Overcoming the Constraints to On-Grid Renewable Energy Investments in Nigeria

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Abstract

Despite several government interventions to promote on-grid renewable energy (RE) investments for nearly two decades, there is still no on-grid RE plant in Nigeria. This thesis explains why. It starts by establishing that the projected reduction in global RE prices alone will not be enough to drive on-grid RE investments and that government intervention is required, especially as on-grid RE offers an important climate change mitigation option for the country. Critically, the thesis also provides a nuanced perspective to the argument in the literature that suggests that energy transition in natural resource-rich economies is inhibited by the dichotomy between a resistive hydrocarbon-intense regime and an emerging RE niche. This thesis argues that this dichotomy is not the key constraint to adoption of on-grid RE in Nigeria. Indeed, there is little evidence for such a dichotomy at present, and it is an open question whether or not the dichotomy will emerge as a constraint to adoption of on-grid RE in Nigeria in the future. Instead, this thesis argues that there are wider industrial organisational issues that constrain all generation investments on the grid in Nigeria, including on-grid RE investments – and these constraints are sustained by certain political features commonly observed in rentier states like Nigeria. Recognising that rentier states like Nigeria are not perpetually bound to inefficient markets, this thesis also examines the political economic conditions necessary for change that enables the government to successfully promote on-grid RE investments in Nigeria. Finally, the thesis recognises the power of ideas to overcome market constraints within political restraints and proposes a policy option to successfully promote on-grid RE investments in Nigeria.

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Abbreviations

AGC	Automatic Generation Control
APC	All Progressives Congress
AT&C	Aggregated Transmission and Commercial Losses
ATC&C	Aggregated Transmission Commercial and Collection Losses
BAU	Business-As-Usual
CBN	Central Bank of Nigeria
DGSO	Domestic Gas Supply Obligation
DisCo	Distribution Company
DPR	Department of Petroleum Resources
DUoS	Distribution Use of Service
EPSR	Electric Power Sector Reform
FES	Future Energy Scenarios
FGN	Federal Government of Nigeria
FIT	Feed-In Tariff
FMEnv	Federal Ministry of Environment
FMWPH	Federal Ministry of Power, Works and Housing
GACN	Gas Aggregation Company of Nigeria
GasCo	Gas Company
GDP	Gross Domestic Product
GenCo	Generation Company
GHG	Greenhouse Gas
GSA	Gas Supply Agreement

GTA	Gas Transportation Agreement
GW	Gigawatt
GWh	Gigawatt-hour
HV	High Voltage
IOC	International Oil Company
IPP	Independent Power Producer
KPI	Key Performance Indicator
LAO	Limited Access Order
LCOE	Levelised Cost of Electricity
LNG	Liquefied Natural Gas
LRMC	Long-Run Marginal Cost
MAP	Meter Asset Provider
MDA	Ministry, Department and Agency
MLP	Multi-Level Perspective
MO	Market Operator
MW	Megawatt
MWh	Megawatt-hour
MYTO	Multi-Year Tariff Order
NACOP	National Council on Power
NASS	National Assembly
NBET	Nigerian Bulk Electricity Trading Company
NCNC	National Council of Nigeria and Cameroon
NDC	Nationally Determined Contribution

NDPHC	Niger Delta Power Holding Company
NEEP	National Electric Power Policy
NEP	Nigerian Electrification Program
NEPA	National Electric Power Authority
NERC	Nigerian Electricity Regulatory Commission
NESI	Nigerian Electricity Supply Industry
NESO	Nigerian Electricity System Operator
NGC	Nigerian Gas Corporation
NGN	Nigerian Naira
NIPP	National Integrated Power Projects
NNPC	Nigerian National Petroleum Corporation
NPC	Northern People Congress
NREEEP	Nigerian Renewable Energy and Energy Policy
OAO	Open Access Order
ONEM	Operator of the Nigerian Electricity Market
PCOA	Put-Call Option Agreement
PDP	Peoples Democratic Party
PEEST	Political, Economic, Environmental, Social and Technology
PHCN	Power Holding Company of Nigeria
PRG	Partial Risk Guarantee
PSRP	Power Sector Recovery Programme
PSRP	Power Sector Recover Program
PV	Photovoltaic

RE	Renewable Energy
REFIT	Renewable Energy Feed-In Tariff
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
SCADA	Supervisory Control and Data Acquisition
SCP	Structure-Conduct-Performance
SCPR	Structure-Conduct-Performance-Regulation
SO	System Operator
TCN	Transmission Company of Nigeria
TEM	Transitional Electricity Market
TSP	Transmission System Planning
TUoS	Transmission Use of System
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollar
VAT	Value Added Tax
WACC	Weighted Average Cost of Capital

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1 Introduction

1.1 Background

Economic prosperity in low and middle-income nations including those in Sub-Saharan Africa (SSA), is dependent on productive energy consumption (Eggoh et al., 2011; Kahsai et al., 2012; Pablo-Romero and Sánchez-Braza, 2015). Twenty-seven out of the world's twenty-eight poorest countries are in Africa, and all twenty-seven have poverty rates above 30% (World Bank, 2019a). Only 42.7%[1] of the population in SSA has access to electricity (World Bank, 2019b). Nigeria, SSA's most populous country has just 59%[2] electricity access for its 190 million people (World Bank, 2019b), and those with access do not receive adequate and reliable supply. The demand-supply gap in Nigeria's electricity sector has far-reaching implications for the economic growth and social wellbeing of Nigerians. The electricity sector is suffering from frequent outages to the point that almost all industrial consumers and a significant number of residential and other non-residential consumers generate their own electricity at enormous costs to themselves and the Nigerian economy. The Federal Government of Nigeria (FGN), in its effort to develop a sustainable electricity industry, privatised the sector in 2013; however, as shown in Chapter 3, performance is stagnant.

Nigeria's gas-dominated electricity sector has a liquidity crisis, and it is susceptible to gas pipeline sabotage and global oil and gas market shocks. Its impact on the environment is also

[1] In 2016.
[2] Ibid.

often detrimental, especially in the Niger Delta region of Nigeria where oil and gas firms mine the raw fuels. As Nigeria pushes its economic growth agenda, gas power generation on the grid, which currently accounts for 71% of electricity supply[3] (will increase over the next few decades causing a higher demand for fossil fuels. This may lead to further degradation of the environment, especially in the Niger Delta.

In addition to environmental degradation resulting from fuel mining, Nigeria also suffers the devastating effects of climate change, which is in part, caused by global fossil-fuelled energy production. Africa is one of the most vulnerable continents to climate change due to its low adaptation capacity. The devastating impacts of climate change includes the loss of life and properties, and enormous damage to infrastructure and ecological systems (Bouwer, 2019). Its impacts also include the exacerbation of communal conflicts as natural resources such as freshwater becomes scarce, especially in vulnerable areas of the country (Akpodiogaga & Odjugo, 2010; Osuafor and Nnorom, 2014). The DfID (2009) estimated that climate change impacts could cost Nigeria between 6% and 30% of its GDP by 2050, which could be worth between USD 100 billion and USD 460 billion. The lifestyle and security of communities around Lake Chad in north-eastern Nigeria have also been drastically affected as the lake reduced to 5.6% of its size in 1960 by 2010 (Akpodiogaga-a and Odjugo, 2010). Nigeria committed itself to the global effort to combat climate change when it signed the Paris Agreement in 2015 at the

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[3] Secondary data collected from the National Control Centre in Osogbo, Osun State, Nigeria. 21st October 2017.

United Nations Framework Convention on Climate Change (UNFCCC) and subsequently developed its Nationally Determined Contribution (NDC), the country’s strategy to combat climate change and its impacts.

In Nigeria’s NDC, the country committed to deploying renewable energy (RE) technologies among other strategies to mitigate climate change. However, Nigeria’s NDC only considered the deployment of small-scale RE technologies, amounting to 13 Gigawatt (GW), even though deployment of large-scale RE technologies has been considered for two decades in Nigeria. This thesis looks into large-scale RE as a climate change mitigation option in a context where expansion of energy supply is urgently needed. It also looks into why utility-scale on-grid RE investments have been constrained in Nigeria.

1.2 Importance of On-Grid Renewable Energy

RE is a critical part of the solution to the double-edged problem of global environmental concerns and the energy crisis in low- and middle-income countries such as Nigeria. RE avoids the environmental and reliability issues associated with gas-fuelled energy production. This is especially important in Nigeria where there is an inadequate gas pipeline infrastructure. RE can be deployed in two ways: off-grid and on-grid.

Off-grid solutions include RE-powered portable devices, RE-powered home systems, RE-powered mini-grids, and large-scale captive[4] power plants. These systems do not require the existing grid infrastructure[5].

On-grid solutions can be grouped into two. In one group, it can be deployed in a similar way to conventional utility-scale power plants, which generate electricity at a large plant and send energy out to the electricity grid before it reaches the consumer. In the other group, it can be deployed as a hybrid RE system capable of operating in both on-grid and off-grid modes.

While the deployment of both off-grid and on-grid solutions will contribute to the solutions to the energy crisis in Nigeria, this thesis focuses on on-grid utility-scale RE deployment for two reasons. First, on-grid RE systems provide a cheaper electricity solution than off-grid technologies due to the economies of scale achieved with large on-grid RE projects. Off-gird solar PV solutions in Nigeria can cost between USD 0.46/KWh to USD 0.86/KWh (NESG, 2018), while the on-grid solar PV projects in Nigeria are expected to cost USD 0.115 (GCF, 2019). Second, the productive consumption required for economic development is usually found in urban areas (Glaeser and Xiong, 2017), which are usually already connected to the electricity grid. This makes on-grid RE an ideal solution for productive electricity consumption and economic development. Off-grid RE deployment is an important component of the solution to

[4] Captive power plants serve a customer or cluster of customers without the grid infrastructure.
[5] The grid infrastructure is the interconnected network of generation plants, high voltage transmission lines, sub-stations, and the distribution lines.

solve the energy crisis in Africa and Nigeria; however, it needs to be accompanied by on-grid RE deployment.

1.3 Slow Adoption of Renewable Energy

Africa is endowed with substantial RE resources, which include but are not limited to, hydro, solar, wind, geothermal, and biomass resources. Africa has the potential to meet nearly a quarter of its energy needs from indigenous RE by 2030, requiring an average annual investment of USD 70 billion to 2030 (IRENA, 2019). However, despite the abundance of RE resources in Africa, the adoption of RE technologies has been limited. In 2018, the continent produced only 4% of its grid electricity from RE sources excluding LHP stations (IEA, 2019). In the European Union, it reached 38% in the 2020 (Agora Energiewende and Ember, 2021).

In Nigeria, RE is emerging as a popular off-grid solution, gradually displacing expensive off-grid diesel-fuelled electricity generation units. However, the adoption of on-grid RE plants is yet to begin. In the Nigerian electricity supply industry (NESI), which supplies on-grid electricity to grid-connected consumers, the available electricity supply capacity is between 3,000 MW to 4,500 MW[6]. The on-grid generation capacity is made up of large hydro and gas power stations with no other RE generation capacity. The FGN has promoted on-grid RE through industrial policies for almost two decades, leading to its procurement of fourteen on-grid solar photovoltaic (PV) projects in 2016. These fourteen projects have a joint capacity of over 1,000 Megawatts

[6] Secondary data collected from the National Control Center, Osogbo, Osun State, Nigeria. 21 October 2017.

(MW) accounting for one-ninth of the FGN's 2030 on-grid RE capacity target of 9,000 MW. The FGN's on-grid RE target, which is called Vision 30:30:30, aims to reach 30,000 MW of total available on-grid electricity generation capacity by 2030 with 30% of that capacity made up of RE technologies. This thesis explains why the fourteen solar PV investments have been constrained and had not reached financial close three years after being procured by the government[7]. It also explains how the integration of on-grid RE will affect the Nigerian electricity market and what contribution it might make as a climate change mitigation option.

1.4 Conceptual Approaches for Energy Transition

The first fourteen on-grid RE projects procured by the FGN in 2016 have been stalled, and the associated investments have been constrained. This thesis seeks to explain why and to understand what is required to stimulate unblock investments in on-grid RE generation in Nigeria in coming years. As such, it aims to contribute to the understanding on the challenges confronting investment in large-scale RE investment in Africa.

This research work is set within the wider energy transition literature about the conditions required for energy transition from hydrocarbon fuels to renewables. Several conceptual frameworks have been developed and proposed to understand energy transitions. These conceptual frameworks include the carbon curse theory and the multi-level perspective (MLP) theory.

[7] The 14 projects had still not reached financial close when this thesis was submitted on the 25 April 2021.

The carbon curse theory, which is discussed in Chapter 2, proposes that countries endowed with surplus hydrocarbon fuels are likely to have higher GHG emissions than countries that do not (Friedrichs and Inderwildi, 2013). Two of the four key arguments in the carbon curse theory suggest that the energy mix of a country is influenced by institutionalised hydrocarbon fuel subsidies and easy access to hydrocarbon fuels in fuel-rich countries. This suggests that the dominant hydrocarbon fuel industries and legacy hydrocarbon infrastructure in fuel-rich countries inhibit and, to an extent, resist energy transitions. The implication is the establishment of a dichotomy between emerging renewables and a resistive hydrocarbon regime.

From the MLP theory literature, which is also discussed in Chapter 2, one can infer the same dichotomy. The MLP theory emphasises the social-cultural drivers of energy transitions, recognising the interaction between people and technology in 'socio-technical systems' (Geels, 2011). It also recognises that most sustainable technological transitions struggle to compete with established technology regimes, especially when external costs of established technologies are not considered; and that the involvement of dominant incumbent firms in supporting new technologies is often required to accelerate the breakthrough of technological innovations (Geels, 2011). The MLP theory literature tends to conclude that resistive technology regimes inhibit innovative technologies (Pohlmann, 2019).

The prevailing theme across the literature that uses these conceptual frameworks is the existence of a dichotomy between an emerging RE niche and a resistive hydrocarbon-intense regime. This thesis argues that this dichotomy is not the key constraint to adoption of on-grid RE in Nigeria. Indeed, there is little evidence for such a dichotomy at present, and it is an open question whether or not the dichotomy will emerge as a constraint to adoption of on-grid RE in Nigeria in the future. Instead, this research argues that there are wider industrial organisational issues that constrain all generation investments on the grid in Nigeria, including on-grid RE investments – and these constraints are sustained by certain political features commonly observed in rentier states like Nigeria.

Chapter 4 will show how all new on-grid generation investments (including on-grid RE investments) have been constrained by an electricity market liquidity crisis, which is caused by three key industrial organisational dynamics – particularly an unsustainable electricity retail subsidy regime, which locks distribution companies into a vicious circle of poor performance and low payment collection and creates a problem of indebtedness for the whole on-grid electricity market. These industrial organisational dynamics have caused a liquidity crisis in the on-grid electricity Market in Nigeria. Chapter 4 also shows how certain rentier state characteristics, including the rentier mentality and low administrative capacity have sustained the industrial organisational dynamics that enable the liquidity crisis. All of these factors come together to create the liquidity crisis that inhibits all new generation investments on the grid (including on-grid RE investments).

Finally, this thesis also argues that to successfully promote on-grid RE investments in Nigeria, certain critical political conditions must emerge. The successful promotion of on-grid RE investments or energy transition requires an understanding of the political dynamics that make it happen. As Osunmuyiwa et al (2018) argued, the energy transition literature would benefit from political economy literature as political intricacies shape transition trajectories. This draws on political economic insights from the RST and Khan' (2010) political settlement theory. It also uses the political settlement theory-based causal dynamics developed by Whitfield et al (2015) to explain the conditions for change – the conditions that enable the government's intervention to promote on-grid RE investments in Nigeria.

1.5 Case Study Selection

To provide deeper insights into energy transition and its constraints, this thesis uses Nigeria as a case study for three important reasons. First, Nigeria is an oil and gas producing state with an intricate dependence on oil rents and on that exhibits features of a rentier state (Omoje, 2006; Adogamhe, 2008). The hydrocarbon-intense oil and gas sector in Nigeria is an important industry to Nigeria's economy, accounting for 65% of government revenues (NEITI, 2016). Nigeria is a useful case with which to examine the causal dynamics that constrain energy transition in fuel-rich and fuel-dependent countries, especially does that exhibit the rentier mentality. It is also useful for competitive clientelist countries where the removal of institutionalised benefits poses high social costs to the ruling political coalition.

Second, Nigeria also provides a useful case for analysis because it is emblematic of many sub-Saharan African Countries with relatively low productivity and low industrial activity. According to Whitfield et al (2015), a common feature of post-independent African economies was the relative weakness of capitalists at independence. The issue of weak capitalists in newly independent African states was compounded by rivalling and struggling political coalitions that controlled access to economic rent to maintain power (Whitfield, 2015). Therefore, political support has been necessary for technology adoption that have the potential to redistribute rent. Nigeria provides a useful case to understand the political conditions required for energy transitions in countries where market forces are often subordinate to political calculus. This much was also recognised in Chapter 3, where the author used a bottom-up modelling approach, recognising that in the electricity market in some low and middle-income countries, non-market forces can distort energy transition trajectories (Urban et al., 2007; Shukla, 1995).

Third, Nigeria's energy demand is expected to increase rapidly as it has Africa's largest population at about 190 million people with an annual population growth rate of 2.6% (World Bank, 2019c). Nigeria's population is expected to reach 400 million by 2050, and has the potential to have a GDP size of USD 7.3 trillion by 2050 – 40% of the current size of the European Union – compared to USD 397 billion in 2018 (PWC, 2015). Nigeria's energy mix in the coming years is vital as it has the potential to be a large contributor to greenhouse gas emissions (GHG). It is important to understand how energy transition could unfold in Nigeria; what could constrain energy transition; and what impacts energy transition could have on Nigeria's electricity market.

1.6 Research Design

1.6.1 Research Goal

The overarching research question in this thesis is "how can the constraints to on-grid RE be overcome in Nigeria?" To answer this overarching question, it is important to first understand the in-depth causal dynamics that create constraints to on-grid RE investments in Nigeria. That way, it becomes less challenging to identify an answer to the overarching question. Second, it is also important to understand how the constraints can be overcome through government intervention in a country such as Nigeria, recognising that powerful political (non-market) as well as economic forces can reinforce existing policy positions. Given that government intervention or policy in itself is a political process, it is not enough for government to adopt a policy, governments also need to be able to successfully implement that policy. This thesis explains the conditions necessary for the government to successfully intervene to promote on-grid RE investments in Nigeria.

1.6.2 Research Questions

The overarching question can be broken down into three research questions:

1. What part will falling RE prices play in driving the on-grid RE transition in Nigeria?
2. How are on-grid RE investments in Nigeria constrained?
3. What are the political economic conditions that must emerge to successfully implement the government's policy to drive on-grid RE investments in Nigeria?

1.6.3 Research Objectives

In line with the three research questions, this thesis has three research objectives:

I. To understand whether or not the project reduction in RE costs will drive on-grid RE investments in Nigeria.
II. To establish the causal dynamics in the electricity market that constrain on-grid RE investments in Nigeria.
III. To establish the political economic conditions that must emerge to successfully implement the government's policy to drive on-grid RE investments in Nigeria.

1.6.4 Research Boundary

While this thesis seeks to understand the constraints to on-grid RE investments in Nigeria, it focuses on the constraints to on-grid solar photovoltaic (PV) investments in Nigeria. This is because solar PV technology is the most advanced technology in terms of readiness for deployment on the grid in Nigeria. All fourteen RE projects that were procured in 2016 from the private sector by the government are on-grid solar PV projects. Chapter 3 explains that the projected falling price of RE technologies alone will not drive on-grid RE investments. It also estimates the potential of on-grid RE as a climate change mitigation option, which should make it a priority for the Nigerian government. Chapters 4 explains the constraints to the fourteen procured on-grid solar PV projects in Nigeria. Chapter 5 of this thesis explains the political economic conditions that need to emerge before these projects reach financial close.

1.6.5 Research Methods

This thesis uses an interdisciplinary approach – energy modelling, industrial organisation, and political economy – due to the nature of the research questions. Using an inter-disciplinary approach can increase the explanatory power of research (Cheng et al, 2009). The interdisciplinary approach used in this thesis looks both to understand forces that constrain the energy transition and identify politically credible ways forward. Amongst other contributions, the energy modelling chapter (Chapter 3) establishes that market forces alone will not drive the transition to on-grid RE in Nigeria – the dramatic and ongoing fall in the international price of solar PV notwithstanding. As Daggash (2020) shows in her energy modelling results, intermittent RE technologies would not be deployed in a least-cost scenario to meet Nigeria's 2030 climate change mitigation targets – "not even solar PV".

The industrial organisational analyses in Chapter 4 shows the systemic problems in the NESI that constrain all new investments on the grid in Nigeria, both conventional and RE. The analyses in Chapter 4 also benefits from insights in the rentier state literature.

The political economic approach in Chapter 5 gives additional insights into the political constraints to on-grid RE investment but critically, explains the processes and the conditions for change in apparently unpromising contexts. Grounded in Mushtaq Khan's (2010) theory of political settlements, the approach in Chapter 5 recognises that policy both reflects and contributes to the distribution of power within a society. The approach in Chapter 5 directs attention to the power and interests of political elites; the influence and technological capabilities of the firms in the electricity industry; and the relationships of both with the relevant regulatory and administrative agencies. Given the prevailing political settlement, efforts to achieve policy change must consider the relative power of forces in favour of and opposed to any proposed change. The political economic approach in Chapter 5 is complemented by Rodrik's (2014) insights into the power of ideas in devising innovative ways to shift the political calculus around change. Hence, the thesis includes the presentation of an innovative policy option in chapter 6.

As befits an inter-disciplinary thesis, each of the chapters has its own methodology. These are explained in detail in the relevant chapters. However, in sum, Chapter 3 uses a bottom-up quantitative simulation method to examine future energy scenarios, showing the impact of on-grid integration on electricity price and carbon emissions. Chapter 4 employs a case study approach that uses theory-driven thematic analysis to analyse qualitative and descriptive quantitative data that corroborate and complement the industrial organisational theoretical propositions that explain constraints to on-grid RE investments. Chapter 5 uses process tracing and a comparative case study method to demonstrate the causal dynamics that explain the conditions for successful government intervention, using qualitative and descriptive quantitative data.

For Chapter 4 and 5, which both required stakeholder interviews, data was collected from 23 semi-structured interviews with industry and political stakeholders (See Table 1.1.). Other data sources included industry reports; primary industry data; and news articles. The interviews were conducted in three Nigerian cities – Lagos, Abuja and Osogbo – and Abidjan, Cote d'Ivoire in the period between January and December 2018. Insights from two out of the twenty-three interviewees contributed only to the Chapter 4, while one of the twenty-three interviews only contributed to Chapter 5 as shown in Table 1.1. The other twenty interviews contributed to both chapters.

Table 1.1: Table of Interviewees.

S/N	Key Interviewee Attribute	Data Relevancy	Interview Location	Mode of Engagement	Interview Date
1	DisCo Executive	Chapters 4 and 5	Nigeria	Face-to-face	05-Apr-18
2	DisCo association	Chapters 4 and 5	Abuja, Nigeria	Face-to-face	06-Jun-18
3	State-owned electricity trader	Chapter 4	Abuja, Nigeria	Face-to-face	19-Feb-18
4	State-owned electricity trader	Chapter 4	Abuja, Nigeria	Face-to-face	19-Feb-18
5	Private Sector GenCo	Chapters 4 and 5	Abuja, Nigeria	Face-to-face	13-Mar-18
6	Private Sector GenCo Former NESI liberalization policy maker	Chapters 4 and 5	Abuja, Nigeria	Face-to-face	24-Feb-18
7	State-owned GenCo Former state-owned electricity trader	Chapters 4 and 5	Abuja, Nigeria	Face-to-face	26-Feb-18
8	GenCo Association	Chapters 4 and 5	Abuja, Nigeria	Face-to-face	31-May-18
9	RE Project Developer	Chapters 4 and 5	Abuja, Nigeria	Face-to-face	07-May-18
10	International Development Financier	Chapters 4 and 5	Abuja, Nigeria	Face-to-face	28-Apr-18
11	International Development Practitioner	Chapters 4 and 5	Abuja, Nigeria	Face-to-face	27-Apr-18
12	International Development financier	Chapters 4 and 5	Abuja, Nigeria	Face-to-face	03-May-18
13	International development financier	Chapters 4 and 5	Abidjan, Cote d'Ivoire	face-to-face	20-Nov-18
14	International development financier	Chapters 4 and 5	Abidjan, Cote d'Ivoire	face-to-face	22-Nov-18
15	Liberalisation Policy Maker (NESI & telecoms)	Chapters 4 and 5	Abuja, Nigeria	Face-to-face	02-May-18
16	Top NESI bureaucrat	Chapters 4 and 5	Abuja, Nigeria	Face-to-face	05-Jun-18

S/N	Key Interviewee Attribute	Data Relevancy	Interview Location	Mode of Engagement	Interview Date
	Policy maker Top RE policy maker Former PHCN staff				
17	Policy maker	Chapters 4 and 5	Abuja, Nigeria	Face-to-face	21-May-18
18	Electricity sector regulator	Chapters 4 and 5	Abuja, Nigeria	Face-to-face	06-Mar-18
19	International development financier NESI Policy maker	Chapters 4 and 5	Abuja, Nigeria	Group face-to-face	28-Apr-18
20	Transmission Company senior staff	Chapters 4 and 5	Abuja, Nigeria	Face-to-face	21-Feb-18
21	Transmission substation operator	Chapters 4 and 5	Osun, Nigeria	Face-to-face	24-Jan-18
22	Retired PHCN Staff (Transmission)	Chapters 4 and 5	Osun, Nigeria	Face-to-face	25-Jan-18
23	Top political elite (once inside the ruling political coalition & then outside the ruling coalition)	Chapter 5	Abuja, Nigeria	Face-to-face	03-Dec-18

1.7 Thesis Structure

This thesis is divided into six chapters as shown in Figure 1.1**Error! Reference source not found.**. This chapter provides the overarching argument of the thesis. It defines the research goal, objectives, and questions. It also includes a context and rationale for this work. It explains why it is important for this thesis to investigate the constraints to on-grid RE investments on the grid in Nigeria.

Chapter 2 reviews the prevailing arguments in the literature about the constraints to on-grid RE deployment. It provides a nuanced perspective to the prevailing energy transition argument that suggests that there is an existing dichotomy between emerging renewables and a dominant hydrocarbon-intense energy regime in fuel-rich low and middle-income countries. The conclusions of the literature review suggest that there are wider industrial organisational constraints to all new on-grid generation investments, including on-grid RE. It also shows how certain features common in rentier states sustain those wider industrial organisational constraints. Finally, it justifies the interdisciplinary approach used in this thesis and shows how each approach helps to answer the overarching research question.

Chapter 3 assesses the impacts of on-grid RE integration on wholesale electricity price in Nigeria from 2016 to 2030. The chapter investigates the pricing story on-grid RE technologies in in Nigeria. This Chapter presents the consequence of reaching the FGN’s 2030 RE target at varying levels of success, showing the upward pressure it has on electricity price. It shows that price will still be a constraint up to 2030, establishing the need for government intervention to drive on-grid RE investments. However, the Chapter also shows the importance of on-grid RE deployment as a climate change mitigation option for Nigeria. It uses a bottom-up approach to build future RE scenarios based on the FGN’s Vision 30:30:30 RE capacity target, and then compares them to a business-as-usual (BAU) scenario. All scenarios in this chapter were simulated in PowerPlan, an energy system simulation tool that allows users to run scenarios from the point of view of a central planning institution.

Chapter 4 presents the industrial organisational and political constraints to on-grid RE in NESI. It uses the SCPR framework, augmented by insights from the rentier state theory, to show how certain industrial economic constraints (sustained by key rentier state features) inhibit the performance of the electricity market. It also shows how the underperformance of the NESI has prompted government policy measures that inhibit all on-grid generation investments, including on-grid RE investments.

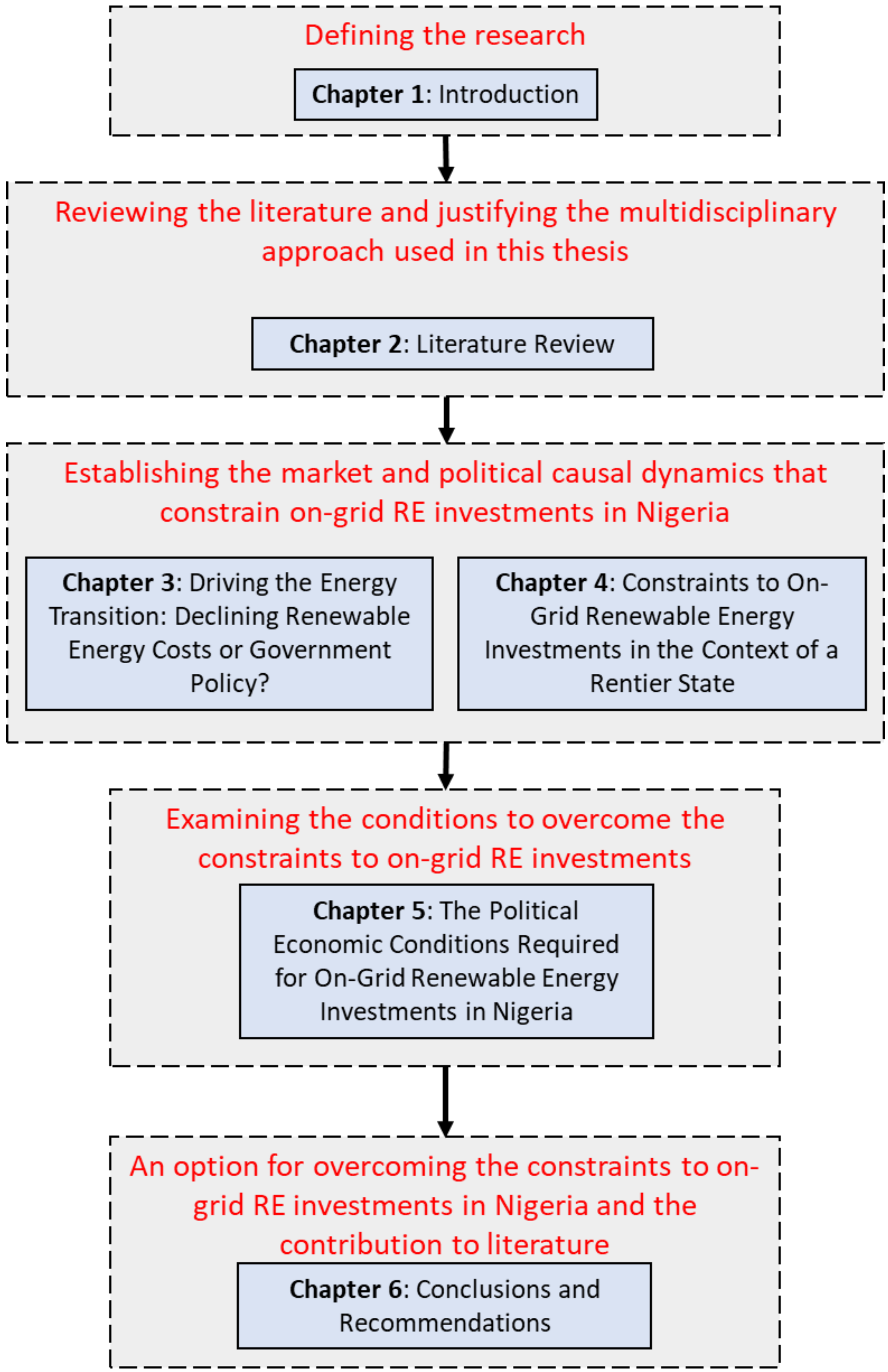

Figure 1.1: Thesis Structure.

This chapter contributes to the energy transition literature by providing nuanced insights into how industrial organisation and political dynamics can impact energy transitions beyond the prevailing argument that there is a dichotomy between emerging renewables and resistive incumbent hydrocarbon-intense regimes.

Chapter 5 uses the politics of industrial policy framework to show how the absence of certain critical political economic conditions have constrained the government's effort to drive change and promote on-grid RE investments in Nigeria. A comparative case study method was used in this chapter to analyse the implementation of industrial policies in the telecoms and electricity sectors. This chapter shows how three political economic conditions emerged during the successful telecoms sector reforms. However, these political conditions have not emerged within the FGN's RE drive and the wider liberalisation reforms of the NESI.

Chapter 6 presents the conclusions of this thesis. Leaning on Rodrik's (2014) emphasis on the power of ideas to overcome market inefficiencies within political constraints, it also proposes a policy option that can sidestep the constraints to on-grid RE investments in Nigeria. Finally, it presents this thesis' contribution to literature and recommends areas for further research.

2 Literature Review

2.1 Introduction

Notwithstanding regional RE costs, many countries, including several low and middle-income countries, have adopted and promoted on-grid RE for climate change mitigation and energy security (IRENA, 2019). However, despite decades of government efforts to promote on-grid RE investments, there is still no on-grid RE power plant deployed in Nigeria. This thesis investigates why on-grid RE deployment in Nigeria is slow.

This literature review has three objectives. First, it discusses several previously used conceptual approaches in the energy transition literature, recognising the insights they can provide for this research and discussing the limitations in using them to understand how to overcome the constraints to on-grid RE investments in Nigeria. Second, this literature review presents the key concepts used in this thesis, explaining how they address the limitations of other conceptual approaches. Finally, this chapter presents the interdisciplinary conceptual approach used in this thesis, establishing the thread that runs through all the key conceptual frameworks used for this research.

2.2 Conceptual Approaches in the Literature

2.2.1 The Carbon Curse Theory

Notwithstanding the cost, the deployment of on-grid RE serves, in part, to mitigate climate change by reducing emissions in the electricity sector. RE technologies supplement and should eventually displace hydrocarbon-intense technologies in the energy mix when low-carbon energy and power balancing technologies that address the intermittency of some RE technologies become more mainstream. The transition from a hydrocarbon-intense energy mix towards a less hydrocarbon-intense energy mix has proven problematic in many hydrocarbon-based fuel-rich countries, including Nigeria (Aliyu et al., 2015; Atalay et al., 2016). The concept of the 'carbon curse' has been developed to explain why countries endowed with high-hydrocarbon fuels are likely to have enduringly higher GHG emissions than countries that do not (Friedrichs and Inderwildi, 2013).

The carbon curse is distinct from the resource curse (Collier, 2007) even though they share a similar conceptual foundation about the adverse effects of surplus natural resources. The resource curse theorises that countries that are endowed with rich natural resources tend to have slower economic growth, due in part to exchange rate overvaluation known as 'Dutch disease', less democracy, and worse development outcomes than countries that are not endowed with rich natural resources (Mehlum et al., 2006). Although Dutch disease partially mitigates the carbon curse by constraining hydrocarbon-intense industrial activity such as manufacturing, Friedrichs and Inderwildi (2013) propose four causal mechanisms that nevertheless make hydrocarbon-based fuel-rich countries prone to high hydrocarbon intensity. They argue that the hydrocarbon intensity in a country is determined by the energy intensity of economic activities in the country and the hydrocarbon contribution to the energy mix of the country. Two of the four mechanisms in the carbon curse theory influence the energy mix of a country and are, therefore, relevant to understanding the constraints to on-grid RE investments in Nigeria.

The first relevant causal mechanism is 'fuel-related crowding out', whereby easy access to hydrocarbon-based fuels, made possible by the presence of legacy fuel extraction infrastructure, can crowd out other sources of energy. Legacy fuel extraction infrastructure for hydrocarbon fuels may either make it cheaper to use hydrocarbon fuels domestically or institutionalise a cultural position in public discourse about the perceived ease of access to surplus fuels.

In Nigeria, relatively easy access to natural gas may be caused by the existing infrastructure to extract oil and gas for the export market. The carbon curse argues that this has made the country lean towards gas as its main source for domestic electricity generation. This causal mechanism may provide insights into the constraints to on-grid RE investments in Nigeria. In 2016, electricity from gas-fired power stations accounted for about 71%[8] of electricity sent out to the national electricity grid. Of the last nine power plants deployed on the grid in Nigeria, all have been gas power plants.

However, outside the electricity sector, the wider hydrocarbon intensity of Nigeria is low due to the opposite crowding out effect of the resource curse and Dutch disease. The abundance of oil and gas in Nigeria has stifled other hydrocarbon-intense activities, such as manufacturing, in the country.

Mayer and Rajavuori, (2017) argue that the carbon curse's crowding out effect in a country's energy mix may be overcome by state ownership policies. They argue that state ownership of initial RE assets can send a signal to investors that the state is genuinely interested in energy transition. However, as Mayer and Rajavuori (2017) admit, state ownership policies are not magic bullets because state-owned enterprises, like other investors, are constrained by both the risk of the market and the willingness of the state to financially support them.

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[8] Secondary data collected from the National Control Centre in Osogbo, Osun State, Nigeria. 21st October 2017.

The second relevant causal mechanism proposed in the carbon curse theory is the existence of uneconomic ‘fuel consumption subsidies’, which fuel-rich countries often come under domestic political pressure to provide and then find difficult to withdraw. The fuel subsidies result in wasteful fuel consumption but may also discourage investment in alternative sources of energy. The theory argues three points within this causal mechanism.

Firstly, the presence of surplus fuels creates expectations from citizens, who believe they are entitled to share in the benefit of natural resource wealth. Fuel subsidies become a feature of national budgets, and bureaucracies are established to administer them. Citizens then become reliant on these subsidies, and it becomes difficult to remove those subsidies even when facing the unsustainable depletion of fuel reserves. For example, in Ecuador, many citizens believe that fuel subsidies only account for a small proportion of resource rent and do not trust their government to spend additional public revenues in a productive way if fuel subsidies were removed (Jakob, 2017).

The second point is that in most fuel-rich countries, subsidised fuel prices are still higher than the cost of fuel production. The cost of fuel subsidies is, therefore, not a direct fiscal cost, but the opportunity cost of not exporting fuels at the international price. This is not felt directly by citizens, whereas higher fuel prices are felt if subsidies are removed. The third point is that, even in some countries where the cost of production is higher than the subsidised domestic fuel price, income from high export prices can subsidise domestic fuel supply.

In summary, the carbon curse theory proposes two useful causal mechanisms relevant to understanding the constraints to on-grid RE energy investments in Nigeria. The first is the constraining effect that relatively easy access to surplus hydrocarbon fuels, via existing fuel extraction infrastructure, can have on other sources of energy. The second is the constraining effect that natural gas subsidies for electricity generation can have on economic competitiveness of on-grid RE investments. However, while the carbon curse theory provides useful insights, it cannot, on its own, sufficiently explain the constraints to on-grid RE investments on the grid in Nigeria.

The carbon curse theory argues that, in practice, the case for RE sources is weakened by easy access to fuels in fuel-rich countries. However, in Nigeria, the FGN procured fourteen on-grid RE project through feed-in-tariffs (FITs) despite its easy access to natural gas. These fourteen RE projects have been stalled and have not reached financial close. This thesis argues that the stall is a result of industrial organisational issues and not an antithetical relationship between emerging RE and resistive conventional technologies. Importantly, the carbon curse theory also does not explain why, just like on-grid RE investments, gas power plants, which have also been procured by the national government in Nigeria, have also been stalled and unable to reach financial close. There is a constraint to both on-grid RE investments and conventional on-grid electricity generation investments in Nigeria. There must be wider common issues constraining on-grid RE and conventional energy investments that the carbon curse theory, which pits RE against conventional fuels, does not explain.

Advocates of carbon curse theory may respond to this criticism by evoking the resource curse, stating that additional investments on the grid may be constrained by low energy demand from manufacturing and other energy-intense productive activities. However, this is not the case in Nigeria. While Nigeria may suffer from the resource curse, its energy demand is nonetheless much higher than the current available energy supply from the electricity grid (TCN, 2017). The evidence for this is in the incessant power outages and electricity rationing that still goes on till date. This implies that there is plenty room for additional supply side investments on the grid, but there are constraints to these investments that appear to constrain both RE and conventional technologies. It is an open question as to whether the carbon curse propositions may become relevant in Nigeria when these wider common constraints in the Nigerian electricity sector are removed.

2.2.2 Multi-Level Perspective Approach to Socio-Technical Transitions

The effort to replace a significant amount of the electricity produced from conventional gas-fired technologies with electricity from RE technologies can be regarded as a technology transition towards sustainability. Technology transitions are defined as major technological transformations in the way societal functions such as transportation, communication and energy production, are fulfilled (Geels, 2002).

Technology transitions towards sustainability necessarily require interactions between technology, politics, markets, and societal cultures for three reasons. First, sustainable transitions are purposeful rather than inevitable and require agents. Second, most sustainable technological transitions struggle, at least initially, to compete with established technologies, especially when external costs of established technologies are not considered. Third, the involvement of dominant incumbent firms in supporting new technologies is often required to accelerate the breakthrough of technological innovations (Geels, 2011). As such, energy transition, a form of technology transition, requires the interactions between technology, politics, markets, and societal cultures to move from a socio-technical system dominated by a hydrocarbon-intense means of energy production towards one with a low-hydrocarbon-intense energy production.

One analytical framework commonly used within the energy transitions literature is the Multi-Level Perspective (MLP) on social-technical transitions (Geels, 2002). This framework was developed to emphasise social-cultural drivers in the literature on energy transitions, recognising the interaction between people and technology in ‘socio-technical systems’. The MLP argues that technology transitions can be analysed on three levels: the ‘regime’, the ‘landscape’, and the ‘niche’.

The regime refers to structures that support and account for the stability of existing socio-technical systems (Geels, 2004). The regime includes institutional structures, actors, and interests, which stabilise socio-technical systems. In the electricity sector in Nigeria, the regime is characterised by a dominant configuration of energy regulations, natural fuel-resource availability, existing power plants and market structure.

The niche refers to the small segments of the market that have off-takers that are willing to support new technological innovations. In the on-grid electricity sector in Nigeria, the RE sub-sector can be referred to as a niche. Niche actors or RE developers aim to move RE technologies from the niche to the regime.

The MLP framework argues that technology transitions happen in a socio-technical landscape. The landscape refers to a wide context of exogenous trends such as fuel prices, macroeconomics, demography, political ideologies, and societal values, which put pressure on the regime and niche dynamics. Within the context of this research, the MLP could be used to understand why on-grid RE has not yet moved from the niche to the regime in Nigeria.

The MLP framework suggests three causal dynamics that enable socio-technical transitions. First, it suggests that for a successful transition, niche-innovations must build internal momentum due to the innovative way in which they tackle a critical problem. An example of niche innovation is the introduction of the ‘M-PESA’ mobile money system, which presented an innovative banking solution for previously unbanked Kenyans by improving access to financial services through mobile telephones (Lepoutre and Oguntoye, 2018). The M-PESA project was able to build momentum because it provided an innovative solution. The project secured £1 million from a challenge fund created by the UK Department for International Development (DfID), which was offering grants for innovative projects that increased access to financial services (Lepoutre and Oguntoye, 2018). The fund was later matched by the project proponent, Vodafone, whose senior executives had previously not placed a lot of attention on the project (Lepoutre and Oguntoye, 2018). Also, Dóci et al. (2015) show how Dutch renewable energy communities (RECs), which seek to protect the environment and gain energy cost savings, are building global niches by participating in networking groups with other RECs to share knowledge and create organised lobby groups to build momentum for RE in the Netherlands. Other niche innovations include battery-powered electric vehicles (Berkeley et al., 2017) and organic food (Smith, 2006).

Second, the MLP framework suggests that changes at the landscape level are required to put pressure on the existing regime. Some macro-economic pressures, including rising oil prices, climate change and natural disasters (Hansen and Nygaard, 2014; Hermwille, 2016), can have impacts on the existing dominant technologies. Rising oil prices and climate change create an incentive for dominant regime actors to support alternative and renewable sources of energy. Similarly, the narratives from the Fukushima earthquake put pressure on the nuclear power regime in Japan and Germany (Hermwille, 2016). The MLP would argue that changes in the landscape (such as climate change and the opportunity to mobilise climate finance) could put pressure on the Nigerian electricity sector, creating a path for RE on the grid.

The third causal dynamic proposed by the MLP is that the destabilisation of the regime creates a window of opportunity for niche innovations to transit into the regime. The destabilisation of the regime is a consequence of the simultaneous pressures from the landscape and an adequately supported niche. An example of this is in Sweden, where simultaneous pressure from the climate change emergency and the oil crises in 1970s and 1980s created pressures on the domestic heating sector (Lucia and Ericsson, 2014). First, the oil crises exposed Sweden's overdependence on oil, which created the impetus for the government to diversify, causing the partial collapse of the oil regime in the country. Second the emergence of climate change as a national issue in the 1980s created the second impetus for the transition away from high carbon-emitting fuels. In the niche, biomass fuel was protected as a fuel source for domestic heating by exempting it from the carbon tax the government introduced to penalise carbon-emitting fuels. The protection of biomass in the niche and the pressure from the oil crises and climate change in the landscape enabled the destabilisation of the oil regime and enabled biomass to become the dominant fuel source for domestic heating between 1990 and 2011. Geels (2011) argues that these three dynamics have a circular causality in the way they reinforce one another.

The MLP framework provides useful insights for energy transition studies. However, like the carbon curse theory, it does not explain all the features of the on-grid energy transition in Nigeria. The case of on-grid RE in Nigeria has not been the story of a niche technology that cannot replace new conventional energy investments to break into the regime. The reality on the ground shows that both new on-grid RE investments and new on-grid conventional energy investments are stalled. There is little evidence to suggest that the stall is technology-specific or that the stall is specific to just on-grid RE investments.

On-grid RE investors were able to build momentum in Nigeria between 2012 to 2016, providing the government with an innovative option for diversifying the country's energy mix. During this time, the government protected the momentum by establishing an attractive feed-in-tariff (FIT) for on-grid RE to incentivise investors[9]. The government also signed power purchase agreements (PPAs) with the RE investors to protect their revenue and provided them with tax incentives[10]. In the landscape, climate-focused million-dollar grants from foreign governments and concessional climate finance from international organisations provided the incentives for the regime actors to join the on-grid RE momentum. In the regime, key dominant regime actors have supported the momentum of on-grid RE technologies. At least three major conventional energy regime actors in the private sector have invested in developing the first wave of fourteen utility scale RE projects[11]. The government bureaucrats responsible for electricity also played a critical role in pushing the government to sign PPAs with the RE investors[12]. There has been a significant amount of support to on-grid RE investors.

