apparent from the respondents that different socio-economic factors influence community renewable energy transition. One key factor is the lack of access to modern energy services in rural areas. Other factors according to the respondents include: environmental concerns; meeting international obligations; security of energy supply; and geographical considerations.

5.2.2 Reflections on the current electricity regime challenge as a determinant for community renewable energy

In addition to the socio-economic and environmental developments presented in section 5.2.1, respondents also indicated that the transition to community

renewable energy is also influenced by factors from within the current system of rural electrification. These factors are presented as follows.

5.2.2.1 Inadequate capacity of the grid system

Respondents from the Rural Electrification Agency (RP009), Energy Commission of Nigeria (RP004) and Nigerian Electricity Regulatory Commission (RP010) firmly believed that the inadequate capacity of the current grid system to satisfy the growing demand for electricity is another reason for shifting to community renewable energy. This is illustrated in Table 5.7.

Table 5.7 Comments showing inadequate capacity of the present grid system as a determinant for community renewable energy in Nigeria

Comments	Research respondent
"…the fact that we don't have adequate generation power to services the present customers who are on the grid."	Nigerian Electricity Regulatory Commission (RP010)
"We have about 170 million people currently struggling with just about 4000 MW. …the current market is grossly undersupplied, and the grid has no capacity to satisfy that…"	Energy Commission of Nigeria (RP004)
"There is no need to extend the grid when the present on-the-grid customers are not adequately served."	Rural Electrification Agency (RP009)

Source: Interviews

To further highlight the views presented in Table 5.7, research participant RP010 contended that:

> *"The fact that we don't have adequate generation power to service the present customers who are on the grid, it does not make sense to go about extending the grid network again. This is to tell you that it does not augur well to go about budgeting for extending grid when you don't have the power to service those networks."*
>
> RP010

The quotation here indicates that given the fact that the current grid system does not have adequate capacity to meet existing demand for electricity, it makes little sense to extend the grid even further. As such community-scale renewable energy is possibly the best option for providing electricity in rural areas.

5.2.2.2 High cost of extending the grid

Given the fact that the majority of Nigerian people are geographically located at a distance from the existing transmission grids, some respondents (see Table 5.8) outlined that it is economically unjustifiable to continue with rural electrification using grid extension. Respondents stated that it is unattractive for any investor to extend the grid to small and remote areas because of the significant and rising investment that will be required. Some of the views depicting cost and rising investment needed for grid extension are presented in Table 5.8.

Table 5.8 Comments showing high cost of extending the grid as a determinant for community renewable energy in Nigeria

Comments	Research Respondent
"...it is too expensive…"	Commercial developer (RP018)
"…it does not make economic sense…"	Nigerian Electricity Regulatory Commission (RP012)
"…because the cost of grid extension is higher and is rising."	Rural Electrification Agency (RP008)
"…it is cheaper to electrify the rural communities with community-scale renewables."	FMPower (RP014)

Source: Interviews

The following excerpts from respondent RP012 illustrate further the views presented in Table 5.8:

> *"…some rural areas are very far from the existing grid, and it will not make economic sense for any person to extend the grid to those*

places…..Because the poles, the wire cables and the troubles that are required to take electricity to these places are huge. Moreover, when you look at the communities, what they might need is not more than few kilowatts of electricity per day."

RP012

The high cost associated with grid extension is consequently another factor that influences community renewable energy.

5.2.2.3 Unreliability of the current system

Respondent RP019 viewed that the shift to community renewable energy is necessitated by the frequent exposure to breakdown and the unpredictable nature of the centralised electricity system in Nigeria. According to this respondent, utilisation of community renewable energy in Nigeria is necessitated by the fact that the grid is no longer reliable:

"The utilisation of community renewable energy in electricity generation is necessary because of the fact that even in the urban area the grid is no longer reliable, because of the frequent power failure. You need to have alternatives sources of power to the grid system."

RP019

In summary, it is evident from the respondents that different regime-related factors are influencing community renewable energy transition. One important regime-related factor is the incapacity of the present grid system to meet the current demand for electricity. Other factors, according to the respondents, include the excessive cost of extending the grid to rural areas and the unreliable nature of the centralised grid system in Nigeria that often results in blackouts.

5.2.3 Reflections on bottom-up development as a determinant for community renewable energy

In addition to the socio-economic and environmental developments, and the challenges of the current system of electricity provision, this research also found that bottom-up developments also influence the transition to community renewable energy. The following sections present these developments.

5.2.3.1 Scale advantage

Respondents highlighted that transition to community renewable energy has also been influenced by the modular or scale advantage of renewable energy technologies, with Table 5.9 providing statements to illustrate this.

Table 5.9 Comments showing scale advantage of renewable energy as a determinant of community renewable energy

Comments	Research respondent
"…it does not require all these long transmissions."	Energy Commission of Nigeria (RP001)
"…the possibility of setting electricity generation in smaller scale…"	FMPower (RP016)
"…you can develop it even in a remote location because it is modular in nature, unlike the grid."	Renewable Energy Agency (RP007)

Source: Interviews

The views presented in Table 5.9 are further illustrated by the following quotation from respondent RP001.

> *"…renewable energy technology is modular; it does not require all these long transmission lines. You can install it in a particular place and start harnessing it. It is site specific. Besides, where you have the resources such as hydro, wind or biomass, you can easily install the technology and start to generate electricity for the locality."*
>
> RP001

It is evident from the views presented here that community renewable energy is promoted because of the scale advantages which makes it relatively more suitable for the electricity demand of rural people.

5.2.3.2 Price and performance improvement

Another reason for community renewable energy transition as stated by some of the respondents is the recent improvement in price and performance of renewable energy technologies. Table 5.10 summarises such views.

Table 5.10 Comments showing improvement in price and performance of renewable energy as a determinant of community renewable energy

Comment	Research Participants
"…you know there was a lot of research and the price of, for instance, solar panels has gone down, and the performance has increased over time."	Research community (RP020)
"If you look at the price of solar panel, it is now affordable. So, many people can now install it."	FMPower (RP015)
"…there are efficient panels now, efficient batteries…"	Energy Commission of Nigeria (RP002)

Source: Interviews

5.3 Reflections on Transition Planning and Decision-Making Processes

This section presents the respondents statements on the national planning and decision-making processes regarding community renewable energy developments. Key themes that emerged from the data include: the setting of an arena and the identification of societal problems; developing vision and objectives; strategies and pathways development; and local community and stakeholders' participation. Others include: unclear guidelines and the

responsibilities of actors; ownership and cooperative societies; as well as setting renewable energy targets.

5.3.1 Reflections on the setting up of an arena and the identification of societal problems

The initial planning step for community renewable energy transition was applauded by different respondents. For instance, the view of research participants from FMPower, FMEnvironment and Nigerian Electricity Regulatory Commission suggested that Nigeria's Ministry of Power has helped in constituting an arena known as the Inter-Ministerial Committee on Renewable Energy and Energy Efficiency (ICREEE). The committee represents the platform where various actors usually convene to deliberate on issues that relate to rural electrification and renewable energy developments in general. Table 5.11 gives illustrative examples of such opinions.

Table 5.11 Comments indicating the setting of arena and problem identification

Comment	Research Respondent
"…we already have a platform; the inter-ministerial committee offers us the opportunity to come together."	FMEnvironment (RP015)
"Yes, we have a kind of platform where we meet from time to time to deliberate on how we can go about providing energy access."	FMPower (RP016)
"…the inter-ministerial committee is the platform that brings the entire group of stakeholders to deliberate on such issues."	Nigerian Electricity Regulatory Commission (RP010)

Source: Interviews

To further illustrate the views expressed in Table 5.11, respondent RP016 contended that:

> *"We already have a platform for that…We have the inter-ministerial committee on renewable energy and energy efficiency that made up of*

stakeholders from Ministry of Power, Ministry of Environment, Ministry of Water Resources; the Energy Commission of Nigeria, Rural Electrification Agency, Nigerian Electricity Regulatory Commission and other stakeholders."

RP016

In summary, the respondents' views expressed above suggested that Ministry of Power has helped constitute a national platform where the challenges facing rural communities are identified, with possible solutions deliberated by various stakeholders. However, as it will be seen in later sections, the communities were not given any consideration.

5.3.2 Reflections on developing vision and objectives

In addition to the setting of the arena and the identification of the challenges facing rural communities, the Nigerian government through the Inter-Ministerial Committee has recognised the importance of designing a long-term vision for sustainable development of rural communities. Designing a long-term vision is imperative in the transition process because it facilitates the creation of short-term objectives. Respondents suggested that although there is no country-specific long-term vision for community renewable energy transition, various actors were involved in the discussion and adopted the UN sustainable energy for all 2030 vision. The following quotation by a respondent from the Nigerian Electricity Regulatory Commission effectively illustrates this very effectively:

"You are aware that the federal government has endorsed the United Nation's sustainable energy for all initiative by 2030. On this note, the government is working toward realising this ambition by 2030…"

RP010

Another respondent RP015 had a similar view:

> *"We have the vision to make sure that electricity reaches communities where there is no access to electricity by 2030."*
>
> RP015

The statements by respondents RP010 and RP015 clearly indicate that the sustainable energy for all by 2030 as the guiding vision for community renewable energy. To achieve the vision set, the committee has agreed to a 75 percent electrification target by 2020. A respondent from FMPower stated:

> *"…. we want to have about 75 percent of the population electrified by 2020, and we endorsed that as our point of reference."*
>
> RP012

The statements by some respondents highlight that Nigeria is working toward realising the UN's sustainable energy for all initiative by 2030 and that the Inter-ministerial committee has adopted that goal as Nigeria's vision for realising community renewable energy in rural areas.

5.3.3 Reflections on strategies and pathways development

After developing a transition vision, transition management recommends developing pathways with the aim of translating the future vision into practice. Feedback from respondents suggested that all the stakeholders have reached a consensus that electrification of rural communities should be confined to community-scale renewable energy. Table 5.12 provides examples of statements by respondents.

Table 5.12 Comments showing community renewable energy as the pathway adopted by stakeholders

Comment	Research Respondent
"…we suggested that rural electrification scheme in Nigeria should be confined to off-grid systems driven by renewable energy resources."	Nigerian Electricity Regulatory Commission (RP010)
"…we all agreed that the best way to electrify every nook and cranny of Nigeria is the communal-based renewable energy projects."	FMEnviroment (RP017)
"…it was agreed that rural electrification in Nigeria should be strictly carried out using community-scale renewable energy."	FMPower (RP014)
"...and in that context, community-scale renewable energy is the only option we have…"	Energy Commission of Nigeria (RP001)

Source: Interviews

To further illustrate the statements presented in Table 5.12, respondent RP010 stated that:

> *"I chaired the Inter-ministerial Committee, where we're able to suggest that given the fact that we do not have adequate generation to service present customers who are on the grid. …we suggested that rural electrification scheme in Nigeria should be confined to an off-grid system driven by renewable energy resources."*
>
> RP010

Respondent RP014 shared a similar view to RP010:

> *"The country is big and wide, and the cost of running transmission lines to these rural communities is high. Therefore, we all agreed that the best way to electrify every nooks and cranny of Nigeria is the off-grid communal based renewable energy projects."*
>
> RP014

While community-scale renewable energy is being recommended as the preferred pathway as revealed by respondents RP010 and RP014, respondent RP010 added that it was all agreed by stakeholders that to achieve the goals

set, the agreed pathway must encourage the participation of local communities:

> *"There is a consensus that if we want to reach to the vision 2020, we must encourage the participation of rural people in the electrification of their area."*
>
> RP010

5.3.4 Reflections on local community and stakeholders' participation

On the involvement of local communities in the transition process, one respondent from the Energy Commission of Nigeria believed local communities have an important role to play. The respondent's statement presented in the following quotation reiterated the significance of giving specific roles to the local communities:

> *"So, community involvement is the very key to any community renewable energy project. Whether it is a private, government or individual project, community needs to be part of it. They are the custodian at the end of the day, they are the beneficiary at the end of the day, and they are the people to speak to about the benefit of the project at the end of the day."*
>
> RP002

On the contrary, the views of other respondents showed no presence of local community involvement in the strategic decision-making process. A selection of some of the comments indicating the absence of local community engagement in strategic decision-making is presented in Table 5.13.

Table 5.13 Comments showing lack of community involvement in strategic decision-making process

Comment	Research respondent
"No, the local communities are not involved…"	Energy Commission of Nigeria (RP001)
"…there is no representation of local communities in the Committee."	Rural Electrification Agency (RP006)

Comment	Research respondent
"…the communities cannot be part of the Committee."	FMPower (RP016)
"I don't think the communities are represented in this type of decision-making."	Community leaders (RP022)
"They [communities] were not given any specific room for participation… there is no specific role given to them in the planning or decision making."	Research Community (RP020)

Source: Interviews

Similarly, respondent RP010 believed that state and local government are not adequately considered in the transition planning process. Some research respondents believed that the communities are closer to state and local governments and as such, there is a need for them to be involved adequately in the decisions that will affect their communities. The following statement illustrates this:

> *"…this should be done not only by the federal government; the state and local governments must also be involved because the communities are under the state and local government. Therefore, each must have a role, and each must have a contribution to make."*
>
> RP010

In summary, the statements given above provide examples of comments regarding community and stakeholders' involvement in transition planning. But state and local government and communities are clearly under-represented.

5.3.5 Reflections on guidelines and responsibilities of actors

Regarding actors responsibilities, respondents stated that there are no clear guidelines as to the responsibilities expected of key actors. Respondents from the Rural Electrification Agency and Research Community believed that there

are duplications of responsibilities as well as vague guidelines among the institutions that are promoting renewable energy. Table 5.14 summarises the comments made about unclear guidelines and the responsibilities of actors.

Table 5.14 Comments demonstrating lack of clear guideline and responsibilities of actors

Comments	Research respondent
"…one of the issues we discussed was who does what, who is in charge of what, which agency do you [as an investor] *go to, where do you get your information."*	Rural Electrification Agency (RP006)
"So there is no synchronised approach… So, the efforts and the resources being put into it are quite disjointed, and that affect the overall implementation, the result, and the outcomes."	Research Community (RP020)
"I think there has to be a defined function for the agencies so that you can hold one responsible."	Rural Electrification Agencies (RP006)

Source: Interviews

The statements depicted in Table 5.14 show a general feeling about unclear guidelines and the duplication of responsibilities among the institutional actors involved in renewable energy developments. To further clarify this issue, research respondent RP06 stated that there is a need for each organisation to have a clear function. The following quotation illustrates this very effectively:

> *"I think there has to be a defined function for the agencies so that you can hold one responsible. Every agency should be doing what it is supposed to be doing. Even when there is replication there should be synergy. So that data can be obtained which helps in planning and what can be done in future".*
>
> RP006

In summary, respondents showed the absence of clear guidelines and well-defined actor responsibilities among government agencies. The statements

make clear that most of the organisations are undertaking renewable energy activities independently without collaboration and synergy with the other key actors in the electricity industry.

5.3.6 Reflections on ownership and cooperative societies

It was identified that current community renewable energy initiatives do not promote local ownership of renewable energy in Nigeria. One research respondent from the Energy Commission of Nigeria believed that there is no programme aimed at encouraging community ownership:

> *"Currently, I do not think local ownership of renewable energy projects is very popular in Nigeria…..I believe there are not any programmes to encourage local people to own renewable energy projects."*

RP003

The following statement from research respondent RP010 reflects further on whether Nigeria is considering the possibility of promoting community renewable energy through cooperative societies. The comment suggests that efforts are underway to create a framework where cooperative societies will take the lead in developing community renewable energy:

> *"If you look at the economic viability of renewable energy to some certain extent, you hardly can get a private utility that will be involved in this kind of venture... In that context, the cooperative societies are the best institution to be used or any village level institution that you may think; and then the government can go about subsidising the capital cost, and then create a framework where all the communities will be involved in the cooperative societies."*

RP010

Another respondent, RP007 shared a similar view to RP010. This respondent believed that the recent establishment of rural electricity users' cooperative

societies by the Rural Electrification Agency in some rural communities is a step in the right direction:

> *"We at the agency have this idea to encourage rural communities to establish what we called Rural Electricity Users Cooperative Societies. The intention was to allow these cooperative societies charge electricity users certain amounts to be paid into the cooperative account, which will be used for the upkeep of projects sited in that rural area."*
>
> RP007

Conversely, when asked if cooperative societies will be involved in the ownership of community renewable energy projects, research respondent RP007 believed that this would be a difficult task to realise, given the level of income of rural people:

> *"Perhaps with time, it will be a good idea if the cooperative societies will participate in the ownership but as at now, I don't think it is possible to have rural communities own renewable energy projects. The majority of the rural people are poor, and some are even struggling to make a living. If you ask them now to own a renewable energy project probably, they will think you are out of your senses."*
>
> RP007

Respondent statements illustrate that the government recognises the importance of cooperative societies in promoting community renewable energy and has engaged in creating rural electricity users' cooperative societies in some rural areas. The aim of the cooperative societies is to participate in the collection and maintenance of projects sited in their locality. However, respondents were pessimistic as to whether these cooperative societies could afford to own renewable energy projects without significant subsidies.

5.3.7 Reflections on renewable energy target.

Experience has shown that successful transitions require targets to be set. Respondent RP011 reiterated that Nigeria had set a very ambitious goal for renewable energy:

> *"We have a very ambitious target for renewable energy. The requirement is 10 percent of renewable energy mix by 2020."*
>
> RP011

5.4 Reflections on *Shape* Community project development

The transition project provides the context within which transition pathway(s) can be piloted to trigger learning and stimulate the process of co-evolution of technology and practice. The following sections present respondent understandings of the implementation of the project under review. The key themes discussed in this section include: project objectives; project design; community involvement; stakeholder participation; and, monitoring as well as the learning outcomes.

5.4.1 Reflections on project objectives

Respondents from FMPower viewed the pilot project as a transition experiment that aims to instigate social learning required for the transition to happen. The respondents believed that the project was developed to put into practice the initiatives of the Inter-ministerial Committee. Table 5.15 illustrates a summary of the statements expressed by the respondents.

Table 5.15 Comments the objectives of the *Shape* community renewable energy project

Comment	Research respondent
"Having drafted the policy on renewable energy and energy efficiency, the Ministry of power was recommended to carry out some pilot schemes on an off-grid basis. The	FMPower (RP014)

Ministry decided to conduct three pilot projects. Shape [project] *is one of these projects."*	
"The pilot project was unveiled to test run the federal government initiative of rural areas electrification using renewable energy."	FMPower (RP015)
"When we drafted the feasibility study of the operation light up rural Nigeria using renewable energy, it was agreed that we have to start from somewhere. So, based on the favourable solar radiation in the area, the Shape project was carried out."	FMPower (RP016)

Source: Interviews

The following statement from the Energy Commission of Nigeria illustrates the points contained above further:

> *"One is to create awareness for the people there to know that this technology is feasible; and … to demonstrate to the people and governments that renewable technologies are feasible so that they can invest. It was also unveiled to demonstrate to the business minds so that they can also invest. These are the things that informed the development of the Shape project."*
>
> RP001

A pattern emerges from the respondents that the *Shape* community renewable energy project was unveiled to test the pathway adopted by the Inter-ministerial Committee. The aim being: to demonstrate the feasibility of community renewable energy to investors, government and the public.

5.4.2 Reflections on stakeholder participation

A stable network of front-runners and powerful actors who precisely represent the required tide capable of supporting the development of both learning by doing and learning by interacting is necessary for a transition project to succeed. This is because no single actor unilaterally has the power or resources

to produce a transition. Respondents from the Nigerian Electricity Regulatory Commission (RP010), Energy Commission of Nigeria (RP001), Commercial developers (RP018) and Rural Electrification Agency (RP008) firmly state that most actors were not involved in the *Shape* off-grid community renewable energy project. Table 5.16 present respondent statements.

Table 5.16 Comments demonstrating lack of stakeholders involvement in *Shape* community project development

Comment	Research respondent
"…we do not know about this project until when it is about to be commissioned by the President."	Nigerian Electricity Regulatory Commission (RP010)
"Not all of them [actors] were involved, in fact, the way they do things in this country, even the Energy Commission of Nigeria that is the policy maker of the government, were not informed, we only heard about it."	Energy Commission of Nigeria (RP001)
"As of now, I believe the private sectors are missing."	Private developer (RP018)
"…this is our core mandate, and that means we ought to be involved. Besides, we have a unique strength and experience in that regard."	Rural Electrification Agency (RP008)

Source: Interviews

The statements presented in Table 5.17 are further illustrated by the following quotation from research respondent RP001:

> *"Not all of them* [actors] *were involved, in fact, the way they do things in this country, even the Energy Commission of Nigeria that is the policy maker of the government, were not informed, we only heard by about it…... Not every stakeholder was carried along."*
>
> RP001

In summary, it is apparent from the respondents that FMPower executed the *Shape* project without the participation of key actors. However, most respondents believed it is important that all stakeholders be consulted and

supported to enable them to learn and bring their experiences to bear on the project.

5.4.3 Reflections on community involvement

Respondent statements regarding local community participation in the *Shape* project showed that local community members were involved in different aspects and stages of project development. The following quotation from research participant RP018 (a commercial developer) believed the *Shape* local community was adequately consulted before the start of the projects:

> *"…before we started the project…..we had a series of meetings with them. The first thing we did was we called on the community leader to help us in recruiting technicians, welders, cement mixers and casters from the community. We recruited security personnel for the equipment from the community. We trained technicians on how to install the equipment."*
>
> RP018

The statement expressed in the above quotation can be corroborated by research respondent RP022 (a community leader):

> *"…we had a series of meetings with them* [developers]*...They informed us about the intention of the Federal Government to carry out this* [*Shape*] *project….Also, two people from the village were trained to provide security cover to the project."*
>
> RP022

These respondents indicate that adequate consultation with the local community was made prior to the commencement of the project. The consultation centred on informing the community of the project and in seeking security protection for the project. There is no evidence to suggest that the community was involved in the implementation decision.

5.4.4 Reflections on commercial viability of the project

On the commercial sustainability of the *Shape* community project, the view of research respondent RP018 shows that the *Shape* project has not met the technical requirement of a commercial project. According to this respondent, the project has no electricity meters through which consumer usage can be determined and charged. This respondent believed that no one would be attracted to invest in such a project because there is little way of ensuring one could recoup the investment. The following statement from participant RP018 confirms this:

> *"… but things like this are usually government led, but we need to think of a model that will generate revenue for whoever invested his money. That is the missing element of the Shape project….There is no much of thinking on the part of the return on investment for any investor that is coming in to invest."*
>
> RP018

Similarly, research respondent RP015 corroborates the view of RP018 regarding the commercial viability of the *Shape* community project:

> *"The one we did in Shape, the community are not paying any charge…."*
>
> RP015

In contrast, the views of research respondent RP010 condemned, in strong terms, the present arrangement that allows the beneficiaries of the community project to receive electricity free. This respondent believed it is difficult to sustain a project of this kind:

> *"It is not going to be sustainable because a lot of public infrastructures that were done in that kind of framework had all failed. …if they*

> [government] *think they want to give out project graciously; I think it does not augur well for the system."*
>
> RP010

Another respondent from Nigerian Electricity Regulatory Commission shared a similar view:

> *"Of course, we have privatised the industry, and if we are to integrate that system with existing ones, no customer should take energy free. Whether they were metered or not, they should pay for the electricity they consumed. That is the only way we can sustain the industry."*
>
> RP011

The statements provided by these respondents clearly indicate that the *Shape* project does not incorporate a commercial framework into the design of the project. Presently the project has been developed and implemented without any mechanism through which electricity usage can be measured, and appropriate charges determined.

5.4.5 Reflections on monitoring and communication

Continuous monitoring is a vital part of the search and learning process of transitions. Monitoring in transition management is not only required at the strategic level but also at the piloting or experimentation stage of the transition process. Respondents elicited varied responses on the monitoring and evaluation of the pilot scheme under review. The following statement makes clear that there have been efforts made:

> *"We monitor the system to see how it is working, and we try to sensitise the people."*
>
> RP015

In contrast, respondent RP006 expressed doubt about the efforts being made to monitor the *Shape* project. The following statement illustrates this:

> *"…it would have been wise if there is deliberate effort to be logging information from the site. So that you will be able to assess the performance, the maintenance, the weakness of the system; whether there is a reason to increase the capacity, whether there is a reason for reorientation of the people, the usage and so on. But, right now I don't think this is the case."*
>
> RP006

Regarding monitoring and communicating the outcomes of the *Shape* project, respondent RP020 states that insufficient effort has been made by the actors in charge of the project to share the lessons learnt from the *Shape* project:

> *"The information is not easily accessible. When you go to the website of these organisations, some of them are not interactive neither are they engaging. So you need to make an extra effort… There has always been an information gap even on how success stories are being passed out. I am not satisfied because you have to go an extra mile to get some of this information."*
>
> RP020

In summary, respondents indicate that several efforts have been made by the project developer to monitor the outcome of the transition project. A participant believed that the current challenge of the project is that the people in the rural community do not comply with the limitations regarding the appliances they can use on the installation. However, some respondents believed information on the project is not accessible. The respondents also believed that there is a lacuna in how information or the success of a project is being passed on.

5.4.6 Reflections on Learning Outcomes

As stated in Section 4.5.4, learning consists of gaining understanding about how to do things better within the context of established goals and assumptions. Respondents expressed different learning outcomes, with these being presented in Table 5.17.

Table 5.17 Comments showing the first-order learning outcome from the implementation of *Shape* project

Comment	Research respondent
"*We have learnt that subsequent projects should be of higher capacity because Shape's capacity is very low.*"	Commercial developer (RP019)
"*…we have learnt that we need to put a secondary check, by putting limiters or breakers, which will improve the system's safety.*"	FMPower (RP014)
"*…but as time goes on, they are going to design a metering system that will check the amount of energy an individual used. From there the people could start to pay…*"	FMPower (RP015)

Source: Interviews

Even as the views presented in Table 5.17 could be regarded as first-order learning, this type of learning alone cannot contribute to regime change. Therefore, it must be complemented by second-order learning to be able to effect changes to the dominant set of configurations. Nonetheless, other respondents generated several second order learning outcomes, as presented in Table 5.18.

Table 5.18 Comments demonstrating second-order learning from the *Shape* project

Comment	Research respondent
"*…we have also learnt that we need to educate the people on energy efficiency and conservation. We need to tell them that they need to switch off the lights when not in use.*"	FMPower (RP015)

"And if you are going to up-scale, this project has shown or teaches the people the importance of energy management."	Commercial developer (RP018)

Source: Interviews

The following statement from research respondent RP014 points out the lessons learnt from the *Shape* community renewable energy project:

> *"…because if not for the experience from the pilot project, the Ministry wouldn't have been able to see the sustainability part of it.…"*
>
> RP014

In summary, it is clear that the *Shape* project has instigated both first and second order learnings. For example, project developers have learnt the need to incorporate metering into the design of community projects. The project also highlights the need to educate local communities on energy conservation and efficiency, and it has been shown that there is a need to get other actors, such as the private sector, involved in the implementation of socio-technical projects.

5.5 Reflections on Market Supports and Business Models

Market supports are considered essential in sustainability transitions because when left to the socio-technical regime, socio-technical innovation faces some selective pressures from the mainstream structure and may be eliminated prematurely. Similarly, new technologies require new rules and approaches and new business support models because the new paradigm envisaged may not be facilitated using the existing business structures. This section presents respondents comments on the availability and effectiveness of market support instruments as well as the steps taken to establish new business models for the facilitation of community renewable energy.

5.5.1 Reflections on financial incentives

Financial incentives or instruments are those that support particular behaviours or actions. Supportive instruments such as green funds and soft loans may be justified as financial incentives for mobilising additional resources for socio-technical innovations. Research respondents from the Renewable Energy Agency (RP005), Nigerian Electricity Regulatory Commission (RP011) and Energy Commission of Nigeria (RP001 and RP002) stated that there is a wide range of financial incentives provided by both public and private organisations to support rural electrification using renewable energy. Table 5.19 presents some of the statements generated.

Table 5.19 Comments demonstrating the availability of public and private financial incentives

Comments	Research respondents
"In doing that a fund called the Rural Electrification Fund (REF) established by the Act and states that the fund will be used to partner with private sector, communities, state government…"	Rural Electrification Agency (RP005)
"The REF has a huge fund… and that is enough support... It is a revolving fund and with a very low-interest rate, almost interest-free."	Nigerian Electricity Regulatory Commission (RP011)
"…there are some financial institutions that are interested in such types of a project like Bank of Industry, UNDP and some commercial banks such as the Access Bank, Eco Bank and so on."	Energy Commission of Nigeria (RP001)
"…there is government intervention through the Bank of Industry (BOI) on renewable energy... Besides the World Bank is pushing money to the power sector and part of the money is going to be set aside for renewable energy."	Energy Commission of Nigeria (RP002)

Source: Interviews

The views presented in Table 5.19 show the availability of both public and private support for community renewable energy. Nevertheless, the opinions

of research respondents from the Nigerian Electricity Regulatory Commission (RP011), and the Rural Electrification Agency (RP005 and RP007) indicate the inadequacy and lack of effective implementation of public financial support. Table 5.20 summarises some of the statements provided.

Table 5.20 Comments demonstrating inadequacy and ineffectiveness of financial incentives

Comment	Research respondent
"If we said, we are going to establish one off-grid solar project per local government that will translate into billions of Naira. So the fund is not enough."	Rural Electrification Agency (RP005)
"I do not know the state of implementation of that fund. Whether it effectively being utilised. I sometimes know they had some issues that it was almost closed down…"	Nigerian Electricity Regulatory Commission (RP011)
"You cannot tell somebody that you have allocated or budgeted money for rural electrification and then diverted that money for something else."	Rural Electrification Agency (RP007)

Source: Interviews

In summary, some respondents believe that there are available funds for supporting community renewable energy. However, other respondents believe the allocation to the REF fund is insufficient to support wide scale deployment of renewable energy in Nigeria. Similarly, some of the respondents expressed doubt as to the effective implementation of the fund. Because of diversion of cash away from the fund to be used for other purposes other than what the fund was initially meant to achieve. Other financial incentives revealed include loan facilities being provided by commercial and development banks. On whether community renewable energy investors can effectively access this facility, one respondent (RP001) believed as long as the project is bankable

with proven technologies the facility can be obtained by anyone promoting renewable energy development.

5.5.2 Reflections on regulatory and fiscal incentives

In addition to financial incentive, respondents provided statements on various regulatory-based incentives that have been set up to accelerate the deployment of renewable energy in general. For instance, statements provided by the Nigerian Electricity Regulatory Commission (RP010 and RP013) indicate the availability of regulatory incentives in the form of a feed-in tariff. See Table 5.21.