However, even if an MLP analysis concludes that the support provided to on-grid RE momentum – through activities and trends in the niche, regime, and landscape – has been insufficient or has been a disingenuous effort by actors in a resistive regime, it still does not explain why conventional technologies have also been stalled.

The emphasis of the MLP is to understand how one technology moves from the niche to the regime to displace the regime technology partially or fully. This means that the MLP is looking to understand how new investments in regime technologies can be replaced by new investments

[9] (NERC, 2012)
[10] Source: Interview with on-grid RE Project Developer. Abuja, Nigeria. 07 May 2018.
[11] Ibid.
[12] Ibid.

in niche technologies. However, in Nigeria, there is no new generation investment. All on-grid generation investments are stalled. As such, this thesis is compelled to avoid a conceptual approach that seeks primarily to explain, for example, how new gas power plant investments might be the displaced by new on-grid RE investments. The approach in this thesis seeks instead to understand the technical, economic, and political bottlenecks that constrain all generation investments in the sector with special attention given to on-grid RE investments.

The MLP could be used as a lens through which to analyse the constraints to on-grid RE investments in the landscape, regime, and niche. However, it does not have an established set of causal dynamics that explain the technical and economic bottlenecks that constrain on-grid-RE investments. It would need a supplementary framework to analyse, in detail, the technical and economic bottlenecks that constrain investments in the various subsectors of the electricity sector in Nigeria.

This thesis does not use the MLP framework because it is not well equipped to explain the common constraints faced by both on-grid RE and on-grid conventional technologies. Instead, it uses an industrial economic conceptual framework that is well equipped to explain the limited growth and performance of the electricity sector with special emphasis on explaining the zero growth of the on-grid RE in Nigeria.

Furthermore, while the MLP framework recognises the role of political actors and agents in applying pressure on regimes and protecting niches, it does not have fully developed set of causal mechanisms in the political dimension and has not been widely applied in a wide variety of political contexts, especially low- and middle-income countries. To analyse the political regime, especially in rentier states like Nigeria, the MLP framework needs to be supported by concepts from the political economy literature as recognised by Osunmuyiwa et al. (2018).

Even so, Pohlmann (2019) argues that scholars attempting to integrate power dynamics into the MLP framework tend to “essentialise” the organisational power of actors in the regime and niche – attaching organisational power to the regime. He argued that energy innovations diffuse into the regime through a more nuanced set of dynamics, showing how power structures within the energy sector are not bound to take “the relational form of dominant versus marginalised actor.” It is nevertheless critical to understand the political intricacies that shape energy systems as recommended by Osunmuyiwa et al (2018).

2.2.3 Rentier State Theory

A commonly used conceptual framework in the political economy literature is the Rentier State Theory (RST). The RST describes a state that derives a substantial fraction of its revenue from the sale of indigenous natural resources to external clients. The state’s ownership of natural resources allows it to earn income from its sale and receive rent – a reward for ownership of the resources. Beblawi (1987) applied this theory to explain the stagnation in productivity in oil-rich Gulf states, despite enormous income from oil sales in those states. Beblawi described four main characteristics of rentier states.

First, a rentier state is a state, where earning above-normal profits due to natural resource scarcity is a dominant feature of the political-economic landscape. As no state can have an absolute rentier economy, Beblawi states that rentier states are states where rents play a dominant role in the state's affairs and state institutions are built around the generation and distribution of rent.

Second, Beblawi explains that a rentier state depends on substantial external rent, which is sufficient to support its economy without a strong, productive class. This is crucial to the definition of a rentier state. If, on the contrary, a state receives substantial revenue from domestic sources, the state likely has a strong domestic productive class to which the government must then be accountable. In rentier states, the government is not accountable to the citizens because it can survive without their taxes.

Third, in a rentier state, only a small minority of the population is involved in the generation of external rent. The majority are only involved, as beneficiaries, in its distribution and utilisation. This excludes states that depend significantly on tourism from Beblawi's definition of rentier states. While these states depend on external rents made from their ownership of natural tourist attractions, the income is generated by the large fraction of the population, who conduct economic activities in the tourism industry. In these states, taxation and representation are likely to be critical features of the state.

Fourth, the principal recipient of external rent in a rentier state is the government. It controls how rent is generated and distributed across society. Maintaining control of the generation and distribution of rent allows ruling political and economic coalitions to maintain political and economic power in society. The state and its rents are a prize to contending economic and political coalitions. When they capture power, they can bestow external rent access on a few loyal and necessary allies to maintain power. The state also distributes rent to the rest of society, commoditising and buying their legitimacy. One way in which this legitimacy is bought in oil-rich rentier states by distributing energy subsidies to the citizenry.

2.2.3.1 Nigeria as a Rentier State

Nigeria can be said to fit a rentier state's description (Sandbakken, 2016; Omeje, 2016). Nigeria has a historical dependence on oil rents. A significant proportion of oil rents accrue to the government through export sales by the national oil company and petroleum profit tax paid by the private companies. According to the Central Bank of Nigeria's (CBN) annual reports, the country depends mostly on oil revenues, which accounted for 65% of government revenues between 2010 and 2018 (CBN, 2018). Before the recent decline in oil prices, oil rent in Nigeria accounted for 74% of government revenues between 2010 and 2014 (CBN, 2018). Exports from the oil sector represented over 92% of total exports in each year between 2012 and 2018 (CBN, 2018).

Just as was said of the Gulf states, the Nigerian political elite survive by exploiting oil revenues. The state distributes rent to the ruling elite to maintain power (Ani Kifordu, 2011). It also distributes rent to citizens by providing some benefits without robust taxation or sufficient accountability. One common benefit citizens are bestowed in rentier states is a subsidy. In Nigeria, rent distribution through subsidies has existed in many sectors of the economy, including energy and telecoms (Okonjo-Iweala and Osafo-Kwaako, 2007).

Just like the carbon curse theory, the RST recognises the distribution of rent through energy subsidies. However, the RST provides deeper insight into rent distribution through energy subsidies than the carbon curse theory. The carbon curse theory recognises that hydrocarbon resource-rich states tend to distribute energy subsidies, which are difficult to remove after becoming institutionalised and growing into a permanent cultural feature in society. The RST goes further and explains the benefits of this feature, not just to the citizenry but also to the political elite. It argues that energy subsidies are a means for the government to empower its loyalists and buy its legitimacy from its citizenry without sufficient accountability to them (Moore-Gilbert, 2016). Removal of energy subsidies does not just create opposition from the citizens, who benefit from cheaper energy, but it can also create opposition from the political elite in two ways. First, it removes a means by which political elites seek to maintain power by buying legitimacy from citizens. Second, it redistributes rent that would otherwise go to government loyalists, who implement or benefit from the energy subsidy regime through other means than receiving cheaper energy. Krane (2018) explained that demonstrations took place in Oman after fuel prices were indexed to international market prices. Attempts to remove institutionalised energy subsidies are typically met by stiff resistance from the citizens through labour movements and protests (Bazilian and Onyeji, 2012).

A compelling argument in the literature suggests that energy subsides inhibit energy transitions (Monasterolo and Raberto, 2019). Monasterolo and Raberto (2019) argue that smooth phasing out of fossil fuel subsidies can contribute to improve macroeconomic performance, decrease inequality, and help the government to find fiscal space to support stable renewable energy policies. This implies that energy transitions are challenging to achieve in rentier states such as Nigeria, where institutionalised energy subsides are embedded in society.

The RST has the potential to provide insights that explain why on-grid RE investments are constrained in Nigeria with three specific features of rentier states – (i) rentier mentality; (ii) active opposition to rent redistribution; and (iii) dysfunctionality in rentier states. This section discusses all three insights.

Rentier Mentality

One common phenomenon in rentier states is what Beblawi (1987) called the *rentier mentality*. He argued that the rentier state creates a rentier mentality. The assumption about the rentier mentality is that it does not follow the work-reward mentality. He argued that reward is an isolated fact for the rentier and not the result of effort and a strong work ethic. As rentier states can survive on external rent instead of domestic taxation, citizens can grow accustomed to receiving state benefits without the financial pressure of supporting the state through taxes.

Beblawi (1987) argued that the rentier mentality creates material expectation due to institutionalised rent distributions by the state. He added that the rentier mentality creates political apathy amongst the citizenry. In two quantitative surveys of Gulf States' citizens, Puranen and Widenfalk (2007) and Hertog (2020) showed that while citizens agree with strong statements about achievement, competition and hard work on an abstract level, their concrete life choices do not. However, contrary to the rentier state's claims, Hertog (2020) showed that there could be high political interest from citizens in the Gulf states despite minimal taxation.

In Nigeria, the rentier mentality might present an obstacle to on-grid RE investments in several ways. It can be challenging for RE technologies to compete with gas-fired power stations, which currently enjoy gas subsidies instituted by the Nigerian government. In Nigeria, gas-fired power plants buy gas from local gas producers at a government-mandated subsidised price, which is lower than the export price (Shodipo, 2015). Removing this gas subsidy will increase electricity price from gas-fired power stations, which generate about 71%[13] of on-grid electricity in Nigeria. The rentier mentality can explain the challenge with increasing the retail price of electricity, which the citizens deem to be their entitlement in line with the rentier mentality. The rentier mentality dynamic in RST suggests that an increase in retail electricity price, resulting from gas subsidy removal, has the potential to diminish the power and legitimacy of the ruling political elites.

[13] Secondary data collected from the National Control Center, Osogbo, Osun State, Nigeria. 21 October 2017.

Additionally, Rieche (2010) also argued that polices such as FITs and other energy transition instruments tied to an increase in electricity bills would be difficult to implement in rentier states, where fuel subsidies are institutionalised and part of the societal contract. He argued that its implementation would force the government to be more accountable and interact more with the population, creating room for more government scrutiny.

However, it is essential to note that removing gas subsidies might not enough to make RE technologies such as solar and wind technologies economically competitive in Nigeria. Despite global average reductions in RE costs, the cost of implementing on-grid solar or wind technologies in Nigeria is relatively high. Daggash (2020) shows that in a cost-optimisation scenario, intermittent renewable energy technologies will not make it into the energy mix in Nigeria – "not even solar PV". This thesis also dedicates Chapter 3 to illustrate that the projected global cost reductions of RE technologies' will not be the key driving force in overcoming the constraints to on-grid RE in Nigeria. There is a need for additional and robust policy support from the government. This thesis presents an option for such a policy based on the constraints and barriers identified in this research.

Finally, energy subsidies, which the rentier mentality often perpetuates, can cripple a country's energy market. As Chapter 4 shows, the retail subsidy in Nigeria's electricity sector is unsustainable. The government cannot keep up with subsidy payments, which has caused a liquidity crisis across the entire value chain. Utility companies are unable to meet up with operational costs and debt servicing, making the sector insolvent and undesirable as a destination for new investments, including on-grid RE investments.

Dysfunctionality in Rentier States

Beblawi (1987) argues that rentier states are likely to maintain engagement with citizens through taxes in a limited way to minimise government accountability. The rentier state does not have what Di John (2009) describes as "reciprocal obligations with citizens via the nexus of domestic taxation." A common feature of rentier states is their limited capacity to administer the state. The rentier state does not invest in collecting sufficient information about the citizenry because a significant amount of its earnings do not depend on it. This has a critical knock-on effect besides the obvious threat that population growth, fluctuating commodity prices and dwindling natural resources pose to rent generation and distribution. Rieche (2010) agrees with (Hertog, 2006) and (Yates, 1996), arguing that the rentier state inhibits its capacity to administer when it does not engage with citizens through tax collection or service delivery for productive enterprises. They argue that because the rentier state fails to build the robust administrative machinery required to collect tax and provide services to productive enterprises, it does not have the administrative capacity to regulate the economy's productive sectors. The rentier state does not have enough information about citizens and the productive sectors to regulate them or provide services to them effectively.

The rentier state theory might help to explain Nigeria's electricity market's dysfunctionality, thereby explaining the on-grid energy investments constraints. It might help explain the historic commercial underperformance of the electricity sector, which was solely administered by the state until 2013. The state did not invest in collecting the required information about the sector to administer it because the now-defunct state-owned electricity utility did not depend on the commercialisation of the electricity sector. This is evident in the post-2013 drive to close the information gap in the sector (FGN, 2018). The now-defunct state-owned electricity utility did not need to generate the required revenue for operations from its customers – a process that would require comprehensive data about its customers. Instead, it depended on the central government's budgetary allocations, which came mostly from oil rent. The now partly privatised electricity market in Nigeria suffers from dysfunctionality and enormous commercial losses, partly because the market does not have enough information about its consumers. As we find in Chapter 4, the lack of sufficient information about on-grid electricity consumers makes it difficult for the market to run efficiently. It also makes it challenging for the regulator to regulate more efficiently. The dysfunctional market creates a liquidity crisis that makes it difficult for new entrants, including new renewable energy and new conventional energy investors, to enter the market.

Active Opposition to Rent Redistribution

The RST might explain the on-grid RE challenge in Nigeria by arguing that there is active opposition to energy transition by conventional technology players and other actors who might be worse off due to on-grid RE proliferation. Like many theories in the political economy literature, the rentier state does well to explain Nigeria's energy sector's contending interests, specifically interests between off-grid renewable energy interests and off-grid diesel-powered energy interests. Osunmuyiwa et al. (2018) propose an integrated framework that combines the MLP framework and the rentier state theory. They tease out a dynamic relationship in the electricity sector regime between the 'socio-technical regime' and the 'politico-economic regime'. They state that the socio-technical regime consists of technocratic institutions and actors in the electricity sector, while the political-economic regime consists of political actors and interest groups in the electricity sector. They argue that both regimes collaborate to resist energy transition in Nigeria and keep enjoying the existing rent distribution.

More specifically, they argue that regime actors, who are opposed to the energy transition, employ defensive strategies, discursive strategies, and the strategic use of structural or institutional resources to block energy transitions and create rules to maintain the status quo. Among other points, they suggest that political actors captured state assets during the privatisation of the on-grid Nigerian electricity sector and used that as an opportunity to block the energy transition in favour of their interests in fuel and diesel generator importation. Their argument's conceptual basis is that the emergence of on-grid RE technologies is expected to change the distribution of rent in Nigeria, and those in the regime, who stand to lose, oppose the transition. They have provided evidence for this in the off-grid electricity sector. However, there is little evidence of active opposition to on-grid RE investments in the on-grid sector.

It is important to note that a significant proportion of on-grid solar PV project developers in Nigeria are also dominant energy sector actors with considerable investments in conventional assets in the energy market[14]. Conventional power generation firms, just like the RE firms, have the option of building on-grid RE plants. Indeed, several firms with conventional generation assets are among the first fourteen solar IPPs engaged by the FGN. There is no significant cluster of specialist on-grid RE firms with any competitive advantage over conventional power generations firms looking to diversify. All the domestic on-grid RE development firms rely on

[14] Source: Interview with on-grid RE Project Developer. Abuja, Nigeria. 07 May 2018.

foreign technology and engineering companies' technical capacity, as do conventional power generation companies looking to diversify[15].

By contrast, in the case of off-grid RE investments, off-grid RE technologies are in direct competition with importers and distributors of off-grid diesel- and petrol-powered generators, which are backed by powerful vested interests Green (2017). Off-grid renewables are in direct competition with diesel and petrol power generation for unserved and underserved consumers on the grid (Osunmuyiwa et al., 2018).

Nonetheless, one could still argue that there might be a rationale for active opposition to energy transition by conventional power generation firms, which have sunk costs in gas exploration and production activities. However, this is not the case. To explain why this is not the case, it is critical, at this point, to differentiate between the actors in the gas production sector and those in the gas-fired electricity generation sector. While some actors are invested in both businesses, it is critical to establish this distinction because the two businesses do not have the same incentives in Nigeria. Any analysis that assumes them to be the same faces the risk of assuming they have the same interests.

On the one hand, gas production actors belong to the oil and gas sector. They mine gas primarily for the export market, as is typical in rentier states. These actors would rather sell gas to the international market than sell to domestic consumers, such as the on-grid gas-fired electricity

[15] Ibid.

generation companies, for two reasons. The first reason is that the international market is willing to pay for gas at a higher price than the local market. Second, the contractual and invoice settlement arrangements are more reliable in the export market than domestically in the Nigerian electricity market. Gas producers have little incentive to sell gas to the local market instead of the international market. In fact, the government compels gas producers in Nigeria to sell gas to electricity generation companies through a regulation called the DGSO regulation. The DGSO regulation compels gas producers to sell an annual quota of gas to the domestic market at a subsidised price (Shodipo, 2015). However, the government does not pay gas producers a subsidy for the difference between the export price and the DGSO price because the DGSO price is still higher than the cost of gas production. The economic loss to the gas producers is the opportunity cost of selling to domestic consumers, such as gas-fired-electricity generation companies, instead of the international market.

A proliferation of on-grid RE plants in Nigeria will only reduce the gas producers' domestic obligation, allowing them to gain more revenue from the export market. Several gas production companies are also investing in diversification and are among the actors developing the first wave of 14 on-grid utility-scale solar power plants in Nigeria.

The gas-fired electricity generation companies, on the other hand, want to buy electricity from the gas producers because the DGSO price is subsidised. However, even at a subsidised price, they cannot settle their invoices with the gas producers because of the liquidity crisis in the on-grid electricity sector, as shown in Chapter 4. They only pay the gas companies a fraction of the bill for the gas supplied to them.

A proliferation of on-grid RE plants might seem like a losing scenario for gas-fired generation companies, but this is not the case. As already mentioned, several gas-fired generation companies, just like the gas production companies, are also investing in diversification and are among the actors developing the first wave of 14 on-grid utility-scale solar power plants in Nigeria. Besides, the electricity sector's demand-supply gap creates enough room for investors to promote both technology types.

Additionally, the on-grid energy transition in Nigeria is unlikely to occur without gas playing a major and critical role as a transition fuel. The recognition of gas as a transition fuel is essential for a just energy transition, especially in the context of low- and middle- income countries, whose economies are intricately woven with fossil fuels or cannot immediately foot the upfront bill of such a transformation. This notion is further backed by the Common But Differentiated Responsibilities Principle, which recognises that all countries are responsible for addressing environmental and climate issues but are not equally responsible (Brunnée and Streck, 2013). In this context, even in the government’s most ambitious on-grid RE targets, gas still accounts for 59% of installed capacity over the next decade (FGN, 2016) – and a higher percentage of electricity production. This removes the incentive to oppose the transition – at least over the next decade.

However, one could present yet another argument to suggest the existence of active opposition to energy transition on the grid by rentiers. One could argue that while there is ample electricity demand for both RE and conventional technologies to thrive in Nigeria, there is a limited window for government-guaranteed revenues on the government’s balance sheet. The government is currently the only credit-worthy bulk buyer of electricity from generation companies; therefore, new on-grid RE generation companies would have to compete with existing conventional energy generation companies for limited government-guaranteed sales. This is likely to cause existing conventional energy generation companies to resist new on-grid

RE generation companies to avoid sharing government-guaranteed sales. This might be the case, but the resistance by existing generation companies would not be against new on-grid RE companies alone. It would also be against new conventional energy companies. The opposition is not to an energy transition but to new entrants seeking to share in the rents from the government guaranteed revenues – especially as the government is already falling behind current payments due to the liquidity crisis.

This thesis agrees with Osunmuyiwa et al. (2018) that the nature of Nigeria as a rentier state plays a critical role in determining the level of deployment of RE technologies; however, for the case of on-grid RE in Nigeria, the features of the rentier state that influence on-grid RE investments does not include strategies of opposition by actors in the regime, who are looking to maintain the status quo.

Insights from the Rentier State Theory

In summary, the RST has the power to shed light and provide insights on a significant number of features and dynamics in countries like Nigeria. This research draws on two rentier state dynamics that influence the on-grid electricity sector in Nigeria. In the first dynamic, the RST explains the relationship between the state and citizens via rent distribution through subsidies, including electricity subsidies – and highlights the nature and impact of the resulting rentier mentality. Second, it explains the dysfunctionality observed in rentier states that cannot administer and regulate productive sectors of the economy, such as the on-grid electricity sector, because they do not have sufficient administrative capacity and information about consumers and citizens. This thesis uses these two powerful insights from the RST to shed light on the constraints to on-grid RE investments in Nigeria.

2.2.4 Reflection on Electricity Price and On-grid Energy Transition

The Carbon Curse theory, the MLP and the RST all highlight a price problem for on-grid RE deployment. The existing energy source is cheaper for consumers than the new source, which impedes uptake of the new source. However, these theories emphasise different reasons for the price advantage of the existing energy source.

Both the Carbon Curse theory and the RST argue that institutionalised energy subsides in energy-rich countries can create a barrier for more expensive RE technologies that have the potential to increase traditionally low energy prices. While the Carbon Curse theory and the RST both argue this, the RST goes deeper.

The RST argues that rentier states can survive on external rent instead of domestic taxation – citizens can grow accustomed to receiving state benefits without the financial pressure of supporting the state through taxes. The rentier mentality dynamic in RST suggests that an increase in retail electricity price, resulting from relatively high RE prices or gas subsidy removal, has the potential to diminish the power and legitimacy of the ruling political elites. Furthermore, because rentier states are structured around oil rent production and distribution, even if a cheaper energy source was available, a rentier state could resist a transition due to the benefits of oil rents to the state and political elite.

By contrast, the pricing argument within the MLP literature often focuses on the dynamic increases in efficiency that occur as a new technology expands in scale. Increasing scale can attract both additional research and development investment and investment in complementary technologies and systems that reduce the cost of the overall technology package. The challenge for a niche technology is, therefore, to achieve scale expansion, which an established technology has already achieved. Industrial policy can either facilitate or block this. Eventually, as technologies develop in the niche and become more mature, competitive pricing can enable them to be diffused in the regime.

The Carbon Curse theory, the MLP, and the RST all argue that for on-grid RE deployment to be widely successful, RE technology prices must ultimately be competitive. To achieve this, subsidy removal for conventional technologies is likely to be required, although this is challenging politically. In addition, active industrial policy may be required to support the progressive expansion of on-grid RE technology, until the point at which it becomes price competitive with conventional energy sources. These narratives are at variance with the recent narrative in some circles that the falling global weighted average of RE technology prices should be sufficient to make on-grid RE competitive in countries like Nigeria and, therefore, drive the energy transition.

2.3 Key Concepts in this Thesis

This section describes the key concepts used for this research. It explains why they were chosen over some previously discussed approaches and highlights how they address the limitations of those approaches.

2.3.1 Energy Modelling

As explained in the previous Section (2.2.4), the Carbon Curse theory and MLP assume that a niche technology with relatively high prices such as on-grid RE technologies will struggle to be competitive with established or 'regime' technologies. In contrast, the expectation in some circles (Schwerhoff and Sy, 2020; Waruru, 2016) is that the falling global average price of RE technologies will drive RE deployment globally, including in Nigeria; hence, this thesis starts by exploring the RE pricing story in Nigeria by modelling and analysing the on-grid energy sector in Nigeria in Chapter 3. Will the current projected on-grid RE prices be low enough to push the on-grid energy transition?

Energy planning models are a tool for investigating "the future of the global and regional energy settings and the effects of energy use on the human and natural environment" (Urban, Benders and Moll, 2007). They are often needed to quantify the impacts of energy transition, and plan potential pathways (Horschig and Thrän, 2017, Chang et al, 2021).

Energy models can be used for forecasting, exploring and back casting key properties of energy systems, including energy demand (Nika et al, 2020; Bourdeau et al, 2019), energy supply (Ayoub et al, 2018), environmental impacts (Pehl et al, 2017), and system costs (Hall and Buckley, 2016).

Savvidis et al (2019) note that energy models have their individual 'specialties' – intended to describe the features and properties of the model that distinguishes it from other models and determines its suitability for specific research questions. These models can be categorised in two ways: the underlying methodology of the model and the analytical approach of the model (Urban, Benders and Moll, 2007). Regarding the underlying methodology of energy models, they classify them into three types: top-down models, which use aggregated data to predict future scenarios based on market behaviour; bottom-up models, which use disaggregated data to build scenarios with little exogenous influence from other sectors of the economy; and hybrid models which combine both types of methodology. The bottom-up approach provides the most useful method to explore the effects of the government's on-grid RE targets. Bottom-up simulation models help to zoom in on the cost and technological characteristics of energy technologies. They are useful in markets within low and middle-income countries such as the NESI, where electricity supply is often independent of the electricity market demand (Urban et al., 2007).

On the analytical approach of the models, Urban et al. (2007) classify the models into four types; optimisation models, which look for best solutions given a set of constraints, with the assumption of a perfect market and perfect consumer; economic equilibrium models, which assume partial market equilibrium that is characteristic of many low and middle-income countries; toolbox models, which are simple bottom-up models for untrained users; and simple simulation models, which are also usually bottom-up or hybrid models that do not assume market equilibrium and have more input flexibility for users. Unlike optimisation models, which rely on overarching market trends, the simulation models are more useful for energy modelling in low and middle-income countries like Nigeria because they consider that market forces have only a limited effect on the energy mix. Simulation models also require scenarios to run. They are often used to analyse the effects of a central authority's planning targets. While it is impossible to accurately predict the future state of the grid in Nigeria, developing future energy scenarios makes it possible to better understand the future uncertainties.

Before explaining the industrial and political causal dynamics that constrain on-grid RE investments in Nigeria, this thesis uses energy modelling to show that RE technologies' falling global average price is not expected to drive RE investments on the grid in Nigeria, establishing the need for government intervention. As Chapter 3 shows, the global cost of RE technologies are falling rapidly, but at a lower rate in Nigeria and much of Africa (IRENA, 2018). IRENA emphasises that the global average cost of RE technologies is "a mirage as individual markets must be examined in detail to understand the likely trends (IRENA, 2019)."

Based on interviews with project developers in Nigeria, cost reductions will also be driven by improvement in regional structural realities such as quality and availability of local infrastructure to mobilise equipment from ports to project sites located in the hinterlands. The further a project site is from the seaports, the more expensive it is to transport equipment to site. The costs of transportation and accompanying insurance go up with distance to the ports. This is further exacerbated by the inadequate infrastructure and security between the seaports and the hinterlands. An improvement in local infrastructure will bring down the cost of RE technologies, especially solar PV and wind technologies which have high resource availability in the hinterlands. In contrast, most of the gas power plants are sited near areas with high gas production in the southern parts of the country closer to the seaports. The cost of RE technologies are higher than conventional technologies in Nigeria, which means that RE integration on the grid, will increase the price of grid electricity.

As Section 2.2.4 explains, the price problem of RE technologies is a critical inhibiting factor for RE. The MLP theory suggests that increasing technology efficiencies and the resulting reduction in RE costs will aid the diffusion of on-grid RE technologies. However, the projected reduction in on-grid RE technology costs in Africa is slower than the global weighted average (IRENA, 2018) and as a result, falling RE prices are not enough to drive the on-grid energy transition in Nigeria even if gas subsidies are removed.

Additionally, the falling cost of RE technologies, which is usually presented in terms of the Levelised cost of electricity (LCOE), has been criticized because it does not consider the system-level costs (energy balancing and grid services) required for integrating RE to the grid (Joskow, 2011; Benes and Augustin, 2016; Ueckerdt, 2013). Chapter 3 of this thesis confirms the significance of these costs in the Nigerian case. The chapter, therefore, corroborates Daggash's (2020) basic finding of the high cost of on-grid RE in Nigeria – even with Solar PV. RE deployment would increase the electricity price in Nigeria in 2030 if the government RE targets were met.

The implication of this is that any integration of RE technologies to the electricity grid in Nigeria is likely to come at a political cost, as it would put an upward pressure on the price of electricity. This is true even if the gas subsidy in the electricity sector is removed. As Nwangwu (2019) highlights, it is not uncommon for citizens to protest the prospects of an increase in electricity price. Nwangwu (2019) noted that thousands of protesters stormed some of the major streets in Armenia protesting for several days the about 17% hike in electricity prices, and that in Ghana, there were protests in 2016 against a 67% increase in electricity tariff.

Chapter 4 and 5 show that the price of RE technologies has two major inhibiting effects on the deployment of RE technologies. The first effect is regarding the willingness and capacity of consumers to pay for higher-priced electricity in Nigeria, where the price of electricity is already contested by consumers, political elites, bureaucrats, and private sector players in the electricity market. As Chapter 5 explains in more detail, consumers do not want to pay more for electricity without observing significant changes in the reliability and quality of electricity supply following previous electricity price hikes. Likewise, the political elite do not want to see the price of electricity go up because their popularity among consumers, who are also the electorate, might suffer. The private sector players in the electricity sector, who have invested significant sums of money, need to see electricity prices increase to cover their incessant losses, resulting from a failing local currency, inflation, and electricity theft. The bureaucrats struggle to find a balance between getting a fair electricity price for the consumers and ensuring that private sector investors get a fair return of and *return on* their investment. Several bouts of contestation in the form of protests and policy U-turns have ensued on the case of grid electricity pricing – and this contestation occurs even without the extra question of the additional cost of renewable energy on the grid. Any increase to the price of electricity, from RE technologies or otherwise, is likely to cause dissatisfaction from consumers as it has in the past, resulting in opposition from the political elite, who are not always in the position to absorb such political costs.

The second inhibiting effect that a RE-induced electricity price hike is likely to have on on-grid RE deployment is regarding the poor liquidity of the Nigerian electricity market. As Chapter 4 explains, the electricity market collects only a fraction of the revenue it expects from electricity sales due to unpaid electricity bills, electricity theft, electricity pricing mismatches and unpaid subsidies. Even the government utility that was specifically set up to cover this foreseen liquidity shortfall is unable to meet its mandate despite being capitalised with USD 800 million and borrowing billions more from the Central Bank. Any additional supply of electricity via the grid, whether from RE technologies or conventional technologies, will exacerbate the liquidity crisis and balloon the debt in the sector. This would come at a political cost to the political elite who have competing governance priorities and limited resources.

To summarise, energy modelling is employed to explore the pricing story of on-grid RE, showing that it will increase electricity price for consumers. Furthermore, Chapter 3 also shows the potential of on-grid RE as a climate change mitigation option for Nigeria. Given the ambition for climate change mitigation in Nigeria and the inhibition presented by the regional price or RE technologies in Nigeria, the government must intervene if on-grid RE technologies are to be successfully deployed.

2.3.2 Industrial Economics: Structure-Conduct-Performance-Regulation Framework

One of the key concepts used in this thesis is from the industrial economics literature, which provides insights into how firms within an industry organise themselves, make decisions and impact market performance. Bain (1968), in his book, *Industrial Organization,* proposed the

Structure-Conduct-Performance (SCP) paradigm. The SCP is based on the idea that the nature of specific goods and services determines the structure of the market in which they are traded; and the market structure determines the conduct of the actors within it, which in turn, determines the performance of the market. This idea was further developed to include the notion that in addition to the structure of a market impacting the conduct of the actors within it, the conduct and performance of actors also impacts the structure of the market (Ferguson and Ferguson, 1994). The resulting framework, the traditional SCP framework, is shown below in Figure 2.1.

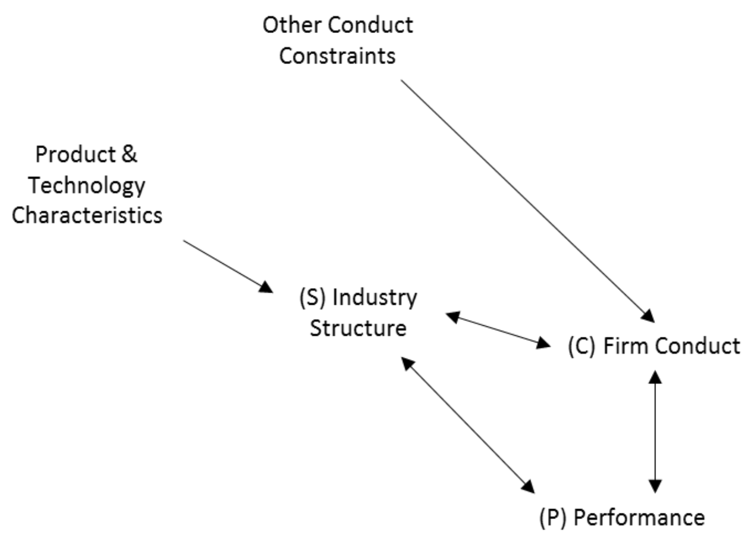

Figure 2.1: Traditional SCP Framework.

In addition to market structure, conduct and performance, several papers have since included a fourth concept, regulation, to the traditional framework (Moh'd M, 2010; Neuberger, 1997; Peng and Poudineh, 2016a; Weiss and Choi, 2008; Zhao et al., 2010). Government regulation may be required to tackle a range of market inefficiencies, including those related to naturally monopolistic or oligopolistic market structures. The addition of regulation to the traditional SCP framework helps to account for the effects of government regulation and policy in a market. Peng and Poudineh (2016) add a regulatory dimension to the traditional SCP framework, thereby proposing the SCPR framework. The SCPR framework has the causal dynamics of the traditional SCP and, additionally, it has a regulatory dimension that influences market structure, conduct and performance.

However, the critical advantage of the SCPR framework, proposed by Peng and Poudineh (2016), is that it addresses the limitations of the carbon curse theory and much of the MLP literature in conducting this research. The carbon curse theory and much of the MLP literature (Pohlmann, 2019) implies an antithetical relationship between emerging RE technologies and a resistive hydro-carbon intense regime. However, as was explained earlier, both on-grid RE and on-grid conventional investments have been constrained. The carbon curse theory is not well equipped to explain why conventional energy investments are also stalled because it emphasises the constraints to RE in the energy mix in favour of conventional energy technologies. For the same reason, the MLP framework is not best equipped to explain the common constraints faced by both on-grid RE and on-grid conventional technologies. The SCPR addresses this limitation because its primary function is to facilitate a deep and wide (technology-neutral) diagnostic of an industry – making it well equipped to explain why both on-grid RE investments and conventional energy investments are constrained in Nigeria.

In this thesis, the SCPR helps to assess the on-grid electricity industry's performance and explain the *conduct* of actors within that industry. Critically, the 'conduct' of firms in the SCPR framework is categorised into two forms of conduct. There is the long-term conduct that refers to investment in new infrastructure by firms, and there is the short-term conduct that refers to the way firms use their infrastructure and price their products. Peng and Poudineh (2017) propose a clear set of causal dynamics that affect long-term conduct and short-term conduct. This categorisation of conduct provides a clear causal mechanism that can be operationalised to reach the objectives of this thesis. Using the SCPR framework, this thesis investigates the constraints to long-term conduct by RE project developers in the Nigerian on-grid electricity industry.

Importantly, the SCPR also captures the key causal dynamics that are reinforced by the MLP framework. It does not view industries or transitions through the lenses of the landscape, regime, and niche. However, the SCPR framework fully recognises the role of incumbent firms and government regulations/policies in influencing the decision of actors to invest in on-grid RE. Additionally, it agrees with the MLP theory that the landscape can exert pressure on the regime. It recognises that dominant or incumbent firms' objectives can be influenced by government regulation, which in turn, is influenced by government objectives. Government objectives are influenced by the performance in the market, which can include exogenous performance metrics such as climate change mitigation. Exogenous performance objectives, such as climate change mitigation, might originate in what MLP refers to as the landscape; however, their influence on the market is exerted through government regulation/policy or firm conduct – dynamics that are already covered in the SCPR framework.

Also, the MLP theorises that on-grid RE investments might be scaled up if the status quo in the regime is destabilised through pressures from the landscape and protected momentum in the niche. The SCPR agrees with this notion but does not implicitly nor explicitly assume that the status quo in the regime is a favourable condition for dominant incumbent firms. Instead, it seeks to diagnose the constraints to performance, implicitly recognising that market inefficiencies can be solved through policy and regulatory innovations that remove market constraints.

Government policy and regulation are required to ensure that dominant market actors do not have overbearing influence on the market. However, government policy and regulation are inherently political.

While the SCPR framework has clear causal mechanisms that account for the agency of commercial actors and regulators in the market, it is limited by its insufficient development of the causal dynamics that explain the behaviour of political actors in relation to the market. Peng and Poudineh (2017) added a political dimension to the SCPR framework to account for the effects of political agency on the SCPR dynamic in the market. They argue that the SCPR dynamic exists in the political dimension just as it does in the commercial dimension of the market with a few adjustments. They state that the political dimension is populated by a structure of various formal and informal interest groups that focus on advancing regulations and policies through conducts such as negotiation, persuasion and/or coercion. They also state that interest groups assess sector performance relative to their respective expectations. If interest groups are not satisfied with how the sector is delivering on their objectives, then they intensify their negotiation, persuasion and/or coercion.

The SCPR framework with the political dimension however creates a research boundary issue that makes it challenging to operationalise. Proposing a structure of competing formal and informal interest groups in the political dimension, as is done in the SCPR framework, raises the challenge of defining the boundaries of relevant interest groups in the political dimension. An example of this problem is the division of political interest groups into Northern and Southern interests in the application of the framework on the gas-to-electricity value chain in Nigeria by Peng and Poudineh (2017). It overlooked the diversity of energy-sector interests among the political elite within the defined groups.

The SCPR framework provides insightful causal dynamics that help explain long-term investment decisions in a market without necessarily emphasising the dichotomy of competing technologies. This is in contrast with the carbon curse theory and MLP framework that both present this dichotomy, which currently lacks sufficient evidence in the on-grid electricity sector in Nigeria. This thesis uses the SCPR framework, but without the addition of Peng and Poudineh's (2017) political dimension. The political dimension of the constraints to on-grid RE investments in Nigeria are best explained through established theories in the political economy literature.

2.3.3 Power of Ideas

This thesis uses insights form the RST to augment the SCPR framework to explain how the political landscape in Nigeria constrains on-grid renewable energy investments. However, this thesis does not just stop at explaining the existing constraints. It looks forward and examines the conditions that must emerge for the sector to overcome the constraints. While the rentier state theory helps to shed light on the existing problem of the liquidity crisis in the NESI, it is not a framework best suited to explain the conditions for change.

As Rodrik (2014) argues, numerous political economic models, which emphasise vested interest, tend to rationalise change or lack of change ex-post, but they cannot reliably analyse change processes ex ante – attributing failure to vested interests and success to insufficiently powerful vested interests. These models, he argues, leaves out what he calls the 'power of ideas.' While the political economic approach in this thesis recognises the powerful role of vested interest, it does not assume it to be the all-determining factor. As Rodrik (2104) and much of the political economy literature argue, policies are successful because they consider political conditions. However, the importance of considering vested interest in implementing successful policy does not minimise the importance of having strong policy ideas – ideas that "minimise the political constraints" and deliver on economic efficiency.

Taking the power of ideas seriously, as Rodrik (2014) argues, can render vested interest ephemeral. Policy innovations by policy entrepreneurs can provide economic efficiency without removing the power of the political elite. Rodrik (2014) highlights examples of this in Japan, Britain, and Germany, where industrialisation did not render the non-industrial political elites powerless. Similarly, in 1979 in China, he explains that the government devised a policy innovation to establish a two-track pricing system for grain, creating a liberalised parallel grain market on top of the government-mandated fixed-price market. This allowed farmers to trade grains in a liberalised market after they had met the demand in the fixed-price market. Rodrik (2014) argues that this policy improved efficiency but shielded the prevailing stream of rents in the fixed-price market from the effects of the reform.

The power of ideas and the effectiveness of policy innovations are recognised in this thesis and is the conceptual foundation for this thesis's conclusion. This thesis concludes with a policy innovation that aims to remove the industrial economic constraints to on-grid RE investments while minimising the inhibitive political constraints. This research aims to understand how to overcome the constraints to on-grid renewable energy investments in Nigeria. The proposal in this thesis's conclusion is the establishment of a Parallel Electricity Market that facilitates free electricity trade alongside the existing fixed-price market. It is discussed in more detail in Chapter 6.

However, before arriving at a policy innovation or a strong policy idea as Rodrik (2014) advocates, this thesis first establishes that RE technologies' falling costs will not be sufficient to drive on-grid RE investments over the next decade. Second, it identifies the barriers to on-grid energy transition from industrial economic and political-economic perspectives. Finally, it uses a political-economic framework to understand the conditions for change in the NESI before developing a policy innovation.

2.3.4 Political Economy of Industrial Policy

Innovating new products typically accounts for a small part of the growth in low and middle-income countries (Khan, 2009). The most important problem for many low and middle-income countries is to learn how to adopt and improve on technologies innovated in higher income countries (Khan, 2009). Technology policies or industrial policies help countries to adopt new technologies through government interventions that address contracting failures and reduce transaction costs. Historical evidence shows that not all industrial policies work. As Khan (2009) argues, to be effective, industrial policies need to be tailored to the political landscape and the capacity of relevant institutions.

As previously stated, government intervention through regulation and policies, which is necessary in imperfect markets, is inherently political. Government intervention is political because it often redistributes economic rent and redistributes institutional powers (Khan and Jomo, 2000). As such, agents that are expected to be worse off due to a government intervention are incentivised to oppose that intervention. However, a significant number of papers which attempt to understand the political factors affecting RE and the NESI end up with a bucket list of symptoms, mostly related to good governance, and not root-causes of inhibitive political realities. These symptoms include corruption (Ogunleye, 2016), lack of transparency (Obioma, 2016), sabotage by redundant industry workers (Joseph, 2014), militancy in the Niger Delta (Paul et al., 2015), vested interests (Gboyega et al., 2011), and lack of political will (Okoro et al., 2007). An awareness of these issues is certainly critical, as shown in Chapter 5 during the early privatisation process in the early 2000s in Nigeria. However, more importantly, it is critical to understand the dynamics that cause the issues identified above. Instead of ending up with a list of issues within the electricity sector in Nigeria, this research aims to explain the causes of these issues.

In addition to operating state-owned assets in a market, industrial policies are the government's main mode of interacting with the market. Governments intervene to correct market failures and reduce transaction costs. They also introduce industrial policies, which create rent, to import technology and knowledge. Schmitz et al. (2013) argue that the challenge is not to avoid rent but to achieve effective rent management. They define rent management as "the way governments create or withdraw policy rents and how they influence their allocation among different actors and for different purposes" (Schmitz et al., 2013). Rent management provides a challenge, as Khan explains using his political settlement theory.

The 'political settlement', which Khan (2013b) refers to as the distribution of organisational power across a society, is important in determining the nature of contestation for rent. The effectiveness or success of an industrial policy depends on how well it is supported by groups with organisational power, who are affected by rent redistribution. Khan (2013a) argues that the governance capabilities of the bureaucracy and capacity of firms also play an important role in the success or otherwise of industrial policies.

Whitfield et al. (2015) build on Khan's work by developing the 'politics of industrial policy framework', which is a set of causal mechanisms based partly on Khan's political settlements theory. They add the 'theory of successful industrial policy' to the political settlement theory to form the politics of industrial policy framework. They propose the theory of successful industrial policy, which states that there are three political economic conditions that must emerge before industrial policy is successful in countries like Nigeria, where business and political transactions are not impersonal. These three conditions are: *mutual interest,* which describes a mutually beneficial relationship between the ruling political elite and capitalists; *pockets of efficiency,* which describes competent and politically insulated units within the bureaucracy created by the ruling political elites; and *learning for productivity*, which describes a bureaucracy that ensures that capitalists use their rent to improve productivity. The politics of industrial policy framework proposes that these three conditions are dependent on two factors: the nature of the contestation for power by political elites and the relative political influence of capitalists in the target sector. Applying the framework to the topic of this thesis, it is argued that the three conditions must emerge before RE can be successfully adopted on the grid in Nigeria.

A similar approach to the politics of industrial policy framework is the limited access order (LAO) theory by North et al. (2007). The LAO theory provides an apt description of the political landscape in countries like Nigeria where the state does not have a secure monopoly on violence. The LAO theory argues that violence is a problem that all societies deal with by creating their own form of order. It argues that *limited access orders,* like Nigeria, solve the problem of violence through an elite coalition made up factions that have a capacity for violence or are perceived to have a capacity for violence. These factions share economic rent among themselves. Since violence in an LAO reduces elite rents, this serves as an incentive to keep peace most of the time. The LAO is essentially recognised in the Nigerian constitution through a law referred to as the ‘Federal Character’ in Sections 14 (3) and (4) of the 1999 constitution, which prohibits the predominance of any ethnic or sectional group in government or in the bureaucracy. The bureaucracy consists of civil servants hired based on the Federal Character. However, if any of the factions, is not given what it perceives as a fair share of rent, it generates violence, thereby, reducing rents for every other group. This is noticeable in the oil-rich region of Nigeria, where gas pipelines are vandalised by groups that feel marginalised, causing disruptions to electricity supply for the rest of the country (Paul et al., 2015).

The LAO theory argues that countries like Nigeria need to develop institutional arrangements to transition from an LAO to an *open access order* (OAO), which solves the problem of violence through impersonal and transparent competition in the market and political organisation. However, as Whitfield et al. (2015) argue, impersonal enforcement of formal institutional rules is not necessary for a functioning capitalism to emerge. They also argue that capitalism does not simply occur spontaneously by extending market opportunities, but rather is an outcome of political struggles regarding rights over resources. The enforcement of formal rules impersonally does not produce a successful capitalism, but it is the other way around (Whitfield et al., 2015). A successfully functioning capitalism creates enough wealth required to enforce the impersonal institutional arrangements or contracts mentioned in North's OAO. A completely transparent and reformed rules-enforcing bureaucracy is expensive and impossible. Consistent with Khan's political settlement approach, the politics of industrial politics framework argues that the developmental priority is to shield key productive sectors from corruption and damaging forms of rent-seeking to stimulate growth that will eventually create the conditions and demand for wider improvements in a country's institutional environment.

This research uses the causal dynamics put forward by the politics of industrial policy framework to examine the conditions for change in the on-grid RE sector. It examines the conditions under which the government can successfully promote on-grid RE investments in Nigeria.