Table 5.21 Comments demonstrating the availability of regulative and fiscal incentives for community renewable energy

Comment	Research respondent
"…we have worked out the feed in tariff for the time being, which we think is the most relevant tool that will be used to introduce renewable energy in Nigeria."	Nigerian Electricity Regulatory Commission (RP010)
"…this Commission is encouraging the development of renewable energy through several means. We have developed the regulatory framework, and we also have the feed-in tariff on the ground now."	Nigerian Electricity Regulatory Commission (RP013)
"….we have the feed-in tariff that in a way incentivise renewable energy."	FMPower (RP016)

Source: Interviews

From the same perspective, one respondent outlined the availability of tax exemption being provided to support community renewable energy transition. In addition to a tax holiday, the respondent also stated that the government has also made it duty-free for renewable energy technology components that are imported into the country:

"Presently the government is trying because there is a tax holiday and is duty-free for renewable energy components that are coming into the country."

RP014

Although the statements presented in Table 5.24 and in the above quotation show the availability of feed in tariff and further tax exemptions, one of the respondents stated that none of the incentives is currently operational:

"I am yet to see the feed-in tariff or tax incentives for investors going into renewable energy operating in Nigeria…. we do not have anything fully operational..."

RP018

Another respondent from the research community shared a similar view:

"I know, and I was privy when NERC called for the consultancy to set up the feed-in tariff system. It was four years now, but we do not have anything fully operational from that up to now."

RP020

In summary, it was found that a feed-in tariff is the major regulatory-based incentive operating in Nigeria. In addition to the feed-in tariff, community renewable energy is also supported by tax exemptions provided to ease the importation of renewable energy equipment. However, some respondents highlighted that both the feed-in tariff and tax incentives have not been effectively implemented. So, there is a clear gap between what is said and what is on the ground.

5.5.3 Reflections on business models

Business models are the means and processes by which individuals and firms organise their activities to fulfil their economic objectives. It is considered essential for driving a socio-technical transition. Respondents outlined different

business model arrangements for various engagements envisaged for community renewable energy in rural areas. The following statement from research respondent RP011 signifies that some regulatory business models that have been put in place to support the development of community-scale renewable energy:

> *"There are several* [regulatory] *models. I can tell you we have several models for all type of community engagement be it off-grid or on-grid system."*
>
> RP011

A business ownership style that encourages a communal stake is regarded as being important in community renewable energy deployment and has been instrumental in the success of community renewable energy in many places including Denmark. Respondents were asked whether a cooperative business model might be adopted as a vehicle for community renewable energy in Nigeria. The respondents indicated that the Rural Electrification Agency has already helped some communities to set-up cooperative societies. The cooperatives are to undertake collections and maintenance of the community renewable energy project sited in their localities

> *"…we have gone ahead to form about 315 Rural REUCS within communities where we are providing power, be it grid extension or renewable… The main aim is to ensure that they are responsible for any installations in their environment, and for carrying out some small maintenance…"*
>
> RP006

Regarding the appropriateness of the cooperatives as a model for the development of community renewable energy, research respondent RP007 believed that it was the most suitable means to electrify rural communities.

However, given the economic state of most rural areas in Nigeria, it would currently be difficult to realise this:

> *"… it will be a good idea if the cooperative societies will participate in the ownership but as at now I don't think is possible to have rural communities owning renewable energy project…. However, like I earlier said the intention to create electricity users cooperative societies in the rural areas is a right step in the right direction."*
>
> RP007

Another research respondent shared a similar view to research participant RP007. This respondent showed that lack of awareness among communities as well as a lack of policies similar to what is obtainable in other successful countries is one of the key issues that may affect the implementation of a cooperative style model. He said:

> *"To be honest, I do not see that coming to Nigeria anytime soon because of the lack of knowledge, lack of awareness, lack of policies that encourage this* [idea]. *We do not have that and government policies are not encouraging it."*
>
> RP018

Respondent RP007 states that the government has to put in more subsidies for the capital cost of renewable energy investment in order to allow cooperatives to partake in the community renewable energy transition:

> *"The government needs to subsidise the capital of renewable energy projects in the meantime to allow or enable the communities or the cooperatives to own* [renewable energy] *projects."*
>
> RP007

In summary, respondents revealed several perspectives on viable business models and their appropriateness for community renewable energy development in rural areas. Some of the participants believed that Nigeria has already developed several regulatory frameworks for different kinds of community renewable energy businesses. This has included cooperative societies. However, the respondents believed that without subsidies for the capital cost of renewable energy technologies, these cooperatives would be incapable of engaging in the ownership of community renewable energy.

5.6 Reflections on Transition Barriers

Barriers may affect and threaten transition at any stage of the transition process: pre-development, take-off, acceleration and stabilisation phases. This section explores the different barriers affecting the smooth transition to community renewable energy. Respondents indicated several challenges and these are classified as: actor interaction; institution; infrastructural; and socio-political problems.

5.6.1 Reflections on actors related problems

Actor problems are barriers that result from the incapacity or incapability of actors or agents of change to perform. Respondents suggested different actor related factors posing as barriers to the successful transition to community renewable energy. The following sections present these barriers.

5.6.1.1 Economic capacity of the local communities

The statements across the range of participants suggested that despite the willingness of rural communities to pay for electricity services, the majority are poor and unable to do so. Table 5.22 presents respondents' comments on the

lack of economic capacity of rural communities to patronise community renewable energy.

Table 5.22 Comments demonstrating the inability of individuals to pay for electricity services as a barrier to community renewable energy

Comment	Research respondent
"*They* [communities] *may have the willingness to pay, but they may not have the ability to pay."*	Rural Electrification Agency (RP005)
"...these are people that can barely feed themselves. So how are you going to get your return on investment? This is the key barrier right now."	FMEnviroment (RP017)
"…but the biggest challenge is how the communities can pay for the electricity bills…"	Community leader (RP021)
"*…unless the government subsidies the tariff to the rural consumer, they can't afford to pay…*"	Rural Electrification Agency
"*…one is the ability of the community to able to pay for the services,"*	Energy Commission of Nigeria (RP003)

Source: Interviews

While the statements presented in Table 5.22 indicate the lack of capacity of the users to pay for electricity services as a barrier, Table 5.23 also presents respondent statements highlighting the inability to finance renewable energy projects.

Table 5.23 Comments showing inadequate capacity of the local communities to raise fund as a barrier to community renewable energy

Comment	Research respondent
"It is difficult for communities to raise the funds required for renewable energy projects."	Nigerian Electricity Regulatory Commission (RP012)
"…the people are likely not going to be able to raise enough funds…"	Community Leaders (RP022)
"When you mentioned the cost of renewable energy technologies many	Energy Commission of Nigeria (RP001)

people jump, complaining that it is too expensive, and they cannot afford it."	
"…*they* [communities] *cannot raise the capital required for this type of investment."*	Nigerian Electricity Regulatory Commission (RP013)

Source: Interviews

In summary, the statements presented show that one of the key barriers inhibiting the successful transition to community energy is the difficulty in raising funds required for projects. And further in some cases, local people may not even have the ability to pay for electricity services.

5.6.1.2 Lack of awareness

In addition, to the lack of financial capacity to engage in community renewable energy projects, respondents also stated that lack of awareness and information as another major actor related challenge affecting the possible shift to community renewable energy. Table 5.24 summarises some of these views.

Table 5.24 Comments demonstrating lack of awareness as a barrier to community renewable energy

Comment	Research respondent
"…many of them [rural people] are not even aware of what renewable energy is all about. So the lack of awareness is there…"	Energy Commission of Nigeria (RP001)
"And because they are more familiar with the grid system, they will begin to think could this be one of those white elephant projects."	Rural Electrification Agency (RP006)
"…the lack of information."	Local citizens (RP023)
"…the problem we have now is the low level of community awareness."	Energy Commission of Nigeria (RP004)
"…the people do not know the importance of such activities, and because they do not know, they may resist whoever is coming in to establish a renewable energy project."	Nigerian Electricity Regulatory Commission (RP013)

Source: Interviews

It is interesting to note that lack of awareness affects not only local people but also other key actors in the Nigerian electricity industry. For instance, in the following statement from respondent RP022 states that there is no adequate information. The impact has been to raise questions and reservations amongst key actors:

> *"The problem is the fear, with many of the banks not even convinced about the reliability of renewable energy. There is no adequate information and that is why they are afraid of putting in their money."*
>
> RP001

To sum up, the participants believed that lack of awareness is a major barrier to the successful transition to community renewable energy in rural areas. Lack of awareness affects not only local communities but also other parties such as the investment community that is required for the transition to renewable energy.

5.6.1.3 Lack of required skills

The skill required for the development and use of technology is vital in promoting socio-technical transition. Respondents from the Energy Commission of Nigeria, FMPower, and the Nigeria Electricity Commission believed that the lack of people with the required skills to operate renewable energy installations in rural areas is a significant challenge. Table 5.25 presents a summary of the statements in this area.

Table 5.25 Comments showing lack of required skills as a barrier for community renewable energy

Comment	Research respondent
"…locally there is not enough expertise….required to develop and maintain them."	FMPower (RP012)

"…other problem may be technical, in terms of getting the experts who will be able to operate the installations…"	Energy Commission of Nigeria (RP003)
"…in most cases, you discovered that the communities lack the capacity."	Energy Commission of Nigeria (RP004)
"…they need to have the required capacity to be able to maintain it for sustainability."	Rural Electrification Agency (RP007)

Source: Interviews

The following statement from research respondent RP003 further highlights the views presented in Table 5.26:

> *"The key barriers are in the area of the required capacity to be able to ensure community renewable energy is being sustained. Besides, it has been a serious challenge because quite often when you go around some of the communities where renewable energy projects were executed some years back, you will discover that they were not maintained because of the lack of capacity."*
>
> RP003

In summary, it is evident from the perspective of the respondents that the lack of capacity of local individuals to pay for electricity services or participate in funding community renewable energy projects constitutes a major actor related barrier to community renewable energy transition. Other barriers include the lack of awareness and information amongst the actors involved in the transition process.

5.6.2 Reflections on institution related barriers

Institutional barriers may result from incapacity or weak institutional settings which favour incumbent actors and hinder the new system from transforming, for instance, by not sufficiently supporting emerging innovations. Respondents elicited several institutional challenges affecting the possible shift to community renewable energy.

5.6.2.1 Overlapping functions and unclear responsibility

Respondents from the Rural Electrification Agency indicated the overlapping of roles amongst government agencies and institutions as well as the unclear responsibilities in the industry as one of the institutional barriers affecting community renewable energy transition. For instance, respondent RP006 stated that the absence of clear guidelines and responsibilities of government agencies resulted in difficulties for investors or those interested in promoting renewable energy. Table 5.26 summarises the comments indicating the overlapping of functions among public institutions as a barrier to community renewable energy transition.

Table 5.26 Comments showing overlapping of functions among government institutions as a barrier for community renewable energy

Comment	Research respondent
"…there is still a lot of confusion…"	Nigerian Electricity Regulatory Commission (RP013)
"…we have duplications in the power sector."	Rural Electrification Agency (RP007)
"…you don't know who is in charge of what."	Research community (RP020)
"…it is our mandate, but the Ministry went ahead to develop the project."	Rural Electrification Agency (RP007

Source: Interviews

The following quotation from respondent RP006 of the Rural Electrification Agency further illustrates the views presented in Table 5.26:

> *"…the major problem is that there is still a lot of confusion as to where investors and developers should specifically approach; because so many agencies are carrying out renewable energy activities simultaneously. Who does what, who is in charge of what, which agency do you [as an investor] go to, where do you get your information."*
>
> RP006

Respondent RP007 voiced a similar view:

> *"… but, we have duplications in the power sector. When investors want to invest in Nigeria, they often find it difficult to know whom they should approach."*
>
> RP007

The views presented here show a lack of clear demarcation of responsibilities among the government agencies that are actually promoting renewable energy.

5.6.2.2 Lack of clear guidelines on the privatisation

Another respondent, this time from the Nigerian Electricity Regulatory Commission, believed that the lack of clear guidelines as to the position of community–scale energy systems when the national grid eventually reaches the rural community is also another issue of concern for the development of community renewable energy. This is more so because, under the current arrangement, only the existing DISCOs were granted the right to the distribution and sale of electricity within their area of jurisdiction including rural locations that were located in that jurisdiction. For instance, respondent RP010 stated:

> *"What will happen to those mini-grid systems, who own the assets? We need to have a framework that will categorically say what will happen to those assets when the grid eventually reaches the rural areas. I think this is one of the issues we need to resolve."*
>
> RP010

This statement provided by respondent RP010 indicates that this could be inhibited by the lack of clear guidelines.

5.6.2.3 Weak effort in capacity building

Inability to create institutional capacity on renewable energy was also seen by respondent RP006 as another institutional barrier to the current effort to develop community renewable energy in rural areas. According to the interviewee, this is capable of slowing down the effort of making renewable energy possible in rural areas. RP006 states:

> *"….lack of capacity building in that field is reducing the aggressiveness in pushing off-grid renewable energy in rural areas electrification."*
>
> RP006

The statement presented here demonstrates a lack of capacity building in the field of renewable energy as another barrier that may inhibit the successful transition to community renewable energy in rural areas.

5.6.2.4 Weak quality controls mechanism

Weak effort in controlling the proliferation of substandard renewable energy equipment is also perceived as another institutional barrier inhibiting the smooth transition to community renewable energy in rural areas in Nigeria. Perceptions across the range of the research respondents showed that there is no serious effort to tackle the rise of substandard renewable technologies. Table 5.27 presents some of the statements provided by respondents.

Table 5.27 Comments showing weak quality control mechanism as a barrier to community renewable energy

Comments	Research respondent
"…because of corruption you find substandard systems finding their way into the country."	Commercial developers (RP018)
"If contractors will be honest to themselves regarding quality."	FMPower (RP015)

"…once substandard components are getting their way into the country, the people will continue to feel that renewable energies do not work."	Research community (RP020)
"…the market is saturated with inferior technologies, and that is another issue of concern."	Community member (RP022)
"…we have not seen any concrete action to stop substandard materials from coming into the country."	Nigerian Electricity Regulatory Commission (RP013)

Source: Interviews

The following statement from research respondent RP020 further highlights the views presented in Table 5.27:

> **"***But you see another challenge we have in Nigeria is the proliferation of substandard renewable energy equipment, for instance, solar panels. People already had doubts, and if the feedbacks of those who already used it, is not encouraging, the other individuals; who are waiting in the wings, will get totally discouraged."*
>
> RP020

In summary, research outcomes indicate several institutional barriers affecting the transition to community renewable energy in electrifying rural communities in Nigeria. These barriers as viewed by research respondents include the overlapping of functions amongst government institutions as well as the unclear guidelines in the electricity industry. Others include weak efforts in building institutional capacity as well as weak quality control mechanisms.

5.6.3 Reflections on interaction related barriers

Interaction barriers emanate from inertia or network problems that subject the interaction of actors promoting the development of socio-technical innovation to challenges. The following sections give the research participants' views on the interaction related barriers.

5.6.3.1 Non-engagement of actors

One of the obstacles about interactions raised by research respondent RP011 is the issue of the non-engagement of relevant stakeholders such as local and state government participation in the transition planning and implementation processes. According to the research participant, the States and local governments are closer to the rural people than the national government. Therefore, their engagement is crucial for the development of any project affecting rural communities. The following statement from respondent RP011 illustrates this:

> *"…stakeholders such the state and local government are crucial. If they don't understand why they should participate, there would be a problem."*
>
> RP011

Similarly, research participant RP018 believed the investment communities are not given the necessary consideration in the transition process:

> *"…what is lacking is the participation of the private investors …and that is a major issue of concern."*
>
> RP018

The statements presented here illustrate the need for the involvement of actors such as local and state government as well as private investors in the transition planning and implementation process. The limited involvement of these actors may adversely affect the speed of the transition process.