2.4 Summary of the Interdisciplinary Conceptual Approach of this Research

As shown in Figure 3.2, this thesis uses an interdisciplinary conceptual approach to understand the constraints to on-grid energy transition in Nigeria and proposes an option to overcome them. It uses an energy system simulation model to show that the projected reduction in RE costs alone will not drive the on-grid RE investments and estimates the potential of on-grid RE as a climate change mitigation option. It concludes that government intervention is required to successfully promote on-grid RE investments in Nigeria. It uses the SCPR framework plus insights from rentier state theory to capture the market and political causal dynamics that constrain on-grid RE investments in Nigeria. The SCPR framework was used to analyse the detailed market constraints within the NESI, while insights from the rentier state theory helped to explain how the political configuration in the country sustains those industrial constraints. The thesis also examines the conditions for change, recognising that even rentier states can develop productive sectors of the economy despite interests. The politics of industrial policy framework helps to shed light on the conditions for change and the proliferation of on-grid RE investments. Finally, Rodrik's concept of the power of ideas is the conceptual basis on which the conclusion of this chapter is based. This thesis concludes with the recommendation of a policy innovation.

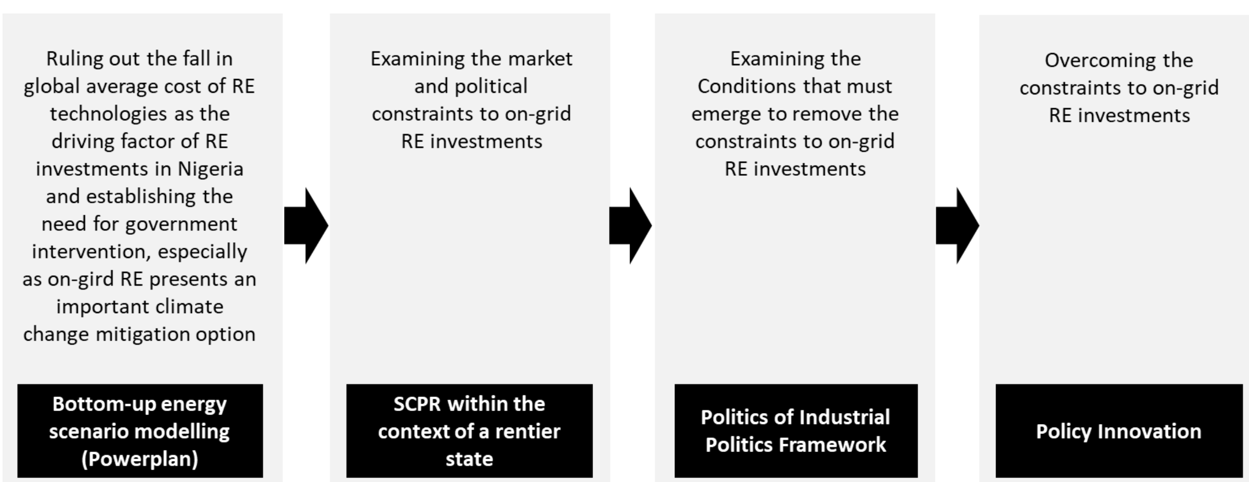

Figure 2.2: Conceptual approach used in this research.

2.5 Conclusion

Several papers in the literature have used the carbon curse theory and the MLP theory to establish a dichotomy between an emerging RE niche and a dominant resistive hydrocarbon-intense regime, which is said to constrain adoption of RE in oil- and gas-rich countries. This chapter has argued that there is currently insufficient evidence for this in the on-grid electricity sector in Nigeria. While it is an open question as to whether this dichotomy will eventually emerge, this thesis argues that there is a wider industrial organisational causal dynamic that currently constrains on-grid RE in the NESI – sustained by the bureaucratic dysfunctionality and rentier mentality common in oil rich rentier states like Nigeria. Therefore, this thesis uses an industrial economic framework to understand the barriers to on-grid RE investments in the context of a rentier state.

The thesis also recognises that oil rentier states are not destined to have unproductive sectors outside the oil sector. Thus, it employs the politics of industrial policy to examine the conditions under which the electricity sector can be more productive and attract on-grid RE investments.

Considering the arguments of Rodrik (2014) regarding the power of ideas – and informed by constraints and conditions for change in Chapters 4 and 5 – this thesis recommends a policy innovation option that aims to unblock investment in on-grid electricity generation in Nigeria.

However, the thesis first establishes, in the next chapter, that RE technologies' falling global average price is not expected to drive RE investments on the grid in Nigeria. Government intervention through policy is necessary.

3 Driving the Energy Transition: Declining Renewable Energy Costs or Government Policy?

3.1 Introduction

If Nigeria achieves its 2030 renewable energy (RE) generation targets, the declining global average costs of RE technologies will not be the driving factor. To meet its targets, the government needs to enable the sector to deploy RE technologies on the grid through industrial policies. This chapter shows the impacts of achieving Nigeria's on-grid RE targets on wholesale electricity price in the country from 2016 to 2030. The results show that, by 2030, RE deployment could result in a rise in wholesale electricity price by 10% to 28% compared to a business-as-usual (BAU) scenario – even if the government eliminates the gas subsidies enjoyed by gas-fired power plants. Consequently, the cost of RE will not be the driving factor for on-grid RE deployment. This conclusion agrees with the conclusions of simulations conducted by Daggash (2020), who concluded that meeting Nigeria's 2030 climate change mitigation targets in a least-cost scenario would not include the deployment of intermittent on-grid RE technologies – "not even solar PV".

However, many countries, including several low and middle-income countries, have promoted and deployed on-grid RE for climate change mitigation and energy security despite regional costs of RE technologies. This chapter sets the scene for the cost of deploying renewables in Nigeria until 2030, showing its upward pressure on wholesale electricity price, thereby establishing the need for industrial policies to promote and deploy on-grid RE in Nigeria, especially given the option it presents for climate change mitigation. The chapter uses a bottom-up approach to build future energy scenarios based on the Federal Government of Nigeria's (FGN) 30% RE capacity targets. This research develops four future energy scenarios with varying levels of RE penetration in the energy mix. They include three scenarios with varying

RE penetration levels and one business-as-usual (BAU) scenario, where RE technologies do not feature in the energy mix. The BAU scenario refers to the unchanging share of RE technologies in the energy mix and not the current growth rate of the on-grid energy generation infrastructure. As Chapters 4 and 5 show, the on-grid energy generation growth is inhibited by the liquidity crisis in the sector. Even investments in conventional generation technologies are constrained. The BAU scenario in this Chapter does not assume that on-grid generation suffers zero growth. The objective of the chapter is to understand the additional effects of on-grid RE deployment, especially on the price of electricity. Therefore, it is important that the counter factual scenario (i.e. the BAU scenario) is capable of meeting demand with the same level of reliability as the RE scenarios. The three RE scenarios were compared to the BAU scenario to demonstrate the system-level additional effects of on-grid RE deployment in Nigeria. This research simulates the four scenarios in PowerPlan, an energy system simulation tool that allows users to simulate scenarios from a central planning institution's perspective.

This chapter also shows that the government's on-grid RE targets could provide a critical climate change mitigation option. It could yield a further reduction in GHG emissions by 28.7% compared to the commitments recorded in Nigeria's first Nationally Determined Contribution (NDC).

3.1.1 Background

Like many Sub-Saharan African countries, Nigeria suffers from energy poverty and the devastating impacts of climate change. Gas-fired electricity continues to dominate the Nigerian Electricity Supply Industry (NESI). Two types of gas powerplants were in operation in Nigeria in 2016 – Combined Cycle Gas Turbines (CCGT) and Open Cycle Gas Turbines (OCGT). CCGTs are more efficient than OCGTs because they have waste heat recovery systems to recover heat from the turbine's exhaust fluid (Vatapoulous et al, 2012). OCGTs do not have waste heat recovery systems. OCGTs waste the heat from the exhaust fluid – emitting it into the atmosphere. CCGTs made up 28% of available gas-fired generation capacity, while OCGTs made up 72%. OCGTs and CCGTs made up about 71% of electricity production in 2016[16]. They also made up 84% of the available generation capacity in 2016[17]. The remaining production and plant capacities come from three large hydropower (LHP) plants. As shown in Chapter 5, the NESI's dependence on gas power plants makes it susceptible to continuous gas supply disruptions. The FGN, through the National Council on Power (NACOP), recognised the opportunities presented by renewable energy resources and the dangers posed by the current energy mix and approved the Sustainable Energy for All Action Agenda (SE4ALL-AA) in 2016.

The SE4ALL-AA sets out a government target called "Vision 30:30:30" – to have at least 30,000 MW of available installed generation capacity on the grid, with 30% coming from a diverse range of RE technologies by the year 2030[18]. Using this target, the chapter investigates the effects of on-grid RE deployment in Nigeria on wholesale electricity price, grid reliability and GHG emissions. Amongst other things, it shows that on-grid energy transition could result in significant hikes in wholesale electricity price.

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[16] Primary data collected from the transmission company's National Control Centre (NCC), during fieldwork.
[17] Ibid
[18] The details of the policy, however, show that the RE generation capacity target is 28%, and was only rounded up to 30% when creating the policy name, Vision 30:30:30.

This chapter draws on the scenario-based approach used by Urban et al. (2009) to answer Research Question 1:

> What part will the falling prices of RE technologies play in the on-grid RE transition in Nigeria.

The scenarios draw primarily on the FGN's Vision 30:30:30 target and, to a lesser but useful extent, from industry stakeholders' participatory input. At its outset, this research aimed to use a more participatory approach to scenario development, but this proved challenging to implement due to the difficulty in convening key stakeholders from the Federal Ministry of Power, Works and Housing (FMPWH), other relevant FGN departments and agencies, and industry stakeholders.

This chapter does not attempt to forecast the likely state of the NESI in 2030, but rather, it aims to show the effects of achieving the government's on-grid RE deployment targets at varying levels of success. For this reason, all four scenarios assume the available capacity on the grid reaches 30,000 MW in 2030. Whilst reaching the 30,000 MW grid capacity may seem too optimistic an assumption to make based on historical developments in the sector, it was essential to incorporate it into all scenarios to help narrow the analysis and provide clearer insights into the additional effects of deploying RE on the grid at varying levels of RE penetration without ballooning the number of scenarios discussed in this chapter.

3.1.2 Structure of the Chapter

This chapter proceeds as follows. The Methodology used to model and simulate future energy scenarios is presented in Section 3.2. The simulation tool used was presented in Section 3.2.1. Section 3.2.2 shows how the NESI was modelled on PowerPlan. Section 3.2.3 shows how the four scenarios modelled in this chapter were developed. The chapter also discusses the wholesale electricity price drivers (Section 3.2.4); highlights the benefit of system-level modelling (Section 3.2.5); and outlines the data sources and assumptions used in the modelling (Section 3.2.6). In Section 3.3, the results of the scenario simulations are presented, showing the effects of on-grid RE deployment on wholesale electricity price (Section 3.3.1), system reliability (Section 3.3.2), and GHG emissions (Section 3.3.3). The results are discussed in Section 3.4, and the conclusion presented in Section 3.5.

3.2 Methodology

The analyses in this chapter use a three-step approach applied by Urban et al. (2009). The first step involved modelling the NESI on an energy simulation tool, PowerPlan, to reflect the power sector's state as it was in 2016 – the base year. The second step involved developing four future energy scenarios based on the FGN's 2030 on-grid RE targets. The final step involved modelling and simulating the scenarios on PowerPlan.

3.2.1 PowerPlan

PowerPlan is a bottom-up interactive energy simulation tool. Bottom-up energy simulation tools use disaggregated data and focus on the details of the electricity market's supply side. Bottom-up simulation tools help to zoom into the cost and technological characteristics of energy technologies. They are useful for analyses in electricity markets in low and middle-income countries, such as the NESI, where non-market forces distort traditional supply and demand relationships (Urban et al., 2007; Shukla, 1995). However, as Urban et al. (2007) state, a bottom-up approach's weakness is that conventional drivers of energy supply such as demand, global trends in technology change, and local resource availability are exogenous. This chapter only investigates the effect of meeting FGN's RE targets at varying levels of success without speaking to the policy's quality or its probability of being implemented successfully.

PowerPlan allows users to explore the characteristics of an electricity system from a central planning perspective. It allows users to simulate an electricity network starting from a reference year to a target year. Users of the tool play the role of a central planning institution that decides when to build and add new power plants to the electricity network. PowerPlan’s simulation interval is one year. So, at the end of each simulation step, PowerPlan produces four key results amongst other results. The four key results are electricity price, system reliability, fuel consumption and GHG emissions. These four key results help users to decide on how to plan and invest in the next year. This chapter, however, does not use the tool in this way. This chapter uses the tool to simulate pre-determined scenarios developed from published FGN targets to show how the four key model results change from 2016 to 2030.

Subsequent paragraphs show some key insights into how PowerPlan works.

1. **Production Simulation Module**: this module calculates the amount of electricity produced annually. The module uses the user-defined simultaneous maximum demand (SMD) and load duration curve (LDC) to calculate the amount of electricity required each year. The SMD is the maximum instantaneous demand on the grid in a given period, while the LDC shows the duration for which to expect all demand levels – from the least expected demand to the SMD. This module’s outputs are the annual electricity production and system reliability, which the tool calculates using the annual electricity demand and available generation capacity.
2. **Cost Module**: the cost module calculates the cost of electricity using electricity production from the Production Simulation Module and the user-defined technology costs. The technology costs include capital investment costs; fixed operation and maintenance (O&M) costs; and fuel costs.
3. **Fuel and environment module**: this module calculates annual fuel consumption and GHG emissions. It uses the electricity production output from the Production Simulation Module to calculate annual fuel consumption, GHG emissions and solid waste.

A more detailed presentation of how the PowerPlan tool works can be seen in other papers (Benders, 1996; Urban et al., 2009). **Figure 3.1** shows how the four modules of the PowerPlan tool work together.

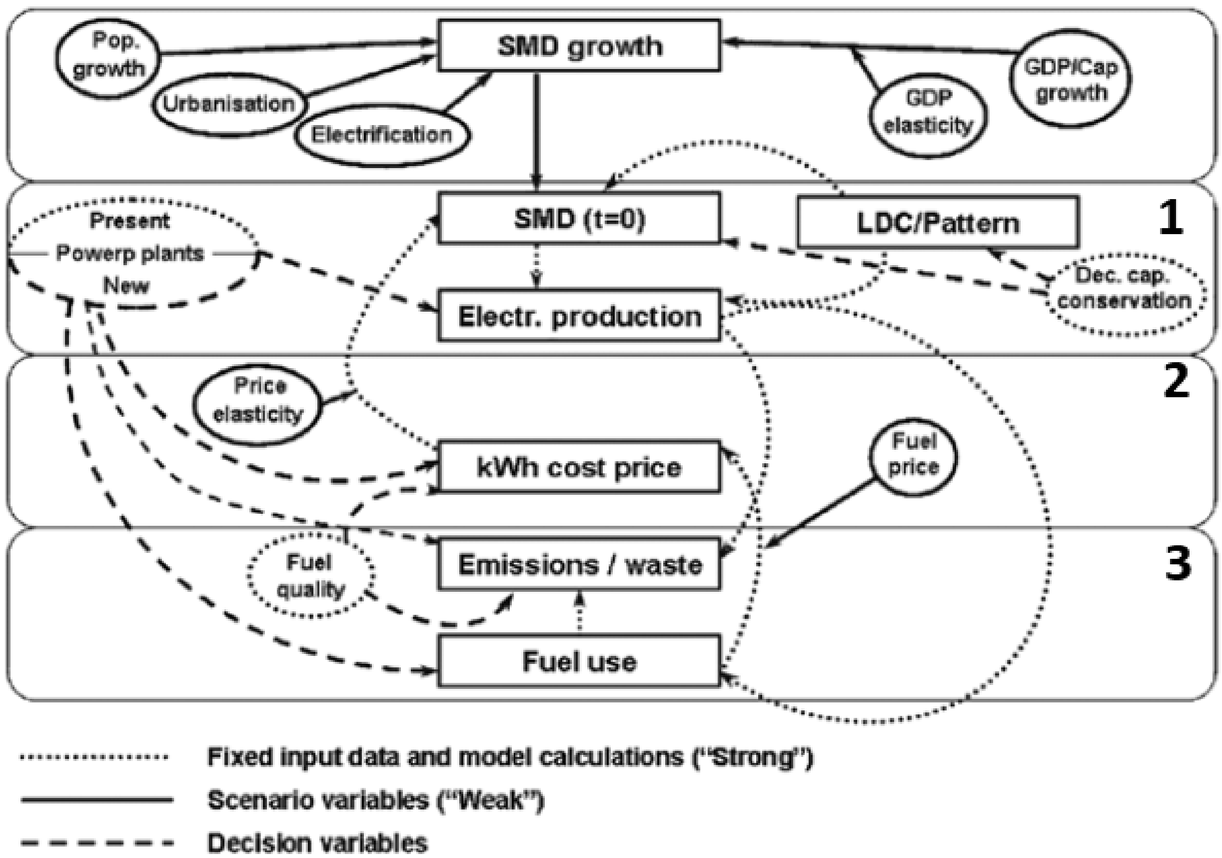

Figure 3.1: Modules of the PowerPlan tool.
Source (Urban et al., 2009)

3.2.2 Modelling and Calibrating the Nigerian Electricity Supply Industry

This section presents the first step in the three-step approach mentioned earlier – to model, calibrate and validate the NESI on PowerPlan. The 2016 annual report by the Transmission Company of Nigeria (TCN) was the source of the bulk of the data collected to build the NESI on PowerPlan. The year 2016 was chosen as the base year because the 2016 annual TCN report was the most recent validated report available during the data collection period of this research.

Whilst some data was publicly available for 2017, the data was incomplete, and TCN's management had not validated them. The data collected from the 2016 TCN report included installed generation capacity, available generation capacity, energy production, and fuel consumption for each power plant on the grid. This chapter also uses primary SMD and LDC data from the National Control Centre (NCC) of the TCN. See the list of data used to build the 2016 NESI in **Table 3.1**.

Table 3.1: Data used to build the NESI on PowerPlan and their sources.

NESI input model	Value in 2016	Source
SMD (MW)	5,222	NCC, 2017
SMD growth (%)	9.4	TCN, 2017
Available capacity (MW)	7,788	TCN, 2016
Annual energy generated (TWh)	28	TCN, 2016
Fuel consumption (PJ)	229	TCN, 2016
Wholesale electricity price (USD/KWh)		
Hydro	0.033	NBET, 2016
Combined cycle gas turbine (CCGT)	0.062	NBET, 2016
Open cycle gas turbine (OCGT)	0.043	NBET, 2016

The detailed and thorough 2017 TCN transmission study also provided a useful source of information for SMD growth. The SMD growth data was directly inputted into the model, bypassing the tool's SMD forecasting module (shown at the top of Figure 3.1).

Cost data for each existing power plant was not available; however, the actual per kilowatt-hour (KWh) cost of electricity production for each power plant was available from the bulk buyer, NBET, and used to back-calculate estimates of the capital cost of existing power plants.

Also, the electricity price in this chapter refers to the wholesale price of electricity and not the retail price. This chapter focuses on wholesale price because adding transmission and distribution costs in the analysis introduces a complexity that is made more challenging to analyse owing to insufficient data from the NESI. Due to the current dysfunctional nature of the NESI, transmission and distribution investment plans and obscure subsidies in the NESI could not be reliably simulated on PowerPlan. This is because transmission and distribution capacities are currently below the capacity required to deliver electricity to consumers, making it difficult to estimate what amount of distribution and transmission investment would be required for every incremental increase in generation capacity or demand. The exclusion of transmission and distribution costs still allows for a useful understanding of what RE integration does to wholesale electricity cost, which passes through to the retail cost of electricity.

After building the NESI model on PowerPlan, the first simulation was executed to ensure that it was an accurate representation of the NESI. In 2016, the actual volume of electricity sent out by NESI GenCos was 28.03 TWh, consuming 228 PJ of gas. The average wholesale price of electricity was USD 0.033/KWh for LHP plants, USD 0.062/KWh for OCGT power plants and USD 0.043/KWh for CCGT power plants. There is currently no industry-validated GHG emission data for NESI GenCos, so the African Development Bank's (AfDB) Clean Development Mechanism-based GHG emission accounting tool was used to estimate the GHG emission levels in the NESI. After several iterations, the model was successfully calibrated as shown in **Table 3.2**

Table 3.2: Calibrated NESI Model results for 2016

Model output	**2016 NESI data**	**NESI Model output**
Energy sent out (TWh)	28.03	28.00
Natural gas consumed (PJ)	231	229
GHG Emissions (ktCO_{2e})	N/A	12,361

Wholesale electricity price – Hydro (USD/KWh)	0.033	0.033
Wholesale electricity price – OCGT (USD/KWh)	0.062	0.062
Wholesale electricity price – CCGT (USD/KWh)	0.043	0.042

To calibrate the energy sent out (in TWh), the planned and unplanned availability of power plants were adjusted within the model so that the energy sent out on the model matched the actual energy sent out in the NESI. To calibrate the amount of natural gas consumed (in PJ), the efficiency of the gas power plants on the model was adjusted so that natural gas consumption on the model matched the actual natural gas consumption in the NESI. To calibrate the wholesale electricity price (in USD/KWh), the capital cost and operational cost of each power plant was adjusted so that the average wholesale price from each power plant matched the actual wholesale electricity price from each plant in the NESI.

3.2.3 Four Future Energy scenarios

After, the NESI model was built and calibrated on PowerPlan, four future energy scenarios were developed. This subsection presents the scenarios used in this chapter and shows the rationale behind their development.

The FGN, through its Vision 30:30:30 policy, aims to reach 30 GW of installed capacity on the grid by 2030 with 30% of that capacity coming from RE technologies. There are three RE scenarios and one BAU scenario examined in this chapter. One of the RE scenarios in this chapter assumes that the RE capacity target will be met, while the two other RE scenarios assume that the RE capacity target will be partially met at varying levels of success. RE30 assumes 30% RE available capacity penetration; RE20 assumes 20% RE available capacity penetration; and RE10 assumes 10% RE available capacity penetration. The fourth scenario is a

Business-as-Usual (BAU) scenario with zero RE penetration. There are four sub-scenarios within each scenario. Each sub-scenario was developed by simulating each of the four main scenarios with different price levels for RE technologies and thermal fuels.

To effectively contrast the impacts of on-grid RE deployment with conventional energy deployment, the future scenarios were developed with four identical assumptions. All four scenarios have the same projected demand; the same energy production in the target year; the same simulation length; the same projected installed capacity for conventional hydroelectric power plants, coal power plants and nuclear power plants (see below); and the same pool of real pipeline projects from which the technology deployment of each scenario is built.

The four scenarios have identical projected electricity demand based on forecasts by TCN. The starting point for the demand forecast was the base year, 2016, which was estimated by TCN using a bottom-up approach, meaning TCN carried out an extensive data collection exercise from the lower end of the transmission grid to identify the demand at the 33kv and 11kv feeders in 2016, including suppressed demand. After establishing the 2016 electricity demand in Nigeria, TCN forecasted the electricity demand for 20 years based on projections for four categories of consumers – residential, commercial, industrial, liquified natural gas (LNG) sector and electricity exports to neighbouring countries. For each category of consumer, TCN selected key drivers for the electricity demand for each group as shown in **Table 3.3**.

Table 3.3: Key drivers used for demand forecast per customer group

Sector	Population growth	Number of customers	GDP	Electricity tariff
Residential	x	x	x	x
Commercial			x	x
Industrial			x	
LNG			x	

Exports	Constant as based on agreements rather than economic development

Source: (TCN, 2017)

Other factors such as grid losses, suppressed demand, off-grid demand and load shedding have also been included into the projected demand. The key drivers for the demand forecast are population growth, on-grid customer expansion, GDP growth and electricity price. The final annual energy production in the target year in each scenario is also identical. All scenarios assume that there will be a total of 205 TWh of electricity sent out from power stations to grid in the target year 2030.

All four scenarios have the same simulation length. The simulation length of all four future scenarios is 15 years from 2016 to 2030 because the analysis within this chapter aims to understand what effect the FGN's Vision 30:30:30 target will have on electricity cost, CO_2 emissions, fuel consumption and grid reliability by 2030.

Finally, all four scenarios were built using an existing pool of on-grid pipeline projects recognised by the TCN. This existing pool was assembled by TCN, based on projects which were under development by the private sector and government as of 2017. The modelling uses this pool of projects as they represent the projects most likely to be used to achieve Vision 30:30:30. For each scenario simulation, power plants within the existing pool of future projects were deployed based on the energy mix of each scenario. For technologically similar power plants within the existing pool of pipeline projects, the order of deployment was based on expected commissioning dates of the projects in the pool as outlined by TCN. In scenarios where the required deployment of technologies exceeds the existing project pipeline capacity, hypothetical power plants were modelled and simulated.

3.2.3.1 Description of scenarios

Business-as-usual (BAU) scenario

The BAU scenario is the base case scenario that assumes that the current level of RE penetration on the grid in Nigeria will remain zero till 2030. This scenario assumes that the available installed capacity on the grid will be made up of large-scale hydro power (LHP) plants, gas-fired power plants, coal power plants and nuclear power plants. In this chapter, LHP is classed as a conventional technology. This scenario also assumes that the installed capacity contribution of LHP plants (15%), coal power plants (10%) and nuclear power plants (6%) will be as described in the FGN’s Vision 30:30:30 target. The rest of the installed capacity is met by gas-fired power plants (69%).

This thesis does not assess the credibility of the government’s Vision 30:30:30 targets but only seeks to explain its effects on the electricity market, especially on wholesale electricity price. Hence, technologies such as nuclear power, which feature in the FGN’s 30:30:30 target, have been left to remain in the scenarios. It should be noted that the level of nuclear power deployment is constant in all scenarios, so its particular effects are not relevant in the analyses in this chapter. Likewise, coal power technology is a high-GHG emitting technology, which is receiving less support from financial institutions across the world, but features in the FGN’s 30:30:30 target. However, it remains constant in all scenarios, so its particular effects are not relevant in the analyses in this chapter.

This scenario is driven by the possibility that the FGN could focus on conventional and thermal sources of energy generation and ignore or discard its own on-grid RE targets, perhaps in favour of off-grid RE plants. The 2030 RE capacity in the vision 30:30:30 targets was replaced entirely by gas power plants in this scenario.

10% Renewable Energy (RE10) Scenario

The RE10 scenario assumes that FGN's 2030 RE target is only partially met. It assumes that only 10% of the on-grid capacity in 2030 will be made up of RE technologies. This scenario assumes that all RE technologies deployed till 2030 are based on Solar PV technology due to its likelihood of being the first RE technology to be deployed on the grid. All the future on-grid RE generation projects, which already have PPAs with NBET, are based on Solar PV technology. This is a result of the abundance of natural solar resource in Nigeria; the relatively short time required for PV deployment; and the falling cost of deploying PV. This makes solar PV technology the most likely RE technology to be deployed.

All levels of deployment of LHP plants, coal power plants and nuclear power plants remain the same in the RE10 scenario as they are in BAU scenario. The RE10 scenario assumes that 3,200 MW of solar PV plants will displace 3,200 MW of gas power plants, allowing solar PV to account for 10% of the total installed capacity on the grid. By 2030 in the RE10 scenario, available installed capacity on the grid will be made up of large-scale hydro power plants (15%), coal-fired power plants (10%), nuclear power plants (6%), gas-fired power plants (59%) and solar PV plants (10%).

20% Renewable Energy (RE20) Scenario

The RE20 scenario assumes that FGN's 2030 RE target is also only partially met. It assumes that only 20% of the on-grid capacity in 2030 will be made up RE technologies. This scenario assumes that all RE technologies deployed till 2030 are based on solar PV technology and small and medium hydro power (SMHP) plants, due to their prospects of being the first two RE technologies to be deployed on the grid.

After solar PV, SMHP plants are the next likely RE technology to be deployed on the grid due to recent government efforts to concession existing small dams to be used for electricity generation. The concession process for six SMHP dams was started in 2018, however, conclusion of the process is unclear. This makes SMHP plants the most likely RE technology to be deployed after Solar PV.

The RE20 scenario assumes an energy mix of solar PV (16%), SMHP (4%), plus hydro power plants (15%), coal-fired power plants (10%), nuclear power plants (6%) and gas-fired power plants (49%). The solar PV and SMHP deployment levels in this scenario are the same as those in the FGN's targets. The difference between this scenario and the 30:30:30 target scenario is that no other RE technology is deployed. Instead, other RE technologies envisaged by the 30:30:30 target scenario are replaced by coal- and gas-fired power plants.

30% Renewable Energy (RE30) Scenario

The RE30 scenario is the FGN's target scenario. It assumes that the FGN's vision 30:30:30 policy target is fully met. The vision 30:30:30 policy targets 30% RE penetration on the grid; however, the details of the policy show that the target is 28%. The vision 30:30:30 policy has a target energy capacity mix of gas-fired power plants (41%), coal-fired power plants (10%), nuclear power plants (6%), hydro power plants (15%), SMHP plants (4%), solar PV plants (16%), concentrated solar power (CSP) farms (3%), wind farms (3%) and biomass power plants (3%).

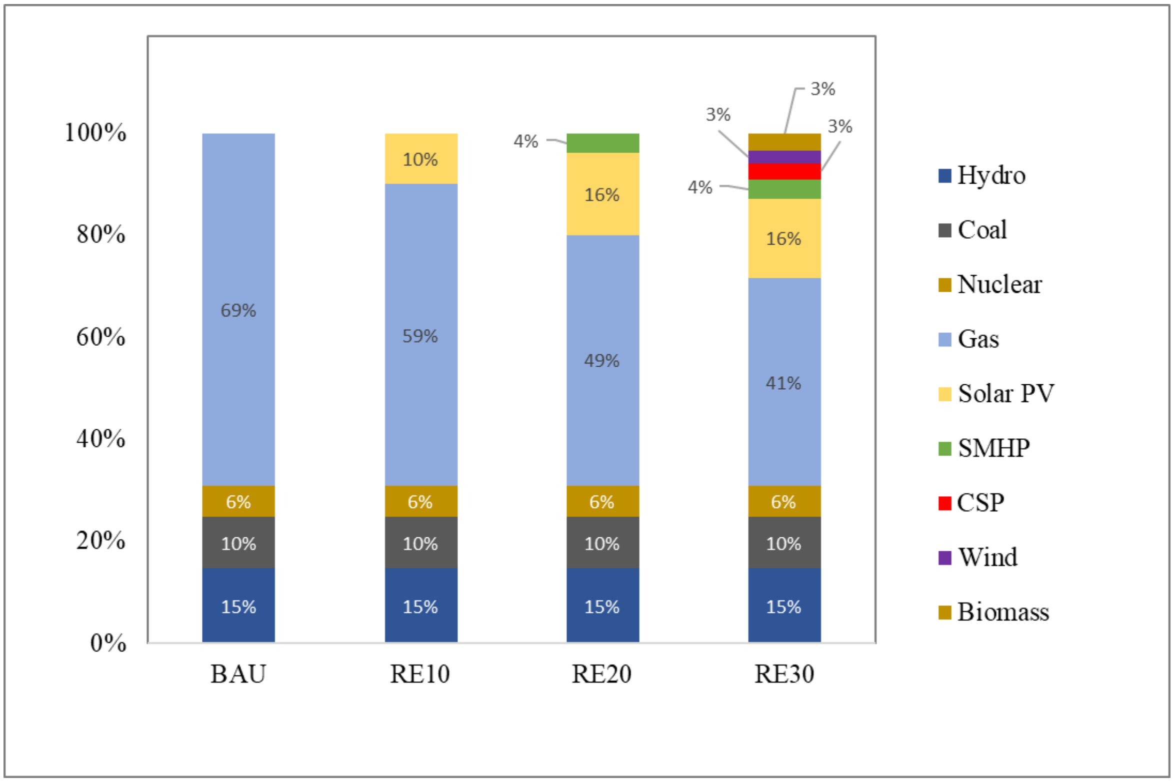

Figure 3.2: Overview of energy mix in 2030 for each scenario.

There were four sub-scenarios developed within each of the four main scenarios. Each of the four scenarios have been simulated with varying combinations of costs for conventional technologies, RE technologies, and thermal fuels as shown in **Table 3.4**. Each sub scenario differs by gas and RE technology prices.

The objective of creating these sub-scenarios is to understand the impact of (exogenous) technology and fuel cost trends on the wholesale price of electricity in the NESI. Realistically, technology and fuel cost trends would have an impact on the energy mix itself, making some of the sub-scenarios in **Table 3.4** less probable than others. For example, the sub scenario that meets the government's target with high renewable energy technology costs and low conventional and fuel costs could be argued to be less probable than the sub-scenario, where the target is met with low renewable energy technology costs and high conventional technology and fuels costs. However, this chapter uses a bottom-up approach that considers price an exogenous factor.

Table 3.4: Scenarios and sub-scenario cost assumptions.

S/N	Scenario	Sub-scenario	Conventional power plants capital and O&M costs	RE power plant capital and O&M costs	Gas cost	Other thermal fuels cost
1	BAU	BAU-1	high	n/a	DGSO	high
2		BAU-2	high	n/a	low	high
3		BAU-3	high	n/a	high	high
4		BAU-4	low	n/a	DGSO	low
5		BAU-5	low	n/a	low	low
6		BAU-6	low	n/a	high	low
7	RE10	RE10-1	high	high	high	high
8		RE10-2	high	low	high	high
9		RE10-3	low	high	low	low
10		RE10-4	low	low	low	low
11	RE20	RE20-1	high	high	high	high
12		RE20-2	high	low	high	high
13		RE20-3	low	high	low	low
14		RE20-4	low	low	low	low
15	RE30	RE30-1	high	high	high	high
16		RE30-2	high	low	high	high
17		RE30-3	low	high	low	low
18		RE30-4	low	low	low	low

The benefit of bottom-up models, as Shukla (1995) and Urban et al (2007) recognise, is that market equilibrium only accounts for a small proportion of the economy in many low-income countries due to excessive non-market influences. Nonetheless, this chapter focuses on addressing the more internally coherent scenarios that assume that renewable energy technologies prices will be low.

It is also important to note that a high RE price scenario appears improbable because it assumes that cost reductions for RE technologies would be slowed down despite enormous global investments in RE. In the decade ending in 2019, USD 2.6 trillion was invested in RE, and an additional USD 10.2 trillion will be invested in RE by 2050 (IRENA, 2016; BNEF, 2019). Therefore, it may be more useful to consider with more weight the scenarios that assume a faster rate of reduction in RE costs.

3.2.4 Wholesale Price Drivers

In this section, the three main technology characteristics that determine the wholesale electricity price in the model – capital cost; operation and maintenance (O&M) and fuel costs; and capacity factor – are very briefly introduced. System-level energy and power balancing costs are also introduced, and the regional variation in renewable energy costs is highlighted. Then, this section explains the key data sources and discusses the detailed technology and fuel costs that are used for the modelling in this chapter.

4.2.4.1 Capital Cost

Historically the capital cost – the upfront cost – of renewable energy technologies has been higher, on average, than that of conventional technologies. However, the capital costs of solar and wind power plants have dropped significantly over the last decade. According to data collected by IRENA in 2019, the global average cost of solar PV technology has fallen by 82% since 2010; CSP by 47%; onshore wind by 39%; and offshore wind at 29%, according to cost data the agency collected from 17,000 projects (IRENA, 2019). This drop is due to high learning rates with RE technologies compared to slower learning rates for conventional power plants, which have matured and standardised technologies. The capital costs of RE technologies, especially solar, wind and biomass technologies, are expected to continue to decline over the next decade, and this is reflected in the modelling conducted in this chapter. The decline in capital costs has driven, in part, the falling per-unit costs of solar and wind technologies. The capital costs for conventional technologies are expected to remain the same throughout the model simulation period because the conventional energy technologies are standardised.

4.2.4.2 O&M and fuel costs

As shown in the costs data in Section 3.2.6, the O&M and fuel costs of RE technologies are often lower than those of conventional technologies. Technologies, such as solar, wind and SMHP have no fuel costs, which helps to keep their running costs low. By contrast, biomass power plants still incur relatively high fuel costs, especially in markets where biomass plants do not have regulatory incentives such as tipping fees – income generated from waste disposers, who offload their waste to biomass power plants. The fixed O&M costs of solar farms are often lower than conventional power generation technologies because they have far fewer moving parts. Other RE technologies with turbines and thermal combustion engines require more operational costs than solar PV. These include wind, biomass, concentrated solar power (CSP), and SMHP technologies. Consequently, the running cost advantage of RE is significant for solar, wind, and SMHP technologies due to zero fuel costs and even more significant for solar PV due to low O&M costs.

4.2.4.3 Capacity Factor

The Capacity factor of energy technologies is a significant determinant of their per-unit costs. The *capacity factor* is the ratio of energy produced by an energy generation technology within a given period to the energy that could have been produced by that technology if it could operate at nameplate capacity continuously throughout that period. The capacity factor is largely determined by its availability to generate electricity; its marginal cost of generating electricity; and its technological constraints. The availability of the plant is the amount of time it is available to produce electricity. Plant availability is limited by the duration of plant downtime when the plant or its fuel supply infrastructure has to undergo maintenance or repair. The lower the availability of power plant, the less energy it produces, and the lower its capacity factor is. Another determinant of a plant's capacity factor is the marginal of cost of generating electricity, which is the operational cost of increasing the output of a power plant per unit. Marginal costs are dominated by fuel costs. RE technologies have virtually no marginal cost so they are always dispatched on the grid when they are available. Conventional technologies (except hydropower), on the other hand, have higher marginal costs than RE technologies such as solar and wind technologies. Technologies with higher marginal costs are typically dispatched after technologies with lower marginal costs.

Finally, the capacity factor of intermittent RE technologies are limited by technical constraints. Wind and solar energy technologies rely on stochastic natural resources, such as solar and wind. Therefore, they are unable to operate at full capacity continuously. For example, the output of solar farms drops as temperature rises or as irradiation from the sun decreases (Aburiya and Mutaka, 2007). The effect of ambient temperature on the output of solar PV panels varies by the type of solar PV technology being used. The capacity factor of solar PV can be as low as 11% (the average load factor in the UK for solar PV in 2019) or higher than 29% (the average capacity factor for solar PV achieved in Arizona between 2014 and 2017). Similarly, the output of wind farms cuts out as wind velocity falls below the minimum required to turn the blades or goes above the maximum beyond which the turbines are at risk of getting damaged (Eisenhut et al., 2007). The lower the output from solar and wind power plants, the more expensive they are because of the resulting higher fixed costs per unit of energy generated.

While solar and wind technologies usually have lower capacity factors than conventional technologies, the *availability factor* of RE technologies – the fraction of the time they are available to run – is generally higher than conventional power plants, which typically undergo more frequent down-times and maintenance. New conventional power plants have high but slightly lower availability factors than RE technologies. While the availability factor of RE technologies like wind can go up to 95% and solar, 98%, the availability factor for new conventional power plants can go up to 90% and even higher.

In summary, intermittent RE technologies such as solar and wind have high availability factors but low capacity factors due to stochastic wind and solar resources, while conventional technologies and other RE technologies such as biomass and SMHP technologies have high availability and high capacity factors. It is important to note that LHP and SMHP technologies situated in climate-vulnerable locations, may experience stochastic water availability due to changes in rainfall pattern, reducing the capacity factor of the LHP and SMHP plants and making them more expensive.

RE technologies costs are dominated by capital costs (especially for CSP and biomass), operational costs (especially for wind and biomass), and the capacity factor (especially for wind and solar technologies). Conventional technology costs are dominated by capital costs (especially for nuclear and hydro plants with new dams) and operational costs (especially for gas power plants).

3.2.5 System-Level RE Costs

In addition to the plant-level costs of RE technologies, there are additional systems-level costs of RE technologies that are significant and sometimes left out of the narrative about the declining costs of RE technologies. There are two main system-level costs attributable to on-grid RE technologies: energy balancing costs and power balancing costs.

Energy balancing costs are the costs of addressing the stochastic nature of intermittent RE technologies, especially wind and solar. To deploy solar and wind technologies, which sometimes over-produce and under-produce energy on the grid, the grid must incorporate energy balancing technologies such as demand side response, flexible generation, energy storage systems and international interconnectors to export or import energy. These energy balancing options create significant additional costs.

In this chapter, we only consider flexible generation because of the low level of development of the other strategies in Nigeria. Flexible generation cost is the cost of building and operating flexible conventional power plants to address the low output of solar and wind power plants during periods of low solar irradiation or unsuitable wind speeds. In this chapter OCGTs are used as energy balancing technologies to backup intermittent RE technologies.

Power balancing costs are the additional costs that arise in the short term due to instantaneous demand and instantaneous RE production. These costs occur in periods when RE utilisation is curtailed because of congested transmission lines. While this effect can impact both RE and conventional technologies, it can be particularly impactful on RE technologies, such as solar PV, CSP and wind, which have their plant locations restricted by natural resource availability. A cluster of solar PV, CSP or wind farms in areas with high resource availability can lead to sub-optimal use of transmission resources, creating transmission constraints (Hitaj, 20150). This effect can also impact gas-fired power plants, which may sometimes have their location constrained by access to fuel. In Nigeria, for example, most gas-fired power plants are located in the gas-rich Nigeria Delta region of the country due to a limited gas supply infrastructure. However, gas power plants, can be distributed more evenly across the transmission grid with the proliferation of gas pipeline infrastructure. Even though gas pipeline vandalization, which is not rare in Nigeria, can inhibit the development of gas pipelines across the country, in the case of renewables, the plants are permanently constrained by resource availability. In periods where grid congestion arise, flexible back-up power plants are switched on due to RE curtailment. Another situation that raises power balancing costs is where RE plants are curtailed when they reach the maximum instantaneous renewable power penetration (MIRPP) or System Non-Synchronous Penetration (SNSP) – beyond which the grid becomes unstable. However, this thesis does not consider the additional cost of power balancing due to limited availability of transmission data and limited functionality of PowerPlan.

The system-level modelling done in this chapter helps to shed light on the energy balancing costs commonly left out of the narrative on declining RE costs. One purpose of this chapter is to show the total additional cost of meeting the government's on-grid RE targets and to demonstrate that the declining global costs of RE technologies alone will not be the driving factor to enable the government to meet its target.

3.2.6 Data Sources and Key Model Assumptions

The capital cost assumptions used in this chapter can be found in **Table 3.5**. The capital and operational cost assumptions for conventional technologies were sourced from the International Energy Agency (IEA) (IEA, 2015b). The capital and operational cost assumptions for conventional technologies are fixed within a constant range of low and high-cost values with no decline in technology costs. The reason for the fixed range is the standardisation of conventional generation technologies over the decades. The cost data for RE technologies were sourced from the International Renewable Energy Agency (IRENA) (IRENA, 2018, 2016). The RE technology cost trends have two scenarios: high and low. In both scenarios, the technology costs reduce over time, but at varying rates. The low-cost scenario for RE assumes a faster cost reduction rate than the high-cost scenario.

IRENA suggests that the capital cost of RE will continue to fall over the next decade as investments in RE continue to increase. For, example, according to IRENA, the capital cost of solar PV is expected to fall by as much as 59% between 2018 and 2025, while CSP and wind technologies are expected to fall by 43% and 26% respectively by 2025. However, IRENA's capital cost reduction projections, have a range of high and low-cost boundaries that reflect two cost scenarios. One scenario has a faster rate of RE cost reduction than the other. At a global level, capital cost reductions will be driven by increasing economies of scale, more competitive supply chains, technology improvements and global demand and supply of RE technologies. However, as IRENA emphasises, the global average cost of RE technologies is "a mirage as individual markets must be examined in detail to understand the likely trends (IRENA, 2019)."

Based on interviews with project developers in Nigeria, cost reductions will also be driven by improvement in regional structural realities such as quality and availability of local infrastructure to mobilise equipment from ports to project sites located in the hinterlands. The further a project site is from the seaports, the more expensive it is to transport equipment to site. The costs of transportation and accompanying insurance go up with distance to the ports. This is further exacerbated by the inadequate infrastructure and security between the seaports and the hinterlands. An improvement in local infrastructure will bring down the cost of RE technologies, especially solar PV and wind technologies which have high resource availability in the hinterlands. In contrast, most of the gas power plants are sited near areas with high gas production in the southern parts of the country closer to the seaports.

This chapter focuses on low RE cost scenarios which assume, among other conditions, that local infrastructure will be improved during the model simulation period. Other local RE cost reduction options include siting RE projects at economic distances from the transmission grid. The farther an on-grid project is from the transmission grid the higher the cost of the project because transmission lines must be built to connect the project to the transmission grid. In contrast conventional technologies are more established technologies with fixed investment cost boundaries.

The weighted average cost of capital (WACC) for RE is also an important determinant of the cost of RE. However, in Nigeria, capital is generally scarce, with the result that high WACC also impacts conventional projects. Therefore, the WACC in this chapter is uniform across all scenarios. The WACC used was 14% as used in the MYTO – Nigeria's official tariff setting methodology[19].

The O&M assumptions (see Table 3.6) used in this chapter also have high and low scenarios. However, the O&M data assumes a fixed boundary throughout the simulation period due to the constraints of Powerplan, which only allows users to assume a fixed O&M cost value for each power plant. This creates a limitation for the simulation of O&M contribution to electricity price, especially with RE plants, which are expected to have a falling RE O&M over the next decade. However, the effect of this limitation is limited as O&M costs contribute less than 10% of RE price per KWh in the simulations in this chapter. Furthermore, only scenarios with low RE costs (capital and O&M) are given weight in the analysis in this chapter. In this chapter the cost of RE reduces with time, driven by the declining capital costs of RE.

The assumptions for future natural gas costs, uranium fuel costs and coal fuel costs were sourced from the U.S. Energy Information Administration (U.S. EIA, 2019), with the exception of the current local price for natural gas in Nigeria called the Domestic Gas Supply Obligation (DGSO), which is a regulated price for domestic natural gas consumers in Nigeria. The DGSO price for local gas-powered electricity generation companies is subsidised and fixed at USD 2.8/MMbtu[20], lower than 2016 gas price at USD 3.46/MMBtu (U.S. EIA, 2019). The DGSO price is deemphasised in this analysis because this chapter assumes that the gas subsidy is likely

[19] MYTO 2015 Excel-based model collected from the Nigerian Electricity Regulatory Commission (NERC).
[20] Data collected from the Nigerian Electricity Regulatory Commission (NERC).

to be removed if gas production is expected to increase through private sector participation to meet the natural gas demand in all scenarios (FGN, 2017).

Table 3.5: Capital Cost Projections of Energy Technologies from 2016 to 2030 (USD/MW).