5.6.3.2 Political interference

Respondent RP006 believe that interference with the rural electrification programmes by politicians is also reducing the rate of community renewable energy deployments in remote areas. The respondents showed that even

where indicators favour community renewable energy, the Rural Electrification Agency is often compelled to carry rural electrification through grid extension:

> *"…our activities are initiated by the National Assembly members. They say this is what they want for their constituencies. So when they put this in the budget, we are bound to go and capture what they want exactly."*
>
> RP006

It is evident that from the statement presented above that interference with the activities of government agencies affects the rate at which community renewable energy development can be carried out in rural areas.

5.6.3.3 Lack of political commitment

Similarly, respondent RP007 stated that the lack of commitment by political office holders could act as a barrier. The following statement illustrates this in the context of this particular study:

> *"…both government and those handling rural electrification must be sincere in their dealings. You cannot tell somebody that you have allocated or budgeted money for rural electrification and then diverted that money for something else."*
>
> RP007

Respondent RP011 shared a similar view:

> *"….if the policy maker can remove sentiment and selfishness and face rural electrification policies seriously, we can achieve that. For instance, I know the ministry has been doing a lot to develop small hydro potentials, but for more than three years now, they are talking about feasibility studies."*
>
> RP011

In summary, the research respondents revealed the lack of effective engagement of actors, including the local and state government, in the transition processes as a major interaction barrier affecting the smooth transition to community renewable energy. Other interaction barriers as

revealed by the research respondents include interference with the activities of the rural electrification development agencies by politicians as well as the lack of political commitment in carrying out rural electrification programmes.

5.6.4 Reflections on infrastructure barriers

As was noted in Chapter 3, infrastructural barriers are challenges that result from insufficient or weak information, financial or physical infrastructure. In this regard, respondents depict several infrastructural barriers inhibiting the possible transition to community renewable energy.

5.6.4.1 Inadequate data for planning

Successful planning depends on the presence of adequate data. A respondent from the Nigeria Electricity Commission believed the lack of data for planning purposes is also a central barrier inhibiting the transition to renewable energy in Nigeria. He states:

> *At a certain time, I asked the REA if they have all the un-electrified communities or the mapping of the renewable resources in Nigeria. They do not have this data and when this data is not there how do you go about achieving the rural electrification target."*
>
> RP010

5.6.4.2 Deficient national quality standards

Commercial developer respondents, the Energy Commission of Nigeria and local people revealed the lack of appropriate policies regulating the quality of renewable energy equipment imported into the country. The statements outlining deficient national quality standards are presented in Table 5.28.

Table 5.28 Comments showing deficient national quality standards as a barrier to community renewable energy

Comment	Research respondent
"…we are also supposed to have regulations for the renewable energy sector. For instance, we are expected to have a minimum standard for the kind of batteries that we import into the country."	Commercial developers (RP018)
"…policy should specify the minimum quality standard of renewable materials... But then, we do not have that."	Rural Electrification Agency (RP008)
"…if the government can set the standards for renewable technologies; then we will go a long way…"	Local citizens (RP024)

Source: Interviews

The statements presented in Table 5.28 are further highlighted by respondent RP018:

> *"The Standard Organisation of Nigeria (SON) should ensure that each equipment that enters the country has the required quality standard. The policy should specify the minimum quality standard of renewable materials that will be imported into the country, and there should be policy to regulate it."*
>
> RP018

5.6.4.3 Low electricity tariff and lack of subsidy

One respondent, this time from the Rural Electrification Agency, also stated that the current electricity tariff is very low and may not attract investors to participate in community renewable energy. He stated:

> *"Most of the barriers are in terms of the tariff. Knowing how small the communities are and considering the investment involved, most of the people feel the payback is small. Hence, it is not lucrative for investors…."*
>
> RP005

This view is not surprising as most investors may be discouraged by a tariff that may result in an extended payback period, however, if renewable energy is subsidised, this will compensate the low electricity tariff. Nonetheless, some participants from the commercial developers perceived the lack of subsidy to offset the initial cost of renewable energy as another infrastructure barrier affecting the transition to community renewable energy in Nigeria. Statements illustrating this are presented in Table 5.29.

Table 5.29 Comments demonstrating lack of subsidy as a barrier for community renewable energy

Comment	Research respondent
"…there is the need to subsidise the capital cost of renewable energy."	Commercial developer (RP018)
"…obviously the lack of subsidy for the initial investment."	Commercial developer (RP019)

Source: Interviews

The following statement from respondent RP018 further cements the views presented in Table 5.29:

> *"…except the government comes with some institutional support or subsidy for renewable energy, those people that are far from the grid should forget about accessing electricity for a long time to come."*
>
> RP018

This clearly indicates that without a subsidy to support renewable energy, the transition will be difficult to happen.

5.6.4.4 Difficulty in acquiring project sites

From another perspective, the transition to community renewable energy is also perceived to be challenged by the difficulty in acquiring land for siting a renewable energy project. This view is presented in the following statement from respondent RP006:

> *"Again, most renewable energy projects require a sizable land… It depends on how land can easily and cheaply be acquired by investors in order to be able to site their investment without affecting their cost."*
>
> RP006

The view presented by respondent RP006 could be because renewable energy technology projects such as solar farms require a sizeable amount of land and thus may be affected by how investors can easily acquire land at a cost that may not significantly affect their investment.

5.6.5 Reflections on socio-political related barriers

The transition to community renewable energy is also challenged by the uncertainties created by the social restiveness that characterises the Nigerian political scene. The following statement by respondent RP013 indicates that instability may well discourage investors from investing in community energy:

> *"…lack of stability due to unrest and uncertainties within communities. Nobody will put his money where there is no peace."*
>
> RP013

Another respondent stated that deliberate action to destroy or damage public or private property is a major challenge to community renewable energy:

> *"The barrier is that in our communities, you know because of the level of poverty in most of the rural areas, my fear for this kind of initiatives is the security of the installations against vandalism or theft. So for me, the fear of vandalism or theft are the key problem for renewable energy in rural areas."*
>
> RP015

5.7 Summary

The data presented in this chapter uncovered many important issues about the processes and governance approaches to community renewable energy in

Nigeria. The results revealed rich insights into the five key categories contained in the theoretical model that informed the data collection process. Under these categories, several interesting themes and sub-themes have emerged.

Three major themes have emerged to explain transition determinants: socio-economic and environmental developments; regime related issues; and, bottom-up developments. Under the social-economic and environmental developments, data revealed a lack of access to electricity and Nigerian government commitment to providing accessible electricity to rural people. Other sub-themes shown by the data include: environmental concerns; meeting international obligations; security of energy supply; and, geographical considerations.

The recurring issues that emerged from regime related determinants include: inadequate grid capacity; high costs to extend the grid; and, unreliability of the existing grid system. Lastly, the sub-themes that emerged from bottom-up developments include: scale advantages as well as price and performance improvement in renewable energy technologies.

Some of the themes that emerged from the transition planning and decision-making category include the creation of an arena known as the ICREEE. The ICREEE serves as a platform for stakeholders to identify the challenges facing rural communities and it deliberates on possible solutions. The results showed lack of proper engagement of stakeholders such as investors, local and state government as well as communities. Another key issue that emerged is that

most of the agencies promoting renewable energy are carrying out renewable energy activities without clear guidelines and collaboration with one another.

Regarding implementation of the transition project, some of the respondents focused on stakeholder participation, and community involvement. The results showed that although local people were consulted before the commencement of the project to inform them of the project and offer employment, there is no evidence to suggest that local people were given any opportunity to voice their opinions.

On incentive instruments and business models, the recurring voices centres on the provision of financial and regulatory incentives. The results indicated that the government has provided a feed-in tariff regulation and a special statutory fund through the REA to support renewable energy deployment in rural areas. However, some respondents believe the money allocated to the fund was insufficient, and sometimes further the fund is diverted to other purposes.

The data has also shown that Nigeria has already developed several regulatory frameworks for different kinds of community renewable energy businesses. However, in what appears to be the recognition of the appropriateness of the cooperative-style model of community renewable energy, the Nigerian government through the REA have helped some rural communities establish and register electricity user cooperative societies. Respondents believed that without subsidies to pay for the capital cost of renewable energy technologies, rural cooperatives would be incapable of sustaining community renewables.

The results indicated several barriers, which were classified as: actor interaction; infrastructure; institutional, and, socio-political related. The actor

barriers include lack of local community capacity to either pay for electricity services or participate in funding community renewable energy projects and a lack of awareness and information amongst the rural and investment communities. On the other hand, interaction barriers include: the absence of effective engagement of actors such as the local and state government in the transition; constant interference by political office holders with the activities of the rural electrification; and, lack of commitment and transparency.

Furthermore, institutional barriers include: duplication of responsibilities; low-level efforts to build institutional capacity; a low electricity tariff; and, a lack of subsidies to support the capital requirement for community renewable energy investment.

Finally, infrastructure barriers include: the proliferation of substandard renewable energy equipment; lack of data for planning; and inadequate information. The results also indicate fear of political instability and social restiveness that can discourage prospective investors from investing in community renewable energy projects.

The ensuing chapter discusses the findings in line with the reviewed literature.

Chapter Six

Discussion of Key Findings

6.1 Introduction

The previous chapter presented the outcomes of the semi-structured interviews conducted for answering the research questions. This chapter discusses the findings of the outcomes. In doing so, the chapter evaluates the major themes identified (including socio-economic and environmental developments, current electricity regime challenges, setting of the transition arena, etc.) against the existing literature. While the literature explains some of the themes, other new issues have emerged from the data, which this study found to be useful in modifying the theoretical model for application in developing countries such as Nigeria. The discussion of these key themes will be carried out in the following sections.

6.2 Socio-Economic and Environmental Developments

The socio-economic and environment developments represent the landscape. At this level, the dominant driver revealed by the data presented in Section 5.2.1.1 is the inaccessibility to modern energy services and the government commitment to widening energy access to the rural inhabitants. This finding is different with an earlier study by Foxon et al. (2008a) that found government commitment to national and international targets for emission reduction as the dominant factor influencing the transition to low-carbon energy in the UK. The difference could be because of the variances in context. While the UK is regarded as a developed economy where the level of energy poverty is insignificant in relative and comparative terms, developing countries such as Nigeria are still grappling with much higher levels of fuel poverty, especially in rural areas.

But it is also evident from the findings stated in Section 5.2.1.3 that transiting to community renewable energy in off-grid rural areas is also being influenced by Nigeria's commitment to reducing carbon emission and other environmental pollution at the rural area level. A similar finding with the preceding is that transition is being driven by Nigeria's commitment to meet international environmental obligations. As a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, Nigeria has made international commitments to promote sustainable development, including meeting its reporting obligations to the UNFCCC and reducing carbon emissions within its national circumstances. Hence, the findings revealed that Nigeria is under pressure to promote sustainable energy, with community renewable energy in rural areas seen to be a major path to achieve these international commitments. For example, it was stated by research participant RP012 that issue of renewable energy in Nigeria is receiving attention because Nigeria was one of the signatories to international agreements such as the Kyoto protocol. Thus by default, the use of community renewable energy is an option to help mitigate climate change problem. This is consistent with aforementioned Foxon et al. (2008a) study that found government commitments to meeting national and international obligations as the key pressure driving low carbon energy transition in the UK.

The revelation that Nigeria is developing community renewable energy to broaden its energy mix to achieve energy security is comparable with Bosman et al. (2014) who found the driver to secure energy supply as the driving force for sustainable energy transition in the Netherlands. However, it is perhaps surprising that the concept of energy security or a secure energy supply has been, for a long time, applied exclusively to net energy importing countries

(see for example: Abdo and Kouhy, 2016). Thus, this raises the question of the rationale for energy security pressure in driving community renewable energy transition in Nigeria, which is a net energy exporter country.

Sovacool and Brown (2010: 79) indicate that the concepts of energy security are, "*so narrow that they tell little about comprehensive energy challenges*". According to them and quite clearly, energy security should also cover issues such as energy supply availability, reliability, and affordability. It was outlined in Section 2.3.1, that many of Nigeria's electricity production plants are either operating at low production capacity or sometimes completely shutting down due to reasons that include shortages of gas supply, and deliberate destruction of pipelines that supply gas to the thermal stations. Kempener et al. (2015) position is that community-scale energy can be developed to evade electricity supply shutdowns that can be occasioned by undersupply of resources, deliberate attacks or even natural catastrophes, with this study supporting this.

6.3 Current Electricity Regime Challenges

Given that the centralised electricity system has no adequate capacity to meet the electricity demand of the present customers who are on the grid, it was discovered that developing community renewable energy is not only important but also crucial in meeting rural electricity challenges. For instance, comments by research respondent RP004 show that the electricity market is grossly undersupplied and the centralised grid system has no capacity to satisfy the demand. Therefore, decentralised community energy as an alternative to centralised grid electricity is being developed. This finding is consistent with

Frantzeskaki and van Daalen (2007) who state that inadequacy of an existing system can act as a driving factor for a socio-technical transition.

6.4 Bottom-up Developments

The study also found the modular or site-specific nature of community renewable energy technologies is a bottom-up factor in determining the transition in rural areas. This finding also indicates that transition to community renewable energy in off-grid rural areas electrification is also driven by the continuous improvement in renewable energy technologies such as the photovoltaic cells that can harvest energy more efficiently. Other bottom-up factors include the falling price of renewable energy technology that reduces the cost of renewable electricity per kilowatt. This is in contradiction to Seyfang and Hexaltine (2012) and Seyfang et al. (2010) who focused on the creation of local initiatives, associations or movements at the grassroots level as a key driver in energy transition.

6.5 Transition Arena and Problem Identification

Research studies (see for example: Ceschin, 2014) have recognised the vital role of participatory policy-making in steering sustainability transition. To realise this objective, transition management has set as a precondition the formation of a transition arena. As stated in Section 3.8.2.1, the setting up of a transition arena is considered significant for the following reasons. First, a transition arena provides the basis for steering a transition to achieved stated objectives. Secondly, a transition arena provides the context for all actors to come together with the purpose of aligning the different concerns of all the stakeholders (Loorbach and Rotmans, 2006).

The findings presented in Section 5.3.1 indicate that the FMPower has assumed the leading role of steering transition and has helped in forming a platform known as the Inter-Ministerial Committee for the purpose of renewable energy development including steering the transition to community renewable energy in off-grid rural areas electrification. This step is comparable to the Dutch Ministry of Economic Affairs (EZ) assumption of the leading role as the "transition manager" to implement sustainability energy transition in the Netherlands (EZ 2004 cited in Kern and Smith, 2008). The setting up of the Committee indicates a significant step towards the participatory understanding of the problems faced by rural communities and the envisioning of a desirable future for rural communities in Nigeria. It implies that the commencement of the transition to community renewable energy in Nigeria agrees with the theoretical model which suggested the establishment of an arena for the purpose of developing an alternative solution.

6.6 Stakeholders and Community Involvement in Planning and Policy Decision-Making

As the name of the Inter-ministerial Committee indicates, the composition of actors is dominated by policy-makers and other government related actors. The findings presented in Section 5.3.4 of the previous chapter shows no evidence of any involvement of non-governmental, civil societies, private businesses or regime incumbents in the transition planning. This contrasts with Lindenau and Böhler-Baedeker (2014) who discovered the involvement of different actors such as motoring associations, public transport providers, non-governmental social and environmental organisations, and local companies in the planning of sustainable transport system across Europe.