Source: (IRENA, 2018, 2016; IEA, 2015b)

Technology	Scenario	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Solar PV	low	1,510	1,388	1,293	1,199	1,104	1,009	914	820	725	630	630	630	630	630	630
	high	1,510	1,388	1,345	1,301	1,258	1,214	1,171	1,127	1,084	1,040	1,040	1,040	1,040	1,040	1,040
Wind	low	1,538	1,477	1,464	1,450	1,437	1,424	1,410	1,397	1,383	1,370	1,370	1,370	1,370	1,370	1,370
	high	1,538	1,477	1,464	1,450	1,437	1,424	1,410	1,397	1,383	1,370	1,370	1,370	1,370	1,370	1,370
CSP	low	6,588	5,564	5,319	5,073	4,828	4,582	4,337	4,091	3,846	3,600	3,600	3,600	3,600	3,600	3,600
	high	6,588	5,564	5,344	5,123	4,903	4,682	4,462	4,241	4,021	3,800	3,800	3,800	3,800	3,800	3,800
LHP	low	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050
	high	7,650	7,650	7,650	7,650	7,650	7,650	7,650	7,650	7,650	7,650	7,650	7,650	7,650	7,650	7,650
SMHP	low	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300
	high	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000
Biomass	low		2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
	high		7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000
OCGT	low	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
	high	933	933	933	933	933	933	933	933	933	933	933	933	933	933	933
CCGT	low	627	627	627	627	627	627	627	627	627	627	627	627	627	627	627
	high	1,289	1,289	1,289	1,289	1,289	1,289	1,289	1,289	1,289	1,289	1,289	1,289	1,289	1,289	1,289
Coal	low	813	813	813	813	813	813	813	813	813	813	813	813	813	813	813
	high	3,067	3,067	3,067	3,067	3,067	3,067	3,067	3,067	3,067	3,067	3,067	3,067	3,067	3,067	3,067
Nuclear	low	1,807	1,807	1,807	1,807	1,807	1,807	1,807	1,807	1,807	1,807	1,807	1,807	1,807	1,807	1,807
	high	6,215	6,215	6,215	6,215	6,215	6,215	6,215	6,215	6,215	6,215	6,215	6,215	6,215	6,215	6,215

Table 3.6: O&M Assumptions for Energy Technologies from 2016 to 2030.

Source: (IRENA, 2018, 2016; IEA, 2015b)

Technology	Cost scenario	Fixed O&M cost	Unit	Equivalent USD/KW/Year
Solar PV	low	10.000	USD/KW/Year	10.000 – 18.000
	high	18.000	USD/KW/Year	
Wind	low	41.000	USD/KW/Year	41.000 – 76.000
	high	76.000	USD/KW/Year	
CSP	low	0.020	USD/KWh	20.540 – 48.680
	high	0.040	USD/KWh	
LHP	low	1.0%	Percentage of capital cost per KW per year	10.500 – 63.000
	high	6.0%	Percentage of capital cost per KW per year	
SMHP	low	1.0%	Percentage of capital cost per KW per year	13.000 – 52.000
	high	4.0%	Percentage of capital cost per KW per year	
Biomass	low	2.1%	Percentage of capital cost per KW per year	42.000 – 1,400.000*
	high	20.0%	Percentage of capital cost per KW per year	***Includes fuel costs**
OCGT	low	0.003	USD/KWh	10.791 – 32.375
	high	0.009	USD/KWh	
CCGT	low	14.667	USD/KW/Year	14.667 – 48.172
	high	48.172	USD/KW/Year	
Coal	low	0.000	USD/KW/Year	0.000 – 92.123
	high	92.123	USD/KW/Year	
Nuclear	low	0.007	USD/KWh	55.310 – 118.521
	high	0.015	USD/KWh	

Note: The O&M costs for LHP is assumed at 6% of the capital costs per KW per year. Other sources have it as lower costs, nonetheless, each scenario (see below) contains the same level of hydropower deployment so this has no impact on the estimated additional cost of on-grid RE. This is the same for the minimum fixed O&M cost of coal technologies assumed.

Table 3.7: Fuel Cost Projections of Energy Technologies from 2016 to 2030.

Source: (U.S. EIA, 2019)

Fuel	Scenario	Unit	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Natural gas	DGSO	USD/ SCM	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
Natural gas	Low	USD/ SCM	-	98	97	87	88	84	84	87	91	96	98	99	99	99	98
Natural gas	High	USD/ SCM	-	98	97	102	111	115	118	124	134	144	154	157	165	167	168
Steam coal	Low	USD/ Mtce	-	75	76	75	73	77	77	75	77	77	77	77	75	75	76
Steam coal	High	USD/ Mtce	-	75	76	77	78	81	81	82	83	83	83	82	81	82	83
Uranium	N/A	USD/ kg	-	32	32	32	32	32	32	32	32	32	32	33	33	33	33

SCM – Standard Cubic Meter

Mtce – Million Tons of Coal Equivalent

RE resource availability is also a significant driver of the (per KWh) cost of RE technologies, particularly SMHP, solar PV, CSP and wind technologies. Resource availability indicates the amount of natural resources (solar irradiance, wind and the hydro potential of rivers and reservoirs) available at the plant site to be converted into electricity. The location of a RE power plant is a major determinant of the amount of (hydro, wind and solar) resources available as fuel for a RE power plant. Table 4.8 presents resource availability assumptions for SMHP, solar PV, CSP and wind. For solar, the amount of solar irradiance available at the plant site determines the amount of electricity the solar farm will generate. For wind power plants, it is the wind speeds that are critical; and for hydropower plants – the hydro potential of rivers and reservoirs at the plant site.

Due to the unavailability of adequate data for water resources at future hydropower sites, this chapter uses historical average hydropower capacity factors (78%) from the three existing hydropower plants in Nigeria in lieu of resource availability. For solar and wind resources in Nigeria, this paper used hourly capacity factor data (Pfenninger and Staffell, 2016; Staffell and Pfenninger, 2016) based on satellite data from National Aeronautic and Space Administration (NASA) and the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT).

Four resource availability bands were created for solar PV based on the actual location of the first fourteen projects procured by the FGN. For CSP and wind, two bands were created based on the two highest resource availability regions in the country. A resource availability band was assigned to each solar PV, CSP and Wind plant deployed in each scenario during the simulations. For solar PV, the geographical location of each plant deployed was consistent with the ratio of the locational distribution of existing pipeline plants. For CSP and wind plants, they were split evenly between the two resource availability bands.

The capacity factor for each band can be seen in Table 3.8. The bands indicate that the solar PV power plants modelled in this chapter will produce between 1,530 KWh and 1,753 KWh annually for every 1 KW of installed capacity. For CSP, power plants in the high band are assumed to produce 1,217 KWh annually for each KW of installed capacity, and for the low band, the CSP power plants are assumed to produce 1,027 KWh annually per KW of installed capacity. Likewise for wind, two bands were created which assume that between 2,614 KWh and 3,420 KWh will be produced annually per KW of installed capacity.

Table 3.8: Resource availability assumptions.

Technology	Band	Specific yield	Unit	Capacity factor
Hydro	N/A	-	-	78%
Solar PV	1	1,753	KWh/KWp/Year	20%
	2	1,680	KWh/KWp/Year	19%
	3	1,607	KWh/KWp/Year	18%
	4	1,534	KWh/KWp/Year	18%
CSP	1	1,217	KWh/KWp/Year	14%
	2	1,027	KWh/KWp/Year	12%
Wind	1	3,420	KWh/KWp/Year	39%
	2	2,614	KWh/KWp/Year	30%

This chapter estimates the total additional impact of on-grid RE deployment on the wholesale electricity price in Nigeria. It does so by comparing the three RE scenarios to a BAU as usual scenario where gas-fired powerplants dominate. This approach is more useful than comparing the levelised costs – lifetime per unit cost – of energy technologies. The system-level modelling helps to highlight the additional costs of RE, which are required to mitigate the risks of intermittent RE technologies and maintain grid stability. **Table 3.9** presents a snapshot of the wholesale price of electricity in 2030 under the RE30-2 scenario where conventional technologies costs and fuel costs are high, and RE technology costs are low. The snapshot shows wholesale electricity price of each energy technology in the NESI in the year 2030.

Table 3.9: Simulated Wholesale Energy Price.

Technology	**Average Capacity factor in 2030**	**Estimated Wholesale Energy Price in the NESI in 2030 (USD/KWh)**
Solar PV	17%	0.09
Wind	34%	0.08
CSP	12%	0.56
SMHP	78%	0.12
Biomass	25%	0.47
LHP	78%	0.12
OCGT	41%	0.08
CCGT	81%	0.06
Coal	81%	0.10
Nuclear	90%	0.12

3.3 Results

This section presents a comparison of all the scenarios, showing the system-level additional effects of on-grid RE deployment in Nigeria. It presents a comparison of the wholesale electricity price, fuel consumption, GHG emissions and system reliability across all scenarios.

3.3.1 Wholesale electricity price

The results from the simulation show that the main determinant of absolute wholesale electricity price for all scenarios is the capital cost of conventional technologies (Figures 5.3 – 5.6). The first reason for this is that the RE penetration, even in the target RE30 scenario, is not high enough to affect the price nearly as much as the cost of conventional technologies does. The RE30 scenario projects an on-grid RE capacity of 30% of the total capacity in 2030. However, the energy production share of RE is projected to be much lower at 11% – about one-third of its installed capacity share – because the capacity factor or utilisation factor of solar and wind technologies are much lower than those of conventional technologies. The energy production share of on-grid RE, as expected, is even lower in the RE20 scenario at 8% and in the RE10 scenario at only 2%. This makes the effect of RE on electricity price lower than the effect of conventional technologies. On-grid RE integration nonetheless causes an increase in the cost of electricity.

The second reason is that there is quite a large divergence between the projected high and low capital costs for several of the technologies - most notably LHP, coal and nuclear - that feature in all scenarios and are counted as "conventional" technologies for the purposes of this analysis.

Error! Reference source not found.Figure 3.3 shows large changes in wholesale price due to the effect of LHP plants added to the grid in 2019 and 2021. These feature in all scenarios, because they are part of the existing pipeline of projects planned by FGN. If these LHP plants incur high engineering, procurement, and construction (EPC) costs - and especially if they require the construction of dams – then their inclusion on the grid could double the price of electricity., The effect of the inclusion of high cost LHP plants is also clearly seen in Figure 3.4, Figure 3.5 and Figure 3.6. Where the capital costs of LHP plants are high, this leads to steep price increases in 2019 and 2021 in all four scenarios. However, in the scenarios with low capital costs for conventional technologies (RE10-3, RE10-4, RE20-3, RE20-4, RE30-3, and RE30-4), the addition of the LHP plants, which have high installed capacities and high expected load factors, brings down the wholesale price of electricity.

Note, however, that the effect of the LHPs is mute in assessing the additional cost of RE technologies because all scenarios, including the BAU scenarios, have this feature. The comparison of interest in this chapter is the one between gas fired power plants and RE technologies, which is seen by comparing results across Figures 3.4-3.6.

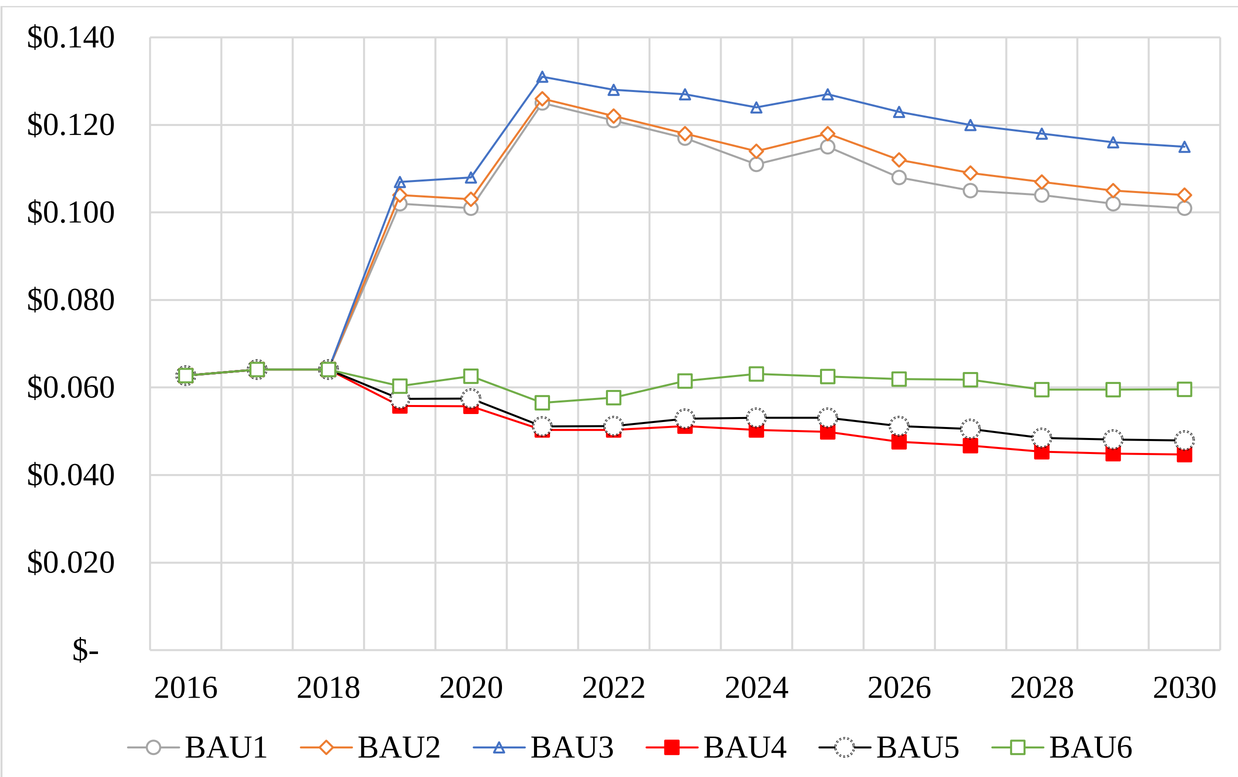

Figure 3.3: Wholesale electricity cost projections for BAU scenarios (2016-2030).

The widening prongs in the Figures 3.4 – 3.6 show the effects of increasing on-grid RE penetration. RE integration has a noticeable effect on electricity price as RE penetration increases, as shown in Figure 3.4, Figure 3.5, and Figure 3.6. The widening prongs on the three graphs as RE penetration increases, shows the incremental effect of RE integration.

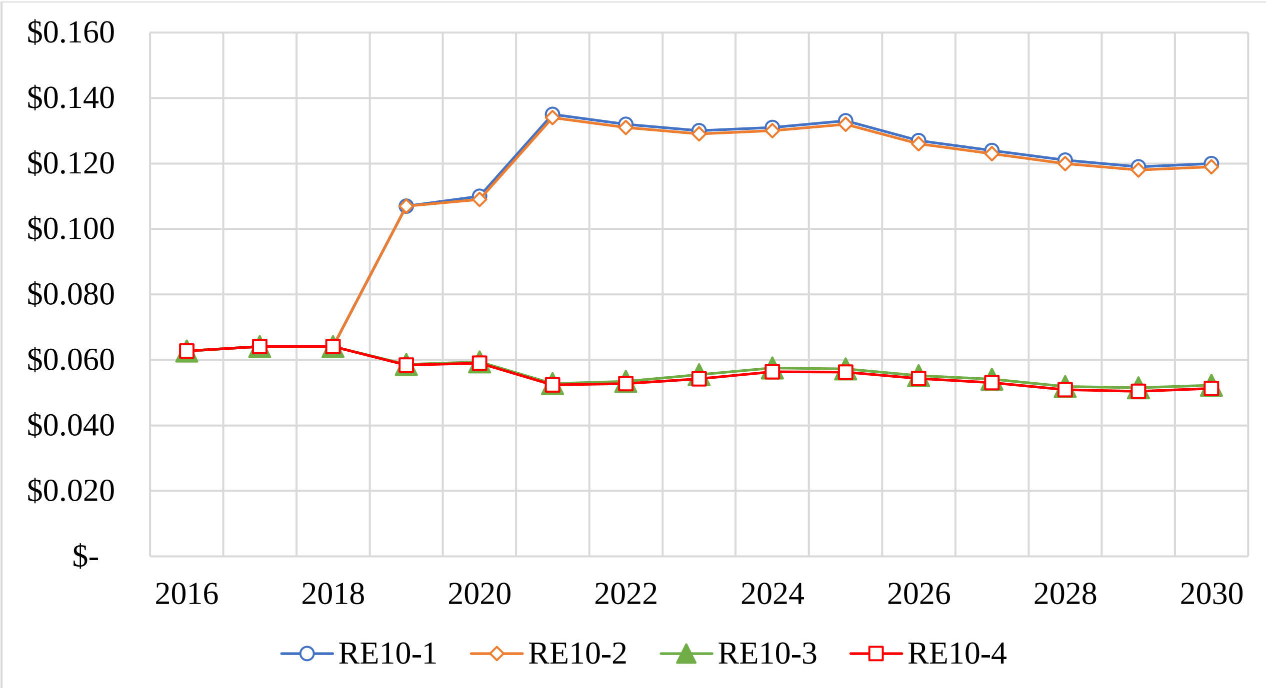

Figure 3.4 Wholesale electricity cost projections for RE10 scenarios (2016-2030).

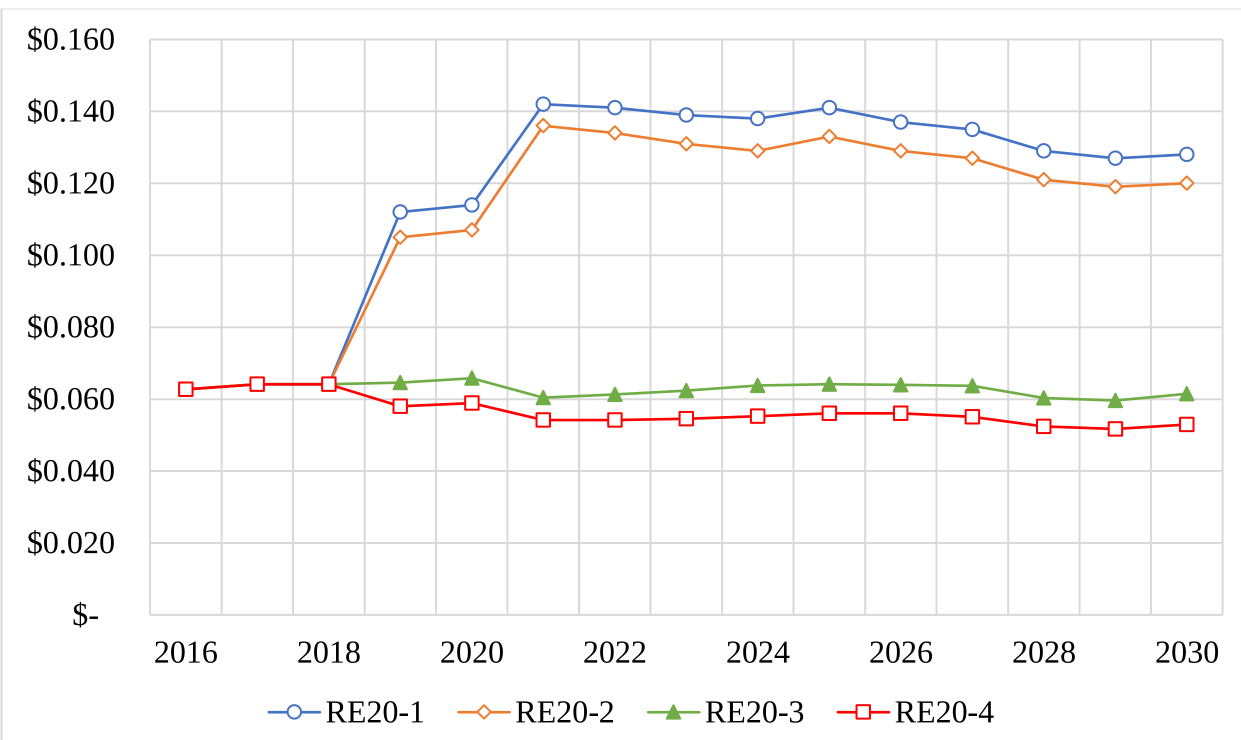

Figure 3.5 Wholesale electricity cost projections for RE20 scenarios (2016-2030).

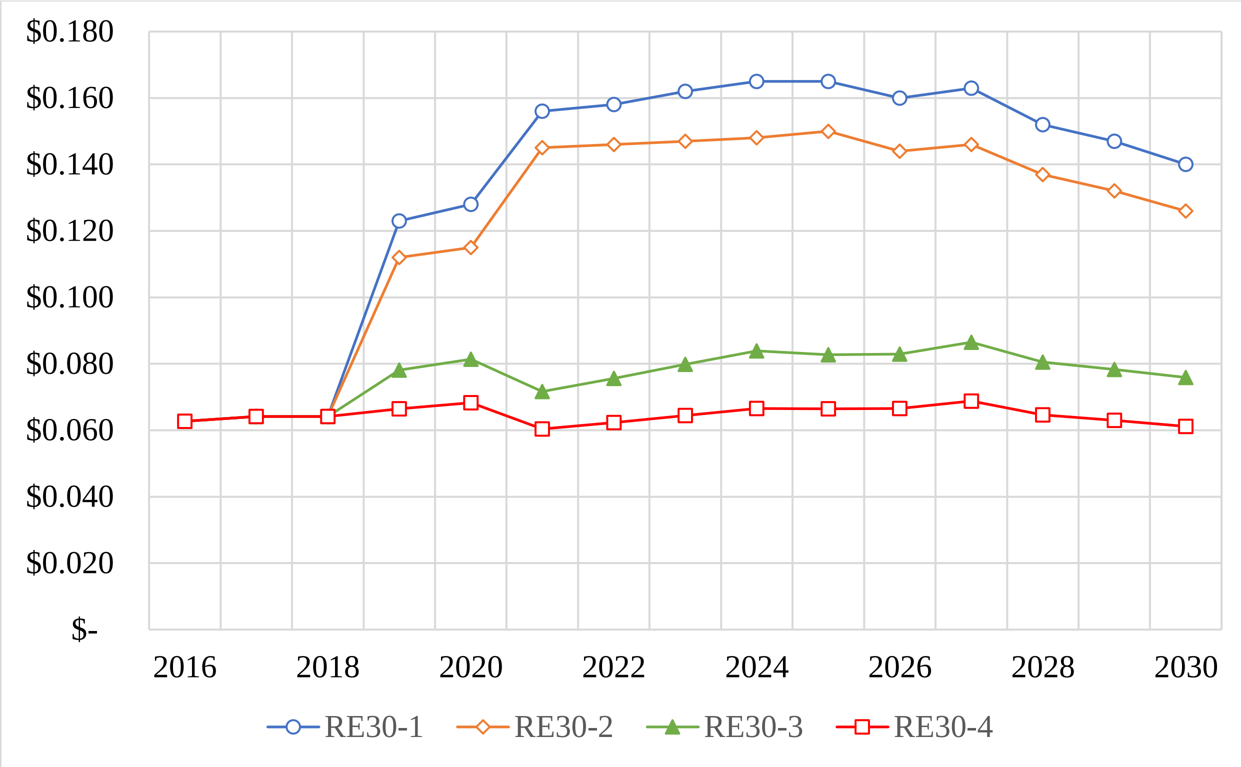

Figure 3.6 Wholesale electricity cost projections for RE30 scenarios (2016-2030).

Figure 3.7 and Figure 3.8 show the additional cost effect of RE integration based on the BAU scenario. The high-conventional-cost BAU-3 scenario is the primary BAU scenario for comparison with high-conventional-cost RE scenarios (RE10-1, RE10-2, RE20-1, RE20-2, RE30-1, and RE30-2), while the low-conventional-cost BAU-5 scenario is the primary BAU scenario for comparison with low-conventional-cost RE scenarios (RE10-3, RE10-4, RE20-3, RE20-4, RE30-3, and RE30-4). However, Figure 3.7 and Figure 3.8 only consider scenarios (RE10-2, RE20-2, and RE30-2) with low RE price projections. This is because the conditions under which RE technologies are deployed at high rates are more probable when RE prices are lower, despite the disconnect between market forces and government planning. Therefore, it is more useful to consider with more weight the scenarios that assume faster rate of reduction in RE costs. These scenarios are RE10-2, RE10-4, RE20-2, RE20-4, RE30-2, and RE30-4, which all assume that the cost of RE falls quickly, while the cost of conventional technologies maintain their constant range of high and low-cost assumptions. Figure 3.7 shows the minimum additional cost that might be expected from on-grid integration between 2016 and 2030 at varying degrees of RE penetration, while Figure 3.8 shows the maximum that can be expected.

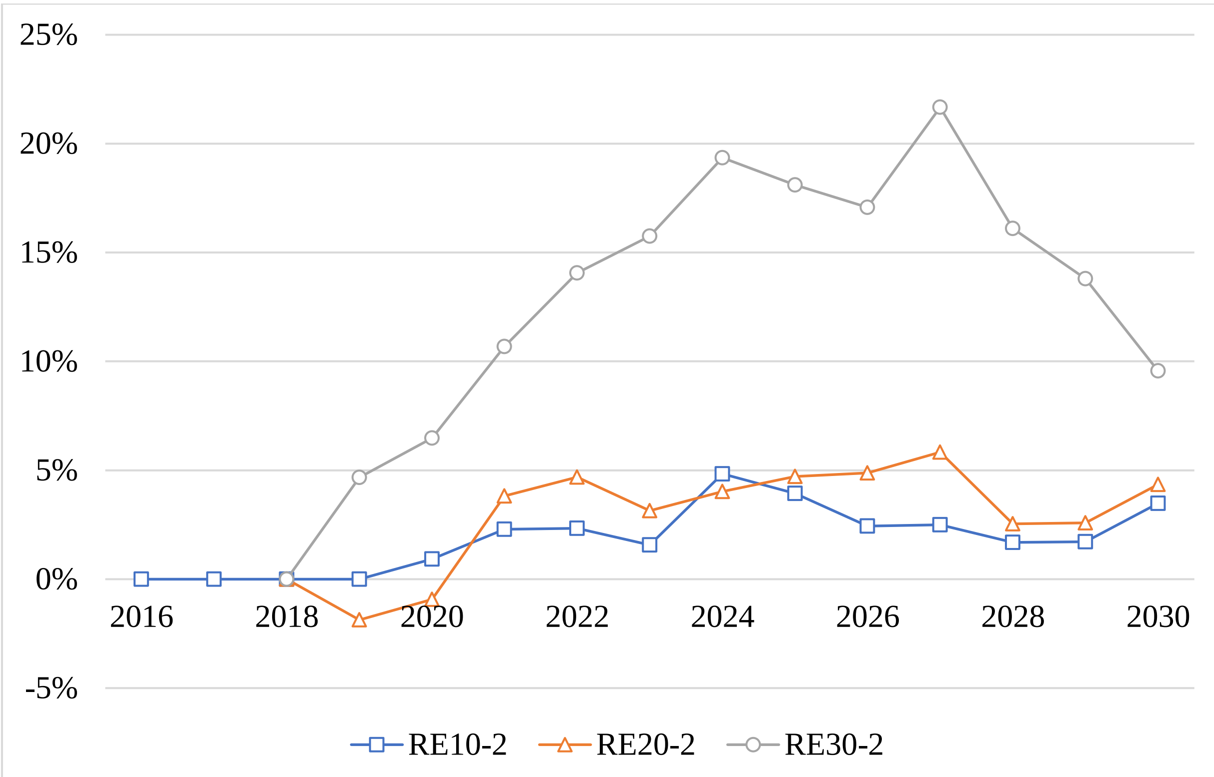

Figure 3.7: The additional effect of RE integration on wholesale electricity price relative to primary base case scenario BAU-3.

The RE30-2 scenario, with high conventional power generation cost and low RE generation costs will cause a wholesale price increase of up to 22% in the mid-2020s and only 10% (see Figure 3.7 by the target year, while RE 30-4, which assumes all technology costs are low, will cause a wholesale price increase of up 36% in 2027 and 28% by the target year. The results from the simulation of the RE30-4 scenario show that it has a higher relative increase in wholesale electricity price than the RE30-2 scenario. However, RE30-4 scenario has a lower absolute wholesale electricity price in the target year than the RE30-2 scenario. This is because on one hand, the costs of both conventional and RE technologies in the RE30-4 scenario are low. On the other hand, the RE30-2 scenario low RE technologies costs high conventional technology costs.

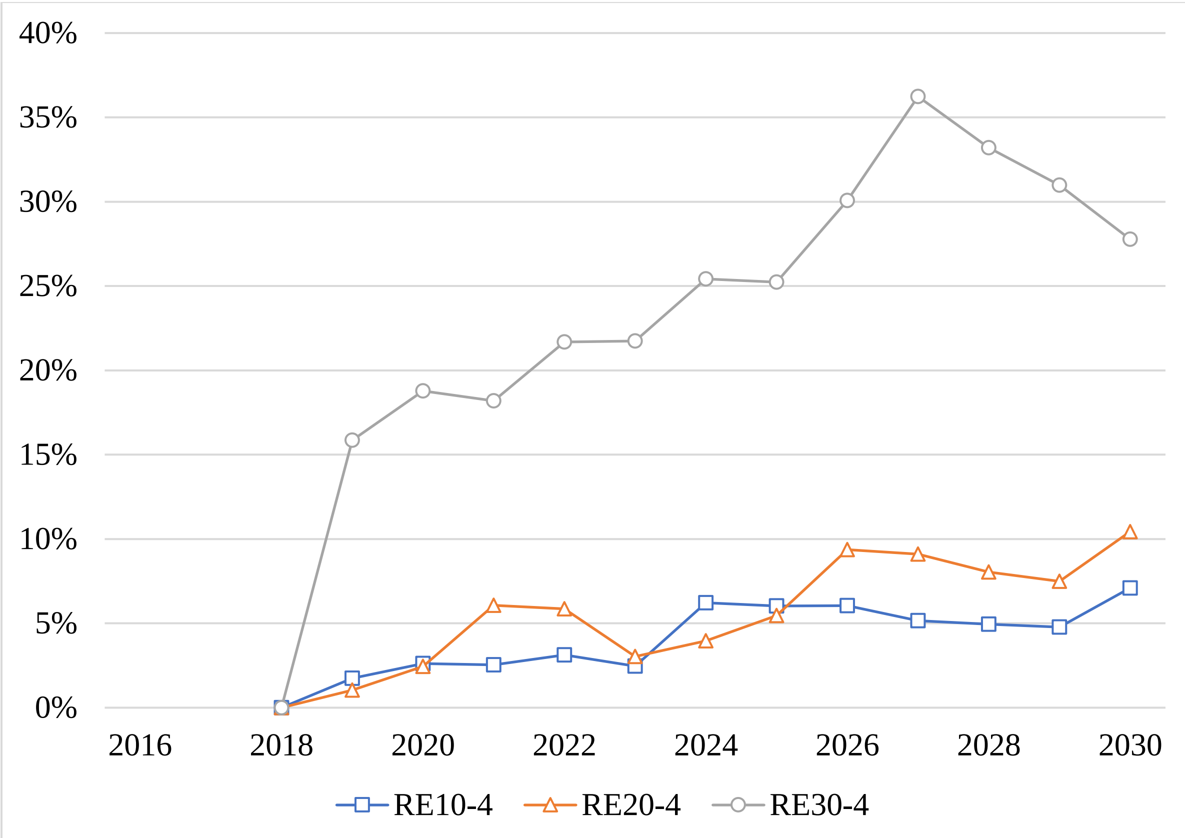

Figure 3.8: The additional effect of RE integration on wholesale electricity price relative to primary base case scenario BAU-5.

It follows that the government's RE target, the RE30 scenario, will cause a 10% to 28% increase in wholesale electricity price on the grid relative to the BAU scenario by 2030, with even greater increases than this possible in the mid-2020s. Disregarding the high RE cost scenarios, in the RE20 scenario, the impact of RE integration on the grid can cause an increase in wholesale electricity price of between 4% and 10% by the target year. For the RE10 scenario the impact of RE integration on the grid is a price increase of between 3% and 7% by the target year.

The exception to net increase in electricity price as a result of RE deployment is in the RE20-2 scenario in the years 2019 and 2020. The RE20-2 scenario assumes high conventional power generation costs and low RE generation costs. In the RE20-2 scenario in 2020 and 2019 the wholesale electricity price is lower than in the BAU-3 scenario in these two years. This is because electricity production from SMHP is more than electricity production from Solar PV in 2019 and 2020. And the electricity wholesale price of SMHP power plants is lower than the electricity wholesale price of solar PV and OCGT power plants at this time. This temporarily drops the price of electricity until 2021 when – in conformity with the FGN's on-grid electricity generation capacity trajectories - PV production surpasses SMHP and drives the price up above the BAU-3 scenario price.

A striking feature of Figures 5.7 and 5.8 is that, while the additional costs of RE in RE10 and RE20 remain at 10% or lower, the RE30 scenario, with the highest RE penetration, has a much higher additional cost of RE. This happens for two reasons. First, the introduction of more expensive RE technologies – CSP and biomass – in government's RE30 scenario causes this spike that result in a wholesale electricity price increase of up 28%. If the government's 30% RE capacity target is met only by solar PV, wind and SMHP, the increase in wholesale electricity price would be lower. While this particular scenario was modelled, it was not included as one the main scenarios in this chapter because it results would be expected to fall within the RE20 and RE 30 scenarios. Another reason for the additional costs in RE-30 is the back-up generation required to support stochastic RE resources-based technologies creates the need to despatch expensive and old inefficiently run gas power plants as back-up generators. Battery technology may mitigate this, but it is not considered in this analysis because it is not currently a priority for the FGN.

3.3.2 System reliability

The system reliability output of the simulations, in the form of the loss of load expectation (LOLE), shows that the RE scenarios create a less reliable grid than the BAU scenarios. The LOLE is the number of days within a ten-year period for which there is an expected interruption on the system. It is estimated using probabilistic approach based on the difference between the total available generation and load demand. The conventional level of reliability for a reliable grid system is a LOLE of 1 day in 10 years. With the inherent low load factors of RE technologies such as solar and wind, which account for the majority of the RE technologies in the RE scenarios, the reliability of the RE scenarios deteriorate with increasing RE penetration on the grid. Prior to including flexible OCGT generators in all scenarios, all four scenarios returned high LOLEs[21]. According to the FGN's self-developed target, RE30, the Nigerian grid can expect a LOLE of 3,077 days in ten years by 2030. This is poor and only a marginal improvement than the current level of LOLE at 3,650 days in ten years. In 2030, the LOLE is; 2,277 in ten years in the RE20 scenario; 1,243 in ten years in the RE10 scenario; and 143 days in ten years in the BAU scenario.

In all scenarios, the grid reliability begins to show some improvement in 2021, when the nuclear power stations begin to come on stream. There is a spike in 2027 and 2030, suggesting a reduction in grid reliability in these two years. This happens because these are the years with the lowest additional generation capacity added to the grid according to the government's capacity

[21] All previous results presented for price, fuel consumption and GHG emissions include the flexible OCGT generators in all scenarios.

expansion trajectory despite a constant rise in demand. Also, the steep improvement in reliability in the year 2028 occurs because that year has the largest batch of generation capacities coming on stream in all scenarios.

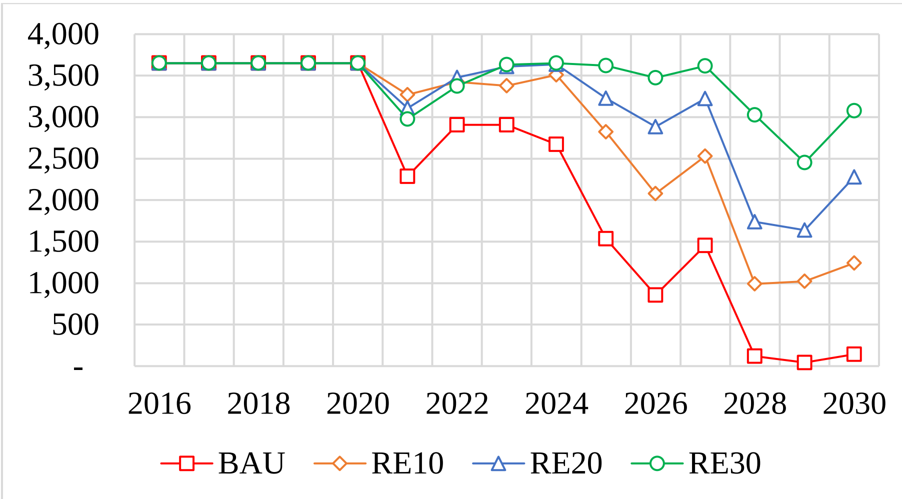

Figure 3.9: Projected LOLE (days in ten years) from 2016 to 2030 for all three scenarios without back-up flexible generation.

All scenarios developed in this chapter are all based on the FGN's RE targets. None of the FGN scenarios end up with a conventionally reliable electricity grid as evidenced by the projected LOLE results shown in Figure 3.9. Each of the scenarios, therefore, need additional energy storage technologies or flexible thermal generation, such as OCGTs, to serve as back up generation and remedy the stochastic nature of RE power plants such as wind and solar power plants. Grid connected energy storage systems were not considered due to their lack of development in Nigeria and their non-existent role in Nigerian energy policy. Instead, additional analysis showed that an additional 950 MW of OCGTs would be required to improve reliability and bring the LOLE to 1 day in 10 years for the BAU scenario; an additional 4,254 MW required for the RE10 scenario; an additional 7,061 MW required for the RE20 scenario and an additional 9,385 MW for the RE scenario. It is important to note that other scholars, including (Eni and

Akinbami, 2017), estimate that much less backup generation is required. The reliability constraint used in the modelling in this chapter (LOLE to 1 day in 10 years) might have been too stringent. Nonetheless, the analyses of the additional costs of RE on the grid is unaffected by this variation because the additional costs in this chapter is based only on the energy (KWh) dispatched. If the point of focus in the analysis was the capital costs required to meet the targets, the variation in flexibility requirements would have been a critical issue.

3.3.3 GHG emissions

The GHG emissions for each energy technology was estimated using the product of the fuel consumption result from Powerplan and the emission factors sourced from AfDB's GHG emission tool. Annual GHG emissions are expected to increase as electricity supply improves; however, consistent with the savings in gas consumption, the RE scenarios resulted in lower cumulative GHG emissions than the BAU scenario. The average annual GHG emission between 2016 and 2030 is projected to be 37,839 $KtCO_2e$ for the BAU scenario, 36,371 $KtCO_2e$ for the RE10 scenario, 32,800 $KtCO_2e$ for the RE20 scenario, and 28,739 $KtCO_2e$ for RE30, the target scenario.

However, when looking at absolute annual GHG emissions, the annual GHG emissions in the BAU scenario goes below the annual GHG emissions in the RE10 scenario from 2028 and below the annual GHG emissions in the RE20 Scenario by 2030 (see Figure 5.12).

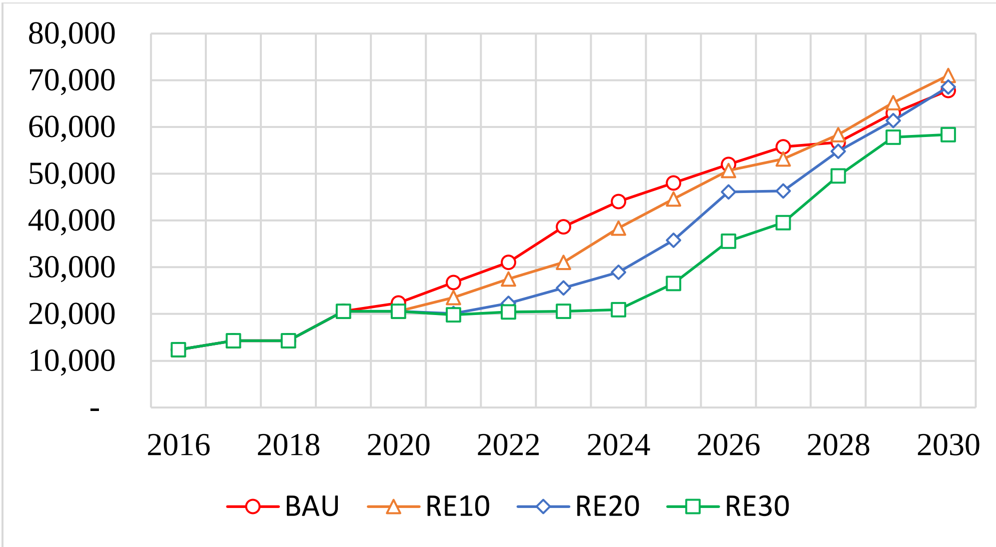

Figure 3.10: Annual GHG emissions (KtCO2e) for all scenarios from 2016 to 2030.

The reason for this counterintuitive result is the difference in phasing of gas power plant expansion in each scenario. In the BAU scenario, the expansion of gas-fired electricity generation is faster than in RE scenarios. The BAU scenario sees an immediate refurbishment of old OCGTs and then expansion of CCGT capacity. In the RE scenarios, RE investments occur immediately, and the refurbishment of existing high GHG-emitting OCGT power plants from their current low available capacity to their intended nameplate[22] capacity occurs later in the simulation timeline, coinciding with the deployment of more efficient combined cycle gas

[22] Nameplate capacity is the original planned capacity of a power plant.

turbine (CCGT) power plants in the BAU scenario. The annual OCGT and CCGT contribution to electricity production can be seen in Figure 3.1.1

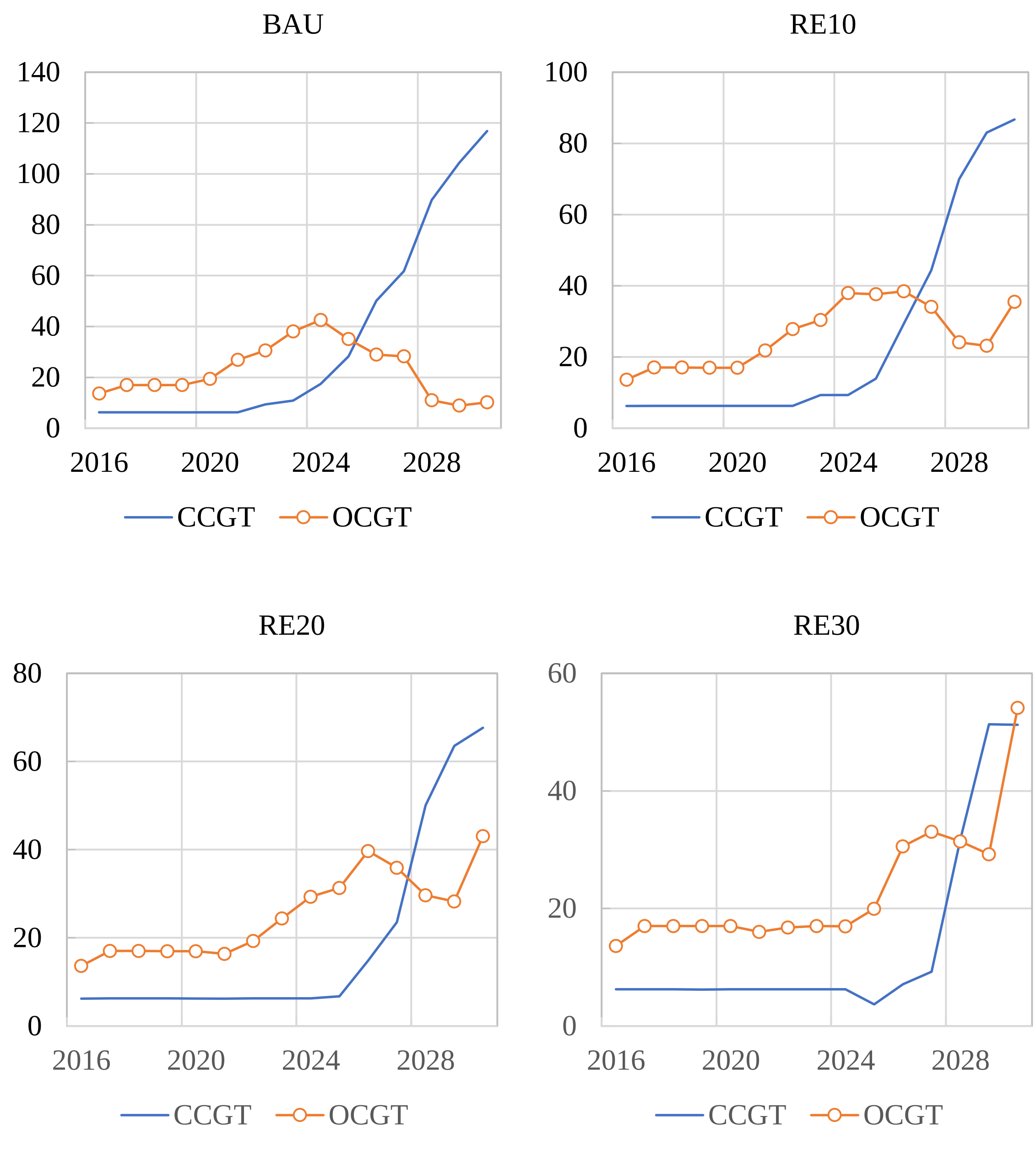

Figure 3.11: Annual electricity generation from OCGT and CCGT power plants in TWh.

In the RE30, this same phenomenon also drives up GHG emissions, but not enough that it exceeds emissions in the BAU scenario. In all scenarios, by 2030, the addition of new OCGT power plants as flexible power plants to balance stochastic RE power generation, helps to reduce the GHG emitting effect of the older and less efficient refurbished power plants. The RE10 scenario may cause up to 5% more annual GHG emission than in the BAU scenario in year 2030, while the RE20 scenario may cause up to 1% more annual GHG emission than in the BAU scenario in year 2030. Nevertheless, annual GHG emissions in RE10 and RE20 scenarios are expected to go back down as baseload OCGT power plants are replaced by CCGT power plants in all scenarios post-2030. Post-2030 in all scenarios, OCGT will be mainly used as flexible generators for energy balancing.

Despite the GHG emitting effect of refurbished OCGT power plants, all the RE scenarios have GHG emission mitigating effects relative to the BAU scenario over the 15-year simulation period between 2016 and 2030. As shown in Figure 3.12, the results of the simulation also show that the cumulative GHG emissions by 2030 is lower than GHG emissions in the BAU scenario (567,584 KtCO_2e) by 4% in the RE10 scenario (545,566 KtCO_2e); by 13% in the RE10 scenario (492,003 KtCO_2e); and by 24% in the RE10 scenario (431,088 KtCO_2e).