Similarly, the theoretical model considered the participation of local communities in transition planning critical because they provide the premises for raising awareness about social reality among the local population and opens new frontiers. This allows people to think about their individual behaviour in the wider societal context (Quist et al ., 2013). The findings of the analysis in the previous chapter, however, indicated no evidence of local community involvement in planning and strategic decision-making. For instance, research participant RP020 stated that no consideration was given to local communities in the transition planning or decision-making. This confirms findings from Abdullahi et al. (2014) that development efforts in rural communities in Nigeria were undertaken without regard to the active involvement of local communities in the planning and decision-making process. The implication is that community renewable energy transition may not be supported locally. As a result, this may affect the successful shift to a new energy system especially when the local communities are expected to take an active role in the system.

6.7 Envisioning and Pathway Developments

Developing long-term vision (of at least 25 years) is regarded as the central function of participatory arena processes because long-term vision serves as a framework for which short-term objectives and programmes are set. The comments by research respondent RP010 in Section 5.3.2 shows access to sustainable energy by all Nigerians by 2030, as the Nigeria's shared long-term vision. This is consistent with other shared long-term sustainability transition visions such as the Finnish safe and secure transport system by 2100 (Auvinen and Tuominen, 2014) as well as the UK's low carbon society by 2050 (Foxon et al., 2013).

The comment by RP010 in Section 5.3.2, revealed that following the development of a long-term vision and short-term goals, a consensus had been reached by the Inter-ministerial Committee regarding the present energy system being insufficient to satisfy the growing energy demand of both urban and rural dwellers. Thus, community-scale renewable energy with local participation is being adopted as the preferred pathway for providing electricity access in remote rural locations. This understanding resonates with the 'thousand flowers' pathway identified as one of the UK's low carbon transition paths (Foxon et al., 2012; Seyfang et al., 2013) and the soft energy pathway proposed by Lovins (1977) and Strachan et al. (2015).

6.8 Community Ownership and Cooperative Societies

Regarding community participation through the ownership of projects at their localities, the views obtained and presented in Section 5.3.6, revealed that current development practices of community renewable energy do not encourage community or local ownership of projects. The government through its agencies have helped communities to establish rural electricity users' cooperatives. Nonetheless, research participants believed that without greater institutional support for the established rural cooperatives, it would be impossible for local communities to partake in community renewable energy ownership.

6.9 Unclear Guidelines and Responsibilities of Actors

Pisano et al. (2014) indicated that when designing transition pathways and agenda, it is crucial to state in clear terms which actors are responsible for which type of activity, project or instrument. However, the findings presented in Section 5.3.5, showed the absence of clear guidelines and division of

responsibilities among government agencies involved in the development of renewable energy. The findings also indicated that most of the organisations who are implementing renewable energy activities independently are not doing so in synergy. This reveals that some of the institutions and agencies have been undertaking separate renewable programmes and piloted projects without consulting or engaging other relevant stakeholders. The finding affirms Mehlwana's (2004) claim of the existence of several uncoordinated renewable energy programmes and fragmented pilot or demonstration projects as one of the key features of renewable energy developments in developing economies.

6.10 Transition Project's Objectives and Design

This study found that transition process at the operational level is currently ongoing with the development of pilot community projects including community-scale solar energy in the *Shape* rural area. The findings presented in Section 5.4.1 showed a consensus on the *Shape* community project as a transition project which was aimed at trialling socio-technical innovations in a real-world context. However, there is disagreement as to the link between the *Shape* project and developments at the strategic level. Some participants believed the project was established to trial the pathways agreed upon by strategic level decision (transition arena); others disagreed with this assertion.

A possible explanation for the disagreement might be the non-involvement of the frontrunner actors and lack of clear-cut delineation of roles and responsibilities among the key institutional actors promoting renewable energy. Some participants believed FMPower was supposed to lend its support and allow the relevant agencies who have the responsibility to develop the project along with the participation of the relevant actors. The Ministry of

power who acted as the transition manager implemented the project without the involvement of most of the frontrunner stakeholders that participated in the strategic development process.

The design of the *Shape* project also came into question. The research reveals that the project supplied electricity without meters being installed in the various consuming units, therefore allowing end-users to receive free electricity. This indicates the absence of any mechanism that either measures the usage or charges an individual consumer. The findings, which are presented in Section 5.4.4, show that the concerns of actors for a commercial and sustainable business model have not been sufficiently articulated in the design of the *Shape* project. A possible explanation for this, as will be seen in the subsequent section, could be the lack of participation of all the stakeholders in the design and development of the *Shape* community renewable energy project.

6.11 Stakeholders and Community Involvement in Project Development

Meroni (2008) has emphasised the importance of involving a broad range of actors in the design of a transition project. The findings obtained and presented in Section 5.4.2 and 5.4.3 however, indicate that the *Shape* transition energy project was conceived and designed by a single actor – FMPower - without the participation of relevant stakeholders.

This finding clearly reveals that the local community was not sufficiently involved in the design of the *Shape* community renewable energy project. This highlights the passive involvement of the local community members in the development stage of the project to inform the local community of the project and for the community to provide local labour for unskilled construction jobs.

This contradicts the model that advocates the active participation of a wide range of actors and local community involvement in designing and developing a socio-technical transition project. Ceshin (2014) maintains that the non-involvement of relevant stakeholders in the development of socio-technical innovation has a number of implications for the success of a community renewable energy transition project. Firstly, conducting a pilot project by a single actor limits the project's chances of getting the wider resource of actors who have the required experience and expertise that will bring legitimacy to the project because no single actor unilaterally has the power or resources to make a transition happen. Secondly, it also limits the chances of developing second order learning which is required for a transition to occur.

6.12 Monitoring, Learning Outcomes and Communication

Scholars advance that both first and second order learnings are essential when implementing transition projects. The findings presented in Section 5.4.5 indicated that the *Shape* project had instigated both the first and second order learnings. The finding revealed that project developers have learnt from the experiences of the *Shape* project and established the need to incorporate metering into the design of community projects. This is because the lack of metering may contribute to unwillingness to pay for the electricity services by the local communities. The project also highlights the need to educate the local communities on energy conservation and efficiency. The project has also shown the need to network with other actors such as the private sector in the design and implementation of pilot projects.

The findings also revealed that several efforts were made by the project developer to monitor and evaluate the outcome of the transition project.

However, the study also showed that it was difficult for stakeholders to know what is happening or taking place at the *Shape* project and to get the right information that they require. This is because of the gap that existed in how information or the success of community renewable projects is being communicated. The finding confirms Mehlwana's (2004) assertion that in developing countries, even in cases of successful projects, lessons learned were mostly undocumented and therefore missing.

6.13 Market supports

Hannon et al. (2013) noted the significance of market instruments in driving a socio-technical transition. Like in some other countries, this study found that materials and components of renewable energy technologies that are imported into the country have been exempted from import duties. In addition, the government has put in place tax breaks for registered renewable energy projects.

The findings presented in Section 5.5.1 further reveal the provision of the REF as the major financial incentive for supporting community renewable energy transition in rural areas. The REF supports both the extension of the centralised grid and the development of renewable energy. However, the REF has been challenged by lack of funds, transparency and accountability issues.

The findings presented in Section 5.5.2, however, indicates that REF and other market supports have not been effectively implemented to promote the transition to community renewable energy in rural areas. This finding is consistent with Mohiuddin (2006) who questioned the effectiveness of grant-based incentives such as the REF. This is because government support for such funds can often fluctuate as priorities change. Additionally, support from

international contributors, which forms one source of funds can recede at any time, thereby challenging its political and financial sustainability.

6.14 Development of Business Models

On the issue of business models for community renewable energy, the findings presented in Section 5.5.3 indicated that several regulatory models for community-scale renewable energy business have been developed. One framework is to allow communities to form themselves into a purposive vehicle to partake in renewable energy provision. However, the study found that the regulatory implication for community projects in off-grid rural areas when the national grid eventually reaches remote rural communities has not been clearly stated. This has created uncertainties for investors of community renewable energy in developing economies and confirms the IRENA (2015) position that there is a lack of a robust regulatory framework for renewable energy in rural areas.

The study also revealed that REA is helping communities to establish electricity users' co-operative societies. The purpose of the users' cooperative is to participate in the collection of bills and maintenance of projects that are sited in their locality. Many of the respondents see the formation of the users' cooperatives as a step toward building a sustainable business model for community renewable energy. Nonetheless, it noted that it would be difficult to realise that objective without support from the government.

6.15 Community Renewable Energy Barriers

Section 5.6 outlined several barriers challenging the transition to community renewable energy in off-grid rural areas. In line with the call made by scholars (for example, Wieczorek and Hekkert, 2012; Twomey and Gaziulusoy, 2014)

to identify and classify socio-technical transition barriers into actor, institution, interaction and infrastructure barriers, this study has extended this by investigating and classifying the barriers affecting community renewable energy transition in rural areas. In addition to the four aforementioned classifications outlined by scholars, this study also adds socio-political related issues. The following sections present the barriers as perceived by the research participant.

6.15.1 Actor related barriers

The research findings reveal several actor related barriers that are challenging the successful transition to community renewable energy in rural areas electrification. One of the key actor barriers is the inability of the local people to pay for electricity services. For instance, the view of research participant RP005 presented in Table 5.22 showed that although local people may have the willingness to pay, they are constrained by their financial inability to pay. This finding corresponds with Ballesteros et al. (2012) who state financial incapacity as a significant factor of concern when considering renewable energy transition in low-income rural areas. The finding is also buttressed by Omer (2007) who maintained that for a renewable energy transition to happen, users must have the ability to pay for the services provided by renewable energy technologies.

In addition to the concerns mentioned above, the findings of the study presented in Section 5.6.1.2 also revealed a lack of awareness of renewable energy technologies among the rural people as another actor related barrier challenging the successful transition to community renewable energy in off-grid rural areas. This finding is consistent with Blenkinsopp et al. (2013), who

found the lack of awareness and understanding of renewable energy technologies as one of the actor related barriers challenging the uptake of small-scale renewable energy in the rural communities of Maharashtra, India. The lack of awareness of and confidence in renewable energy technologies among financial investors is also indicated as part of the actor related barrier challenging the transition to community renewable energy in Nigeria's rural electrification. This is consistent with Prasad and Snow's (2014) statement that the lack of information about technology, performance, cost and planning among investors makes support for renewable energy transition a challenging task.

The low skills of the local people to operate and maintain renewable energy installations is also another actor related barrier affecting the possible transition to community renewable energy in the rural areas. This outcome, which is presented in Section 5.6.1.3, is consistent with Bhattacharyya et al. (2014) who identifies limited capacities to operate and maintain renewable energy technologies at the local level as the fundamental challenge in community-scale energy transition in developing economies.

6.15.2 Institutional related barriers

Institutional barriers are another issue identified in the research. Section 5.6.2.1 revealed the overlapping of function and responsibilities among the institutional actors promoting renewable energy as one of the key institutional barriers affecting the community renewable energy transition. This finding corroborates Ley et al. (2014) and Otitoju and Diara (2013) who identified several policies overlapping within the Nigeria's renewable energy institutional landscape. The finding also aligns with Glemerac et al. (2012) who found the

lack of clarity in institutional responsibilities as a major factor challenging the deployment of renewable energy in Mauritius.

It was revealed by research respondent RP006 that weak institutional capacity building in the area of renewable energy development is another institution-related barrier. This finding is consistent with IRENA (2012b), who states that the insufficient capacity required to drive energy transition among both institutions and individuals is a barrier affecting renewable energy transition in developing countries.

Section 5.6.2.4 revealed the lack of effective quality control that has led to a proliferation of substandard renewable energy equipment as another infrastructural barrier. As noted by Ohunakin et al. (2014), this can be explained by the weak procurement systems for imported renewable energy technologies. The finding is consistent with Glemarec (2012) who states that substandard performance of renewable energy technologies causes user apathy to renewable energy systems and also discourages financial institutions from participation in the market. The reason being the high chances of loan defaults that may result from system breakdowns associated with substandard equipment (Glemarec, 2012).

6.15.3 Interaction related barriers

Section 5.6.3 indicated several interaction related barriers. One of the key interaction related barriers, as stated by RP011 and RP018 in Section 5.6.3.1, is the non-engagement of relevant stakeholders such as local government and state authorities, in the transition process. This finding can be explained by the importance of local and state government in a rural area transition process. Gouchoe and Larsen, (2001) claim that actors such as the local government

are important stakeholders because they are in close contact with local people and this places them in a better position to understand and respond to their energy needs in locally suitable ways than the central governments. Additionally, they also act as educators, customers, regulators, financiers and investment partners in localised energy provision such as the one being envisaged for community renewable energy.

Of some important the study found political interference with the activities of the rural energy development agencies as another major setback for community renewable energy transition rural electrification in Nigeria. The findings revealed that politicians often compel the development agencies to perform activities that are contrary to the objectives of realising community renewable energy transition in rural areas. It was found that some of the parliamentarians prefer grid extension even where the potential favours community renewable energy application. The insufficient awareness and the lock-in to existing practices could explain their apathy toward community renewable energy.

Another finding that relates to the above discovery is the diversion of funding meant for supporting the development of rural electricity project by the relevant authorities. According to the study's findings, the diversion of funds negatively affect the supporting capacities for the new energy system that is being envisaged. A possible explanation for this, as noted by Okafor (2014) could be the poor management and accountability practice that characterises Nigeria's rural electrification development agencies as well as the inconsistency of funding support for rural electrification projects in Nigeria.

6.15.4 Infrastructure related barriers

Flavin et al. (2014) maintain that baseline data and information on the renewable energy potential as well as the level of electrification of rural communities are a vital input for transition. The reason is that it serves as a reference point for project developers, investors and other actors interested in promoting renewable energy transition. Research respondent RP010 found the absence of baseline data as a potential barrier to community renewable energy transition planning which may, in turn, affect the successful renewable energy transition in rural areas. This finding corroborates Flavin et al. (2014) who found the unavailability of data to be a barrier affecting Latin America and the Caribbean transition to renewable energy.

Findings presented in Section 5.6.4.2 indicated the absence of quality control standards in some of the renewable energy equipment purchased with this being one of the main infrastructure barriers facing organisations and communities. This finding is corroborated by Ohunakin et al. (2014) who pointed to deficiencies in the national quality standards for renewable energy technologies.

Renewable energy projects such as solar farms require a significant size of land. Therefore, the level of renewable energy deployment will depend on the availability of land and the simplicity with which investors can secure land for siting their project. Findings presented in Section 5.6.4.4 is consistent with Nasirov (2015) who found that the unavailability and difficulty of obtaining land to be a barrier slowing renewable energy transition in Chile. Ajayi and Ajayi (2013) noted that the bureaucratic land regulations and the importance local communities attach to land in Nigeria could explain this finding. Such a factor

may result in far-reaching negotiations and significant compensation payments to landowners such that renewable energy investors may not want to be involved.

The findings revealed that when compared with the investment requirement of community renewable energy, the present tariff for electricity and the small rural market were insufficient to support a reasonable investment recovery. The study also uncovered that low tariff affects or discourages small business, financial lenders, and energy services companies from investing in community renewable energy projects in rural areas. This finding, which is presented in Section 5.6.4.3, is consistent with Nasirov et al. (2015), who found that a longer investment recovery period to be one of the key barriers affecting Chile's renewable energy deployment in rural areas. The basis of this finding could be understood by the small energy requirement of an average rural area in developing economies and the significant investment requirement for a renewable energy project.

6.15.5 Socio-political related barriers

In addition to the actor, institution, infrastructure, and interaction related barriers, this study also found the fear of social unrest and deliberate destruction of projects and components, as a potential barrier. This barrier presented in Section 5.6.5 was surprisingly not considered by the likes of Wieczorek and Hekkert (2012) and Twomey and Gaziulusoy (2014). However, it has been found to be a potential and significant obstacle in this study. This finding could be explained by the recent insurgencies affecting Nigeria, and the long history of vandalism and theft of electricity transmission and distribution equipment (see Oseni, 2011).