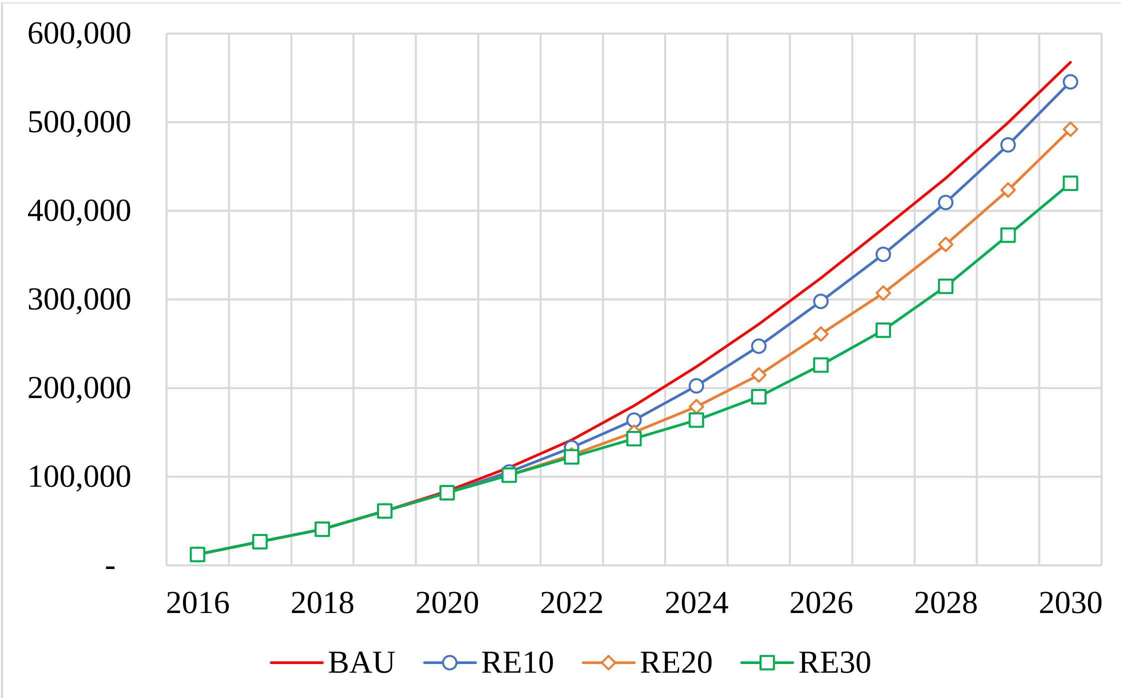

Figure 3.12: Cumulative GHG emissions ($KtCO_2e$) from 2015 to 2030 for all four scenarios.

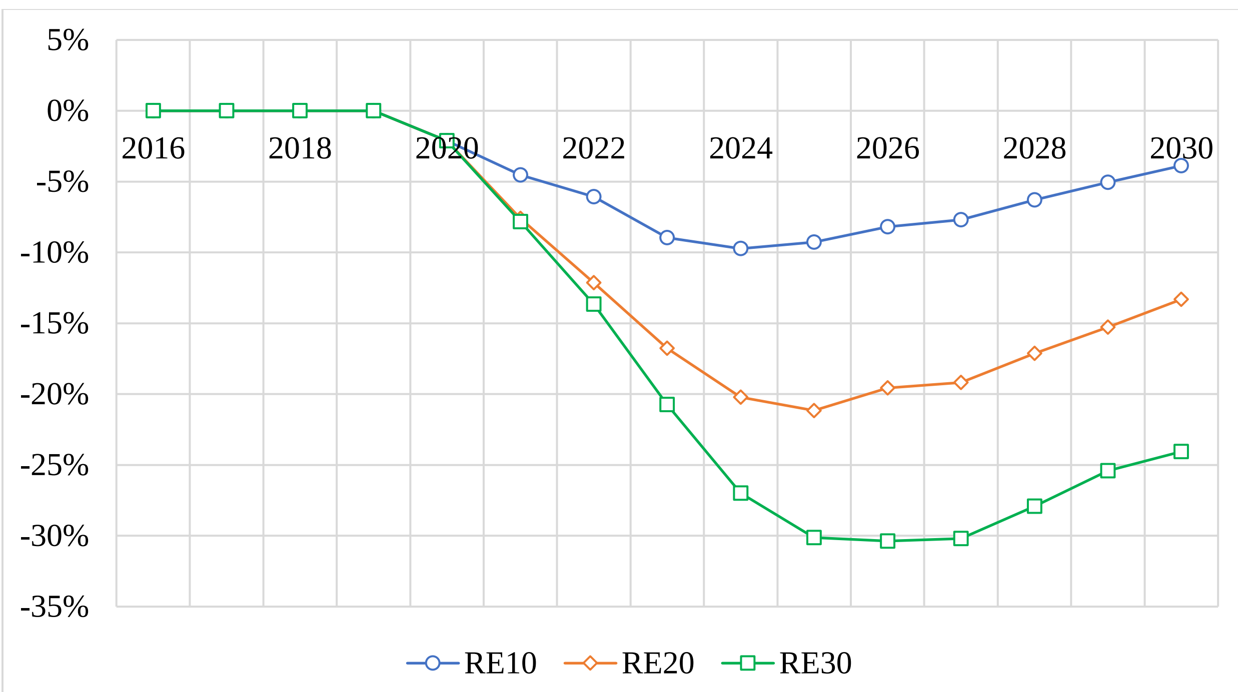

Figure 3.13: Cumulative GHG emissions from 2015 to 2030 for the RE scenarios relative to the BAU scenario.

3.4 Discussion

This chapter shows what the NESI could look like if RE technologies are integrated into the energy mix on the national grid.

Under all RE scenarios, there is an increase in the cost of wholesale electricity as a result of on-grid RE integration. In scenarios RE10 and RE20, where targets are met partially, an increase of between 3 and 10% may eventuate. However, full implementation of the FGN's Vision 30:30:30 targets could result in an increase in wholesale electricity price of up to up to 28% by the target year, 2030. This would happen under scenario RE30-4, where conventional power costs, including fuel costs, are low and RE technology costs are also low. However, in this scenario, the 28% increase in cost is a result of the greater reliance on expensive RE technologies such as CSP and biomass technologies. Considering just RE20 and RE10, where these expensive technologies are not deployed, the increase in wholesale electricity is expected be between 3% and 10%.

The cost of RE integration on the grid can be argued as an inhibiting factor for RE deployment on the grid because it would make electricity more unaffordable for consumers, especially considering the current loop of distrust between the NESI and consumers discussed in Chapter 4. This is further compounded by the fact that the consumers are not currently paying a cost reflective retail tariff and are being subsidised by a non-transparent retail tariff pricing regime upheld by the FGN. However, the price of RE technologies have not prevented other governments from successfully promoting on-grid RE investments through government interventions. Despite several polices over many years, the FGN has been unable to successfully promote on-grid RE. The price of RE technologies will not drive on-grid RE transition. Rather, government intervention is required to promote the transition. Daggash (2020) shows that to meet Nigeria's 2030 Unconditional NDC targets in a 'least cost' scenario, intermittent RE technologies would not be deployed due to its relatively high capital costs and low load factors.

That said, an integrated assessment approach may convince consumers otherwise. With the shrinking of the Lake Chad, the degradation of rivers in the Niger Delta from oil mining activities, the disruption to economic activities from low security of gas supply for electricity generation, consumers may be convinced of the exogenous costs of fossil fuel mining and climate change to their economic and social activities. An assessment of the exogenous costs of fossil fuel mining and over-dependence on gas-fired electricity production needs to be conducted, and its impacts monetised to provide consumers with a clearer picture of the true costs of the electricity they consume. An example of way to capture this exogenous cost is to establish a carbon pricing regime. The PowerPlan model does not account for these exogenous costs.

Nigeria's NDC document sets out Nigeria's GHG emission reduction target of 476 MtCO2e between 2015 and 2030. The FGN plans to achieve this goal partly through off-grid RE deployment, which would account for 31 MtCO2e of the GHG emission reduction target. No on-grid deployment of RE is currently incorporated into the NDC document.

As the second iteration of NDCs are being developed, on-grid RE integration presents an opportunity to establish further GHG emission reduction potential. The GHG emission potential of the RE scenarios in this chapter goes from 22 MtCO2e in the RE10 scenario and 76 MtCO2e in the RE20 scenario to 136 MtCO2e in the RE30 scenario. On-grid RE presents a climate change mitigation opportunity of up to 136 MtCO2, which is equal to 28.7% of the current GHG emission reduction target. Adding on-grid RE to the FGN's climate change mitigation strategy would increase the GHG reduction potential in Nigeria's NDC from 476 MtCO2e to 612

$MtCO_2e$. On-grid energy transition would also be the GHG emission reduction activity with the second highest reduction potential closely behind the FGN's economy-wide energy efficiency efforts, which has a GHG emission reduction potential estimated at 179 $MtCO_2e$ between 2016 and 2030.

Despite the useful insights provided by the method used in this chapter, the method has its limitations.

The method used in this chapter also has a limitation caused by the input data and bottom-up approach used during the simulation of scenarios on PowerPlan. The electricity demand data used in the simulations is exogenous to the data used to develop the scenarios. The development of scenarios was done independently of the demand profile due to the bottom-up approach. While PowerPlan allows users to build an electricity demand profile based on certain macroeconomic trends such as population growth and urbanisation rate, the demand data that was used was extracted from a recent report produced by the TCN. The technology and capacity deployment in each scenario was also developed by the FGN, but by the Federal Ministry of Power Works and Housing (FMP), which is separate from the TCN. In reality the demand, may have an effect on which technologies are deployed and what amount is deployed. As stated by Urban et al. (2009) a downside of the bottom-up approach is that the quality of the policy being simulated is ignored. Only the effects of the policy are assessed. Future research should include an integrated assessment approach, which may account for dynamics and boundaries that tie critical assumptions.

3.5 Conclusion

The method employed in this chapter involved a bottom-up approach that used central planning data from the FGN to create four future energy scenarios on the Nigerian electricity grid. One scenario represented the business-as-usual scenario, which assumed that future electricity demand will be met by hydropower and gas-fired power plants as is the status quo. The other three scenarios assume that RE will be integrated into the national grid at varying levels of penetration in the energy mix – 10%, 20% and 30% respectively. The 30% RE penetration scenario, RE30, is the FGN's target scenario. The other two scenarios were created as varying levels of success in meeting the FGN's targets. The 2016 NESI was created as the baseline on PowerPlan before the four scenarios were added to it.

The results of the scenario simulations gave two main insights. First, the results showed that on-grid energy transition will cause an upward pressure on electricity price till 2030, meaning that the projected global decline in RE costs is unlikely to drive the transition in Nigeria even with the removal of gas subsidies; government intervention is required. The next chapter analyses the bottlenecks in the sector, and shows, that there are industrial organisation issues that constrain investments in the sectors. It shows that these constraints are caused by three inhibitive loops and the dominance of rentier behaviour in Nigeria. Second, on-grid energy transition presents an additional opportunity for Nigeria to increase its GHG emission reduction potential by up to 28.7%.

While this chapter provides useful insights into how on-grid energy transition will affect wholesale price of electricity in Nigeria, future research involving an integrated assessment approach, is required to provide further insights through the addition of dynamics and boundaries that tie together critical scenario assumptions such as national income, monetised climate change-related costs, global supply chain systems and tariffs for RE technologies and conventional technologies.

4 Constraints to On-Grid Renewable Energy Investments in the Context of a Rentier State

4.1 Introduction

The deployment of on-grid RE technologies in Nigeria is a potential solution to the low security of gas supply; devastating impacts of climate change; and the environmental concerns of oil and gas mining in the Niger Delta. The Federal Government of Nigeria (FGN) has published and promoted several on-grid RE policies for nearly two decades, but there is still no RE plant on the national electricity grid. In addition to the price constraint explained in Chapter 3, this chapter explains the market constraints to on-grid RE investments in the NESI. It also explains how those market constraints are sustained by certain key features that are common in rentier states like Nigeria.

There are two central arguments in this chapter. The first argument is that the structure, conduct performance, and regulation within the NESI interact with each other to create constraints to all new on-grid investments, including on-grid RE investments. The second argument is that the rentier mentality and dysfunctionality common in rentier states are responsible for shaping and perpetuating the market constraints within the NESI.

Research Question 2: How are on-grid RE investments in Nigeria constrained?

This chapter answers Research Question 2 by using the structure-conduct-performance-regulation (SCPR) framework and insights from the rentier state theory (RST) to explain the constraints to on-grid RE investments. Peng and Poudineh (2016) developed the SCPR framework based on the traditional Structure-Conduct-Performance (SCP) framework. The traditional SCP framework theorises that the structure of a market determines the conduct of actors within it; the conduct of actors affects the performance of the market; and there are feedback loops that link performance, structure, and conduct. The SCPR provides an additional dimension of analysis to the traditional SCP framework by considering the role of government intervention to protect consumers against the overbearing influence of powerful firms, and to reform imperfect markets. The SCPR also recognises the role of politics in influencing government intervention; however, it is not well equipped to provide full insights into the political-economic causal mechanisms that influence the SCPR dynamic. This chapter uses insights from the RST to augment the SCPR framework, recognising the role of politics in influencing the SCPR dynamic.

This chapter shows how the liquidity crisis in the NESI constrains on-grid RE investments in Nigeria, where rentier state characteristics play a critical role. The outcome of this chapter is the development of a set of causal links that explain the market and political constraints on-grid RE investments in Nigeria.

Chapter structure

This chapter proceeds as follows. The SCPR framework used in this chapter is explained in Section 4.2, while key insights from the RST are highlighted in Section 4.3. Section 4.4 describes the methodology. The findings are presented in three sections. An analysis of the commercial dimension, using the SCPR framework and insights from the RST, is shown Section 4.5. The findings in Section 4.6 show the impact of government regulation on the NESI, and Section 4.7 explain the inhibitions to fourteen licensed on-grid solar projects in the NESI. The results are discussed in Section 4.8, and the conclusion of this chapter is presented in Section 4.9.

4.2 SCPR framework

The SCPR framework shown in Figure 4.1 was developed by Peng and Poudineh (2016) to explain the performance of gas-fired electricity sector in the UK. The SCPR framework argues that the regulatory dimension is a critical dimension of analysis because government regulation, which governments usually introduce to protect consumers and correct imperfect markets, can alter the SCP dynamic and the performance in the market.

This chapter shows how the SCPR dynamic produces the current underperformance in the NESI. It also shows how the underperformance of the NESI constrains on-grid RE investments. Finally, it shows how the rentier state characteristics in Nigeria sustain the underperformance in the sector.

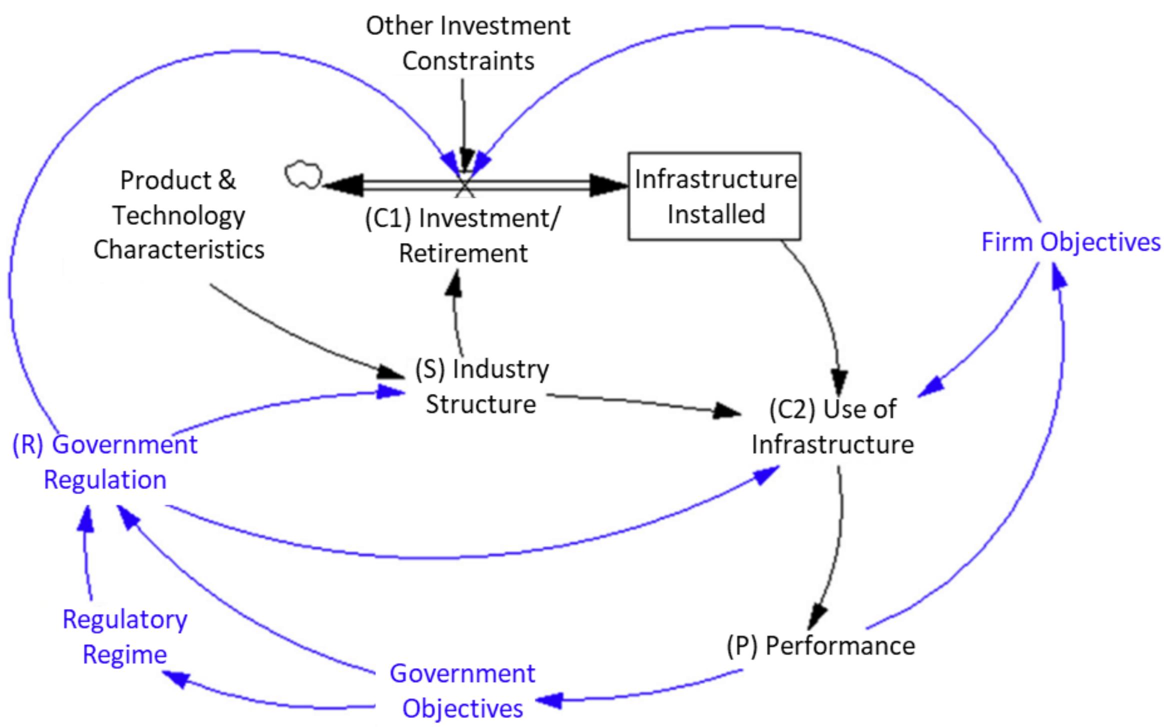

Figure 4.1: The Structure-Conduct-Performance-Regulation (SCPR) Paradigm

Source: (Peng and Poudineh, 2016).

The *structure (S)* of a market is a group of interconnected characteristics of that market such as the number and relative power of buyers and sellers; degree of product differentiation, and ease of entry and exit from the market. These characteristics determine how competitive a market is because unbalanced organisational power in the market gives the buyers or sellers overbearing influence on the market.

The SCPR framework argues that the *structure* in a market, such as the NESI, influences the *conduct (C)* of industry actors and vice versa. In relation to power generation, Peng and Poudineh (2016) also propose that the *conduct* of industry actors can be grouped into two types: long-term *conduct* (*C1*) that changes the capacity of infrastructure, and short-term *conduct* (*C2*) that influences the way the infrastructure is used. Long-term *conduct* involves the increase in the capacity of infrastructure through new investments or the decrease in capacity of infrastructure through the retirement of assets. In the NESI, *conduct* (*C1*) means new investments in any part of the electricity grid infrastructure or the retirement of any asset in any part of the electricity grid infrastructure. New on-grid RE investments in the NESI fall under *C1*. So this chapter explains the causal links that constrain *C1*, which is the *conduct* to increase RE investment on the grid in the NESI.

Conduct (C2), within the context of the NESI, refers to the way NESI operators use the electricity grid infrastructure. Long-term *conduct (C1)* affects short-term *Conduct (C2)* because, the way NESI operators use the grid is constrained by the capacity of the grid. For example, the electricity output of NESI operators is on occasions constrained by the capacity of the grid infrastructure. In turn *conduct (C2)* determines the NESI’s *performance (P)*, which determines whether more long-term investments are made (*C1*).

Finally, the main addition of the SCPR to the traditional SCP framework is the addition of a regulatory dimension. The SCPR framework argues that government intervention is necessary in imperfect and dysfunctional markets. In addition to state owned enterprises, the government interacts with the market through *policies and regulations (R)* based on its objectives and evaluation of industry performance. When government intervenes through industry regulations, it can have three implications in a market.

First, government intervention can cause an increase or reduction in the capacity of infrastructure *(C1)*. In the NESI, this is equivalent to the FGN constraining or encouraging additional investments on the grid. At the end of this chapter, it is clear that government policy adds to the constraints on additional investments, including on-grid RE investments. Second, government regulation can influence the way infrastructure is used *(C2)* by industry operators. In the NESI, the government's grid codes – a guideline for NESI operators – determine the way NESI operators use the grid infrastructure. The government's pricing regulation also constrains the pricing of services within the NESI. Third, government regulation affects the *structure (S)* of the market. Governments often introduce competition regulations to prevent unbalanced powers and underperformance in the market.

In this chapter, the SCPR framework is used to show how on-grid RE investment *(C1)* is constrained by a number of factors, including government *regulation (R)*, the relative market power of NESI actors *(S)*, the way NESI actors use the infrastructure *(C2)* and the resulting poor performance *(P)* of the NESI.

As Chapter 2 spelled out, government regulation is inherently political because it has the potential to redistribute rent and institutional powers.

The SCPR recognises the role of politics in influencing government intervention in underperforming markets. However, it is not well-equipped to tease out the political economic dynamics that influence government regulation. Peng and Poudineh (2017) created a political dimension within the SCPR framework to address political considerations; however, this research uses a more established concept in the literature to address the political-economic dynamics that influence government intervention. The SCPR with the political dimension was not used in this research due to the operationalisation issues mentioned in Chapter 2. This research uses powerful insights from the RST to explain the political-economic dynamics that influence government intervention.

4.3 Insights from the Rentier State Theory

The RST, which is discussed in more detail in Section 4.3 of this thesis, refers to countries that are largely dependent on externally generated rents from extractive industries. In rentier states, a self-serving class of political and business elites, whose prime interest is rent seeking, establish policies and laws that aid them in receiving rent. The RST has the power to shed light on the constraints to on-grid RE investments in Nigeria. As explained in Chapter 2, Nigeria possesses the key features of a rentier state. Its economy and budget are dominated by the generation and distribution of oil rents. Its oil rents are generated from external sources in the export market. Only a small fraction of the population is involved in oil rent generation and the state is the prime beneficiary of the oil rents.

As discussed in Chapter 2, there are two key insights that the RST exposes in the constraints to on-grid RE investments in Nigeria. The first insight is the impact of the rentier mentality on on-grid RE investments. The second insight is the impact of the commonly observed dysfunctionality in rentier states on on-grid RE investments. Another insight, which is commonly emphasised in the literature but has no evidence in the NESI is active opposition to on-grid RE by rentiers in conventional energy regime.

Rentier mentality refers to the attitude of citizens, who grow accustomed to receiving state benefits without the financial pressure of supporting the state through taxes. In rentier states like Nigeria, oil rents have been sufficient to sustain the state without the need for broad-based taxation and the resulting government accountability. Citizens have gotten accustomed to the benefits provided by the state and those benefits are difficult to remove when they become institutionalised. Citizens' expectation of those benefits has become a key feature in how the government gains its legitimacy from the citizenry. Public protests and demonstrations are frequent occurrences when the government attempts to take these benefits away. One such benefit in oil-rich countries like Nigeria is energy subsidy. In Nigeria, the government provides two key subsidies in the electricity sector – a gas subsidy and a retail electricity subsidy. As shown in the previous chapter, the removal of the gas subsidy is important but not enough to drive on-grid RE investments. However, the retail electricity subsidy, in particular, creates a major constraint to on-grid RE investments. This chapter sheds light on how this dynamic presents itself in NESI.

Dysfunctionality in rentier states refers to the impact of the weak administrative capacity commonly observed in rentier states. The rentier state does not invest in collecting sufficient information about the citizenry because a significant amount of its earnings does not depend on it. The rentier state inhibits its capacity to administer when it does not engage with citizens through tax collection or service delivery for productive enterprises. One of the key challenges identified in the 2017 Power Sector Reform Programme (PSRP) is the information gap in the NESI. The NESI, which was historically administered by the Nigerian state, lacks sufficient information about its consumers, because the now-defunct state-owned electricity utility did not depend on the commercialisation of the electricity sector - a process that would require comprehensive data about its customers. It depended on oil rent from the state. This chapter shows how the lack of sufficient information on-grid electricity consumers serves as a constraint to on-grid RE investments.

Recognising that the political-economic landscape influences the SCPR dynamics, this chapter places a strong emphasis on the effect of the rentier mentality and rentier state dysfunctionality on on-grid RE investments in Nigeria.

4.4 Methodology

This chapter uses a qualitative case study approach aided by descriptive quantitative data. This chapter draws on the methodological approach employed by Peng and Poudineh (2017) in their application of the SCPR framework to the gas production and electricity value chains in Nigeria and Bangladesh. The main difference between the methodology in this Chapter and the methodology used by Peng and Poudineh (2017) is that this chapter analyses and presents only one case study, while the latter uses a multi-case approach. The justification for using a case study approach in this chapter was the nature of Research Question 2, which requires in-depth analyses of the NESI to determine how it contains on-grid RE investments. Case studies present a detailed examination of a historical event to develop, test, or demonstrate an explanation that may be generalizable to other events (George and Bennett, 2005).

This chapter seeks to answer Research Question 2 with an existing conceptual framework that proposes its own causal mechanisms. The aim of the chapter is to apply the SCPR framework to establish corroborative, complementary, or contradictory evidence to the hypotheses proposed by the framework. As explained, in Section 4.2, the dependent variable of interest in the SCPR framework is C1 – long-term conduct or decision to invest in additional electricity generation infrastructure. The causal variables are S (structure of the electricity market), C2 (short-term conduct or the way the existing infrastructure is used), R (government regulation of commercial actors, and P (performance in the sector). It is however important to note that the SCPR framework proposes feedback dynamics that propose that all variables in the framework have causal effects on all other variables. This means that while C1 is determined by other variables, it can also cause change to those variables.

Leaning on Peng and Poudineh (2017), the unit of analysis in the case study in this chapter is the electricity sector value chain in Nigeria because Research Question 2 seeks to understand how the organisation of the electricity sector constrains on-grid RE technologies. As Yin (2009) argues, the unit of analysis should wide broad enough that it the data collected about the case contains all the variables or elements of observation in the conceptual framework being used, but not much wider to avoid the temptation to cover "everything". Given the nature of the SCPR framework and the scope of variables within it, the unit of analysis for the SCPR framework is the electricity sector value chain in Nigeria.

To collect data that demonstrate, complement, or contradict the causal dynamics between C1, C2, R, S, and P, this chapter follows Peng and Poudineh (2017), who used the data collection checklist developed by Jamasb et al (2015). The data collection checklist was specifically developed to propose a set of qualitative and descriptive quantitative indicators that help to assess proposed relationships between the structure, conduct, performance, and regulation in a reformed electricity market. The data collected included primary descriptive quantitative data from utilities and regulator; secondary data utility reports and industry wide reports, newspaper articles, and semi-structured interviews with key actors in the utilities, regulator, policy makers and development financial institutions that invest in the Nigerian electricity sector.

The data collected was analysed using theory-driven thematic analysis. The themes were derived from the variables (S, C1, C2, P, and R) in the SCPR framework. Also, given that this chapter draws on insights from the RST, they were also used as themes in the analysis. Various sections of the data were coded to the key themes.

One significant challenge in the data collection phase of the research was the capacity of the author to convene and interview all the relevant stakeholders in the NESI. A critical example of this was the inability of the researcher to convene and interview all electricity generation companies and all the electricity distribution companies across the NESI value chain to capture their insights on the dynamics that link on the structure, conduct, performance, and regulation in the NESI. This was especially important for the distribution companies, which had significantly different degrees of commercial losses in their operations. However, this challenge was mitigated by collecting data and interviewing the two industry associations that represent the power generation companies and the electricity distribution companies respectively. Interviewing senior executives in the associations enabled the author to collect aggregated insights from the generation and distribution companies without having to convene and interview all of them individually.

Another important point to highlight is the nature of confidentiality of some of the interviews conducted. All but three interviewees accepted for the interviews to be recorded to enable transcription and analysis. However, several interviewees requested that the author’s recorder be switched off at certain points during the interview. One such critical moments occurred when a policy maker asked the author to switch off, they recorder when they explained that the government was no longer interested in pushing the on-grid renewable energy projects due to the ballooning liquidity crisis in the sector – even though it appeared publicly that the government was still in support of concluding the 14 projects it had previously procured. The policy maker mentioned that the government was no longer interested in having these projects completed until it had sufficiently resolved the liquidity crisis in the sector. The policymaker mentioned that this was not a technology specific position, and that all new generation investments would be on hold until the liquid crisis had been sufficiently resolved. The policy makers insight was confirmed when, during the author's field work, the government released a policy document, Power Sector Recovery Programme, which restated the policymaker's insight.

More specifically, this methodology in this chapter followed the following steps.

In Step 1, after the SCPR framework was selected as an ideal framework with which to answer Research Question 2, the framework was used as a data collection guide, helping to determine the kind of data required for its application. The data needs were grouped into four: data to describe the structure of the market; data to describe the conduct of actors within the market; data to describe the performance of the market; and data to describe the regulation in the market. As was done by Peng and Poudineh (2017), a checklist developed by Jamasb et al. (2005) was used as a data collection checklist for the structure conduct, performance and regulation in the NESI.

In Step 2 after determining the data needs, a map of all the key institutions which could provide the data was developed. This included institutions at all levels in the sector – the regulator, the state-owned electricity trading company, private and public utilities, prospective NESI market entrants, policy making arms of government, and international development institutions.

In Step 3, the data was collected and then analysed using data visualisation tools on Microsoft Excel to produce visual charts of the trends and key performance indicators in the NESI, the most relevant of which are presented in Section 4.5 of this chapter.

In Step 4, upon generating a clear snapshot of the NESI, key elements of the data that required contextualisation and explanation were identified and outlined. In Step 5, key stakeholders, who could provide context and explanations for these elements of the data were identified. These stakeholders were identified from within the organisations which provided the data and those organisations, whose performance or conduct the data described. Other stakeholders were identified through a snowball technique with the aid of previously interviewed stakeholders. They included stakeholders, who had previously held critical positions within key organisations during the relevant period that this thesis addresses. The snowballing continued until interviewees began to repeat insights from previously interviewed stakeholders. The list of interviewees engaged can be found in Table 4.1.

Table 4.1: List of Interviewees Engaged for the SCPR Analysis.

S/N	Key Interviewee Attribute	Interview Location	Mode of Engagement	Interview Date
1	DisCo Executive	Nigeria	Face-to-face	05-Apr-18
2	DisCo association	Abuja, Nigeria	Face-to-face	06-Jun-18
3	State-owned electricity trader	Abuja, Nigeria	Face-to-face	19-Feb-18
4	State-owned electricity trader	Abuja, Nigeria	Face-to-face	19-Feb-18
5	Private Sector GenCo	Abuja, Nigeria	Face-to-face	13-Mar-18
6	Private Sector GenCo Former NESI liberalization policy maker	Abuja, Nigeria	Face-to-face	24-Feb-18
7	State-owned GenCo Former state-owned electricity trader	Abuja, Nigeria	Face-to-face	26-Feb-18
8	GenCo Association	Abuja, Nigeria	Face-to-face	31-May-18

S/N	Key Interviewee Attribute	Interview Location	Mode of Engagement	Interview Date
9	RE Project Developer	Abuja, Nigeria	Face-to-face	07-May-18
10	International Development Financier	Abuja, Nigeria	Face-to-face	28-Apr-18
11	International Development Practitioner	Abuja, Nigeria	Face-to-face	27-Apr-18
12	International Development financier	Abuja, Nigeria	Face-to-face	03-May-18
13	International development financier	Abidjan, Cote d'Ivoire	face-to-face	20-Nov-18
14	International development financier	Abidjan, Cote d'Ivoire	face-to-face	22-Nov-18
15	Liberalisation Policy Maker (NESI & telecoms)	Abuja, Nigeria	Face-to-face	02-May-18
16	Top NESI bureaucrat Policy maker Top RE policy maker Former PHCN staff	Abuja, Nigeria	Face-to-face	05-Jun-18
17	Policy maker	Abuja, Nigeria	Face-to-face	21-May-18
18	Electricity sector regulator	Abuja, Nigeria	Face-to-face	06-Mar-18
19	International development financier NESI Policy maker	Abuja, Nigeria	Group face-to-face	28-Apr-18
20	Transmission Company senior staff	Abuja, Nigeria	Face-to-face	21-Feb-18
21	Transmission substation operator	Osun, Nigeria	Face-to-face	24-Jan-18
22	Retired PHCN Staff (Transmission)	Osun, Nigeria	Face-to-face	25-Jan-18

In Step 6, the interview questions were designed and developed to obtain insights and information about key data dynamics in the NESI. They were also designed to test the key assumptions in the conceptual framework. In Step 7, there were 24 interviews conducted with key stakeholders, who were best positioned to explain key dynamics and data in the sector.

These interviews all lasted over one hour and typically took place in government and private sector offices. The semi-structured nature of the interview was such that the author began the interviews with guiding questions that allowed the research to gain answers to key questions, but also allowed the interviewees the freedom to provide any additional information that they thought would be useful.

In Step 8, the interviews were transcribed and analysed using data driven themes from the SCPR framework and the RST. In the final step, Step 9, key findings and causal dynamics were drawn out from the analysis and presented using key themes from the SCPR framework and RST.

The findings in this chapter were arrived at using mixed approaches and methods. This chapter uses quantitative and qualitative data to present a clear picture of the structure, conduct, performance, and regulation within the NESI. It uses qualitative data collected from interviewees to explain how the structure *(S), conduct (C2)* of NESI actors and performance *(P*) in the NESI constrain new investments *(C1)* in the market. It also uses the data collected from interviewees to establish the presence of key RST dynamics in the NESI.

This chapter answers Research Question 2 by using data collected from interviewees within the energy industry to develop causal links based on insights from the RST and the SCPR dynamic in the NESI. The datasets used in this chapter were collected through questionnaires, industry reports, policy and regulation documents and one-to-one semi-structured interviews with 24 interviewees. All the relevant data collected were analysed using theory-driven thematic analysis based on the SCPR framework and two key insights from the RST framework.

4.5 Commercial Dimension

In this section, the SCPR framework is used to analyse the commercial performance of the NESI. The commercial dimension is the first dimension of analysis because it sheds light on the technical and commercial bottlenecks in the NESI. It exposes the market constraints that inhibit investments in the NESI, and highlights areas where rentier state characteristics sustain those constraints.

4.5.1 Structure

To analyse the market structure of the NESI, it is first important to describe it. This subsection describes the commercial operation of the sector; it describes the role and function of each category of commercial actor within the sector; and it analyses four market structure characteristics of the NESI: market concentration, barriers to entry, buyer concentration and market demand growth. This section also highlights the rentier state features that shape the structure of the market, especially the monopsony in the wholesale market.

The Nigerian on-grid electricity sector has a partially liberalised market with a single-buyer model, where the government-owned electricity trading company is the sole buyer of electricity from public and private generation companies (GenCos) and sole seller of electricity to all distribution companies (DisCos), which are privatised. There is also a government-owned and government–run nation-wide transmission network. This current market structure, shown in Figure 4.2, came into effect in 2013 when some of the government-owned GenCos and all DisCos were privatised with a total sale value of $3 billion (KPMG, 2016). The process for privatisation of the sector was initiated in 2001.

In 2001, during the first administration of Nigeria’s fourth republic, the FGN developed the National Electric Power Policy (NEEP), which established the need for the unbundling of the former vertically integrated, state-owned utility known as the National Electric Power Authority

(NEPA). This policy led to the proposed Electric Power Sector Reform (EPSR) bill developed to encourage private sector participation in a sector that was riddled with inefficiency, corruption, and infrastructural decay. However, due to labour union opposition, and several other factors described in Chapter 5, efforts to enact the proposed EPSR bill were frustrated (Joseph, 2014).

To improve the NESI infrastructure before the passage and implementation of the EPSR bill, the FGN developed the National Integrated Power Project (NIPP) bill, which became an act in 2004. The bill allowed the national legislature to appropriate funds for turnkey transmission projects; distribution projects; and gas-fuelled power generation projects. The power generation projects under the NIPP were to be privatised once completed. The NIPP generation projects are a group of distribution, transmission and ten gas power projects owned by the Niger Delta Power Holding Company (NDPHC) in the natural gas-rich southern region of Nigeria. NDPHC is a special purpose vehicle jointly owned by the three tiers of government: federal, state, and local governments. It is the implementation arm for NIPP projects (KPMG, 2016).

One year after the NIPP (2004) Act, the previously resisted EPSR bill was signed into law. The EPSR (2005) Act established the Power Holding Company of Nigeria (PHCN), which took over the assets and liabilities of the former vertically integrated utility, NEPA. PHCN was made up of six generation companies (GenCos), eleven distribution companies (DisCos) and one Transmission Company of Nigeria (TCN). However, sluggishness towards privatisation in the sector persisted after the EPSR Act was established. Eventually, the Roadmap for Power Sector Reform (2010) developed by a new government laid out the framework to remove obstacles to privatisation; clarify government’s strategy on divesture, and reform the fuel to power market. Some PHCN assets were eventually sold in 2013, while others were handed over to concessionaires.

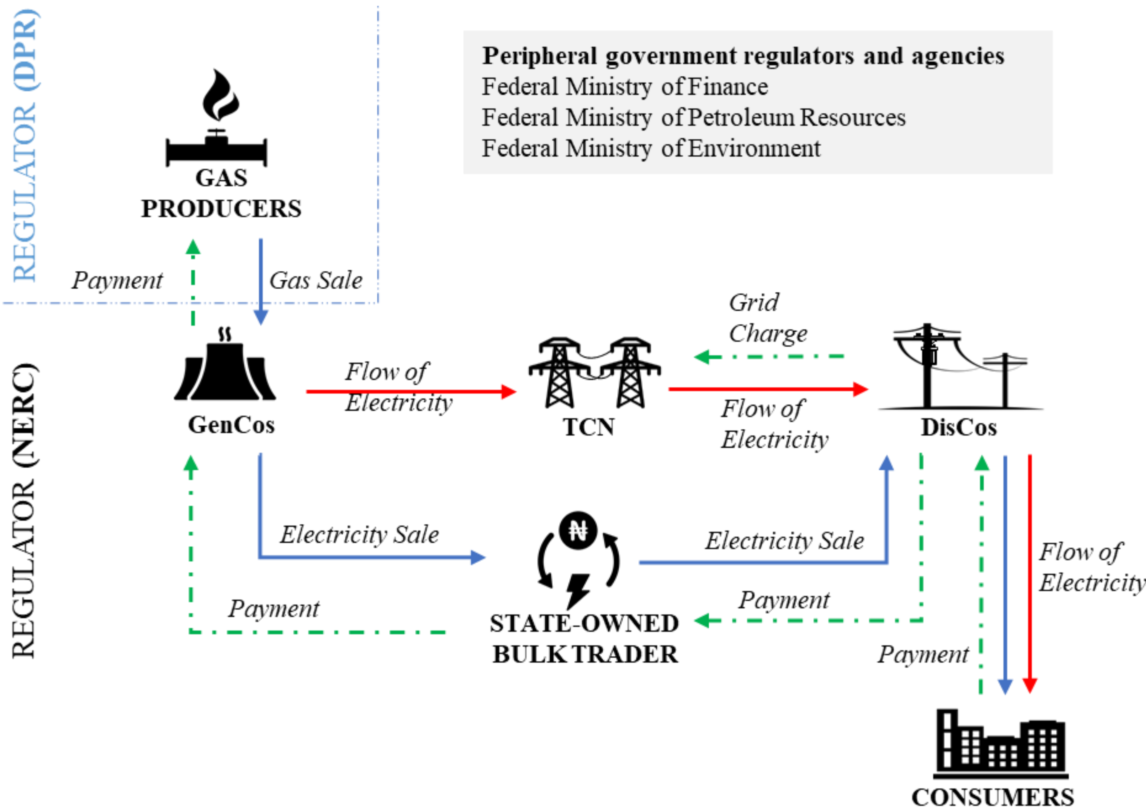

Figure 4.2: Existing Structure of the Electricity Sector in Nigeria.

4.5.1.1 Electricity generation

The electricity market in Nigeria has four groups of GenCos: the concessionaires of the privatised 'legacy assets'; the NDPHC subsidiaries which operate the NIPP gas power plants; Independent Power Producers (IPPs) that existed before privatisation; and one post-privatisation IPP. There are 28 grid-connected power plants in Nigeria with a total installed capacity of 12,760 MW and total operational capacity of 7,788 MW. On average, just between 3,000 MW to 4,500 MW are available annually due to unavailability of gas, breakdowns, and water shortage, and commercial and grid constraints. The gas-fired electricity generation plants produce 71% of daily electricity, whilst large hydroelectric power stations make up for the rest.

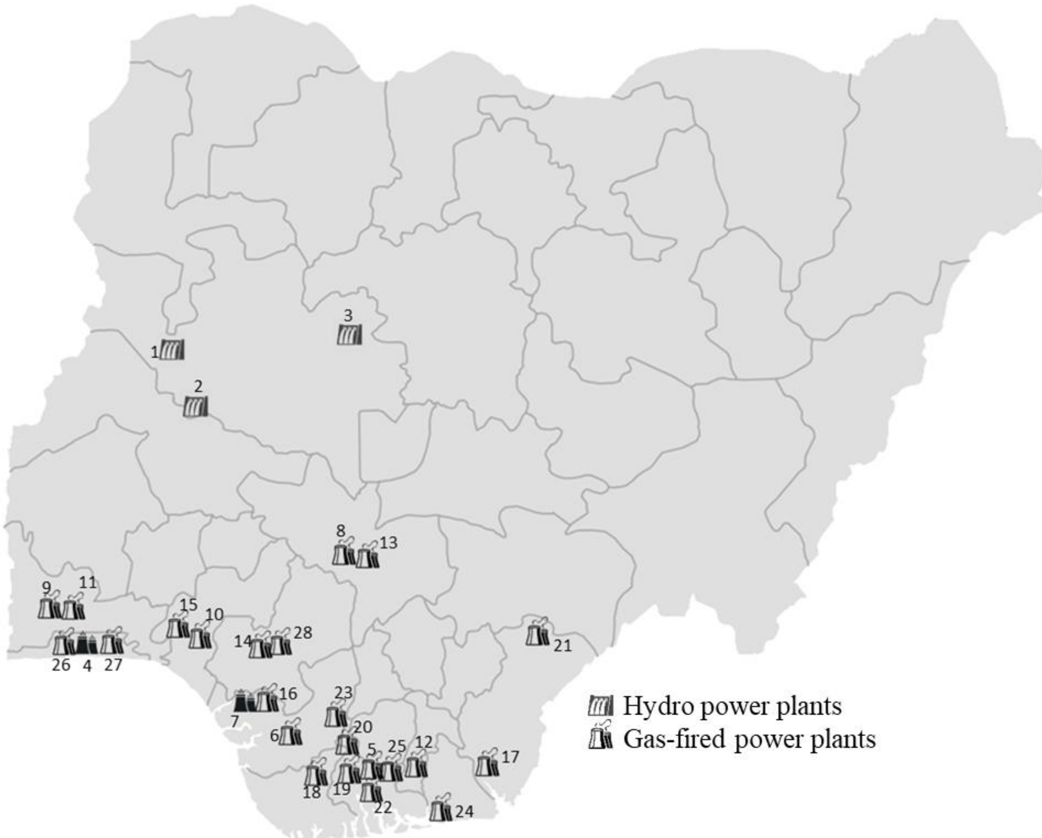

Figure 4.3: On-grid Power Generation Assets in Nigeria.[23]

These GenCos sell electricity to the state-owned bulk trader, NBET, which in turn sells to the financially non-credible DisCos at a loss. This arrangement will stay in place until the DisCos reach a sufficient level of credit-worthiness to purchase power directly from the GenCos. This

[23] Based on data collected from the regulator (NERC).

current arrangement is called the Transitional Electricity Market. It was put in place to increase the confidence of GenCo investors in the NESI.

Figure 5.3 shows the location of all 28 grid connected power stations on a map of Nigeria. The gas power plants are located in the gas-rich southern region of the country while the hydropower plants are in the country's middle belt.

4.5.1.2 Electricity transmission

The transmission company of Nigeria (TCN) has a monopoly in the transmission spectrum of the market. It claims to have a transmission capacity of 7,500 MW and over 20,000 km of transmission lines. The most amount of power ever transmitted on the transmission network is 5,222 MW. The TCN has three major functions, and it executes these functions with three semi-autonomous units; Transmission System Planning (TSP), which owns and manages the assets; Nigerian Electricity System Operator (NESO), which operates the transmission infrastructure; and the Operator of the Nigerian Electricity Market (ONEM), which balances the market transactions between GenCos, NBET and DisCos. In line with the EPSR (2005) Act, TCN was managed by a private contractor from privatisation in 2013 for three years. In 2016, the agreement was not renewed. The existing transmission network can be seen in Figure 4.4.

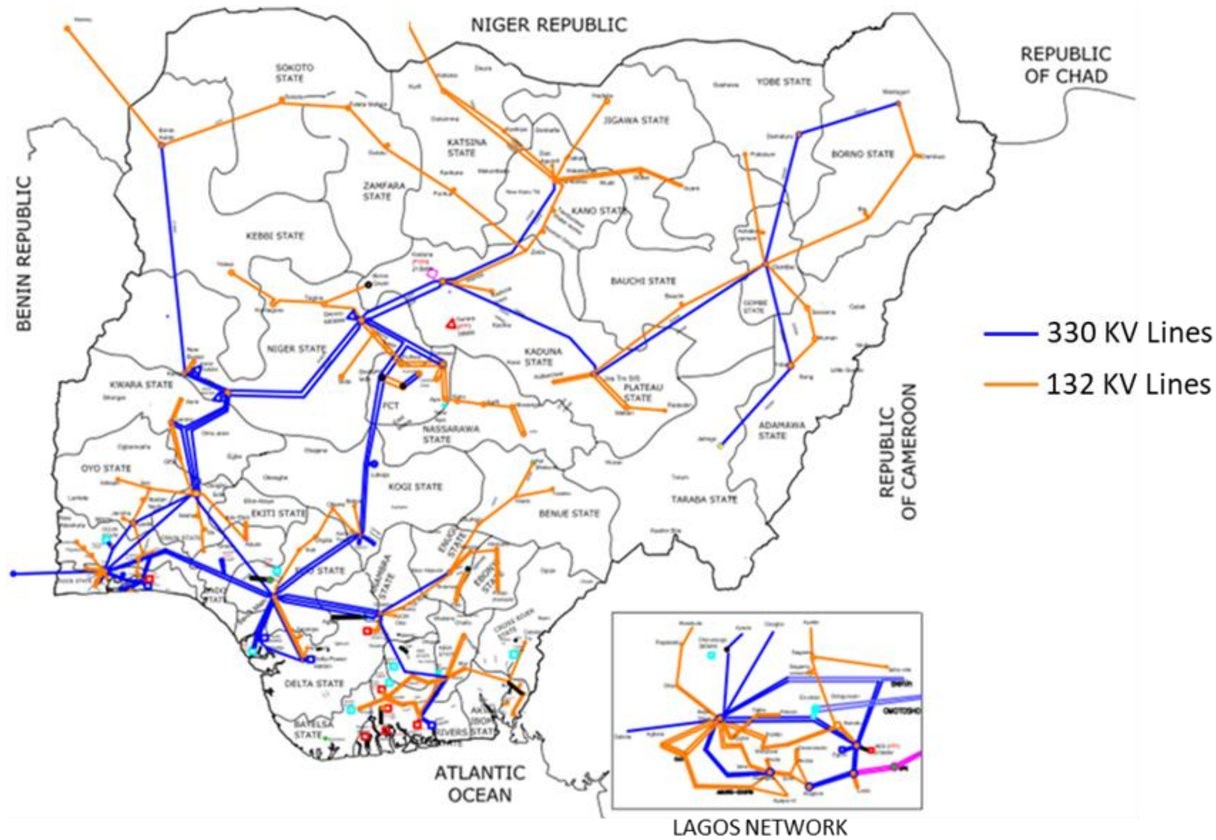

Figure 4.4: TCN's Drawing of the Electricity Transmission Network in Nigeria.

(Source: TCN, 2018)

4.5.1.3 Electricity distribution

There are eleven distribution companies in the NESI. Their coverage area is shown in Figure 4.5. The DisCos buy electricity from NBET and sell directly to consumers with huge collection losses, which are detailed in Section 3.4.1. The distribution companies were sold by the FGN to the current private sector owners; however, the FGN kept a 40%[24] stake in all the distribution companies. Although the DisCos have a joint distribution capacity of 24,457 MW[25], they only have an injection capacity[26] of 13,571 MW[27]. The distribution capacity is constrained by the injection capacity just as the injection capacity is a constraint by the transmission capacity. However, as this chapter reveals, none of these upper limits are ever reached because there is a more pressing commercial constraint.

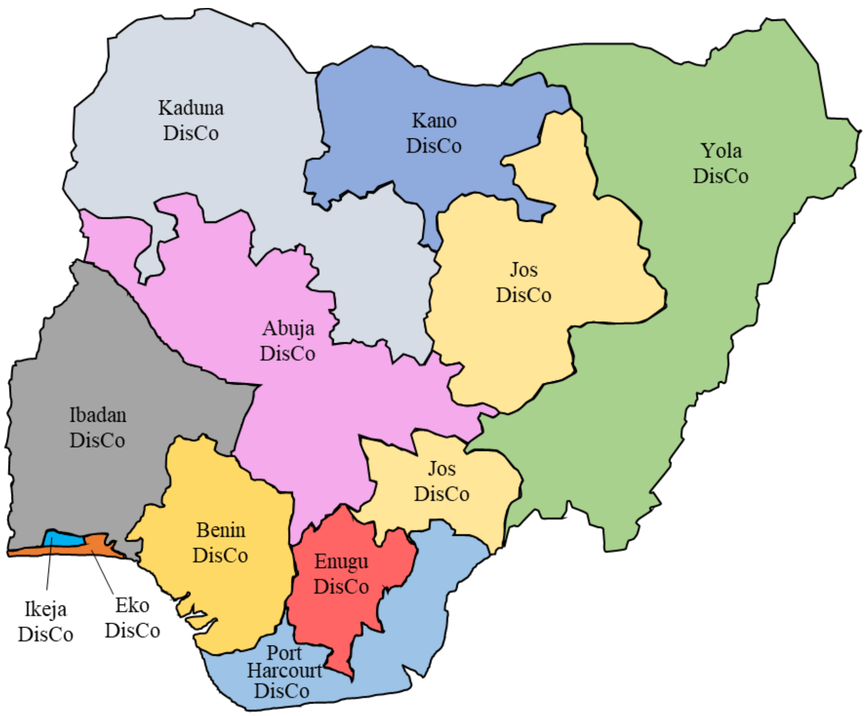

Figure 4.5: The licensed coverage area of Nigeria's 11 electricity distribution companies (DisCos).

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[24] Source: Interview with DisCo Executive. Nigeria. 5th April 2018.
[25] Primary data collected from the regulator (NERC)
[26] Injection capacity is the maximum amount of power DisCos can absorb form the transmission network at a time.
[27] Primary data collected from the regulator (NERC)

4.5.1.4 Nigerian Electricity Regulatory Commission (NERC)

NERC is the independent regulator in the NESI. It was established in 2005 by the EPSR (2005) Act. It undertakes engineering regulations in the sector through the grid codes, which determines the confines within which NESI operators can operate. It also undertakes commercial regulation through its tariff order, which determines how much each NESI operator is able to charge for its services. NERC also issues licenses to operate within the sector.

4.5.1.5 Nigerian Bulk Electricity Trading Company (NBET)

The NBET is the only bulk trader of electricity, and it is owned and run by the FGN through two FGN agencies: The Bureau of Public Enterprise (80%) – a government agency that serves as the secretariat for the National Council on Privatisation (NCP) and implements the government's privatisation policies – and the Federal Ministry of Finance (FMF). NBET purchases bulk electricity from the generation companies through power purchase agreements (PPAs) and sells electricity to the DisCos through vesting contracts. The FGN created NBET to give investors in GenCos the confidence and guarantee that the power they generate will be bought from them at a price agreed upon in the PPA. The investors need this guarantee because the DisCos, whom they would otherwise sell electricity to, are not creditworthy. The credit worthiness of the DisCos had been in question prior to privatisation. NBET is the only firm that offers a bankable PPA because it is owned by the FGN and is backed by Sovereign guarantees.

4.5.1.6 Gas supply

There are ten gas supply companies (GasCos) that supply gas-fired power stations within the NESI. These companies include international oil companies (IOCs), Nigerian National Petroleum Corporation (NNPC) [28] and other private sector firms. The gas suppliers sell gas to the GenCos through the Gas Aggregation Company of Nigeria (GACN). GACN is a government institution which serves as a middleman and a market operator. Only three[29] groups of consumers are allowed to purchase gas through the GACN, including GenCos, petrochemical companies that use gas as an input, and distributors of cooking gas. These three groups of gas consumers each have an FGN-determined fixed price for gas. GACN aggregates gas supply and administrates the pricing mechanism, which determines the price of domestic gas based on the quantity of gas purchased by each price group.

4.5.1.7 Electricity price structure

The Multi-Year Tariff Order (MYTO) lays out the methodology used to set the price of electricity on the grid in Nigeria. The EPSR (2005) Act, which established the current partially liberalised electricity sector in Nigeria, empowers NERC through Section 32(d) to ensure fair prices for consumers and fair return on investment for investors. The EPSR (2005) Act also empowers NERC through Section 76 to create a methodology to determine the price of electricity on the grid.

[28] The national oil company.
[29] These three groups are GENCOs who solely supply electricity to the national grid; companies that require gas as an input for their end products; and local gas distribution companies that sell gas to other commercial and industrial companies in the domestic market.

The MYTO allows electricity sellers to sell electricity at cost reflective tariffs, and it brings certainty to the pricing structure and efficiently allocates risks to industry stakeholders. Efficient risk allocation is done by ensuring that parties that are responsible for certain performance levels bear the risk of non-performance. This principle is clear on paper, but problematic in practice, as the DisCos' poor payment collection performance illustrates. It defines wholesale and retail tariff structures including transmission charges. The MYTO is also an incentive-based tariff model which rewards utilities' performance on loss reduction and improved standards. The methodology provides an allowance for minor reviews twice a year and major reviews every five years: this allows the tariff to be updated to account for new macroeconomic and sector-specific realities such as inflation, American dollar to Naira exchange rate, and generation capacity on the grid.

The retail price of electricity to consumers has four constituent modules which are generation cost module or 'wholesale' tariff; transmission cost module; distribution cost module; and other sector services and tax (see Figure 4.6). The distribution tariff is not to be mistaken for the end-user tariff, which is a summation of all the four aforementioned modules across the value chain. Each of the four modules are developed around three building blocks: allowed return on capital; allowed return of capital[30]; and efficient operating costs and overheads.

[30] Capital expenditure that a utility may claim against its taxable profit.

The generation cost module, which accounts for 36.36% of the retail tariff (See Figure 4.6), is the base cost of the electricity tariff in Nigeria. It is also referred to as the wholesale price of electricity because it is the price at which the bulk buyer, NBET, buys electricity from the generation companies before selling to the DisCos. The generation cost module allows GenCos to retrieve their return on capital; return of capital; and efficient operating costs and overheads. The exceptions are the NIPP GenCos, which are only paid for their operating costs and not the capital investment in their eight gas power plants. The reason for this is discussed later in this chapter. Each of the 28 GenCos agrees to its own wholesale price of electricity with NBET through a PPA that is subject to the approval of the regulator, NERC.

The generation cost module is crucial for private sector investment in the expansion of generation capacity because it determines the level of attractiveness to investors. It is also important to the FGN because it is, in principle, one of the few levers for establishing competition in the electricity market, which has several natural monopolies. The wholesale tariff is in principle, to be reviewed as changes occur in inflation; foreign exchange rate of Naira to USD; and the price of gas.

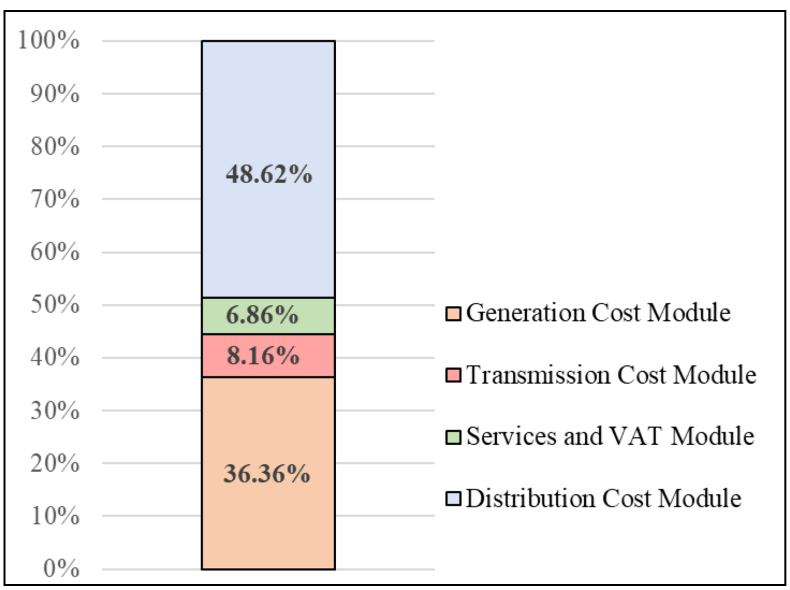


Figure 4.6: Cost modules of the end-user or 'retail' electricity tariff.[31]

The transmission cost module, which accounts for 8.16% of the retail tariff, is the second layer of the electricity tariff in Nigeria. It is called the Transmission Use of System (TUoS) Charge or ‘grid charge’. The TUoS charge is paid to TCN by the DisCos. The payment is made to TCN for transmitting electricity from the GenCos through the TCN-owned transmission network to the DisCo-owned substations for onward distribution to consumers. The TUoS charge allows TCN to retrieve existing and forecast capital costs, efficient operating costs, and allowances for return on capital and depreciation. This TUoS charge is uniform across Nigeria. The TUoS is regulated by NERC because TCN is the only transmission services provider in Nigeria, and almost all electricity on the Nigerian grid flows through its network. The TUoS is also, in principle, indexed to inflation, and the exchange rate with USD.

The services and tax module, which accounts for 6.86%, is the third and smallest layer of the electricity tariff. This module contains the cost of running institutions, including NERC and NBET, which operate and facilitate the NESI. These institutions include System Operator (SO), Market Operator (MO), NERC and NBET.

The distribution cost module is the final and largest layer of the electricity price in Nigeria. It is called the distribution charge, and it is covers the cost of electricity distribution by the DisCos. This charge varies across the eleven distribution networks according to the density of customers

[31] Primary data Collected from the regulator, NERC.

on the distribution network and the terrain in which the network is located. Consequently, in less dense areas, the distribution charge and end-user tariffs are higher than in more dense areas.

There is also a cross-subsidy regime in operation at the retail end of the electricity price. There are five classifications of consumers in the Nigerian electricity market. These are the Residential consumers, Commercial consumers, Industrial consumers, street lighting, and special consumers, which include schools, churches, mosques, military barracks and agro-processing plants. These consumer classes have several sub-classes, which all have different retail tariffs. The lower end consumers and special consumers pay lower electricity tariffs and are subsidised by the larger consumers.

4.5.1.8 Market concentration

The structure of on-grid electricity markets typically contains some natural monopolies[32] in parts of its value chain due to the nature of electricity. The high capital cost and redundancy involved in the transmission and distribution sections of the value chain make it uneconomical for new entrants to compete against existing transmission companies and DisCos. The NESI is similar. It has monopolies in the both parts of the value chain.

Eleven DisCos have monopolies in their respective license coverage areas, while TCN has a national monopoly on transmission. The market concentration at the distribution and

[32] Natural monopolies occur where a single firm can produce output such as to supply the market at a lower per unit-cost than can two or more firms. Natural monopolies also experience high fixed costs and average costs that go down with more output.

transmission ends of the NESI necessitates price regulation. Price regulation allows regulators to set prices at a level that induces productive efficiency (Depoorter, 1999). In the NESI, the DisCos and TCN are only able to charge a regulated price for the use of their network to transport electricity. The government also regulates the components of their pricing regime. |For example, prior to regulatory intervention, DisCos, which have a monopoly in their coverage area, charged consumers for bill collection losses, a risk that should be borne by DisCos, who have the responsibility of collecting revenues from billed customers. NERC, the regulator stopped this practice, forcing the DisCos to put more effort into the efficiency of their bill collection operation.

The monopoly in the NESI is not just enjoyed by DisCos and TCN. The NBET is the only firm that offers bulk electricity trading services in Nigeria. It is not a natural monopoly; however, the credit worthiness of other players in the sector prevents any new competitor from entering the market. The FGN-owned bulk trader has constantly lost money since the transitional electricity market was declared. Any new bulk trader would have to deal with the losses without government liquidity support. This gives NBET huge power as it ultimately decides which new GenCos can come into the market and at what price. If NBET does not accept a prospective GenCo's wholesale tariff, there is no chance of entering the market. This has been one of the proximate causes of the slow adoption of RE on the grid. It was only six years after they started that some of the earliest on-grid RE project developers were able to sign PPAs with NBET. No new entrant could finance their on-grid projects without a PPA from NBET.

While NBET, TCN and the DisCos are monopolies, the GenCos and GasCos are not. However, they are effectively oligopolies, with a few dominant firms. The price of domestically consumed gas is regulated to protect consumers from the high export gas price, which is based on external global supply and demand forces. GasCos are not regulated only because of their selling power but also because of the unattractiveness of the NESI compared to the gas export market. The gas sector regulators assign each a pre-determined quantity of gas to be supplied to the domestic market annually. These supply obligations are unattractive to GasCos because of the inability of GenCos to pay their bills and the low government-regulated price compared to the export market. Thus, the gas industry has no interest in monopolising fuel supply to the GenCos, because this is a loss-making business. It, therefore, has no interest in resisting RE investment on the grid.

4.5.1.9 Barriers to entry

The typical high capital cost of assets in the NESI discourages new entrants from entering the generation sector of the NESI. Prospective GenCos also must deal with the inadequate regulatory synergy within the regulatory dimension discussed in Section 4.7.

In the distribution end of the electricity network, DisCos are natural monopolies. Though DisCos are monopolies, the FGN offers other competitors the chance to manage the DisCo assets even if they may not own them. If DisCos do not meet their operational obligations, the FGN during its 5-year performance review may remove the DisCos as operators of their own assets, forcing the DisCos to hire external operators. However, it’s not that straight forward because the DisCos can argue, as they already do, that they are unable to meet some of their obligations because the FGN itself has not met some of its own obligations. This stalemate has caused a legal and political deadlock, which is expanded upon in Section 4.5.3.3 and Chapter 5.

The operation of the national electricity grid also typically requires one system operator to operate the entire transmission infrastructure as a monopoly. A monopoly in the transmission end of the NESI allows the system operator to maintain a uniform frequency, which requires a single coordinator of supply and demand. Whilst the FGN policy is to maintain ownership and hire a management contractor to manage the transmission assets, this has not happened. In 2013, the FGN hired a management company, which managed the TCN throughout its 4-year mandate; however, the FGN did not start another competitive process to hire another management company or renew the contract of the first management company. There is no indication that the current decision to halt another competitive hiring process is a result of the performance of the first company. There is also currently little market-based incentive for the TCN bureaucrat-led management to operate as efficiently as possible.

In the electricity wholesale trading business in the NESI, the liquidity crisis prevents NBET from having any competition. Any other trader that enters the market with the current performance may suffer huge losses without government support. It could also be argued that the liquidity crisis in the NESI creates barriers to entry in the market to supply natural gas to the gas-powered GenCos. However, domestic gas supply is an obligation imposed by the FGN, at a price that is lower than opportunity cost. GasCos are typically willing to oblige the FGN especially because of the returns they gain from their gas export trade.

4.5.1.10 Buyer concentration

In the wholesale electricity market, NBET has an effective monopsony. It has strong buying power because it is currently the only bankable off-taker for GenCos. This, however, has little effect on the existing wholesale market price because of the negotiated contracts, PPAs, which the GenCos have with NBET. As (Inderst and Mazzarotto, 2008) argue, in intermediate markets with negotiated contracts, a greater concentration of purchases in few buyers do not always lead to a decrease in profits for suppliers. They argue that there is not an automatic mirroring of seller concentration in buyer concentration, especially where there are fixed negotiated contracts, because the contracts are negotiated individually and a lowering of price for one contract does not necessarily lead to the lowering in price in the contracts of other firms. This can be observed in the NESI, when the feed-in tariffs (FITs) for new solar IPPs were negotiated and subsequently reduced, it had no effect on existing NESI GenCos. The cost of service approach, which is used to negotiate wholesale tariff for GenCos is not dependent on the cost of service of other GenCos. As mentioned earlier, the high buyer power of NBET can act as a barrier to entry for prospective GenCos including solar IPPs, but it does not have the buyer power to alter wholesale electricity prices in existing contracts.

NBET is an effective monopsony. Other would-be buyers of bulk electricity could not survive the losses incurred by NBET, which is backed by the FGN. NBET's monopsony is a direct result of Nigeria's condition as a rentier state. Prior to 1999, the rents generated in the oil and gas sector caused the government to ignore the need for the commercialisation or profitability of the now-defunct state-owned electricity utility, NEPA. NEPA operated as a tool for rent distribution to the citizens. Access to reliable and cheap power became a common feature of political campaigns. NEPA and PHCN did not depend solely on its revenue from electricity supplied to the grid. They also depended on budgetary allocations from the FGN despite their poor performance.

As NEPA and PHCN did not need to be profitable, they did not develop the capacity to administer an effective revenue generation regime. They did not have a full knowledge of who their customers were or the true extent of their network infrastructure. This was evident during the privatisation process, when PHCN claimed it received only 50% of the expected revenue from electricity it supplied. The drive to obtain full information on customers also exposed the limited information that existed in the NESI pre-privatisation.

The dysfunctional revenue generation regime was a critical challenge to privatisation. GenCo investors were anxious about inheriting a poor revenue generation regime. In response, the government established NBET as a mechanism to put GenCo investors at ease, promising to shield them from the poor revenue generation regime.

NBET's position as a monopsony creates a barrier for all on-grid investments, including on-grid RE investments as Sections 3.7 and 3.8 show. However, NBET exists as a monopsony due to the dysfunctionality in the NESI and the historically weak administrative capacity of NEPA and PHCN, which did not need to institute a robust revenue generation regime.

The retail market in the NESI is far less concentrated than the wholesale market. NESI has over 6.5 million consumers nationwide. These consumers are categorised into five groups: residential consumers, commercial consumers, street lighting, industrial consumers and special consumers[33]. Whilst there is a low buyer concentration, the DisCos sometimes have to contend with the buying power of the industrial and commercial consumers, who only account for thirty percent%[34] of the DisCos' market, but account for a disproportionately higher percentage of the DisCos' revenue. Industrial customers have proven to be more bankable consumers than residential consumers, who account for about 60% of the DisCos' market. This, however, does not give enough buying power to the bankable customers to influence retail electricity price,

[33] Special consumers, according to NERC, include agriculture and agro-allied industries, water boards, religious institutions, government and teaching hospitals, government research institutes and educational establishments.
[34] Secondary data collected from the regulator (NERC).

which is fixed by regulation. The effect of the bankable customers as an association, however, is different and is discussed in Chapter 5.

In the wholesale electricity market, the eleven DisCos have a fairly even spread of consumption. There is low buyer concentration among the DisCos because their consumption is constrained by fixed contracted quotas and TCN's system balancing operations. TCN transmits electricity to DisCos in accordance with contracted quotas; however, it sometimes prioritises system stability when deciding how much power each DisCo gets. Notwithstanding, DisCos are monopolies in their respective coverage areas, effectively making them the only buyer in the wholesale market. They may not be able to use their market power to control price, but they have enormous powers to control quantity of supply from GenCos. The implications of a DisCo's ability to control the quantity of electricity it receives despite contracted quotas is discussed in Section 4.5.3.3.

4.5.1.11 Market demand growth

TCN estimates that Nigeria's demand for electricity will continue to grow at about 9% annually till 2030. This demand will however continue to be suppressed by both an inadequate electricity supply infrastructure and an insolvent market stemming from the high debt and liquidity crisis in the NESI. Indeed, the Power Sector Recovery Programme (PSRP) – the FGN's response to the crisis in the NESI – states that more supply on the grid will lead to a larger sector deficit. As more electricity sales are recorded and less bills are paid, the debt in the sector widens, which in turn, slows down the market growth in the sector. The FGN's off-grid priority with its Nigerian Electrification Program (NEP) also contributes to the reduction in on-grid market growth rate in the sector as FGN efforts and resources are diverted to off-grid electrification to avoid the issues of a central grid.

In the gas-to-power to fuel market, growth is supported by government regulation, which forces GasCos to sell to GenCos. However, recent events showed that as a new gas GenCo comes on stream, gas supply to the new GenCo, which has FGN guarantees against insolvency, only replaces the gas demand of existing gas GenCos without such guarantees. There is little room for the gas to power market to grow with the existing liquidity crises in sector.

The intermediate and retail market growth is also limited by DisCos, which reject electricity supply in order to control their debt. The market demand will continue to grow in Nigeria; however, supply will continue to be restricted by the liquidity crisis in the retail market.

4.5.2 Conduct

In the NESI, commercial actors are unable to compete by price setting because all contracts in the NESI have fixed regulated prices and tariffs. The opportunity for price competition is only available to new entrants, who compete by offering lower costs to NBET before entering the market. That said, some of the operational conduct of certain actors in the sector affects the electricity price in the NESI.

The major form of competitive conduct in the NESI is output adjustment. In the wholesale end of the sector, GenCos have a fixed regulated price for electricity, so the only way to maximise profit is to minimise down-time and efficiently send out as much electricity to grid as they can. There is a general trust in the NESI that despite the liquidity crisis, the government will eventually pay its debt.

The capacity of GenCos to maintain high output and thus high revenue is, however, constrained by the conduct of other actors in the NESI. Although the grid codes compel TCN to transmit power from generators in economic merit order, TCN also has an obligation to maintain system stability, which often requires less than optimal economic despatch of generators. In the merit order, hydroelectric generation units are the cheapest in the mix and as such, should be fully deployed before gas-fuelled generation units. This is not always the case as GenCos periodically complain about non-transparency in the despatch of GenCos. TCN's transmission line constraints also sometimes force it to constrain supply to some areas, where the DisCos have credit-worthy consumers.

DisCos artificially restrict demand making it difficult for GenCos to reach their desired output and revenue levels. As (Peng and Poudineh, 2017b) argue, the conduct and performance of firms within a market affects the performance and conduct of other firms within the same market. The DisCos' demand restriction also makes it difficult for the TCN to reach its own revenue targets because the TCN charges a tariff on all electricity that flows through its transmission lines from the GenCos to the DisCos. However, this 'load rejection' conduct of DisCos in restricting demand helps the DisCos to control their debt, thereby preventing worsening performance. The DisCos reject load in certain areas, knowing that those areas are only able to pay for a low quantity of electricity and are unable to pay a high enough fraction of their bill. In addition DisCos sometimes restrict supply to areas where the price of electricity is not enough to cover the cost of recovering payments from non-paying customers.

The load rejection by DisCos and the resulting low revenue for GenCos and TCN leads to contestation between the groups of operators. This creates distrust in the sector and makes it difficult for operators to agree on the way forward, thereby stalling solutions to the crisis in the sector.

In addition to this, eight government-owned gas GenCos have suffered a worse fate. In 2017, the first privately[35] financed IPP was commissioned. It is supported by several government guarantees protecting it from the liquidity crisis in the NESI. This new IPP also has a 'take or pay'[36] PPA. Due to grid constraints and the liquidity crises, the FGN-owned GenCo, NDPHC, which does not have active PPAs for any of its eight power plants, have had to drop their output so that the FGN-owned NBET can accommodate the energy produced and sold by the new IPP. NBET must prioritise purchase with the new IPP at the expense of NDPHC to avoid exacerbating FGN liabilities and decreasing confidence in the sector.

As shown in Figure 4.7, when the new IPP began ramping up its electricity sale volumes between March and May, 2018, there was a simultaneous winding down of electricity sale volumes by the state-owned NDPHC. Within two months, the new IPP's electricity sales increased by NGN 5.2 billion (USD 14.3 million) and NDPHC's electricity sales reduced by NGN 5.5 billion (USD 15.3 million). Meanwhile, sales from other GenCos has remained within recent boundaries between NGN 35 billion and NGN 45 billion. It is evident that the NBET is incapable of supporting any newer generation investments on the grid as the government evidently reduced the productivity of its own power plants to accommodate the new IPP, which is protected by several sovereign guarantees.

[35] First non-IOC private IPP.
[36] A 'take or pay' PPA places the off-taker under an obligation to pay for electricity that the GENCO is able to generate regardless of whether the GENCO produces the power or not.

Amongst the commercial operators in the NESI, there is little evidence for self-regulation. The commercial actors in the NESI have no direct control over price. However, self-regulation of the TCN within the current regulatory regime inadvertently affects the price of electricity within the sector.

TCN is obligated to employ the economic merit order to despatch generation units, however, it frequently operates outside the economic despatch regime in order to meet its other obligation to maintain system stability. However, this has an inadvertent effect on wholesale price of electricity because more expensive generation units sometimes come on before cheaper generating units.

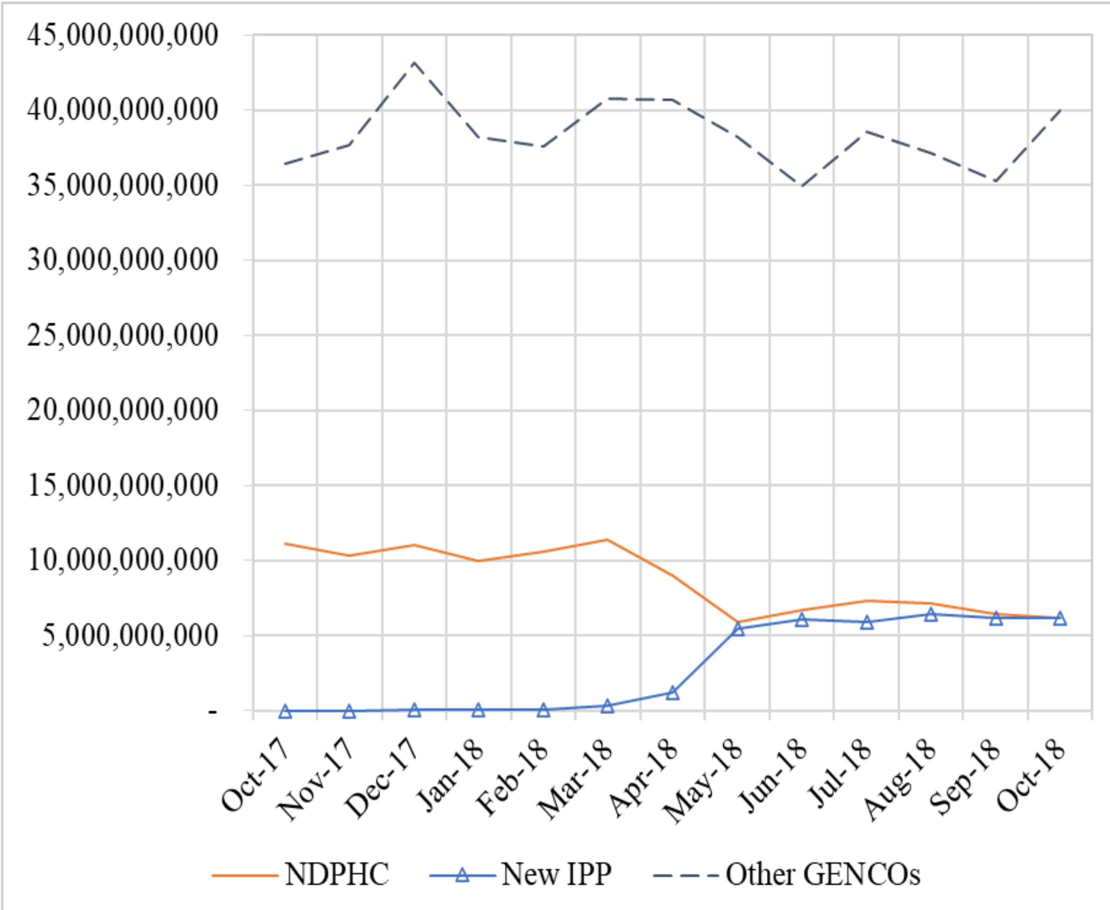


Figure 4.7: Energy billed to NBET (in Naira) by GenCos when a new gas IPP entered the market.[37]

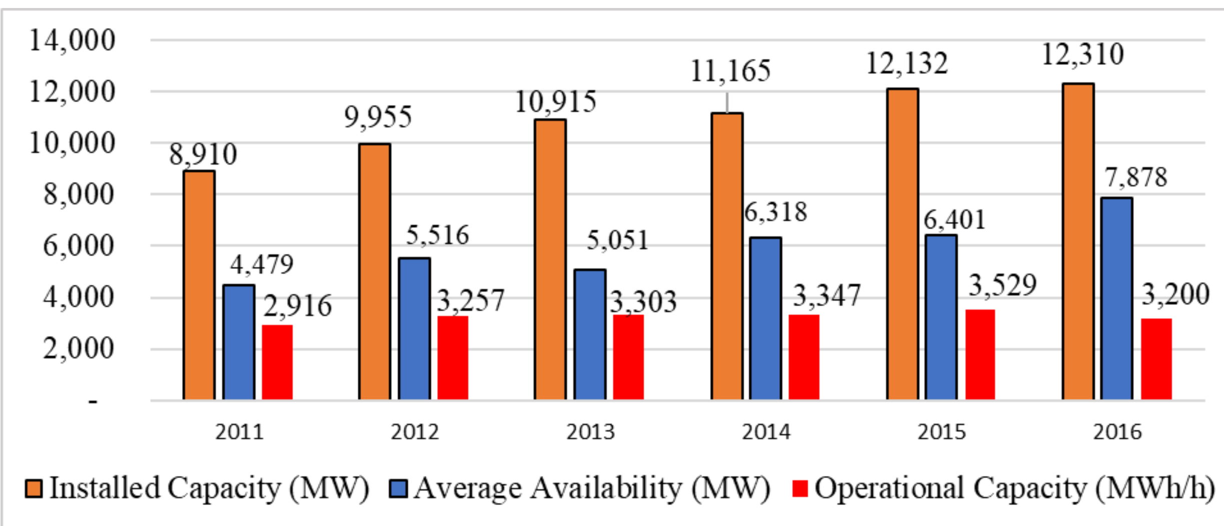
4.5.3 Performance

The NESI is made up of three parts: generation, transmission and distribution. This section presents the performance in all three parts and explains how the conduct of actors within the sector impacts performance.

[37] Secondary Data Collected from NBET, the state-owned bulk trader.

4.5.3.1 Electricity Generation

The generation part of the NESI value chain has a total installed capacity of 12,760 MW[38] as of 2016. Only 7,788 MW of this was available on the grid in the same year due to extensive damages in a significant number of power stations, which require extensive overhaul and refurbishment. A few of the power stations are approaching their expected lifespan with no signs of the management of the plants looking to decommission them. About 20% of installed generation capacity is based on plants, which are 25 years or older[39]. The plants awaiting refurbishment and repairs of some of their generating units have resulted in the loss of 36% of installed capacity as shown in Figure 4.8.



[38] As of 2016 according to the National Control Centre (NCC) in Oshogbo.
[39] Transmission Expansion Plan 2017

Figure 4.8: Trend of operational capacity, average availability and installed capacity in from 2011 to 2016.[40]

Figure 4.9 shows a modest but noticeable improvement in availability of generation capacity since privatisation in 2013. In 2016, average plant availability went up to 64% from 50% in 2011. This is a result of private investment in the sector on one hand and the deployment of new power stations with relatively high availability factors on the other hand.

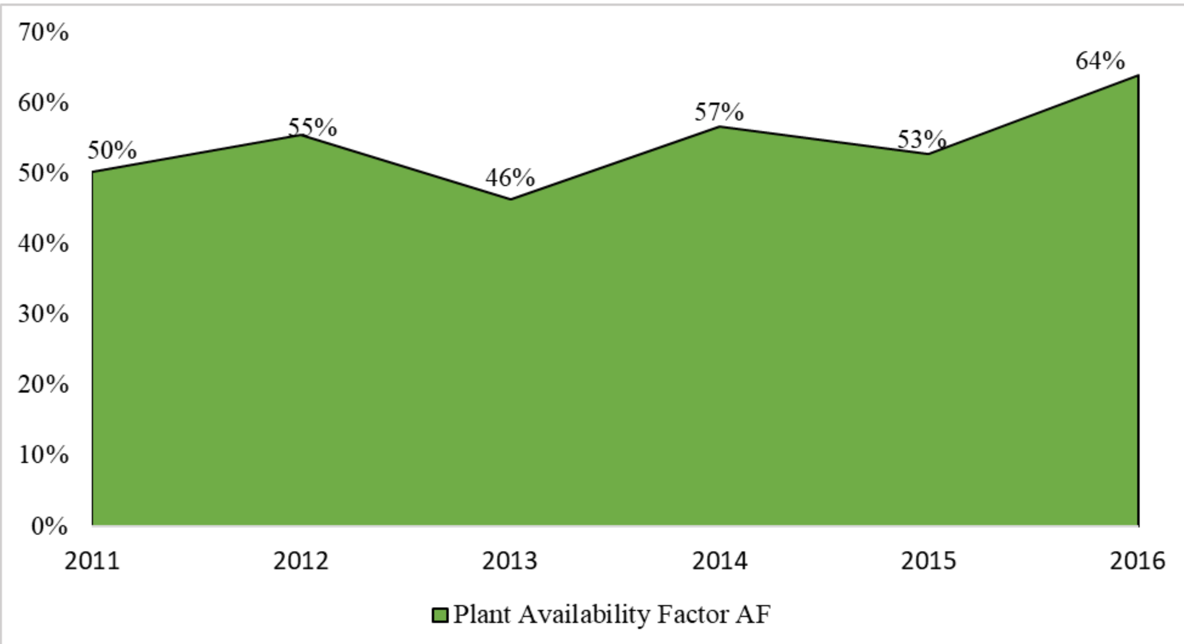


Figure 4.9: Trend of Plant Availability Factor from 2011 to 2016.[41]

The capacity factor of the generation assets are declining due to the effects of seasonal levels of rainfall on hydro power generation, gas supply constraints, transmission constraints, and the

[40] Secondary data collected from the National Control Centre (NCC) in Oshogbo.
[41] Ibid.

rejection of electricity by the DisCos. While plant availability seems to be improving, the total capacity factor of the generation assets is on a steady decline. The capacity factor is the ratio of actual output over time to the maximum possible output over the same period. In Figure 4.10, two sets of capacity factors are presented. The higher range of capacity factors assumes that the maximum possible output is constrained by plant availability, while the lower range assumes that the maximum possible output is constrained by installed capacity. Both show a steady decline in the productivity of the assets. This chart shows that as generation stations increase their generating capacity, their operational capacity declines.

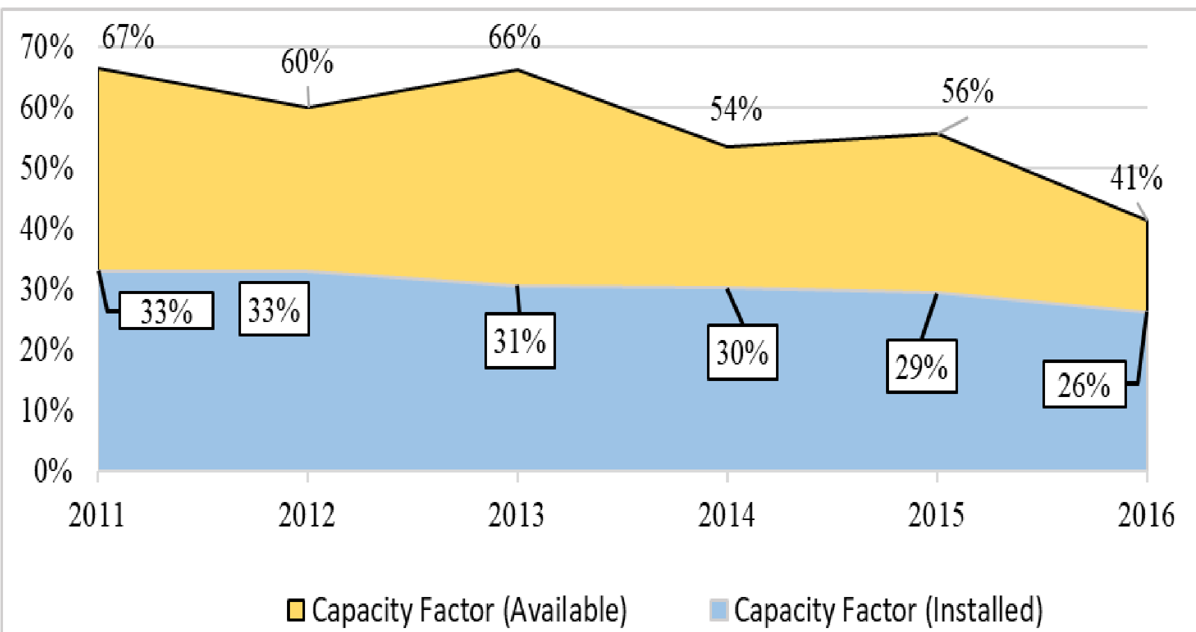


Figure 4.10: Trends of the average installed and available capacity factors on the grid in Nigeria from 2011 to 2016.[42]

The NESI generates power from only two types of fuel: gas and hydro potential. The susceptibility of these technologies to the realities in Nigeria is high. From 2011 to 2016, about 80% of the country's on-grid electricity came from gas power stations and 20% came from hydro power stations (See Figure 4.11).

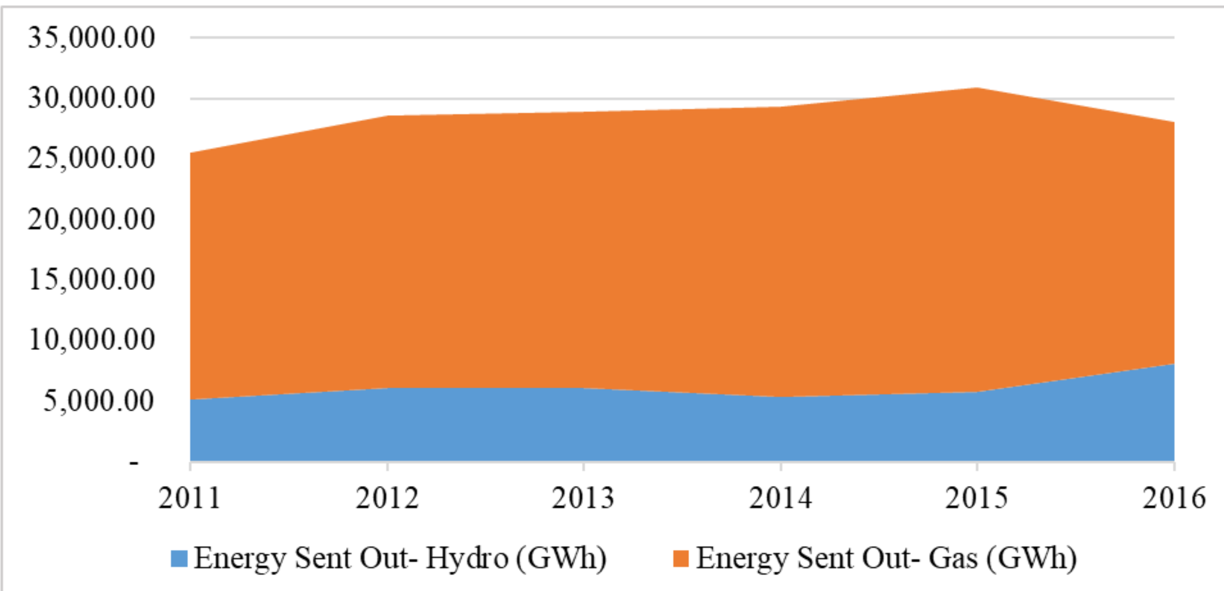


Figure 4.11: Annual energy sent out from hydro and gas power stations to the grid from 2011 to 2016 (GWh).[43]

The susceptibility of the electricity supply to the seasonal variation of the level of rainfall is one of the main constraints of electricity generation performance. Figure 4.12 shows the average

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[42] Ibid.
[43] Ibid.

electricity production levels of all three hydro power stations in Nigeria for six years from 2011 to 2016 plotted next to the average monthly rainfall in the same period. There are only two major seasons in Nigeria: rainy and dry seasons. By mid-April, the end of the dry season, there is a 48% reduction in monthly electricity generation levels compared to mid-October, the end of the wet season. The effect of the seasonal variability of rainfall is an 11% monthly decline of hydro power generation on the grid during the dry season. This significant because hydro power accounts for 20% of all electricity sent out the grid.

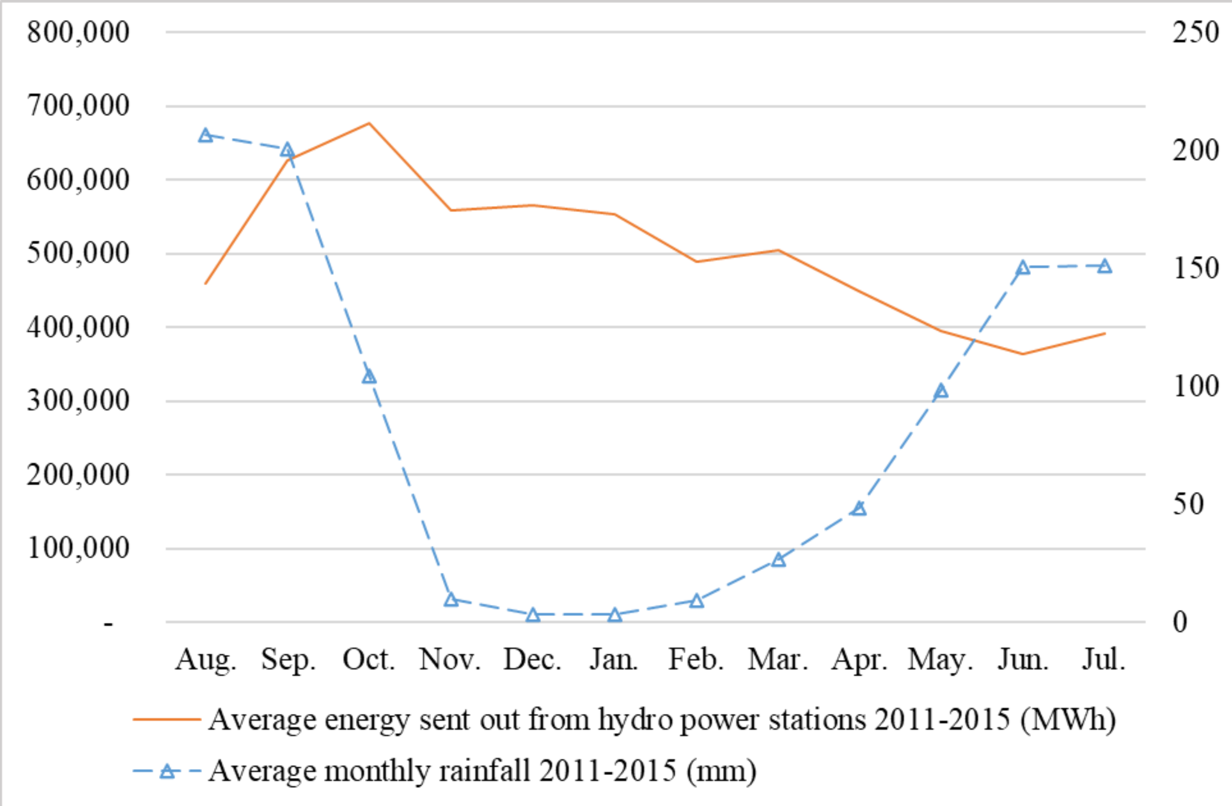

Figure 4.12: Average monthly energy production from hydro power stations and seasonal variation of average monthly rainfall.[44]

Unreliable supply of gas is also an incessant constraint to performance in the NESI. Interruption of gas supply to the gas power stations, which account for 71%[45] of all electricity sent out to the grid, reduces the operational capacity of the gas generation assets. The interruption to gas supply is caused by gas transmission constraints, GenCo debts and sabotage of gas transmission pipelines.

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[44] Ibid.
[45] Ibid.

The enormous deficit in the gas supply infrastructure in Nigeria renders it incapable to meet the gas demand of gas power stations. The state owned gas transportation Company, Nigeria Gas Company (NGC) – a subsidiary of the national oil company, Nigerian National Petroleum Corporation (NNPC) – runs a monopoly and has been unable to invest enough capital into the infrastructure to keep up with the demand for gas transportation. In addition to this, the debts owed to gas producers by GenCos adds to the constraint to gas supply. GenCos that own gas power stations buy gas from gas suppliers through a gas supply agreement (GSA), and the gas is delivered by NGC through NGC's pipelines through a gas transportation agreement (GTA). The GenCo debts resulting from their inability to meet their GSA obligations routinely results in gas being withheld by gas suppliers. GenCos are usually not able to pay the full bill for gas supplied to them. The total gas supply indebtedness of power plants from January 2015 to December 2016 was NGN 155 billion (USD 507 million)[46].