6.16 Summary

This chapter provided a detailed discussion of the data presented in the previous chapter. The discussion revealed rich insights into the processes and governance approaches of community renewable energy transition in rural areas. The findings indicated that the processes and governance approaches are in line with the transition theory. Some of the issues raised regarding the transition planning and decision-making include the creation of a platform known as ICREEE. The data, however, showed that federal government agencies dominate the platform, as there was no evidence to suggest the involvement of actors such as investors, local citizens, other government and non-governmental organisation.

The findings also revealed the lack of defined roles for the government agencies with most of them carrying out renewable energy activities independently without any significant collaboration. This is found to impact on the speed which renewable energy is deployed in rural areas. This was also confirmed at the implementation level, where it was observed that though local people were consulted before the commencement of the *Shape* community project, there was no evidence that they had been significantly involved. This again indicates that the implementation process sidelines local knowledge which may be a significant input in the transition process. This outcome shows that there is still a need for an integrated governance and implementation effort to accelerating the transition process. The discussion also revealed that community renewable energy transition is challenged by several factors which this study classified as actor, institution, interaction, infrastructure, and socio-political related barriers.

Having discussed the findings of the study, the next chapter concludes this study and offers recommendations and implications of this research study.

Chapter Seven

Summary of findings, Contribution and Recommendations

7.1 Introduction

The overriding aim of this thesis was to assess the transformative potential of the community renewable energy processes and governance approaches in accelerating sustainability transition in off-grid rural areas. The study employed several research approaches to achieve the objectives set in Chapter 1. Subsequently, a comprehensive review of the literature was presented in Chapter 2 and 3. Some relevant key areas discussed in the chapters - including a discussion of rural electrification and community renewable energy, a descriptive analysis of policy development in Nigeria's electricity industry, and a review of transition theory. The methodology for conducting the research was presented in Chapter 4, while the practical experiences of key stakeholders in the Nigeria electricity industry were presented in Chapter 5. The penultimate chapter then presented a critical discussion of the findings in comparison to the relevant literature. This chapter summarises the findings of the research questions set out in Chapter 1. Ultimately, the chapter presents the contribution of the study and provides recommendations for practice and policy as well as for further research.

7.2 Determinants of Community Renewable Energy

The study found that several determinants drive the transition to community renewable energy in rural areas electrification in Nigeria. One of the dominant factors at this level, which represents exogenous or external environment beyond the reach or control of the transition actors, is the lack of access to modern energy services experienced by rural communities. And government commitments to providing access to these locations. Other determinants found

in this study include: the need to protect the environment; ensure security of supply; and, meet international obligations. The need to utilise the country's naturally endowed resources and the topographical nature of some rural locations are also some of the other factors determining the energy transition.

The study also revealed that community renewable energy is determined by several issues affecting the current system of rural electrification. These include: the inadequate capacity of the current grid system to meet the ever-increasing demand for electricity; the increasing cost of transmitting electricity to remote locations; and, frequent system failure that characterises the current electricity regime.

At the bottom level, this study revealed that the transition to community renewables is being driven by the modular or scale advantages of renewable energy technologies. The study also revealed that the transition to community renewable energy in off-grid rural areas is also driven by the continuous improvement in the technologies such as the photovoltaic solar cells that can harvest energy more efficiently now. Other determinants include the falling price of renewable energy technology, with this reducing the cost of renewable electricity per kilowatt.

7.3 Planning and Decision-making Processes and Strategies

This study provided a rich understanding of the strategy and processes involved in the community renewable energy planning process. These findings were classified into five main themes: transition arena and problem identification; stakeholders and community involvement in planning and policy decision-making; envisioning and pathway developments; community

ownership and cooperatives societies; and, unclear guidelines and the responsibilities of actors.

7.3.1 The setting of transition arena and problem identification

This research found that community renewable energy is being spearheaded by the establishment of a transition arena, known as the Inter-ministerial Committee on Renewable Energy and Energy Efficiency (ICREEE) by the Ministry of power. The setting up of the committee indicates a significant step towards the participatory understanding of the problems faced by rural communities and the envisioning of a desirable future for rural communities. It implied that the commencement of the transition to community renewable energy is organised according to the suggestion by transition scholars of an assemblage of:

> "*a group of people, usually frontrunners [with the aim of reaching a] consensus with each other about the need and opportunity for systemic change, and coordinate amongst themselves to promote and develop an alternative*"(van der Brugge 2007).

7.3.2 Stakeholders and community involvement in planning and policy decision-making

The study found the composition of the arena mainly consisted of policy, regulatory and other national governmental actors. Empirical evidence has shown the absence of other relevant actors such as the state, local government, and community level actors in the transition arena. More so, the research has also shown that *outsider* actors such as the societies, firms and societal pressure groups were not engaged in the transition planning and policy decision-making. These actors as argued in Section 4.8.2 are required in a transition process because their thinking differs with existing regime actors,

and may significantly play a role in the development of new practices capable of bringing system transformation. The non-inclusion in transition planning and policy decisions may jeopardise the successful transition to community renewable energy in off-grid rural areas electrification.

7.3.3 Envisioning and pathway development

Despite the homogeneity of actors, the ICREEE committee has recognised the existence of several persistent societal challenges such as the lack of access to clean energy and environmental pollution and have reasoned that structural change of the existing centralised electricity system is crucial to achieving sustainable electricity, especially in rural locations. This led the committee to initiate and adopt several transition steps. It was found that members of the committee had embraced sustainable energy for all by 2030 as the long-term vision for community renewable energy. It is unclear however if this vision is shared by all members of the committee. As part of the transition process, the committee also agreed on a short-term objective of achieving at least 75 per cent electrification in Nigeria by 2020 with renewable energy as part of the sources.

The study also found that the members of the ICREEE committee have unanimously agreed that given the current persistent energy crisis and the inadequacy of the current system to satisfy the electricity demand of Nigerians, rural electrification should be confined to community-scale energy powered by renewables.

7.3.4 Community ownership and cooperatives societies

The study found that existing development practice is short of encouraging community or local ownership of projects. However, the study did find that the

government through its agencies has taken a significant step by helping communities to establish rural electricity users' cooperatives. The purpose of the cooperatives is to carry out collections and maintenance of projects sited in their localities. This effort can be understood to be an important step towards community ownership of renewable energy. However, the study revealed that despite the institutional support to create rural cooperatives, it would still be unattainable for the local communities to participate in community renewable energy ownership.

7.3.5 Responsibilities of actors and synergy

The study showed that there was a lack of clear actor responsibilities among the government agencies involved in the development of renewable energy project. The findings revealed that most renewable energy activities are being carried out independently without any significant synergy among the institutional actors promoting renewable energy. In other words, the findings indicated some of the institutions and agencies have been carrying out separate renewable programmes and pilot projects without consultation or involvement with other key stakeholders in the industry. This suggests an important gap exist of efforts in reflexive learning required in steering transition to achieve stated objectives.

7.3.6 Setting of renewable energy targets

It was stated in both practices and sustainability transition literature that one of the important roles of transition leaders and managers is setting targets for renewable energy and working toward realising these objectives. This study has shown that Nigerian politicians have set a very ambitious target for

renewables. Currently, a goal for realising at least 10 per cent of renewable in its energy mix by 2020. However, there is no clear evidence to suggest what has been achieved or if this target can be achieved.

7.4 Project Implementation Processes and Dynamics

Regarding the processes and dynamics involved in the implementation of the *Shape* community renewable energy project, the study identified several responses which were categorised under four headings: transition project's objectives and design; stakeholders and community involvement in project development; monitoring; and, learning outcomes and communication.

7.4.1 Project's objectives and design

This study revealed that transition processes at the operational level are currently ongoing, through the development of community-scale solar energy in the *Shape* rural community. The study found consensus among the research participants on the *Shape* community project as a transition project, which was aimed at putting socio-technical innovations into trials in a real-world context. This indicated a theoretical linkage of events at the top level with development at the bottom. However, there was disagreement as to the link between the *Shape* project and developments at the strategic level. Some participants believed the project was set up to bring into trials the pathways agreed upon at strategic level decision (transition arena) while others disagreed with this assertion. A possible explanation for the disagreement might be the non-involvement of frontrunner actors and a lack of clear-cut delineation of roles and responsibilities among the key stakeholders promoting renewable energy development. Additionally, some participants believed the Ministry of Power was supposed to offer its support and allow the relevant agencies with the

responsibility for implementing projects to function. However, the FMPower who acted as the transition manager implemented the project without the involvement of most of the frontrunner stakeholders.

The study revealed shortfalls in the design of the *Shape* project. Currently, the project supplies electricity without electric meters being installed in the various consuming units resulting in the end-users getting electricity free of charge. This indicated the absence of any mechanism that measures what an individual user consumes and what is owed. It has shown that the concerns of actors for a commercial and sustainable business model have not been adequately articulated in the design of the *Shape* project.

7.4.2 Stakeholders and community involvement

The study also found that the FMPower developed the *Shape* community renewable energy project. The research highlighted that other frontrunner actors who participated in the transition arena were not involved in the development of the *Shape* community project. The study also revealed the non-involvement of other powerful actors such as the financing and investment communities in the implementation of the *Shape* renewable energy project. Further, although there was evidence of local community participation in the development of the *Shape* community project, it was restricted to only passive involvement as receivers of information and the provision of unskilled labour for the construction work. This non-active involvement of stakeholders is capable of leading to lack of social acceptance which may negatively affect the transition in rural communities.

7.4.3 Monitoring, learning outcomes and communication

The study identified that most of the effort and time spent on monitoring the transition project is centred on the technical aspect of the project. The study revealed that limited effort is being made to monitor the responses of the local community members towards the project. It was also found that there are limited attempts to report the progress or development of the *Shape* community project to members of the transition arena and the public in general. As pointed out by research participant RP020:

> *"The information is not easily accessible. When you go to the website of these organisations, some of them are not interactive neither are they engaging. So you need to make an extra effort… There has always been information gap even for how success stories are being passed out. I am not satisfied because you have to make an effort to get some of this information."*

The research also indicated that the *Shape* off-grid community renewable energy project had offered some first-order and second-order learnings. The project has highlighted to practitioners the need to install limiters or breakers, which will improve the system's safety. Another learning outcome from the *Shape* project is the need to reorient users on the need for energy efficiency and conservation.

7.4.4 Market Supports and Business Model

The market supports and business models available, and the extent to which they were effective and appropriate in supporting community renewable energy transition were also discussed. This study has shown that both the government and private sector have made efforts and progress regarding developing a combination of incentive instruments and business models. The outcome is presented as follows.

7.4.4.1 Financial and grant based incentive instruments

The study revealed the presence of government grant known as the REF - Rural Electrification Fund, for off-grid renewable energy development in rural areas. Although the fund also supports the extension of the grid to the rural communities, the emphasis is placed on off-grid renewable energy projects where the potential supports renewable energy deployment. However, the study found that the implementation of the Fund is shrouded with uncertainty, lack of transparency and accountability as well as the insufficient allocation to the fund. The study has also shown the availability of private financing packages offered by commercial and development banks. However, it was suggested that most people were unaware of the packages offered by commercial and development banks. This adds to the lack of knowledge of renewable energy technologies that is already affecting the take-off of community energy projects.

7.4.4.2 Regulatory-based incentive instruments

The study has also found evidence of regulatory-based instruments to support off-grid community renewable energy transition. One of these incentives includes the feed-in tariff. The feed-in tariff was originally designed to support grid renewable energy project but likewise supports off-grid renewable energy projects. However, the study found that the instrument is yet to become fully operational. Other regulatory-based instruments found in this study include tax concession for renewable energy parts imported into Nigeria as well as tax holidays for a renewable energy project. But, most of these tax incentives appear only in principle with no clear evidence of effective implementation.

7.4.4.3 Development of business models

The findings of this research indicated some steps initiated by the Nigerian government to discover viable business models that will support the transition to off-grid community renewable energy. The study found that the government has established several regulatory frameworks for different kinds of rural electrification businesses. To give credence to community-scale renewable energy, Nigeria's regulatory body has developed several regulatory frameworks for the business of community-scale energy in off-grid rural areas. The IEDNO framework enables or allows an individual or community to operate an isolated or off-grid system to supply electricity to multiple customers.

Another initiative developed to support the community renewable energy in rural areas is the establishment of Rural Electricity Users Cooperatives Societies (REUCS) by the REA in each of local community where the REA is locating community renewable energy project. The initiative allows rural electricity users to form themselves into cooperative societies with the aim of making collections and routine maintenance of project sited in their localities. However, as earlier mentioned, these cooperatives were seen as being ineffective in promoting ownership of community renewable energy projects without any form of subsidy to offset the initial cost of renewable energy projects.

7.5 Transition Barriers

This study makes a novel contribution by not just categorising the barriers to community renewable energy in rural areas electrification according to the four areas suggested by Wieczorek and Hekkert (2012) - namely actor, interaction,

institutional and infrastructural related problems but also extending it to include socio-political related problems. The barriers are presented as follows.

7.5.1 Actor related barriers

The research investigation has shown that several actor-related barriers are challenging the transition to community renewable energy. One of these barriers includes the users' financial capacity, which arises because the rural people are regarded as poor and cannot afford to pay or raise the initial funds required for renewable energy investment. In addition to the economic capacity, this study found that a lack of awareness is also a challenge for several actors in the transition process. Most rural people are unaware of the extent to which their behaviour of burning fuelwood and using fossil fuel generators contribute to environmental pollution and unsustainable practices.

It was also indicated that there is also limited awareness about renewable energy and the potential in rural locations. Besides the lack of knowledge of the rural people, this study revealed that other actors such as investors and financing actors are also affected by low awareness of renewable energy technologies and their reliability. Additionally, policy makers are likely to be affected by a lack of knowledge of how best to govern a system change to achieve the desired objectives.

7.5.2 Interaction related barriers

This study has also shown that interaction barriers are challenging electrifying rural areas through community renewable energy. One key interaction barrier found in this study is the level at which the key stakeholders are engaged in

the transition process. There is evidence of limited involvement of outside actors in the transition process. Similarly, it was found that there are limited attempts to interact or network with other key players in the design and development of pilot community renewable projects. Such a trend is believed to have grave consequences on the level of information and resource exchange required for the development of social learning needed for the transition to happen.

7.5.3 Institutional related barriers

Regarding institutional barriers, the finding of this investigation revealed several factors challenging the successful transition to community renewable energy in the rural areas. These barriers uncovered by the study include unclear and overlapping functions among the key institutions that are promoting renewable energy.

7.5.4 Infrastructure related barriers

This study found a lack of information infrastructure, the proliferation of sub-standard renewable technology components, difficulty in accessing land, and unavailability of data for planning purposes as being among the infrastructural barriers affecting the smooth transition to off-grid community renewable energy.

7.5.5 Socio-political barriers

One novel contribution arising from this study is that in addition to the actor, institution, infrastructure and interaction barriers, political and social instability was identified as a new barrier category. This includes the fear of social unrest and deliberate destruction of projects and components. Such a barrier has not

been previously considered in the extant literature but here it is a key obstacle in the successful transition to community renewable energy.