As Peng and Poudineh, (2017) argue, "the degree to which politicisation or state intervention is active in a sector is dependent upon the degree to which its perceived/expected performance deviates from social/interest group expectations and government objectives." The enormous sector deficit necessitates government intervention, which makes additional analysis in the regulatory and political dimensions crucial.

[46] Data retrieved from Power Sector Recovery Plan (PSRP) January 2018.

Gas supply is also interrupted sporadically by gas infrastructure vandalism, which reduces gas production and transportation. The effect of this was severely seen for a significant period in 2016 (see Figure 4.13) resulting in the loss of 2,900 MW[47] of operational electricity generation capacity.

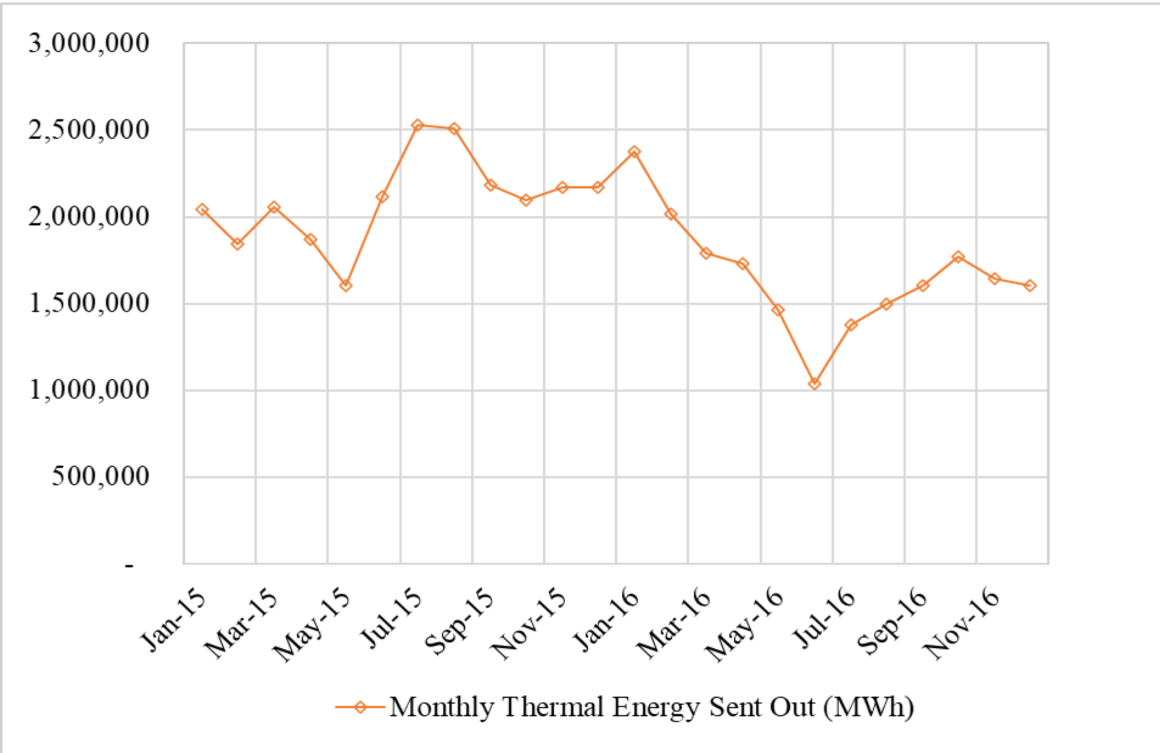

Figure 4.13: Average monthly thermal energy sent out (MWh) in 2015 and 2016 showing susceptibility to vandalism and industrial action.

The commercial performance of GenCos is low. This performance is, however, a result of the conduct of other actors within the NESI. GenCos sell power to NBET through a PPA, which

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[47] Ibid.

places an obligation on NBET to pay 100% of its invoice for power sold to it. However, NBET has never been able to meet up to 50% of its PPA obligations on its own[48]. For 14 months between August 2016 and October 2018, NBET was only able to meet 26% of its PPA obligations to GenCos (see Figure 4.14). This affects the capacity of GenCos to pay off their loans, pay gas supply bills and carry out their infrastructure investment obligations. The FGN has been able to supplement NBET's payment through a loan to NBET to meet up to 80% of its obligations to GenCos.

[48] Source: Interview with Private Sector GenCo. Abuja, Nigeria. 13 March 2018.

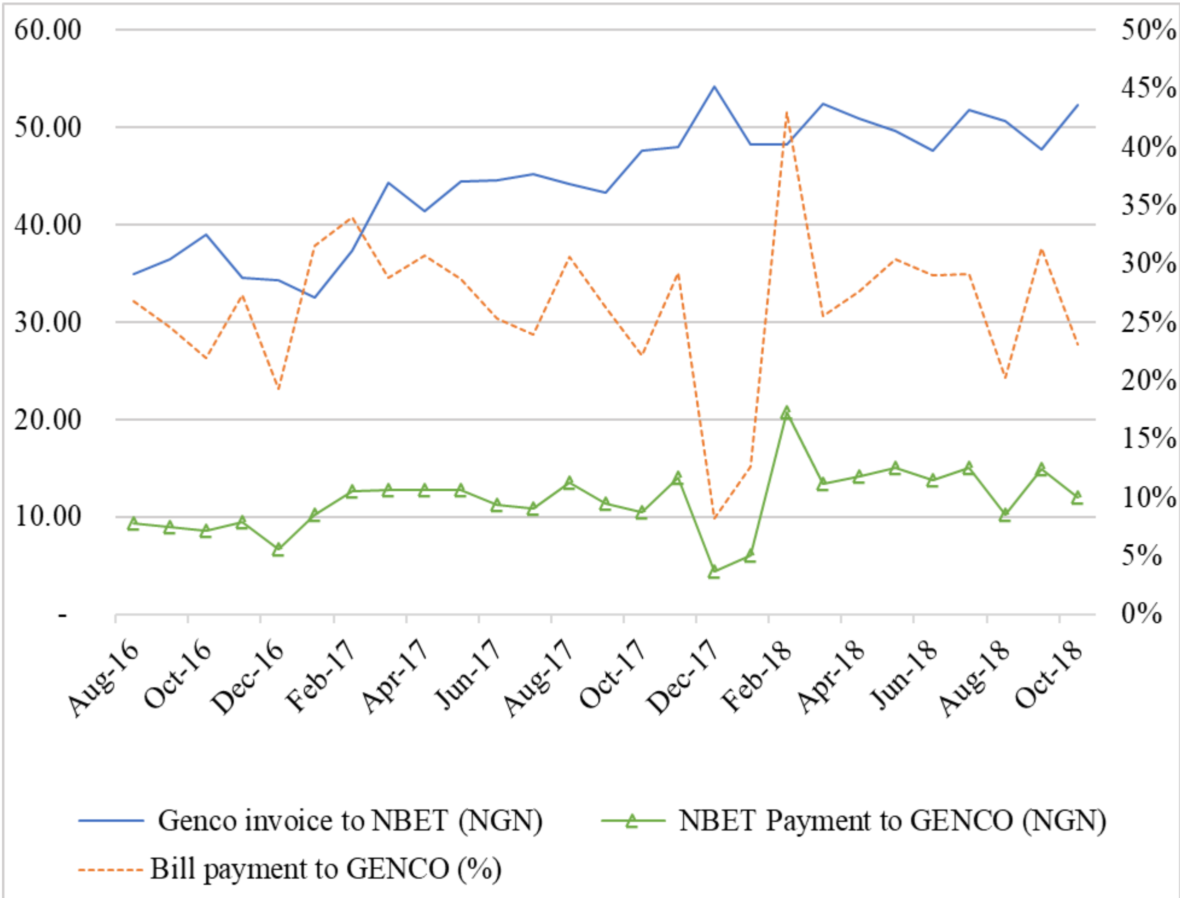

Figure 4.14: Trend of GenCos (in NGN billions) commercial performance for 14 months between August 2016 and October 2018.[49]

4.5.3.2 Electricity Transmission

The highest amount of electricity ever sent out through the transmission network is 5,222 MW. This occurred in December 2017. However, TCN claimed that the transmission network has the capacity to wheel 7,000 MW as of December 2018[50]. In verifiable terms, there has been a steady

[49] Source: Secondary data collect from NBET, the state-owned bulk electricity trader.
[50] Source: Interview with Transmission Company senior staff. Abuja, Nigeria. 21 February 2018.

increase in the total amount of electricity that the transmission network has transmitted at a single time (see Figure 4.15) from 3,804 MW in 2011 to 5,222 in 2017[51].

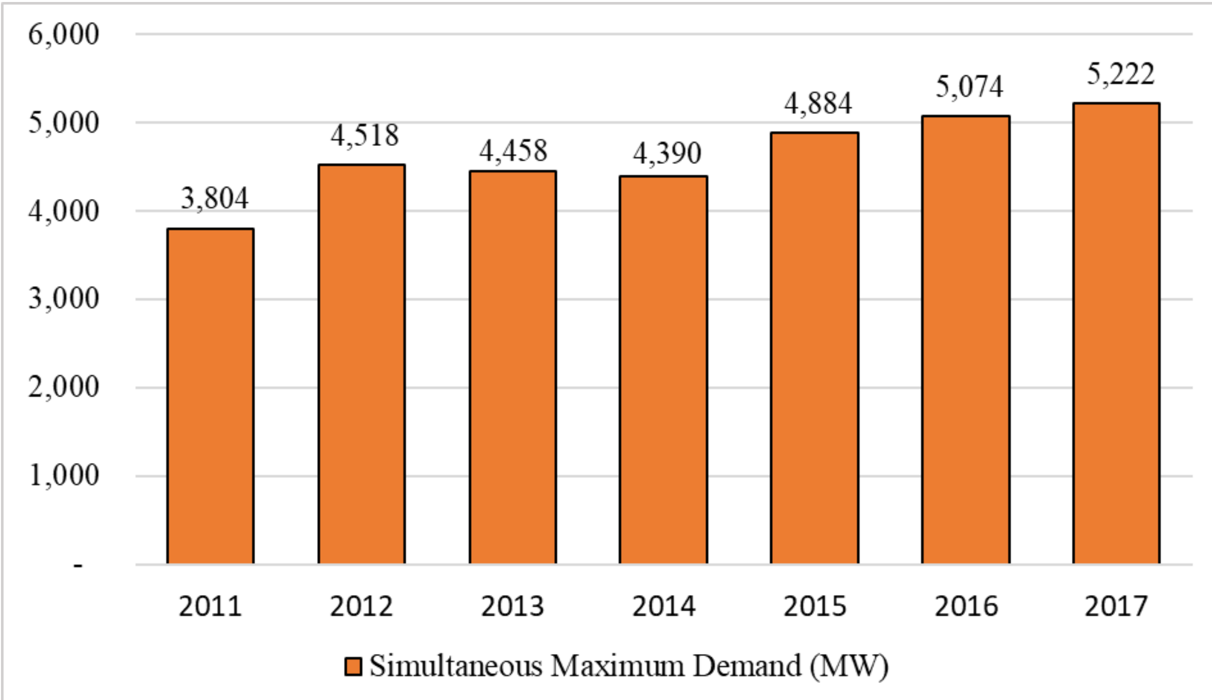

Figure 4.15: Trend of national simultaneous maximum demand from 2011 to 2017.

The grid reliability has also shown some sign of improvement. From 2011 to 2016, the grid recorded decreasing numbers of system collapses. Grid collapses decreased from an annual average of 25 between 200 and 2009 to an average of 23 between 2010 and 2016 (see Figure 4.16). Although grid collapses spiked again in 2016 with 27 recorded incidences, transmission faults were responsible for 19 of these system collapses. These transmission faults were a result

[51] Secondary data collected from the National Control Centre (NCC) in Oshogbo.

of insufficient maintenance of the areas surrounding transmission line routes causing over growth of bush consequently leading to ensnaring of transmission lines; and the use of unreliable and aging line protection equipment. There is also a lack of a comprehensive and modern Supervisory Control and Data Acquisition (SCADA)[52].

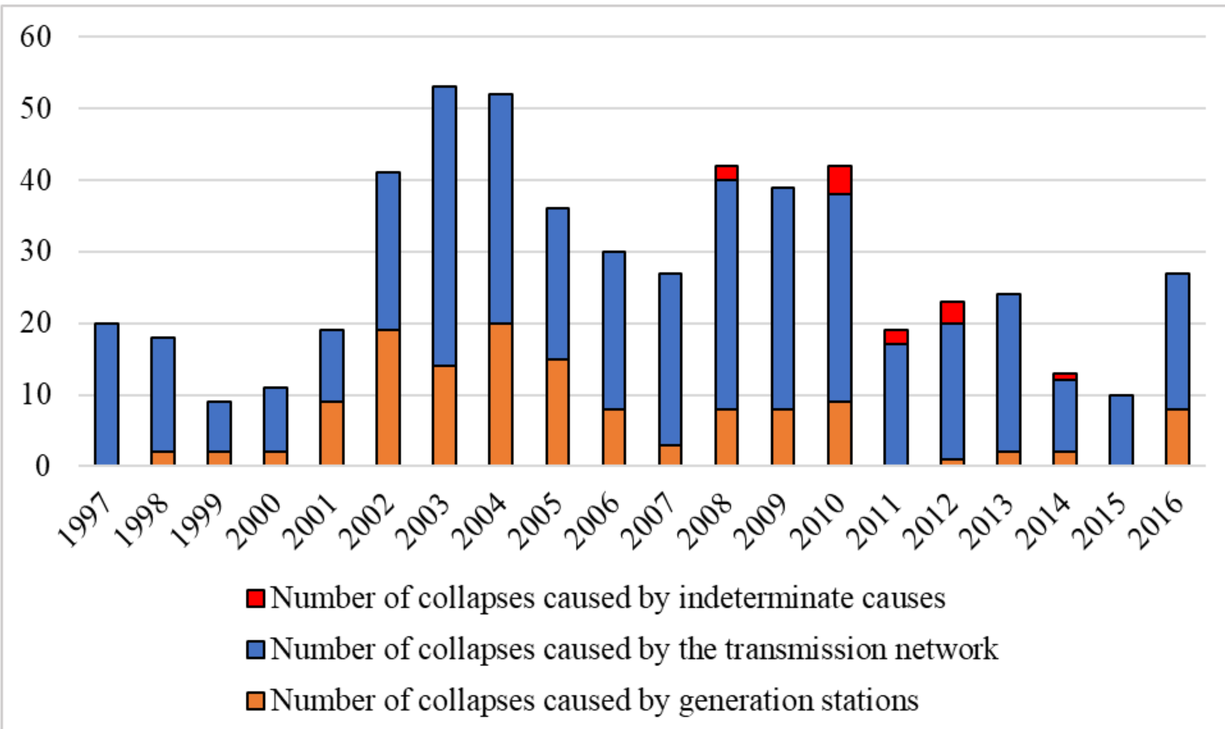

Figure 4.16: Total number of grid collapses in Nigeria from 1997 to 2016 sorted by cause.[53]

Generation faults accounted for 8 of the grid collapses in 2016. The generation faults were caused by tripping of generation station units. When a significantly large generation unit drops

[52] Power Sector Recovery Programme (PSRP) January 2018

[53] Secondary data collected from the National Control Centre (NCC) in Oshogbo.

from the grid, the frequency on the grid drops. This forces other generation units on the grid to increase output to pick up the frequency; however, this usually causes other generating units, which cannot handle the frequency change, to trip off the grid, resulting in a cascaded loss of most generating units until sufficient load has been shed causing partial or total blackout. Abrupt generation reduction on the grid causes the system to collapse because not all generation station units use automatic governor control (AGC), which would allow generation units to respond speedily to a drop in frequency on the grid.

Most of the grid collapses are total grid collapses (see Figure 4.17), which result in total black out. This suggests that the current manual governing control systems in several power stations are not able to respond quickly enough to meet the challenge of falling grid frequency. There is also a need for spinning generation reserve. In 2016, the cause of one of the 27 system collapses is not known. It is referred to as an "indiscriminate" cause of collapse.

Transmission network losses have hovered between 10% and 12% in recent years (see Figure 4.18). In comparison the |Ghanaian transmission network losses are under 5% and South African transmission losses are under 4%.

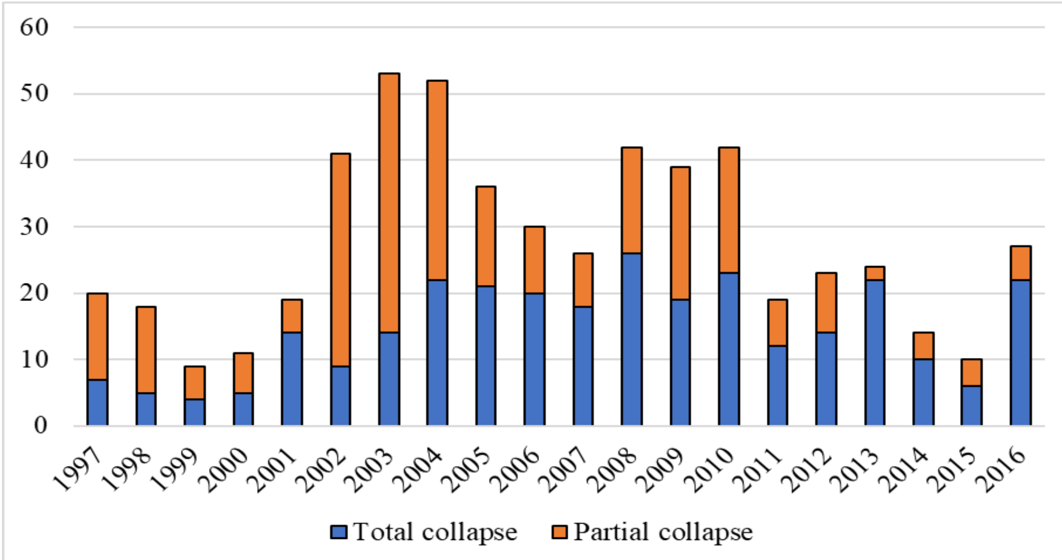

Figure 4.17: Trend of total and partial system losses on the grid in Nigeria.[54]

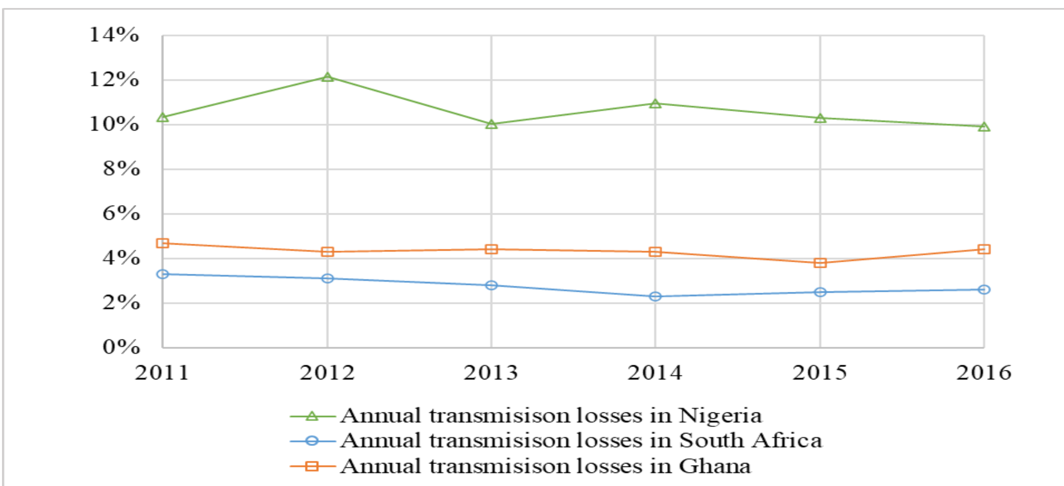

Figure 4.18: Annual transmission losses on the grid in Nigeria from 2010 to 2016.

(World Bank, 2019d)

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[54] Secondary data collected from the National Control Centre (NCC) in Oshogbo.

4.5.3.3 Electricity Distribution

The FGN estimates the simultaneous peak electricity demand in Nigeria in 2016 – including suppressed demand – at 15,271 MW (see Figure 4.19). This is almost three times higher than the highest recorded peak production on the grid in Nigeria[55]. The DisCos are unable to meet the demand of consumers due to generation and transmission constraints. The DisCos also have their own technical and commercial constraints, which make them unable to deliver enough power to consumers.

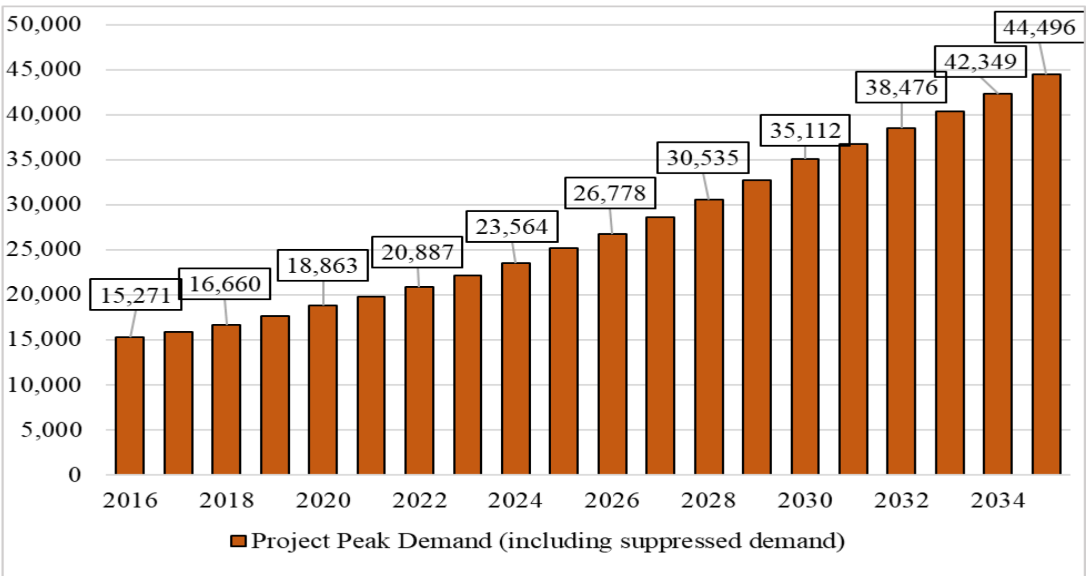

Figure 4.19: Projected grid electricity demand in Nigeria including suppressed demand.

Source: (TCN, 2018)

[55] 5,222 MW is highest peak production on the grid in Nigeria.

The performance of the DisCoSs is crucial to the performance of the entire sector because their financial viability determines the state of liquidity in the rest of the sector. DisCos performance can be analysed by examining their aggregrated technical, commercial and collection (atc&c) losses. The atc&c losses are the total amount of energy sent into the distribution network that is not paid for by consumers. It has three componentrs: technical loss, commercial loss and collection loss. The technical loss is the intrinsic loss that arises from the normal operation of any electrical system. This loss arises when electricty passes through resistive loads such as cables and transfomers. This loss is unavoidable, but can be minimised with effective network maintainance.

Commercial losses, cometimes refered to as the ‘billing losses’ are non-technical losses. They arise when the DisCos are unable to assign electricity consumption to any known consumer. This usually occurs when there is electricity theft by some consumers or when the DisCo is not aware of some of its consumers. This usually causes a revenue shortfall. When the DisCo assets were privatised, the government recognised this loss and agreed to have it built as a component into the end-user electricty tariff. This would mean that the DisCo investor would be able to recover commercial losses by making consumers pay for it through their energy bills. In practice, however, this has not happened due to two factors. First, the regulator has refused to build in an accurate “commercial loss” component into the end-user tariff. This means that DisCos have a revenue shortfall. Second, the consumers who are billed – and who are expected to pay their bills, including the commercial loss component – do not always pay 100% of their bill. DisCos observe that regardless of the amount of supply available, consumers usually have a fixed budget for electricity. This causes a larger revenue shortfall for DisCos. This second factor is referred to as collection loss.

The collection loss is the difference between the amount of energy billed to consumers and the amount of energy paid by consumers. The collection loss is an important measure of performance because the DisCos collect revenue for the rest of the sector. The amount they collect and remit to the rest of the sector determines the viability for the rest of the value chain. In 2016, DisCoS collected only 57% of the bill from their customers, and only setlled 29% of their bill to NBET, who have to setlle the bills from the GenCos. This was worse than their perfomance in 2015 when they had 61% collection rate and 53% invoice sttlement rate[56]. Figure 4.20 shows the collection efficiency of the DisCos over three years between 2015 and 2017. The collection efficiency of individual DisCos ranged between 35% and 90 % between 2015 and 2017. The level of commercial and collection losses have created a liquidity crisis in the sector. The collection loss is in part due to the past dynamic between consumers and the former state-owned utility, which treated electricity like a social service. The low collection efficiency of the DisCos is also in part due to their limited capacity to collect bills across the entire span of their service area. Some DisCos have densely populated coverage areas, which makes it easier and chepaer for them to collect higher revenues than other DisCos.

[56] Power Sector Recovery Programme January 2018

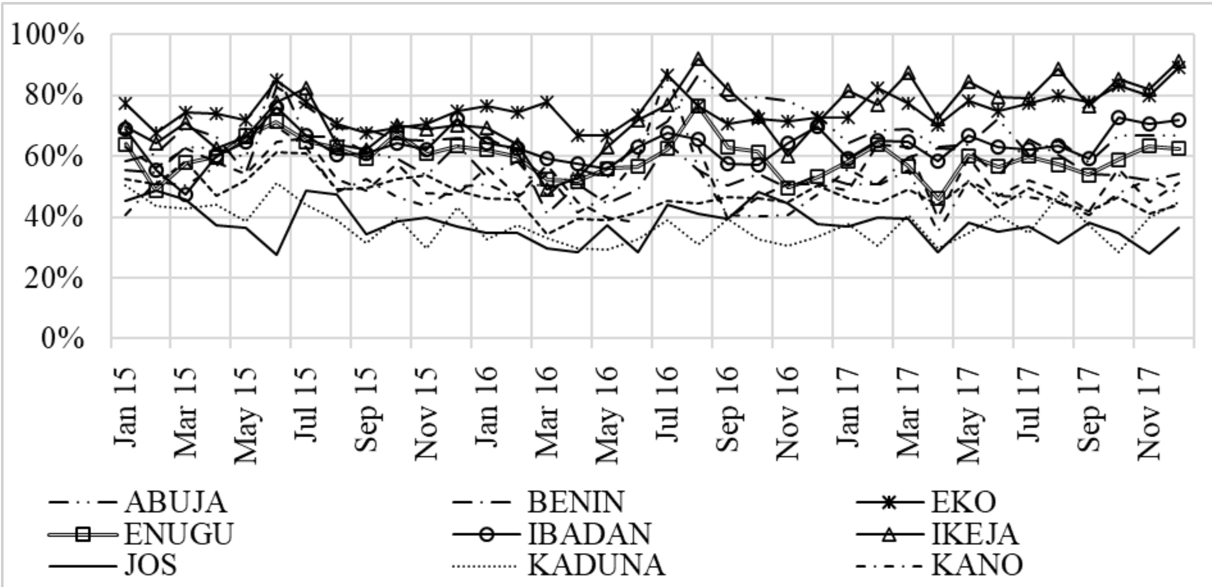

Figure 4.20: Collection efficiency of DisCos for three years from 2015 to 2017.[57]

The atc&c losses are costs to the DisCos, so the atc&c losses were agreed to by the regulator as a necessary cost that should be recovered by the DisCos through the tariff. After privatisation and further consultations, the collection losses were taken out of the tariff model. The regulator argued that it wasn't a cost component that the consumers should be paying for. They argued that it is the DisCos responsibility to collect its revenues[58]. The atc&c losses were replaced with the aggregrateed techncial and comercial losses (at&c) losses as cost compoenets in the end-user traiff model. The DisCoS agreed with this but argued that the the at&c components in the MYTO tariff model did not reflect the true nature of the losses on the system (see Figure 4.21). This has resulted in large losses and has caused DisCos to pay on fractions of NBET's invoices (see

[57] Secondary data collected from the regulator (NERC).
[58] Source: Interview with regulator (NERC). Abuja, Nigeria. 06 March 2018.

Figure 4.22). As of January 2018, even the FGN's Ministries, Departments and Agencies had verified unpaid debts of NGN 26 billion (USD 84 million) owed to the ditribution companies (FGN, 2018).

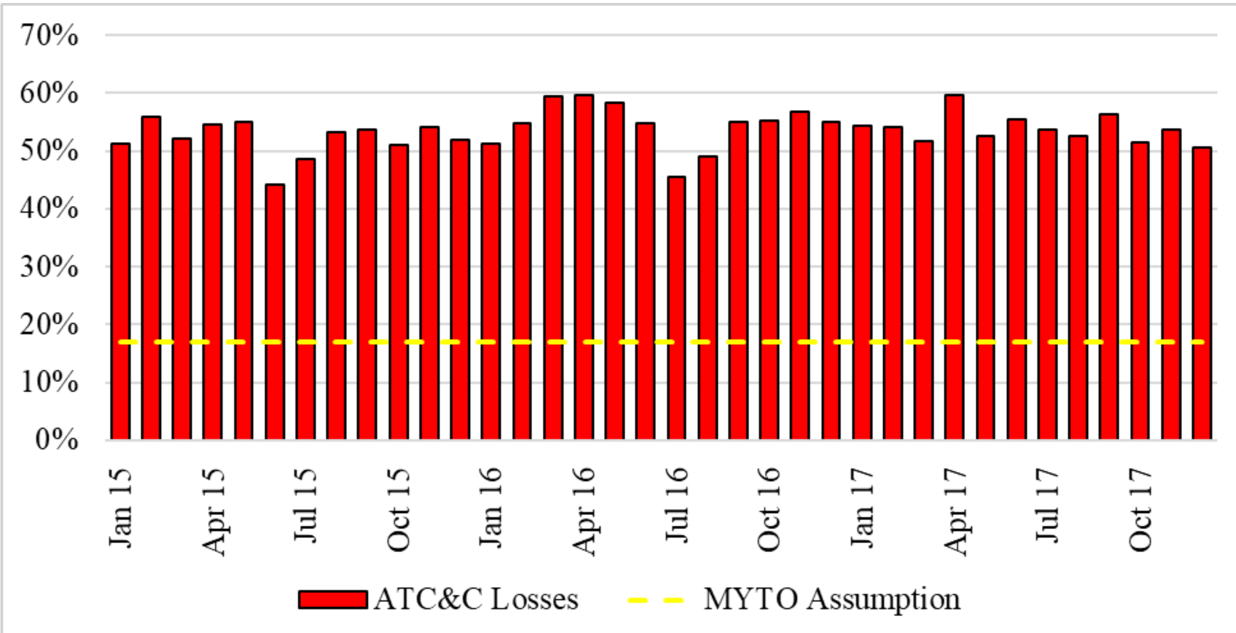

Figure 4.21: Trend of the atc&c losses on all eleven distribution networks in Nigeria for three years from 2015 to 2017.[59]

[59] Secondary data collected from the regulator (NERC).

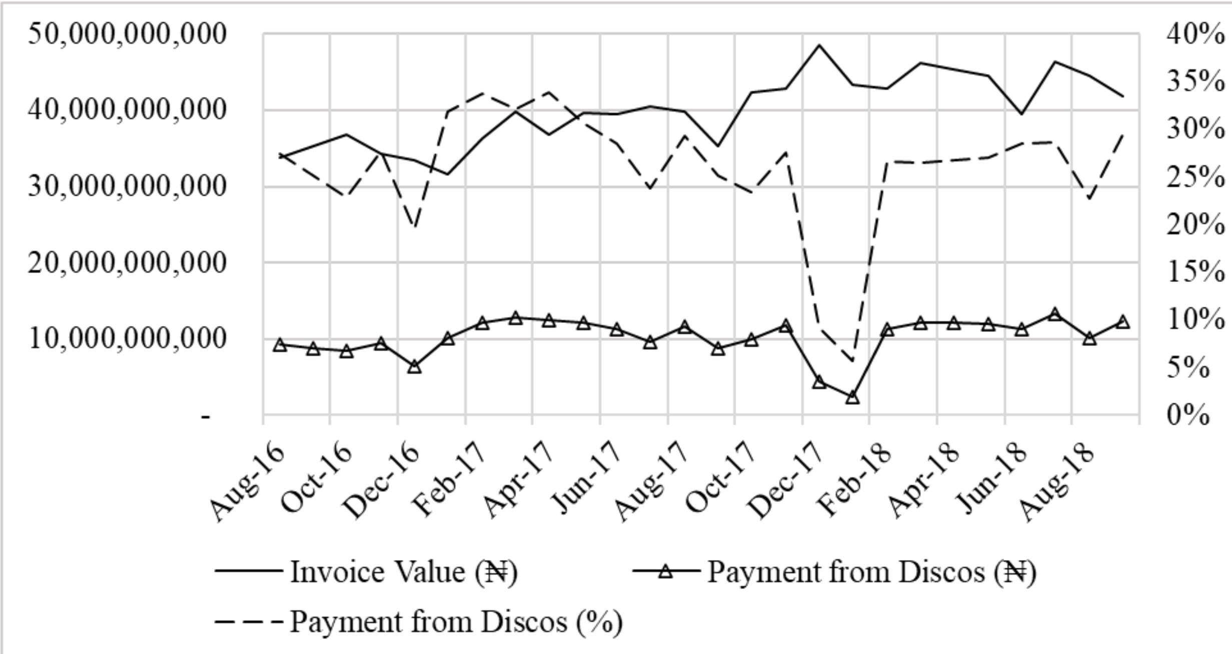

Figure 4.22: DisCo settlement of NBET invoices from August 2016 to October 2018.[60]

However, the largest loss that contributes to the liquidity crisis comes from the tariff shortfall. This loss is the difference bewteen revenues the DisCos currently make and what they would make if the reaail tariffs were cost-reflective. The tariff shortfall is a result of the regulator not updating the tariff sturture with the current industry-wide and macroeconmic conditions. The foreign exchange component of the tariff is based on the USD, however, the regulator and the government have not updated the ratil tariff to reflect existing foreign exchange rate. The value of the U. S. dollar moved from NGN 197 in 2015 to NGN 362 in 2016. The traiff shortfall accounted for 88% of the total market deficit between January 2015 and December 2016. The

[60] Secondary data collected from the regulator (NERC).

tariff shortfall was NGN 420 billion (USD 1.36 billion) from January 2015 to December 2016 and is expected to be 1,150 billion from (USD 3.75 billion) from January 2017 to December 2021 implying that there is a projected increase in the annual shortfall.

The tariff shortfall is directly linked to the rentier mentality obsevred in the Nigeria, especially in the NESI. NESI consumers have grown accustomed to cheap electricty from the pre-privatistaion era of NEPA and PHCN. Efforts to insititute cost-rflective tariffs have been resisted through public demonstraions, protests and labour union action.

A total funding of NGN 1.934 trillion (USD 6.339 billion) will be required to cover the tariff shortfalls from 2017 to 2021 (see Table 4.2). The PSRP proposes that the FGN and World Bank will cover the tariff shortfall between 2017 and 2021 (see Table 4.3) through loans to the NESI.

Table 4.2: Funding requirements for the tariff shortfall from 2017 to 2021.

	NGN Billion	USD Million	Percentage
Sector Revenue shortfall (2017-2021)	1,150	3,770	59.5%
Sector Historical Deficit (2015-2016)	420	1,378	21.7%
CBN Payment Assurance Facility Debt Service	363	1,191	18.8%
Interest	132	434	
Principal repayments/ amortisation	231	757	
Total Funding Requirements	1,934	6,339	

Table 4.3: Funding sources for tariff shortfalls from 2017-2021.

	NGN Billion	USD Million	Percentage
Central Bank of Nigeria Payment Assurance	702	2,301	36.3%

facility (domestic debt)			
Additional Budgetary Contribution (domestic and external debt)	927	3,039	47.9%
World Bank performance-based loan (external debt)	305	1,000	15.8%
Total Government financing	1,934	6,339	100.0%

4.6 Regulatory/government dimension

The regulatory/government dimension is the second dimension of analysis. The need for FGN regulation is evident from the underperformance of the NESI. The role of the FGN in correcting NESI inefficiencies has its own effects on performance in the commercial dimension. This section presents the structure conduct, performance and regulation of government and its agents. It shows the exogenous impact that the regulatory/governmental actors have on the performance of the commercial dimension. It also highlights how the rentier mentality and dysfunctionality in a rentier state like Nigeria influences regulation.

As shown in Figure 4.23, the NESI is independently monitored and regulated by the Nigerian Electricity Regulatory Commission (NERC) as stipulated in the EPSR (2005) Act. NERC regulates the price of electricity through its periodically published MYTO and sets the mode of operation on the grid through its grid codes. Whilst NERC monitors and regulates the NESI, the Federal Ministry of Power, Works and Housing (FMPWH) sets government policy within the NESI, which NERC is legally obligated to consider in establishing its regulations. Other peripheral regulators in the NESI are the Federal Ministry of Environment (FMEnv), which is responsible for regulating the environmental and social impacts of NESI actors; the Department of Petroleum Resources (DPR), which regulates the GasCos. The DPR is responsible for setting the quantity of gas that each GasCo is required to supply to the domestic market. Despite the DPR being the regulator for GasCos, it is the Ministry of Petroleum Resources (MPR) that sets the price for domestically supplied gas in Nigeria. The Federal Ministry of Finance also creates policy to boost the liquidity of the NESI and the Central Bank of Nigeria, which regulates the financial sector, implements the FMOF's liquidity boost policy in the NESI.

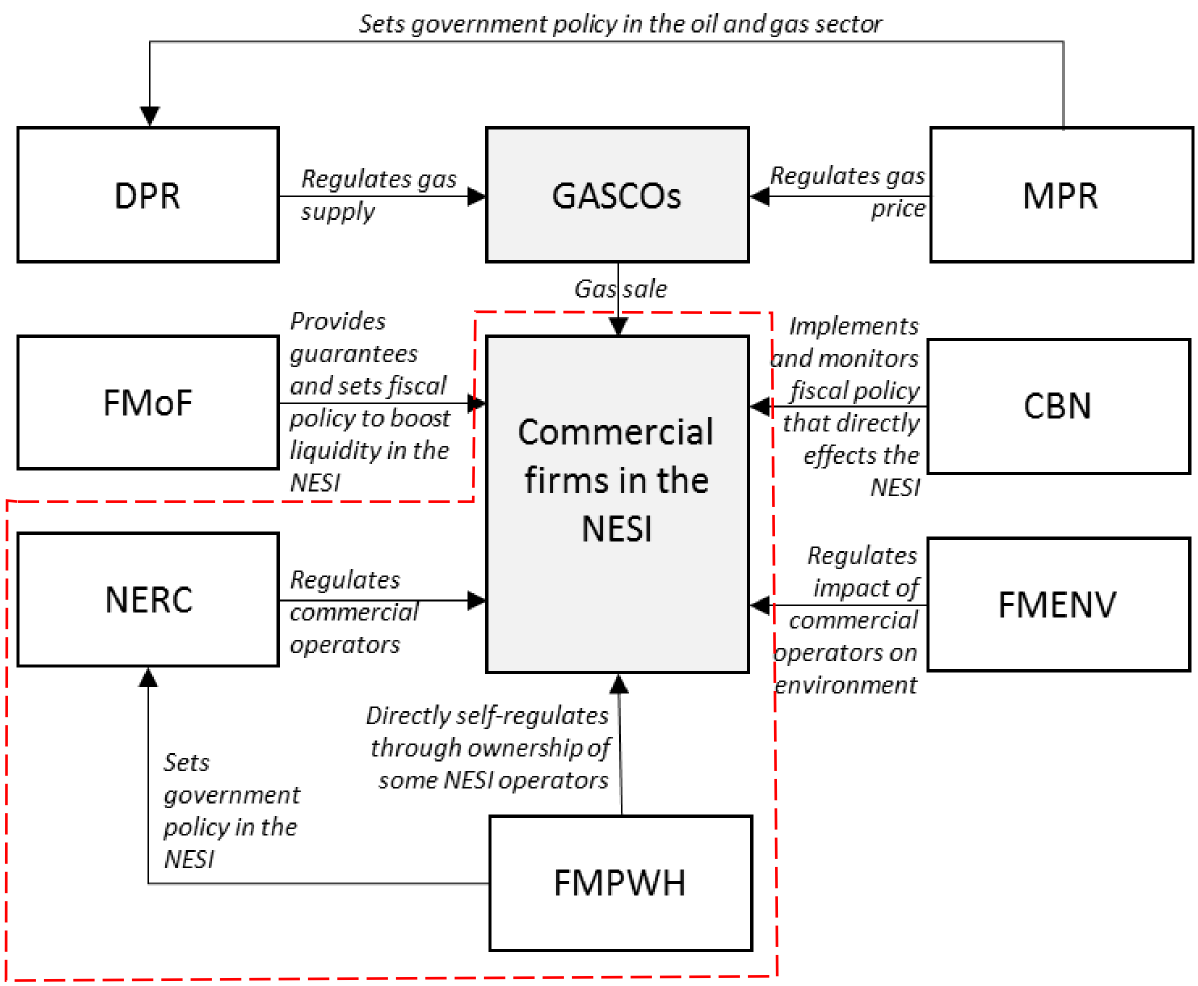

Figure 4.23: Regulation and policy-making that affect the NESI (NESI boundary in red dotted line).

Leaning on the EPSR (2005) Act, this thesis categorises NERC's regulation of the NESI into two types of regulation. NERC implements both protective regulation and competition regulation.

Sections 32 and 80 of the EPSR (2005) Act spell out the function of NERC to protect consumers, while Section 82 spells out NERC's responsibility to continually explore the potential to increase competition within the NESI. Amongst other functions of NERC, these two have had the most effect on the structure, conduct and performance of the NESI.

4.6.1 Pricing Regulation

Protective regulatory policies are intended to protect consumers by preventing or eliminating the existence of activities and conditions that are regarded as unfair to consumers (Nagel, 1994). Protective regulation by NERC involves ensuring that consumers within the NESI get quality supply of electricity at a fair price. NERC's responsibility also includes ensuring that consumers are not unfairly treated by NESI operators during disputes over electricity supply. In practice, the aim of regulation in NESI is to keep retail price of electricity as low as possible for consumers without inhibiting the operators' ability to recover their investments and allowed return on investment.

There are three major modes of protective regulation/policy at the retail end of the NESI. The first, which is arguably the most contested among industry actors, is the non-implementation of the MYTO retail tariff review. The retail tariff review process is a joint effort by NERC, DisCos and the public[61] to agree on a fair price for retail electricity. This review process is supposed to happen periodically – every six months for minor reviews on inflation rate, foreign exchange

[61] Through public consultations.

rate, gas pricing, and electricity supply capacity –and every five years for a major review to agree on agree on revenue requirements and make corresponding tariff adjustments.

NERC as of December 2018, had missed 6 minor reviews of the retail tariff. All four indices employed by the MYTO to calculate the retail tariff in 2015, which should have been reviewed, no longer reflect the DisCo's cost of delivering power to consumers. It is widely acknowledged in industry that NERC has not implemented the reviews due to FGN pressure to prevent electricity prices from rising for consumers. The government distributes rent to citizens through the retail electricity subsidy. A removal of the subsidy would cause an increase in the price of electricity, resulting in resistance from consumers or more accountability for the government. This has created a bottleneck in the sector since the privatisation of the NESI.

Some consumers do not mind paying more for reliable electricity as they currently do through expensive self-generation alternatives, they however do not want to pay higher prices without seeing an immediate and significant change in the reliability of electricity on the grid. Other consumers do not want to pay higher tariffs without prior improvements to the electricity supply service. There is an inadequacy of trust between consumers and DisCos, which is not helped by DisCos, who do what is commonly referred to as "estimated billing."

Estimated billing is a method of billing by the DisCos which passes on their unallowed commercial losses to paying consumers. Instead of paying for what they consume, which should be recorded on a consumption meter, the DisCos add up electricity sales and commercial losses in an area and divide the total among customers. Paying customers usually end up with a higher bill than they ought to pay because with estimated billing, they are also paying for more than the allowed commercial losses already built into the electric price. DisCos are obligated to charge consumers according to their metered consumption; however, many consumers do not have meters. DisCos are also required to provide meters to consumers, but they argue that their current revenue cannot support rapid mass scale deployment of meters. They argue that the non-cost reflectiveness of the end-user tariff makes them unable to provide consumer metering at the required scale and speed. The government response to this is the Meter Asset Provider (MAP) regulation in 2018.

To address the dysfunctionality in the retail end of the NESI, the government's second protective regulation is the MAP regulation, which allows third party firms known as meter asset providers (MAPs) to procure, supply and maintain meter assets to consumers who are willing to pay for their meters to avoid estimated billing. Consumers will be able to pay for their meters through an extra line charge on the bill from DisCos over a 10-year period. The DisCos are responsible for reimbursing the MAPs for their services and are still responsible for the meeting targets in their distribution coverage area. The DisCos claim that this regulation does not adequately share operational risk because the risk of poor maintenance of meters is borne by the DisCo, which is still tasked with collecting revenues from consumers based on measurements on meters supplied and maintained by another firm. This regulation; however, stands and is in the early stages of its implementation.

NERC's third protective regulation/policy is the customer enumeration directive, which also aims to address the dysfunctionality in the retail end of the NESI. It requires DisCos to enumerate their entire consumer base and close the information gap that was created by NEPA and PHCN, which did not need to have comprehensive data about their customers. In 2018, NERC issued a directive that directed all DisCos to enumerate their entire customer base by 31st March 2019. There are two main reasons for this; the first was to help reduce commercial and collection losses. Having comprehensive information about the entire customer base helps to

DisCos to reduce billing losses because it enables them to know which customers to bill for electricity consumed – information that they are currently lacking. The second reason for this directive was to reduce the fixed costs components of the distribution charge, which will go down when previously uncounted customers are included in the MYTO model calculation. Leaving some customers uncounted will keep the tariff higher than it should be since the total cost of electricity is borne by only known customers. The more customers are identified, the less the cost is for each customer. There is some contention between the DisCos and other NESI actors about the possibility of the retail tariff being kept artificially high by keeping the customer count low.