7.6 Significance of the Results

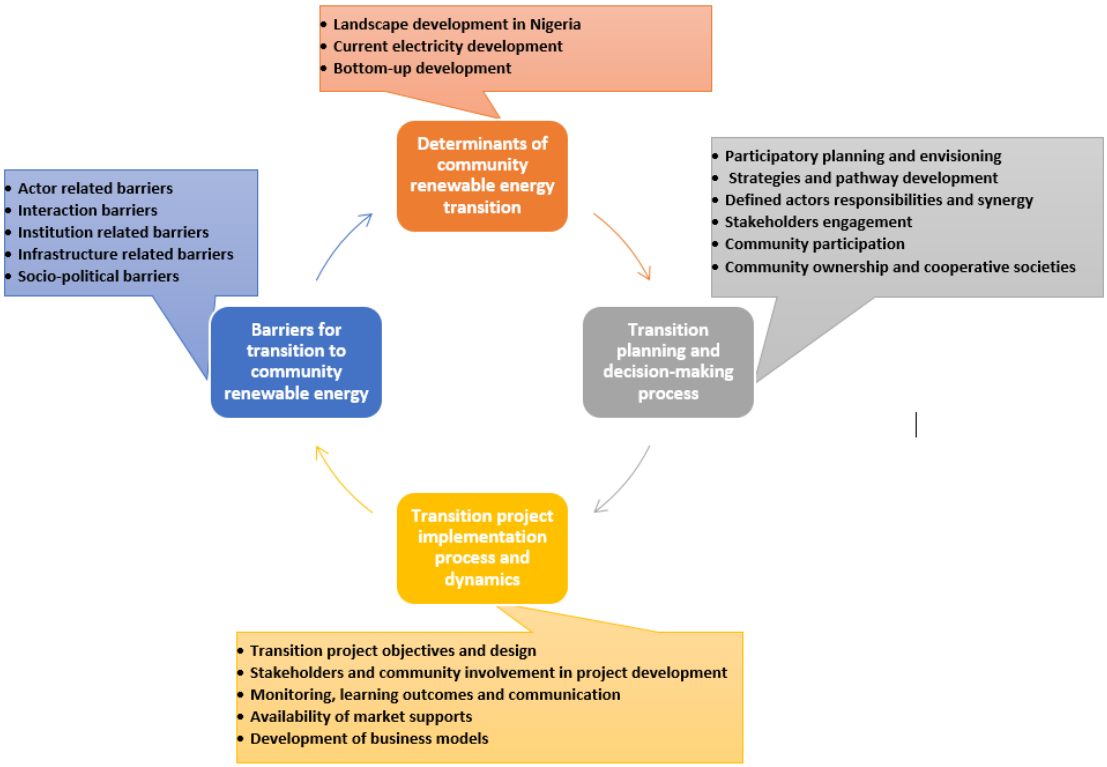
Research in the field of socio-technical transition has over the years developed around the analysis of historical socio-technical transition. As described in Chapter 3, this work contributes towards current attempts to operationalise transition theory and concepts to assess the transformative potential of community renewable energy processes and governance in accelerating sustainability transition in rural areas. This is a significant contribution to the transition literature because it helps in linking theoretical developments with a real-life context. The study also utilises insights from the three transition theory concepts – the MLP, TM, and SNM - in drawing up a theoretical model for the analysis of on-going transition in a single case.

It was also noted in Chapter 3 that social-technical transition is both multi-staged and multifaceted with this presenting difficulties in analytical application. A key strength of the theoretical model formulated in this study as presented in Chapter 3 and operationalised in subsequent Chapters is its ability to provide a framework (developed from transition theory and concepts itself) for the analysis of such a multifaceted and multi-staged system configuration. The study also makes a novel contribution to knowledge by presenting an in-depth investigation of the process and management of the on-going transition in the context of community energy transition in Nigeria.

More so, this study was initially aimed to assess the transformative potentials of community renewable energy transition processes and governance within the elements set in the theoretical model presented in Section 3.8 and Figure

3.5. However, the review of the literature, empirical findings of this study and useful feedback obtained from experts in conferences[7] led to the emergence of additional insights. This highlighted opportunities for developing a comprehensive transition theory model for assessing the transformative potential of community renewable processes and governance approaches in developing countries. Based on this, a new transition theory model is presented in Figure 7.1.

Figure 7.1 New Model for Assessing Transition Processes and Governance Approach



Source: Generated by Author

The new model which has similar sequence and procedure to the research model presented in Figure 3.5, nonetheless it takes into consideration the

[7] see details of the conference presentations in Appendix III

peculiarities of a developing country such as Nigeria. Specifically, the model highlights the need to incorporate questions on challenges that may result from socio-political instability, which affects many developing countries. This issue has not been looked at in sufficient depth by other transition studies but yet has been identified as a very significant issue in this study.

The model also emphasises on the need to investigate whether actors that are charged with the responsibility of accelerating the transition have defined roles and responsibilities. This is because by having defined role and responsibility, each actor can work toward delivery and can further be held accountable for their actions. The model also incorporates synergies amongst the actors, which allows for information dissemination that promotes shared learning experiences required for the transition to happen.

Thus, by developing a framework for the assessment of the processes and governance process of community renewable energy this study further extends transition theory to both innovative technologies as well as the governance approaches through which renewable energy technology is being implemented in developing countries. As earlier mentioned, the application of the model provides a rich understanding that serves as a guide for policymakers, communities, regulatory and development agencies on how they can relate with stakeholders to develop an efficient and effective programme for community renewable energy to address the electricity access challenges in rural communities.

7.7 Contribution to Theory

Developing theoretical understandings of the processes and management of system transition is no doubt a very timely necessity for Nigeria's quest for

sustainable transition in rural areas. This is because such knowledge not only helps in transition planning but also assists in understanding the nature and possibilities of directing transition to achieve the desired objective through interventions that can be made to accelerate further changes. One key contribution to theory arising from this study is its novelty in developing a framework for understanding the processes and governance approaches adopted by stakeholders to develop community renewable energy in rural areas in Nigeria. As discussed throughout this thesis, there is lack of coherent framework for analysing transition governance approach. This thesis not only contribute by bringing together elements from the three transition theory concepts – MLP, TM and SNM under one analytical frame but also extend it to developing country perspectives.

7.8 Contribution to Practice

Firstly, there is a greater need for FMPower to involve actors from the state, local government and community level in future transition initiatives. These actors are believed to be closer to the rural set up than the central government and have their responsibilities in areas that are pertinent for instigating social change.

Another implication of this study on the composition of the transition arena is that there is a need for the involvement of the legislature, the authoritative body that is charged with making laws in Nigeria. This is because the arena process is action-oriented; therefore, the actors need to have more authority to take decisive action. There is also a need for actors from outside (for example civil societies, firms, scientists, societal pressure groups) who are required in a transition process to be involved. The reason is that they do not

share the same thinking with existing regime members and for that, they may play a significant role in the development of new practices capable of bringing system transition to happen. The transition decision-making process may suffer a setback by mainly taking into consideration the views of the government related actors and excluding the opinions of the *outsiders* who can contribute to innovative understandings of the transition process

Another important implication of this study is the need to strengthen the transition arena through the continuous process of communication to feed actors in the arena with background information and detailed knowledge of a particular topic or action taken. This is to enable learning among the participants, which is important because literature has shown that arena participants may lack specific knowledge to expand their understanding (Loorbach and Rotmans, 2006). Therefore, it is the responsibility of FMPower as transition manager to have an overview of all the activities involved. This includes considering the outcomes of the transition project and communicate these to all parties in the transition arena.

7.9 Contribution to Policy

Regarding contribution to policy, this thesis provides interesting policy issues. The most important policy implication emerging from this thesis is the need to know that shifting from one system to another consist of many challenges ranging from social, economics, institutional, political and not just technological. Thus, policy attempts to steer transition to off-grid renewable energy in rural areas electrification should recognise this fact and aim at addressing the challenges from the economic, political, social as well as technological perspectives.

For instance, given the high initial cost of renewable energy technologies and the financial positions of most rural communities, the study argue that policy should include an emphasis on incentivising community-scale renewable energy project. In this regard, this study suggests that REF fund should be restricted to supporting community-scale renewable energy projects alone as oppose to the current practice that also supports grid extension. The study also reasoned that policy objectives recognise the importance and critical role of each of the stakeholders and integrate their concerns in policy planning and implementation.

7.10 Recommendations of the study

There is a need for government to sponsor initiatives aimed at creating awareness among the public of the danger of using firewood and burning fossil fuel as well as the need for sustainable practices. One important step in creating public awareness is developing awareness within the academic community – universities, colleges, and schools. Other important focal points for awareness creation are local government officials and traditional institutions which are considered crucial not only in making decisions affecting rural communities but also because of the existing tradition of using these institutions in disseminating information to the local population in Nigeria.

There is also need for building capacity in the area of making the transition happen. One-step to realise this ambition is to develop initiatives that will train future transition experts. Another step is to facilitate the interaction of institutions with researchers who might enable well-informed decisions. Another recommendation for policy is the need to make public instruments targeted at the removal of barriers inhibiting initial investment in renewable

energy. The REF should be confined to the development of off-grid community renewable energy in rural areas rather than being used to fund grid extension because the current electricity generation is not sufficient to support such an exercise.

There is also the need for policy and regulatory roles to be clarified and made specific to allow institutions to accomplish their respective obligations in an effective and coordinated way. This is because any ambiguity adversely affects investors attempting to fund off-grid renewable energy project or institutions trying to implement the policy or even users trying to take advantage of the policy.

7.11 Limitations and Implications for Further Research

Instead of prioritising an inductive research approach, this research framed the study with indicators deduced from the theoretical model. However, this model perhaps may not constitute an all-encompassing model for the analysis of socio-technical transition. Thus, this thesis acknowledges that although the model provides an attempt to assess the transformative potential of the processes and governance approaches to community renewable energy in accelerating to sustainability transition in rural areas; it cannot claim to offer a comprehensive model for such assessment.

Similarly, the thesis focussed on a single project, however, research outcomes show that there are other off-grid renewable energy projects undertaken by different bodies. It would be interesting to look at these initiatives to draw a wider empirical conclusion that would allow for strengthening or modifying of the assertion made in the theoretical model. Even more, it would be interesting to accomplish further research after the project has existed for an additional

period to assess how it has advanced, and identify whether it has informed other projects or contributed to community renewable energy transition. Research can also be carried out in the future to ascertain how the transition process opens up to other actors in the long term.

Lastly, there is a need for a quantitative research to establish the need for electricity in rural areas in Nigeria and on how community renewable energy could contribute towards sorting energy security in these rural areas.

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Appendix I

Interview Schedule

1. What are the drivers that motivate the development of the initiative for community renewable energy in rural areas electrification?
2. To what extent does government or any other organisation act as a facilitator to bring together stakeholders for the planning and decision-making regarding the community energy initiative?
3. Which stakeholders were involved in the planning and decision-making of the initiatives for community renewable energy in rural electrification?
4. What visions and targets do you think Nigeria has for community energy in off-grid rural areas?
5. What do you think are the strategies/pathways to achieve community renewable energy in off-grid rural areas?
6. What roles do you think were given to the local communities for the transition to renewable energy in rural areas?
7. What do you feel about the involvement of local organisation such as the cooperatives societies in community renewable energy development?
8. Are there any instruments are available, that you aware of, supporting community renewable energy?
9. How effective are the instruments in incentivising community renewable energy?
10. Is there a viable business model for community renewable energy in rural areas?
11. What are the objectives of developing the *Shape* community renewable energy project?

12. Which stakeholders are involved in the implementation of the *Shape* community renewable energy project?

13. Does the local citizens participate in the planning and development of the *Shape* community renewable energy project?

14. What lesson do you think is triggered by the *Shape* community renewable energy project?

15. To what extent do you think the *Shape* project is being monitored and the outcomes communicated to other stakeholders?

16. What level of support do you think existed within the local citizens for community renewable energy?

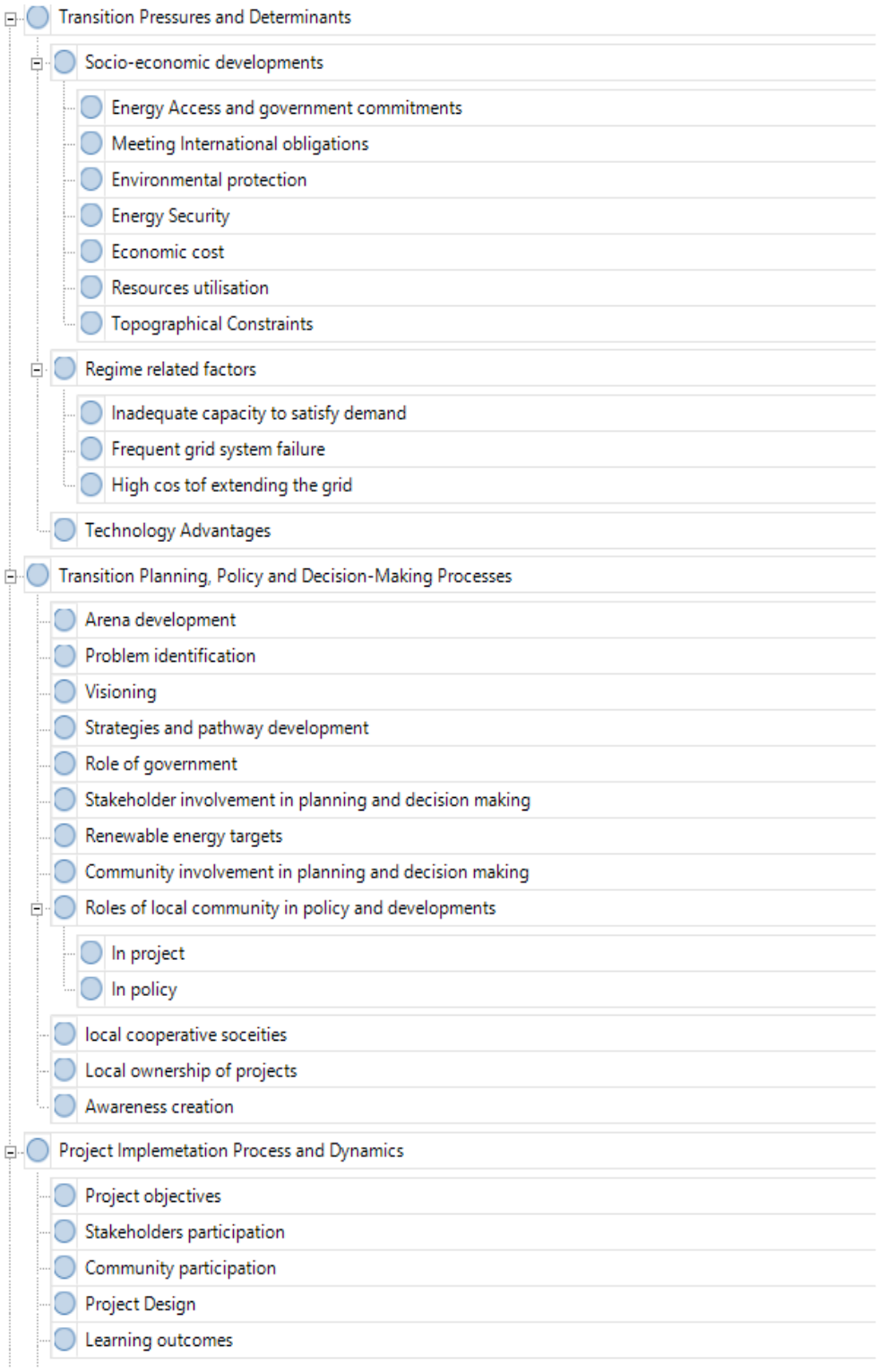
17. How do you think the local community perceives the *Shape* community renewable energy project?

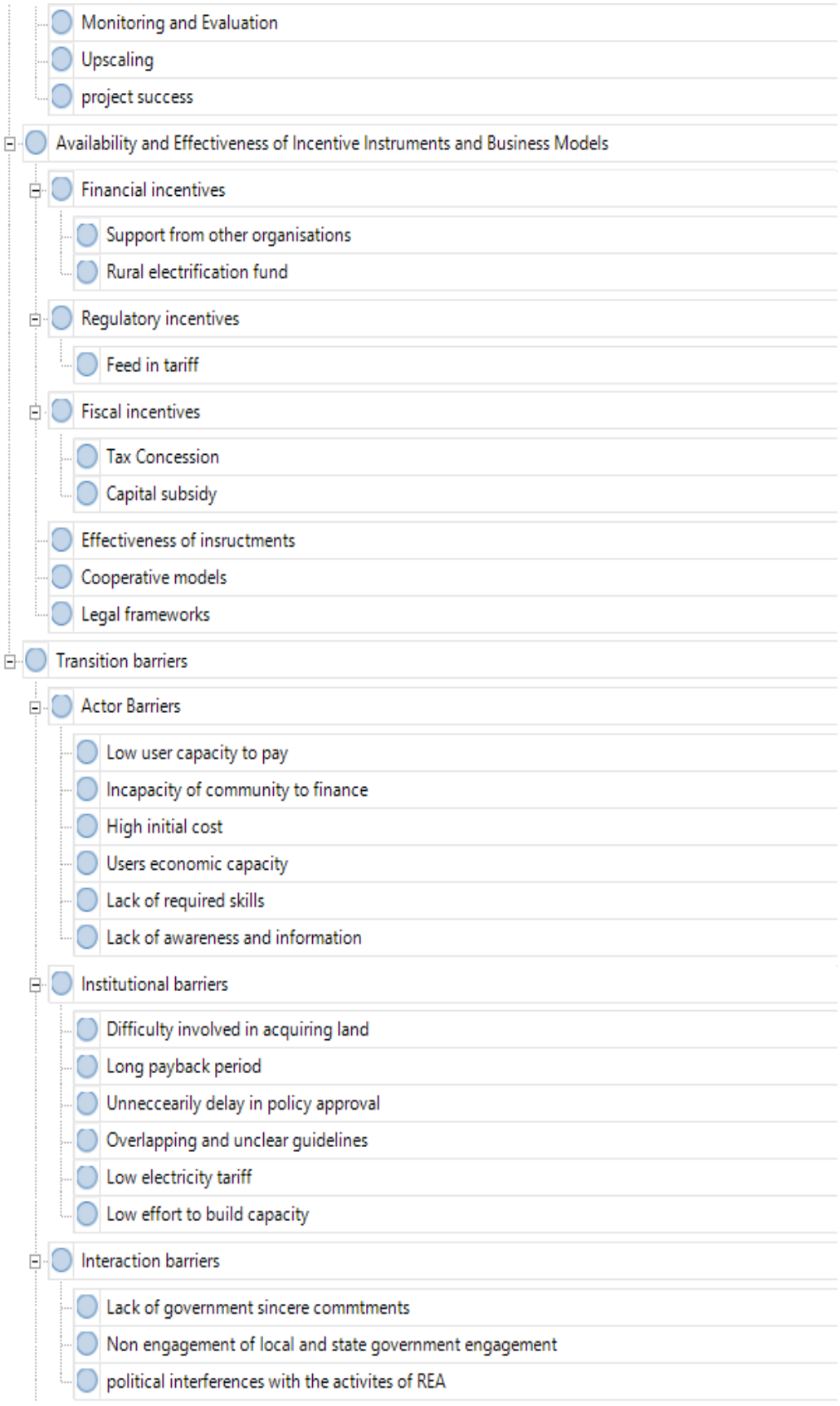
18. What do you think are the barriers for transiting to community renewable energy in electrifying off-grid rural areas?

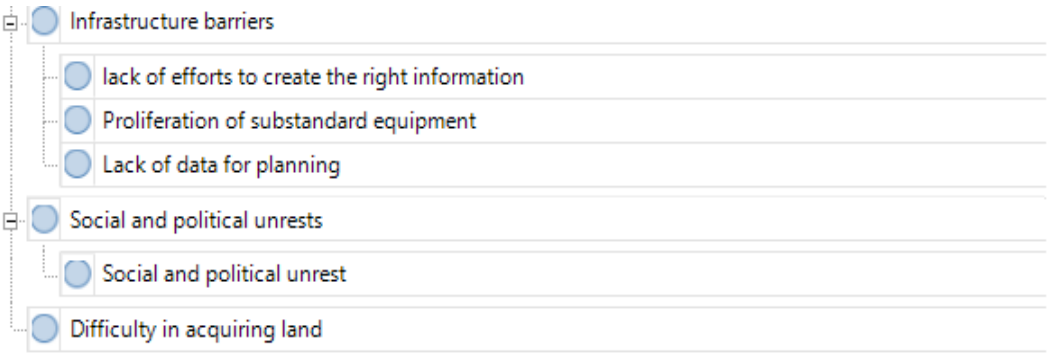
19. Are there any other comments you want to make?

Appendix II

Snapshot of Nvivo Coding Sheet




Monitoring and Evaluation
Upscaling
project success
Availability and Effectiveness of Incentive Instruments and Business Models
Financial incentives
Support from other organisations
Rural electrification fund
Regulatory incentives
Feed in tariff
Fiscal incentives
Tax Concession
Capital subsidy
Effectiveness of insructments
Cooperative models
Legal frameworks
Transition barriers
Actor Barriers
Low user capacity to pay
Incapacity of community to finance
High initial cost
Users economic capacity
Lack of required skills
Lack of awareness and information
Institutional barriers
Difficulty involved in acquiring land
Long payback period
Unneccearily delay in policy approval
Overlapping and unclear guidelines
Low electricity tariff
Low effort to build capacity
Interaction barriers
Lack of government sincere commtments
Non engagement of local and state government engagement
political interferences with the activites of REA


Infrastructure barriers
lack of efforts to create the right information
Proliferation of substandard equipment
Lack of data for planning
Social and political unrests
Social and political unrest
Difficulty in acquiring land

Appendix III

Selected Conference Presentations

Butu, A. I and Strachan, P. 2016. Critical perspectives on socio-technical transition process: A case for community renewable energy development in off-grid rural electrification in Nigeria. *22nd Annual SPRU DPhil Conference*, University of Sussex, Brighton, UK

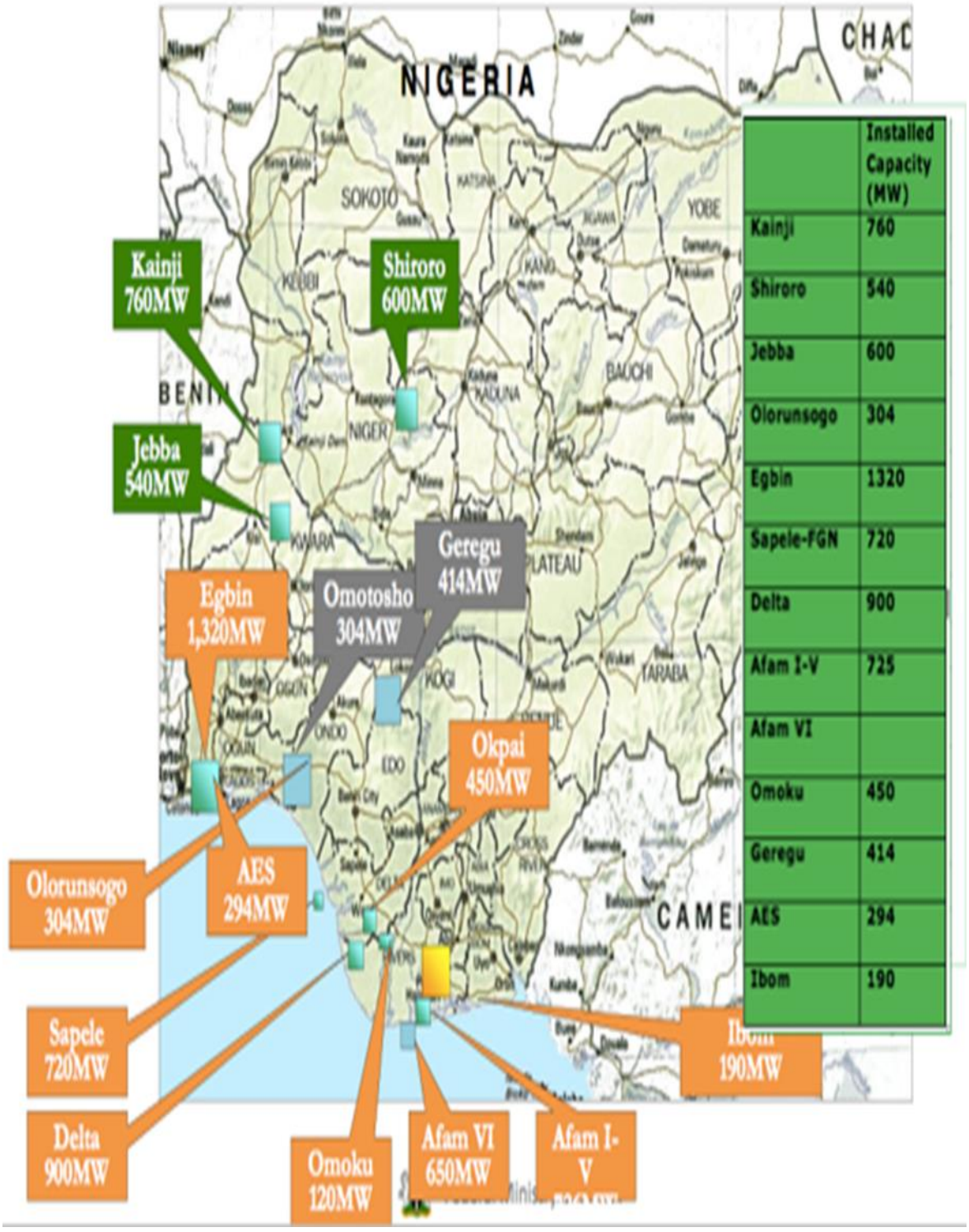
Butu, A. I and Strachan, P. 2016. Understanding Socio-technical transition determinants and blocking mechanisms. Empirical perspectives on community renewable energy in off-grid rural electrification in Nigeria. In: Joanaz de Melo, J., Disterheft, A., Caeiro, S., Santos, R.F and Ramos, T.B (eds) Rethinking Sustainability Models and Practices: Challenges for the New and Old World Contexts. *Proceedings of the 22nd International Sustainable Development Research Society Conference*. Lisbon, Portugal

Butu, A. I., Strachan, P. and Agarwal, A. 2016. Critical Appraisal of Socio-Technical Transition Process: A Case of Community Renewable Energy in Off-Grid Rural Areas Electrification in Nigeria. *7th International Sustainability Transition conference*. Wuppertal, Germany

Butu, A. I., Strachan, P. and Agarwal, A. 2016. Understanding Socio-Technical Transition Pressures and Barriers: Empirical Perspectives on Community Renewable Energy for Off-Grid Rural Electrification in Nigeria. *7th International Sustainability Transition conference*. Wuppertal, Germany

Appendix IV

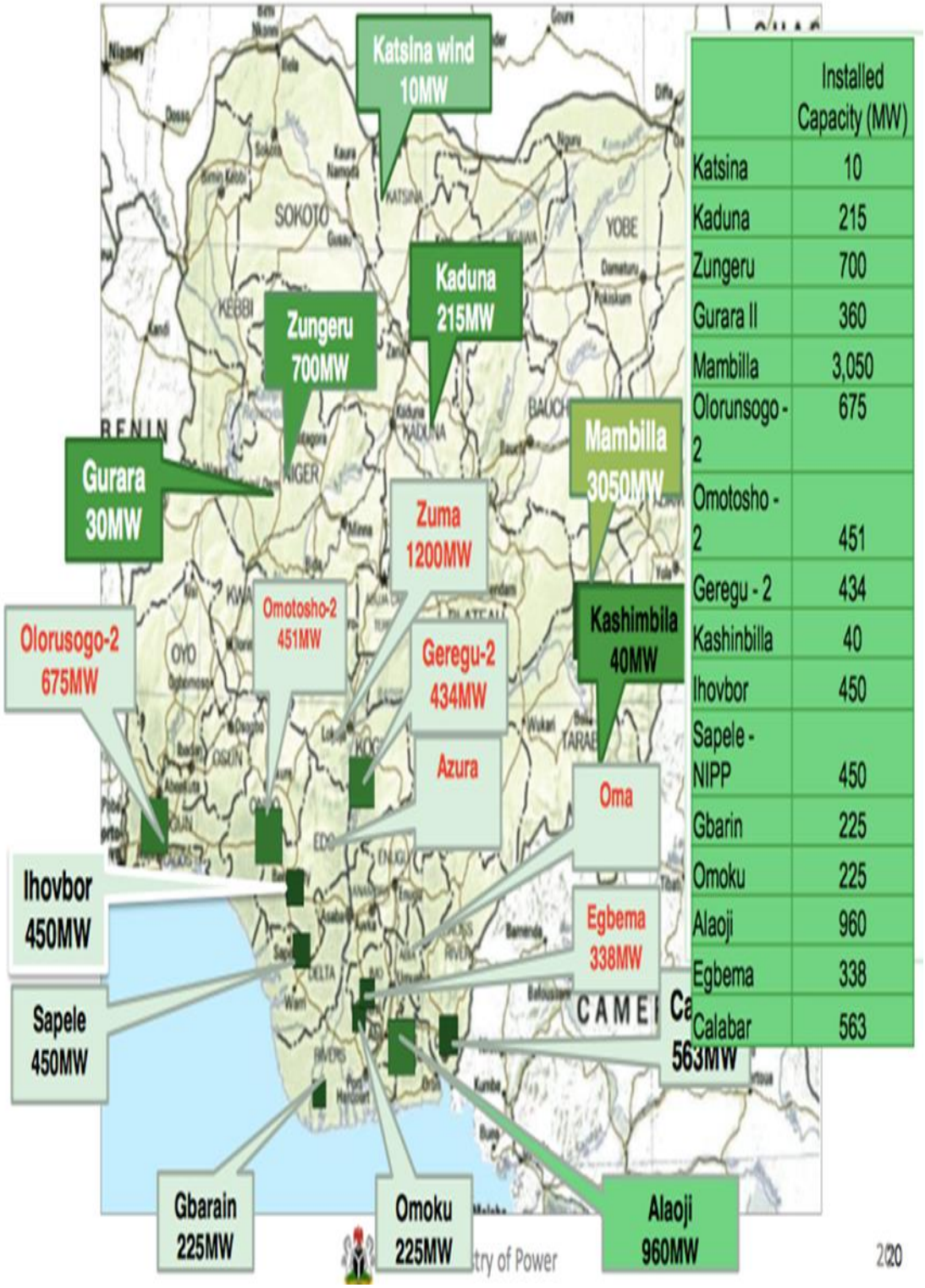
Existing Power Stations



	Installed Capacity (MW)
Kainji	760
Shiroro	540
Jebba	600
Olorunsogo	304
Egbin	1320
Sapele-FGN	720
Delta	900
Afam I-V	725
Afam VI	
Omoku	450
Geregu	414
AES	294
Ibom	190

Appendix V

Newly Completed/On-going Electricity Stations



	Installed Capacity (MW)
Katsina	10
Kaduna	215
Zungeru	700
Gurara II	360
Mambilla	3,050
Olorunsogo - 2	675
Omotosho - 2	451
Geregu - 2	434
Kashinbilla	40
Ihovbor	450
Sapele - NIPP	450
Gbarin	225
Omoku	225
Alaoji	960
Egbema	338
Calabar	563