Additionally, at the point of sale between GasCos and gas GenCos, the MPR also implements protective regulation on the price of gas, which directly feeds into the price of electricity. The Domestic Gas supply obligation (DGSO) is a regulation set by DPR that places a legal obligation on GasCos to supply an annually determined quantity of gas to the domestic market. While DPR sets the quantity of DGSO for each GasCo, it is the MPR that sets the price, which is kept artificially low to control domestic energy costs. This is a critical area for price control because left unregulated, the gas supplied to the domestic market leaves the NESI consumers exposed to two risks: the globally determined price of gas and the foreign exchange rate for the USD. The price of gas is set by the MPR in USD. The price of retail electricity is however set in Naira. A floating gas price and an absence of minor reviews at the retail end of the NESI would blow up the NESI deficits even further.

The DGSO gives an advantage to gas-fired GenCos that is not available to promoters of other technologies, including RE technologies. However, as Chapter 4 shows, a removal of the gas subsidy would not suffice to drive on-grid RE investments.

The DGSO pricing regime, which was set in 2008, is set to change. The 2017 National Gas Policy proposes the adoption of a more attractive pricing mechanism for GasCos. The new pricing mechanism will allow the price of domestically supplied gas float with export liquefied natural gas (LNG) price. The price of domestic gas feeding the NESI will be the export LNG price less regasification costs. The proposed gas pricing regime is a direct response to the performance of the domestic gas sector in the country. This conduct by the FGN is a price incentive for GasCos to invest in domestic gas supply. While the proposed pricing regime is sure to increase sector deficits, the FGN has committed to facilitate a NGN 1,150 billion (USD 3.75 billion) loan support to fund the sector's deficit from 2017 till 2021. This will eventually be expected to be paid back by consumers.

In order to protect consumers from higher electricity tariffs and the potential operational crisis that could ensue from a protracted liquidity crisis, the FGN intervened with a NGN 213 billion (USD 694 million) loan to help improve liquidity in the sector through the CBN. This loan later became a component of the 2015 tariff update to be paid back by consumers.

4.6.2 Competition regulation

NERC introduced the eligible customer's regulation in 2017 after the Minister of the FMPWH declared the eligible customer policy. The eligible customer regulation allows consumers, who consume 2MWh/h, to buy electricity from third parties instead of the DisCos. The EPSR (2005) Act allows this regime to exist after its declaration has been made by the Minister. The purpose of this regulation is to create competition in the retail end of the NESI. Eligible customers may buy electricity directly buy from existing GenCos or new IPPs. An eligible customer transaction can be executed with or without the inclusion of a DisCo. The DisCos may act as transporters of electricity within an eligible customer power purchase agreement. An IPP may also build a power plant close enough to an eligible customer that there will be no need for the DisCos to be included in the arrangement.

While the FGN expects to see higher operational efficiencies from DisCos by introducing competition at the retail end of the NESI, the opposite is likely to happen. This is because the eligible customers are the most important customers to DisCos, providing the DisCos with high collection rates and higher retail tariffs. There is a cross subsidy regime in the NESI that allows high-demand consumers subsidise low-demand consumers. The FGN will have to raise the retail cost of electricity to consumers if high-demand consumers, who subsidise the rest of the market, are taken away from the DisCos. Considering the government and its agents have been very reluctant to allow DisCos charge a higher cost reflective retail price till date, this will further increase the sector deficit. The sector deficit will be made even worse because the DisCos have a relatively high a high collection efficiency with eligible customers. Taking eligible customers away from DisCos will reduce the collection efficiency and exacerbate the sector deficit.

4.7 First fourteen solar IPPs

The Nigerian on-grid RE target, which is known in industry as Vision 30:30:30, was approved by the Federal Executive Council (FEC) of Ministers in 2005. The target is spelt out in the Nigerian RE and Energy Efficiency Policy (NREEEP). The Vision 30:30:30 target is to achieve 32,000 MW of available generation capacity on the grid by 2030 with 30% RE penetration. The remaining generation capacity for on-grid electricity generation is expected to come from gas-fired power generation technologies.

In July 2016, fourteen solar IPPs signed PPAs with NBET at USD 0.115/KWh. At least two of these projects started in 2010 when the FGN published its roadmap to liberalise the sector and encourage private sector participation. In 2012, when NERC released MYTO 2012, it established attractive FITs. For solar projects, the FIT was NGN 67/KWh[62] (USD 0.43/KWh). Figure 4.24 compares the Nigerian FIT with the South African (SA) RE FIT and the South African RE independent power programme (REIPP). The latter was a competitive process, which involved tariff bidding by IPPs. Several successful IPPs in the REIPP were IPPs that had unsuccessfully tried to develop their project with the SA REFIT programme.

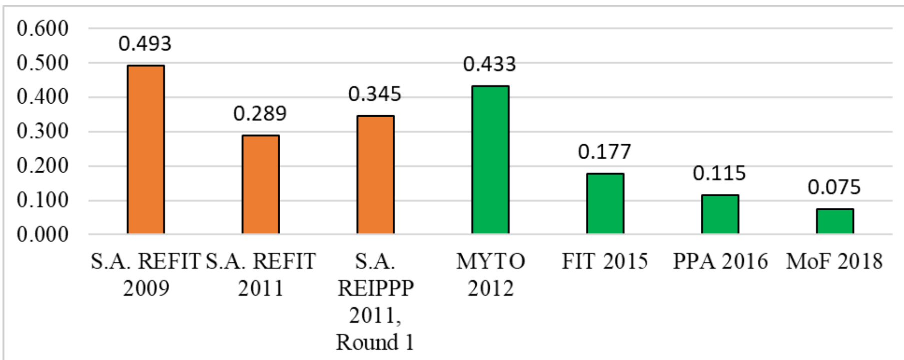

Figure 4.24: Feed-in-tariff in South Africa and Nigeria between 2009 and 2012 in USD. **63**

The tariff in MYTO 2012 attracted several project developers who wanted to get into the industry on the eve of privatisation, which would occur on in 2013. The developers were even more convinced of the solar PV projects because of the inadequate gas supply infrastructure in the country[64]. In 2015, NERC published the 'Regulations on Feed-in Tariff for RE-sourced electricity in Nigeria.' The 2015 FIT for solar PV projects was reviewed down to USD

[62] MYTO 2 (2012).
[63] Data sourced from 'South Africa's Renewable Energy IPP Procurement Program: Success Factors and Lessons' by the World Bank and MYTO 2.
[64] Source: Interview with RE Project Developer. Abuja, Nigeria. 07 May 2018.

0.177/KWh due to falling solar panel costs with inflation and forex escalations that resulted in a projected 8% annual increase in the tariff. The 2015 regulation also mentioned that the DisCos would be obliged to source 50% of their power from renewable sources if available. This was the last FIT regulation published by NERC until the FGN signed PPAs with developers at USD 0.115/KWh due to the buying power of the FGN as the only bankable bulk buyers of electricity.

After signing their PPAs in July 2016, the project developers met a roadblock when they moved to obtain guarantees from the FGN. One of the guarantees they are still currently seeking, is the Put-Call Option agreement (PCOA). This agreement allows solar IPPs to 'put' the solar plant up for sale requiring the FGN to buy the plant at an agreed price if the project is failing due to factors outside the IPPs control, but within the FGN's control. The PCOA also allows the FGN to 'call' for the asset to be sold to the government if the solar IPP is not meeting its operational agreements. The PCOA is in effect a sovereign guarantee covering the solar IPP.

The Minister of Finance had initially proposed to provide the PCOA in Naira – a proposal that the solar IPPs rejected. The IPPs rejected the proposal because most of their debt obligations would be denominated in USD. In March 2018, the minister agreed to provide the PCOA but on one condition – a further reduction in tariff. The Minister, who is also the Chair of the board of NBET, advised that the FGN could not afford to take on the PCOA liability with a tariff of USD 0.115/KWh. The condition given to the solar IPPs by the Minister was to drop their legally agreed PPA tariff to USD 0.075KWh – the average wholesale tariff in 2017. Only two of the fourteen developers agreed to this. There is still no solar IPP that has reached financial close.[65]

While it might be tempting to interpret this as opposition from the regime, one interviewee (policy maker[66]) explained that the government was no longer interested in pushing the on-grid renewable energy projects due to the ballooning liquidity crisis in the sector – even though it appeared publicly that the government was still in support of concluding the 14 projects it had previously procured. The policymaker mentioned that the government was no longer interested in having these projects completed until it had sufficiently resolved the liquidity crisis in the sector. The policymaker mentioned that this was not a technology specific position, and that all new generation investments would be on hold until the liquid crisis had been sufficiently resolved. The policy makers insight was confirmed when, during the author's field work, the government released a policy document Power Sector Recovery Programme (2018), which restated the policymaker's insight.

In addition to the PCOA, the solar IPPs require a partial risk guarantee (PRG) for their projects to reach financial close. The PRG is an agreement between a development financial institution and the off-taker, NBET. The PRG supports liquidity in the upstream sector by guaranteeing a

[65] As of January 2019

[66] Source: Group interview with policy maker and international development financier. Abuja, Nigeria. 28 April 2018.

fraction of NBET’s payment to the GenCo. None of the fourteen Solar IPPs will reach financial close if NBET is not supported with a PRG facility for their individual projects.

The FGN nominates projects that will get the PRG facility. The FGN nominates projects for PRGs because it takes the final risk. The PRG is effectively a loan to NBET to help its liquidity status – a loan that the FGN must pay back to the DFI. Despite accepting to provide PRGs to nominated projects, some DFIs[67] have now rescinded that offer to all on-grid generation projects, including on-grid RE actors, pending satisfactory levels of PSRP implementation.

4.8 Discussion

This section aims to answer Research Question 2: how are on-grid RE investments in Nigeria constrained? This chapter shows that market constraints within the NESI inhibits all new on-grid investments, including on-grid RE investments. It also highlights how the rentier mentality and dysfunctionality common in rentier states are responsible for shaping and perpetuating those market constraints within the NESI. While the SCPR provides in-depth insights into the industrial organisational barriers to on-grid RE in Nigeria, the insights from the RST sheds light on the political economic conditions that sustain the barriers.

4.8.1 SCPR Dynamic in the Rentier State

The findings in Sections 4.5, and 4.7 have shown how the SCPR dynamic determines the performance of the NESI. This section presents the argument that the structure of the NESI

[67] Source: Interview with international development financier. Abuja, Nigeria. 03 May 2018.

inhibits all on-grid generation projects, including RE deployment on the grid in Nigeria. There are three inhibitive loops identified in the NESI that constrain on-grid RE investments.

The first inhibitive loop is based on the monopsony of NBET. As mentioned in Section 4.7, 14 solar IPPs have already signed PPAs with NBET; however, they are yet unable to deploy RE on the grid as a result of their inability to reach financial close on their individual projects. The solar IPPs are not able to reach financial close because they are not yet able to secure two critical guarantees that would make their projects bankable. The first guarantee is the PRG, which is provided by DFIs at the FGN's expense, to boost NBET's liquidity. Some DFIs have put this facility on hold until the FGN has achieved a satisfactory level of implementation of the PSRP. The second guarantee is the USD-denominated PCOA, which the FGN has refused to provide to solar IPPs at the agreed wholesale tariff. The solar IPPs have refused to lower their tariff from USD 0.115/KWh down to USD 0.075/KWh to get a PCOA.

The underperformance of the NESI has caused the FGN's policy to withhold the PCOA and constrain additional generation investment (*C1*). This is one of the three inhibitive loops in the NESI that create barriers to on-grid RE investment (see Figure 4.25). This loop is based on the buyer power of NBET, which has a monopsony as the only bankable bulk buyer of electricity in the wholesale market.

In turn, NBET's monopsony is a result of the rentier state characteristic of dysfunctionality in the NESI's revenue generation regime since before privatisation. Nigeria's status as a rentier state shaped the structure of the NESI by creating the conditions that necessitated the creation and continuation of NBET. Therefore, the dysfunctionality in the NESI is a political-economic barrier to on-grid RE investments in Nigeria.

NBET monopsony can nonetheless be broken up by introducing a parallel electricity market, where large productive, credit-worthy consumers are allowed to buy directly from GenCos. The parallel electricity market is described in the conclusion chapter. If solar IPPs sell directly to large, credit-worthy consumers, it may remove the need for FGN-backed guarantees and therefore remove the constraint defined in the first loop.

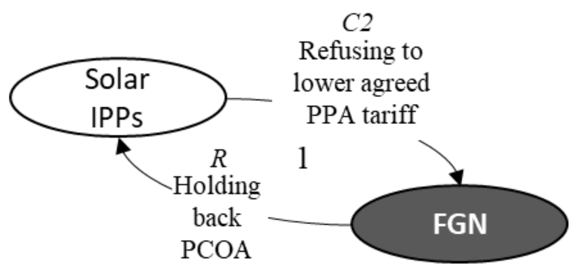

Figure 4.25: Inhibitive loop caused by NBET's Monopsony.

Only two of the solar IPPs reduced their PPA tariff to USD 0.075/KWh[68]. These two firms have signed PCOAs but are unable to reach financial close (*C1*). The FGN has refused to provide PCOAs at USD 0.115/KWh to prevent itself from being overburdened by sovereign liabilities resulting from the liquidity and debt crisis in the NESI. The liquidity and debt crises in the sector are caused by large tariff shortfall and ATC&C losses at the retail end of the NESI. These losses caused the DisCos to pay only 27% of their bill from NBET in 2017. This is largely due to the tariff deficit resulting from non-cost reflective tariffs. Between February 2015 and December 2016, the DisCos were unable to pay NGN 476 billion to NBET. Of that amount, NGN 420

[68] As of February 2018

billion was due to the tariff shortfall at the retail end of the sector. The tariff shortfall was responsible for about 88% of the market deficit in the NESI. The tariff shortfall is caused by the non-cost reflectiveness of the tariffs that the NERC allows the DisCos to charge consumers.

The second inhibitive loop is caused by the unproductive consumer protection policy of the FGN. NERC is unable to set cost-reflective retail tariffs because the FGN does not want the price of electricity to go up for consumers. The FGN refusal to allow NERC raise prices stems from the rentier mentality of consumer, who have grown accustomed to cheap electricity as a form of rent distribution – a means by which it enjoys the benefit of being an oil rich state. The social contract between the FGN and the citizens makes it challenging for the government to allow retail electricity prices to become cost reflective. This, in turn, limits revenues for the DisCos, who have carried out estimated billing and have not met the service expectations of the consumers.

The DisCos defend their conduct by pointing to their insufficient revenues stemming from non-cost reflective tariffs– creating a second full loop that inhibits performance in the sector investment. This loop (see Figure 4.26) is caused by the FGN's ineffectual retail subsidy in the NESI, which sustained by the rentier mentality.

This inhibitive loop caused by the retail subsidy and rentier mentality can be avoided if a parallel electricity market which has cost-reflective tariffs, is created. A significant number of NESI consumers may not be able to afford cost reflective tariffs, however, the FGN should separate those who can from those who cannot. This will enable the FGN to strategise better on how to support less-credit worthy consumers. Credit worthy consumers, many of whom are willing to pay, should be taken to a parallel electricity market where they can be charged cost reflective tariffs. There would be an incentive for credit-worthy consumers to join the parallel electricity market if the cost-reflective tariffs in the parallel market is lower than the current composite tariff, which includes the subsidised NESI tariff and expensive diesel-fuelled self-generation costs.

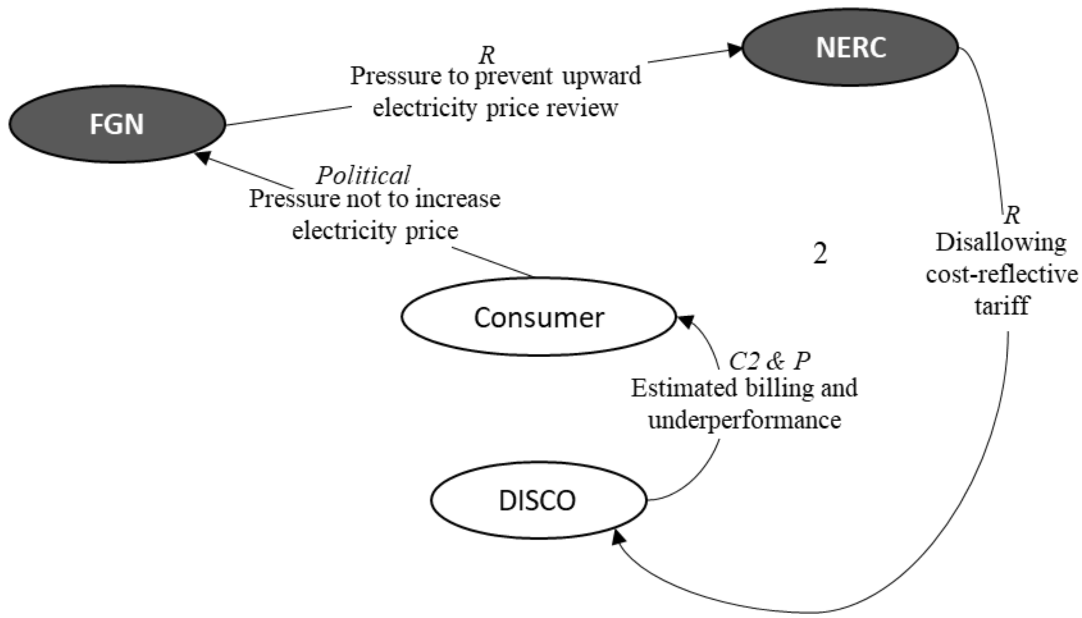

Figure 4.26: Inhibitive loop caused by the FGN's subsidy regime.

There is also a third loop – a loop of distrust between the DisCos and the consumers. The DisCos continue to use the estimated billing system (*C2*) and still do not meet the consumers' expectations of electricity supply. This causes energy theft, consumer apathy and consumer distrust leading to low collection and commercial losses. This loop of distrust is not helped by the FGN's antagonistic approach towards the DisCos – an approach some NESI actors say led to the Eligible customer policy – an inherently useful policy in principle, but one that will inadvertently create unproductive competition for the DisCos.

This loop is sustained by inadequate information about consumers and the network infrastructure. A historically dysfunctional revenue generation regime in the NESI has left it with this information gap that makes it challenging and costly to bill customers accurately manage the grid effectively.

This inhibitive loop can be removed through the introduction of a parallel electricity market, which will allow cost-reflective retail tariffs to be charged to credit-worthy consumers, who do not need electricity subsidies. The income generated from the parallel electricity market will ease the liquidity crisis and can be used to improve critical parts of the grid infrastructure that will help solve some of the problems in the NESI incrementally. As liquidity improves, so those investment, performance and trust.

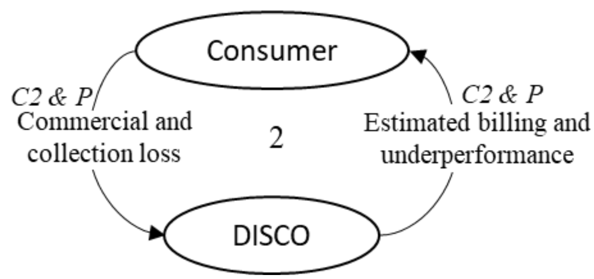

Figure 4.27: Inhibitive loop of distrust between DisCos and consumers

The three inhibitive loops within the NESI create a system of underperformance, which constrains all electricity generation investments on the grid, including on-grid RE investments. The causal dynamics that inhibit RE deployment on the grid in Nigeria is shown in Figure 4.28. The three loops within these dynamics need to be broken before RE can be deployed on the grid in Nigeria.

The PSRP developed by the FGN in 2017 seeks to address many issues within the power sector including the three inhibitive loops identified in this section. However, 'NBET Monopsony' loop is addressed in the PSRP in a way that is unfavourable to on-grid RE deployment or any other on-grid electricity generation technology deployment. The PSRP recommended that the government hold off on encouraging more generation capacity until the NESI performance is significantly improved to avoid blowing up the NESI market deficit.

The introduction of a parallel electricity market for creditworthy consumers will help to break all three inhibitive loops, which are constraints to on-grid RE investments.

C1 = Investment decision, C2 = Price & output P= Performance R= Regulation

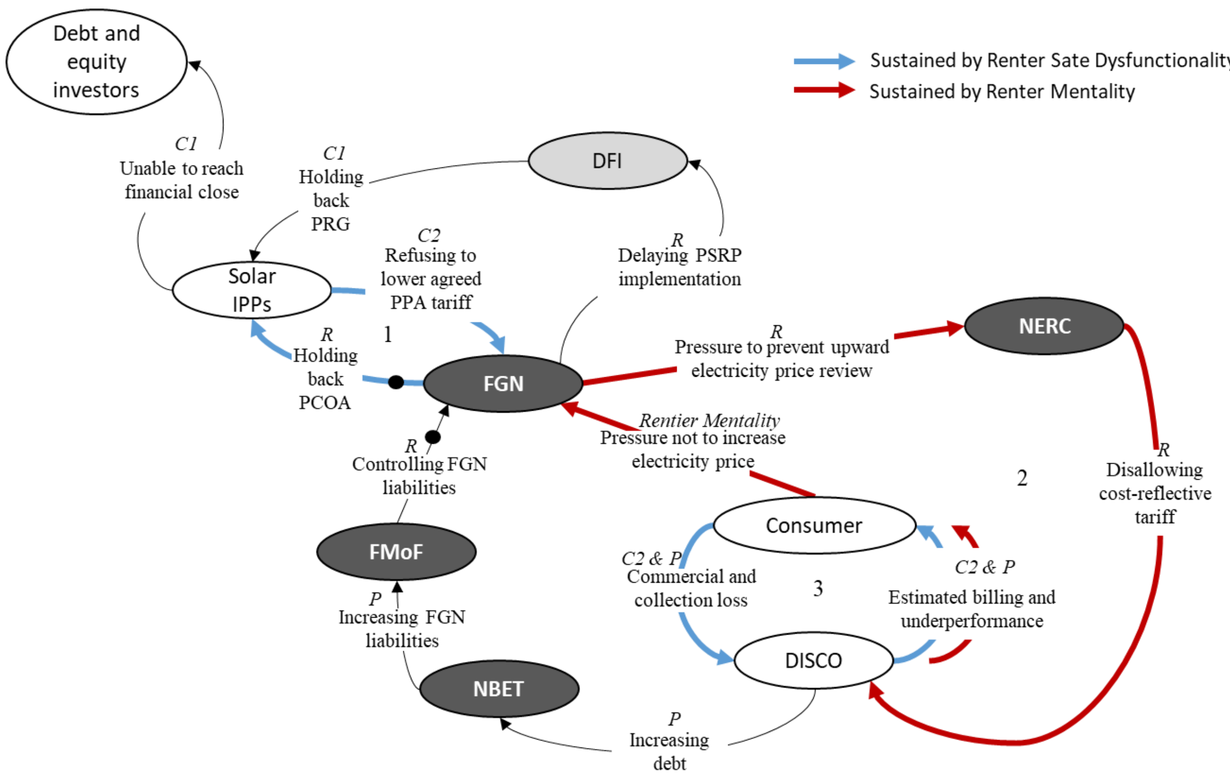

Figure 4.28: Inhibition to on-grid RE investment in Nigeria.

4.8.2 Examining Conditions for Change

The SCPR framework developed by Peng and Poudineh (2016) provides deep insights into the casual dynamics that inhibit RE deployment on the grid in Nigeria. It shows how the structure of the NESI and the conduct of its actors affect performance and necessitate regulation. It also shows how feedback dynamics in the structure, conduct, regulation, and performance within the NESI inhibit the deployment of RE on the grid.

In addition, insights from the RST help to shed light on the causal dynamics presented in Figure 4.28. The SCPR does not fully cover the political economic dynamics that influence the NESI. Integrating insights from the RST into the SCPR analysis explains how the rentier mentality creates an unproductive and inhibitive subsidy regime. It also explains how the dysfunctionality common in rentier states create the conditions for an inhibitive monopsony in the wholesale market and a distrust loop in the retail end of the market.

Although the SCPR framework and RST shed light on the industrial organisational and political-economic barriers to on-grid RE investments, they do not explain why the conducts of NESI agents and government sometimes succeed and other times fail. They help to explain how agents of the government and firms can conduct activities that influence the regulations, policy, conduct, market structure, and performance. They, however, do not explain why some agents are successful and others are not in influencing the SCPR dynamic. It is critical to understand why certain agents are successful and others are not because that would provide critical insights into the conditions for a successful change from the status quo.

To illustrate this point, the FGN has not allowed NERC to establish cost reflective tariffs, yet it liberalised the telecoms sector, where tariffs are cost reflective. Why is the FGN able to remove subsidies in the telecoms sector and unable to do so in the NESI? Could it be that rent distribution in the NESI was more institutionalised than telecoms? Or could it be that threat to rent redistribution, as Rodrik (2014) argues, do not tell the full story? Threat to rent redistribution is an important political constraint; however, policies need to be innovative enough to both correct market failures and minimise political constraints.

In the NESI, why were PPAs signed for 14 solar IPPs in 2016 and then delayed indefinitely since 2017 despite NESI performance remaining relatively stagnant during this period? These are critical questions because they ask why obvious solutions like those included in the PSRP may not be successfully implemented. These critical questions are not answered with the SCPR framework and RST as they are not well equipped to explain the conditions for change. Further examination needs to be done on why some agents or groups of agents are successful in changing or instituting regulatory regimes and policies, whilst others are not. Further examination in the next Chapter will provide a rich insight into the conditions required to successfully alleviate the liquidity crisis and promote on-grid RE investments in Nigeria.

4.9 Conclusion

This chapter explained the causal dynamics present within the NESI that inhibit on-grid RE deployment in Nigeria. The chapter answered the research question: how are on-grid RE investments in Nigeria constrained? This question was answered using the SCPR framework in combination with political economic insights from the RST. The common thread among the three findings is that the constraints to on-grid RE investments are a result of the underperformance of the NESI. The underperformance of the NESI is a result of three inhibitive dynamics that are sustained by key rentier state features in Nigeria.

This chapter showed how insights from the RST can augment the SCPR framework by showing how the political-economic features of oil rich states can influence structure, conduct, performance, and regulation of non-oil sectors of the economy, such as the on-grid electricity sector.

This thesis recognises that the constraints explained in this chapter are not destined to remain insurmountable even in a rentier state like Nigeria. As such, the next chapter examines the conditions for change.

5 The Political Economic Conditions Required for On-Grid Renewable Energy Investments in Nigeria

5.1 Introduction

Chapter 3 of this thesis shows that the projected reduction of RE prices alone will not drive on-grid RE investments in Nigeria, while Chapter 4 explains the rooted industrial and political constraints to the government's on-grid RE procurement programme and its wider liberalisation reform in the NESI. Both preceding chapters established the need for industrial policy. *Industrial policy* in this thesis refers to any government initiative that attempts to stimulate specific economic activities in productive sectors (Whitfield, 2014). However, government interventions or industrial policies are inherently political as they often redistribute rent and institutional powers (Khan and Jomo, 2000). These kinds of redistribution can breed resistance and contestation that often leads to the failure of industrial policies. The previous chapter showed how the potential for rent loss through the removal of institutionalised electricity subsidies to citizens has played a major role in inhibiting new investment in on-grid electricity supply in Nigeria, including on-grid RE investment.

Nonetheless, industrial policies can be successful in reforming underperforming markets – even markets in countries with intricate political dynamics or rentier state characteristics such as Nigeria. For example, the telecoms sector in Nigeria is widely acclaimed to have achieved liberalisation successfully (Usman, 2016; Okonjo-Iweala and Osafo-Kwaako, 2007). Nigeria had an installed capacity of 450,000 telephone lines prior to liberalisation in 2002, and by 2018, it had increased to 172.9 million (NCC, 2019). Additionally, some Gulf states such as Qatar, Saudi Arabia and UAE, which have been described as rentier states, have nevertheless been able to produce high-performing, market-oriented state-owned enterprises (SOEs) when they were expected to produce weak, bloated and dysfunctional SOEs characterised by white elephant investments (Hertog, 2010). Some industrial policies are successful, others like Nigeria's on-grid RE procurement programme are not.

This chapter answers Research Question 3: what are the political economic conditions that must emerge to successfully implement the government's policy to drive on-grid RE investments in Nigeria? The chapter argues that on the one hand, the on-grid RE procurement programme can be successful if it does not come at an excessive social cost to the ruling political elite and if a politically insulated *pocket of efficiency* is created for the RE procurement programme implementation team. In addition, the government and the on-grid RE investors must establish *mutual interest* to push the government policy through; and finally, the project developers must be incentivised to earn and implement *learning rents* – policy-generated rent given to capitalists to improve productivity. On the other hand, the expected outcomes of the wider NESI liberalisation reforms can materialize if a *pocket of efficiency* is created for the regulator, which would enable it to regulate effectively. Unlike the telecoms sector reforms, both the liberalisation reform in the NESI and the subsequent on-grid RE procurement programme were not implemented under the critical enabling political-economic conditions.

This argument begs a deeper question: what factors determine the emergence of these enabling political-economic conditions for certain industrial policies and not for others? This chapter employs the causal mechanisms proposed in the Politics of Industrial Policy (PoIP) Framework to answer the deeper question, showing how the distribution of organisational power in Nigeria determined the emergence of enabling political-economic conditions for industrial policy in the telecoms sector and their absence in the NESI.

While insights from the RST shed light on the political-economic constraints to on-grid RE investments and the wider NESI liberalisation reforms, the PoIP shows how certain policies can be successful despite Nigeria's political configuration. It explains the variation in outcomes with industrial policy in the telecoms sector and NESI.

This chapter will show that Nigeria's status as a rentier state does not doom it to perpetual industrial policy failure. It shows that industrial policy was successful in the telecoms sector despite vested interests. It also provides evidence to show that success in the telecoms sector cannot simply be explained by insufficiently powerful vested interests. Indeed, it shows the telecoms reform policy overcame a false start to become one of Nigeria's most important success stories. This chapter also provides insights into the power of ideas in minimising political constraints and rendering vested interests ephemeral to stimulate specific economic activities in productive sectors.

It is important here to re-state that there is a clear line that separates the NESI from Nigeria's oil and gas sector. While the one produces inputs for the other, they have different incentives. It is critical to re-state this distinction because the gas-fired generation companies in the NESI and the gas producers in the oil and gas sector are not one and the same, and they face different incentives as was explained in detail in Section 2.2.3.1. The oil and gas sector is a major rent generating activity for the Nigerian government, while the NESI is a source of rent distribution like the telecoms sector used to be before it was liberalised.

A comparative method was used in this chapter to compare the implementation of industrial policies in the telecoms and electricity sectors in Nigeria. The findings show that three critical political-economic conditions emerged during the successful telecoms sector reforms. However, these political-economic conditions have not emerged within the Nigerian government's on-grid RE procurement programme nor have they emerged within the wider liberalisation reforms of the NESI.

5.1.1.1 Chapter structure

This chapter proceeds as follows. Section 5.2 presents the PoIP conceptual framework, while Section 5.3 describes the methodology used in this chapter. The findings are presented in two sections. The first section presents an analysis of the evolution of the political settlement in Nigeria's Fourth Republic (Section 5.4), and the second section analyses how industrial policies in the telecoms and electricity sectors were implemented in Section 5.5. The findings are discussed in Section 5.6 and the conclusion of this chapter is presented in Section 5.7.

5.2 Conceptual Framework

This chapter aims to understand what is required to successfully promote on-grid RE investments in Nigeria. It argues that the failure of three political-economic conditions to emerge simultaneously in the NESI has resulted in the failure of both the NESI liberalisation reforms and on-grid RE procurement programme in Nigeria. This section describes the PoIP Framework, which is used in this chapter to analyse government interventions in the NESI and telecoms sector. The success of industrial policy is the adoption of new technology and knowledge to grow and improve productivity in a targeted sector (Khan, 2013). In the telecoms sector in Nigeria, a successful industrial policy means an increase in access to telecommunication and a reduction in telecommunication costs according to FGN targets, whilst in the Nigerian on-grid RE sector, success means the deployment of clean RE technologies on the grid in Nigeria according to FGN targets.

The PoIP Framework is a comparative framework that was developed to understand the conditions under which industrial policies are successfully implemented and the politics that make it possible. This framework was built on two underlying theories (Whitfield, 2015). The first is the theory of successful industrial policy, which argues that for an industrial policy to be successfully implemented, three conditions must emerge; *mutual interests*, *pockets of efficiency*, and *learning for productivity*. The second is the political settlement theory, which explains how the distribution of political power among ruling elite (or politicians) and capitalist firms (or businesses in the targeted sector) affect the development and implementation of industrial policy.

5.2.1 The Theory of Successful Industrial Policy

Industrial policy is a government tool for addressing important constraints affecting technology adoption, and at the same time, it is an intervention that inevitably creates new sources of incomes or rents (M. H. Khan, 2013b) – rents being the above-average profits made by firms as a result of industrial policy.

The theory of successful industrial policy states that there are three conditions necessary for a successful industrial policy; *mutual interests, pockets of efficiency*, and *learning for productivity*. These three interdependent conditions are necessary because they reduce investment risks, increase time horizons, control rent-seeking, and enforce resource allocations and institutional shifts – all of which are essential for industrial policy to succeed. These conditions were presented by Whitfield et al. (2015) as a triangle with three legs. The three conditions are how the three legs interact with each other. The three legs are the ruling elites, state bureaucrats (or civil servants), and capitalist firms as shown in Figure 5.1.

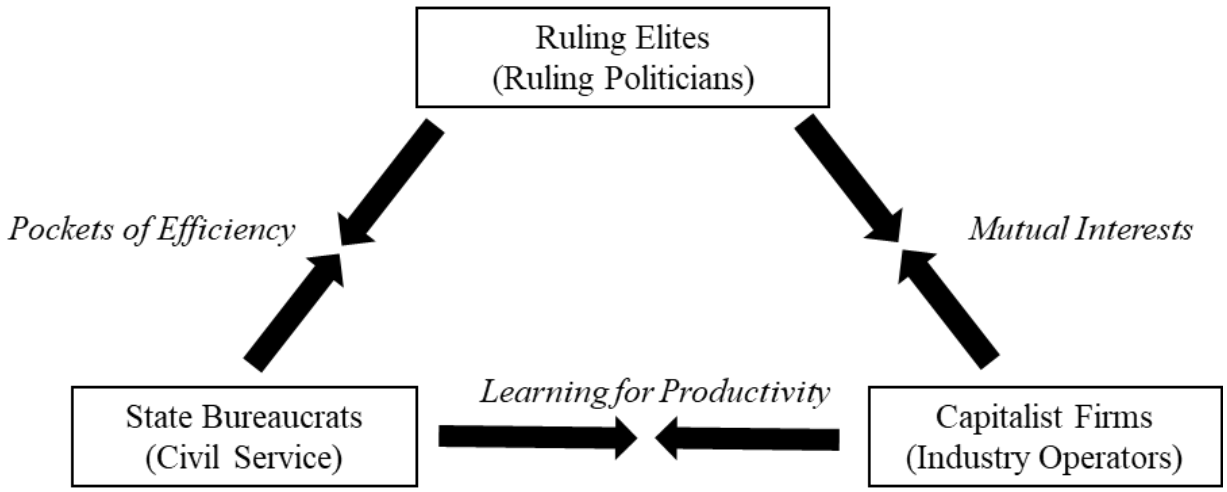

Figure 5.1: Model of the Conditions for Successful Industrial Policy.

Source: (Whitfield et al., 2015)

5.2.1.1 Definition of Dependent Variables

Pockets of Efficiency

The *pockets of efficiency* condition for successful industrial policy states that the state bureaucracy does not need to have strong capabilities across the entire bureaucracy, nor is it possible. It argues that the ruling elites need to create *pockets of efficiency* within the bureaucracy with strong capabilities in charge of industrial policy. These pockets must be shielded from political pressure from members of the ruling coalition and must hold a significant amount of autonomy. This means that the ruling elite proposing an industrial policy must be able to exert control over factional demands within the ruling coalition to shift resource allocation, change institutions, and overcome resistance to the policy. These significantly autonomous *pockets* within the bureaucracy who are politically insulated by the ruling elite must also be knowledgeable about the targeted industry in order to create *efficiency* and increase productivity.

In Nigeria, *pockets of efficiency* are essential because attempts to redistribute rent and institutional powers are usually met with resistance by those who enjoy the existing rents and institutional powers. Political elites can infiltrate critical units in the bureaucracy (Usman, 2020) to maintain the distribution of existing rents and institutional powers or influence the distribution of new ones. In the telecoms sector and NESI, ruling elites need to protect the regulator and critical state-owned industry actors from political elites within and outside the ruling coalition through the creation of *pockets of efficiency,* so that the bureaucracy can withstand the pressures of factional political demands.

Mutual Interests

Firms need predictability of government action to secure their investments. They need assurances that government commitments to a certain policy will remain to protect their investments. Whitfield et al. (2015) state that for this predictability and assurances to exist, there must be close relations between the political elite and capitalists. This close relationship, they argue, can only exist if political elites and capitalists have *mutual interests*. Mutual interest is what motivates political elites to pursue industrial policy.

The *mutual interest* between firms and political elites can be enabled by the rent sought by firms and the interest of political elites. For on-grid RE investments, the rent from the Feed-in-Tariff and the FGN's goal to diversify the electricity supply sources appeared to enable mutual interest when the on-grid RE procurement programme began – but it did not as explained in Section 5.5.2. In the telecoms sector, the FGN's interest in reducing the state's fiscal burdens and raising funds from Global System for Mobile Communications (GSM) license auction sales (Usman, 2018) and the GSM firms' interest in obtaining rents from the exclusivity of the GSM license creates a mutual interest in liberalising the telecoms sector (Usman, 2018).

However, not all *mutual interests* between political elites and capitalists result in successful industrial policy. The interests of different capitalists within a sector do sometimes conflict as in the case of on-grid RE capitalists and off-grid RE capitalists. The FGN's focus on off-grid RE projects has been to the detriment of on-grid RE project developers and all on-grid utilities as a whole. Policies in favour off-grid RE capitalists, who develop off-grid RE projects in urban areas that are already connect to the grid, may affect the customer profile of capitalists operating on the existing grid. Off-gird developers are likely to target creditworthy consumers. Taking credit-worthy consumers off the grid has a strong potential to worsen the liquidity crisis on the grid.

Additionally, the emergence of *mutual interests* between politically influential capitalists and politicians can cause an unproductive loop of rent-seeking. Whitfield et al (20150 argues that this can happen when capitalists, who earn policy-generated rents promote directly or indirectly the illegitimate interests of political elites in return for more rents.

Learning for Productivity

A third condition, therefore, is required to ensure that rents given to capitalists are used to learn and improve productivity. According to Whitfield et al. (2015), this condition refers to several conditions that must emerge between the state bureaucracy and capitalist firms. First, the state bureaucracy must be embedded in their targeted sectors. They are embedded when they have institutionalised relations with the industrial capitalists. This close relation will enable the bureaucracy to collect and possess information and key practical learning from the industry to develop a vision for the sector. The nature and extent of embedment shape the vision of the bureaucrats. Second, bureaucrats need to be able to mediate between the economic concerns of capitalists and the diverse political concerns relating to the priority of government. They must have the skills to manage desired government objectives while incentivising investment from capitalists. Finally, bureaucrats must have the political backing and political connections to enforce policies that make capitalists use rents to invest in learning and upgrading the operations of the industry. Hence, policy-generated rent must be linked to increased productivity.

As will be explained in Section 5.5.1, the presence of learning for productivity in the telecoms sector made it possible for the reforms to sustain its successes. In addition, the sustained success in the telecoms sector has made it more difficult for the growth trajectory of the firms to be derailed by political interference. In the NESI, the *learning for productivity* condition has not been given a chance to emerge. As explained in Chapter 4, the liquidity crisis prevents the NESI operators from collecting their learning rent.

Whitfield et al (2015) argue that politically influential firms can avoid using rents for learning by applying pressure on the bureaucracy through political elites. In the NESI and telecoms sector, industry operators need to upgrade the electricity supply infrastructure with rents given to them by the FGN. Figure 5.1 clearly delineates the political elites, capitalists, and bureaucracy. However, the actors in these roles play more than one role in reality, and some others change roles over time (Whitfield et al, 2015). The PoIP recognises these blurred lines but maintains that for any industrial policy to be successful, the three conditions or dynamics between the actors within those roles must emerge before that policy can be successful. For example, a capitalist, who doubles as political elite, still needs to fulfil the learning for productivity requirement by using rents to improve productivity.

How do the three conditions for successful industrial policy – *mutual interest, pockets of efficency* and *learning for productivity* – emerge? Whitfield et al (2015) use Khan's political settlement theory to explain.

5.2.2 Political Settlements Theory

Political settlement is the relative distribution of organisational power across a society that is reproducible over time and has the potential to change (Khan, 1995; Khan and Jomo, 2000; Khan, 2010). Political settlements theory emphasises how the distribution of political power in a society shapes the way in which ruling elites can implement industrial policies, which affect the distribution of economic benefits in society.

Whitfield et al. (2015) elaborate on the political settlement theory by breaking down the concept of ‘organisation of the ruling coalition’ which they refer to as the ‘distribution of power within and outside the ruling coalition’ into two variables: the degree of vulnerability, and the degree of contestation. They also break down the concept of the ‘ruling coalition’s relationship with the productive sector’ into two variables: the degree of political influence of capitalists and degree of technological capabilities of capitalists. These four variables are the independent variables that determine the emergence of the three conditions for successful industrial policy. The causal mechanics developed by Whitfield et al. (2015) in Figure 5.2 and Figure 5.3links Khan's political settlement theory to the three conditions in the theory of successful indutrial policy.

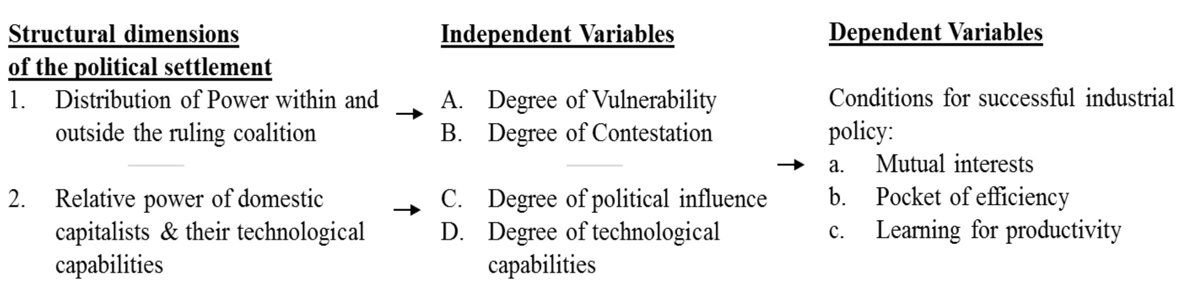

Figure 5.2: Model of the Elaborated Political Settlements Theory.

Source: (Whitfield et al., 2015)

5.2.2.1 Definition of Independent Variables

Degree of vulnerability

The degree of vulnerability refers to the distribution of power outside of the ruling coalition. Khan (2010) argues that the relative strength of organisational power outside the ruling elite is the key factor explaining why some ruling coalitions can make long-term policy plans in a targeted industry, but others cannot. He argues that a high degree of vulnerability results in ruling elites focusing on immediate political survival. A high degree of vulnerability may also mean that institutional change through industrial policies come at a high political cost (Whitfield et al., 2015). This is especially important in competitive clientelist states like Ghana where competition among political factions is fierce (Whitfield, 2018). Whitfield et al. (2015) also suggest that a high degree of vulnerability makes it difficult to *create pockets of efficiency* because the ruling coalition is not powerful enough to politically insulate *pockets of efficiency* within the bureaucracy. However, they argue that whist the degree of vulnerability is a key factor that affects the successful implementation of industrial policy, it is not more important than the degree of contestation within the ruling coalition.

Degree of Contestation

Ruling coalitions are constructed by ruling elites. However, they do not construct coalitions under the conditions of their own choosing (Whitfield et al., 2015). Ruling coalitions are made up of social groups with factional organisational powers with varying interests. The distribution of organisational power among the factions within the ruling coalitions also serves as a causal factor to determines why some industrial policies are successful. The lower the degree of contestation within the ruling coalition, the easier it is to create *pockets of efficiencies* that are politically insulated from ruling elites within the ruling political coalition. It is however important to note, as Whitfield (2018) explains, that it can be difficult to distinguish between vulnerability and contestation in competitive clientelist states, where political coalitions are can change composition frequently.

Degree of Political Influence

The degree of political influence refers to the ability of capitalist firms to protect or further their interest through a political process that matters (Khan, 2010). Whitfield et al (2015) state that the degree of influence of capitalists is a key variable in the emergence of both mutual interests and learning for productivity. They argue that the higher the political influence of capitalists the better the chance for *mutual interest* to emerge. However, they argue that if the degree of political influence of relevant capitalists is high, but the degree of contestation within the ruling coalition is high, *mutual interest* may not easily emerge as contestation between competing factions within the ruling coalition can inhibit industrial policies that they do not benefit from.

Additionally, they argue that capitalists need a high degree of political influence for *mutual interest* to emerge, however, not too high. If capitalists become too powerful, then they are less likely to use rents to enter riskier productive investments because they cannot be compelled to invest rents in *learning for productivity*. This is especially true when the capitalist do not think additional learning will make them significantly more competitive. The framework suggests that for industrial policies to succeed capitalists must have high political influence tempered by mutual dependence between ruling elites and capitalists. Despite the contradictory effects of a high degree of political influence, a worse scenario is a low degree of political influence which prevents *mutual interest* from emerging at all.

Degree of Technological Capabilities

The degree of technological capabilities of capitalists can be assessed by considering the average capacity in the targeted sector relative to their competitors in other countries. Whitfield et al (2015) argue that firms with high degrees of capabilities are more likely to achieve global competitiveness, and thus are incentivised to use rent in improving productivity because this this will allow them to sustain or increase profits in large markets. In contrast, firms with low degrees of technology capabilities are more likely to use rents unproductively or use rent to sustain existing levels of productivity because they have no reasonable chance of reaching global competitiveness. This makes them unlikely to use rents to engage in learning for productive.

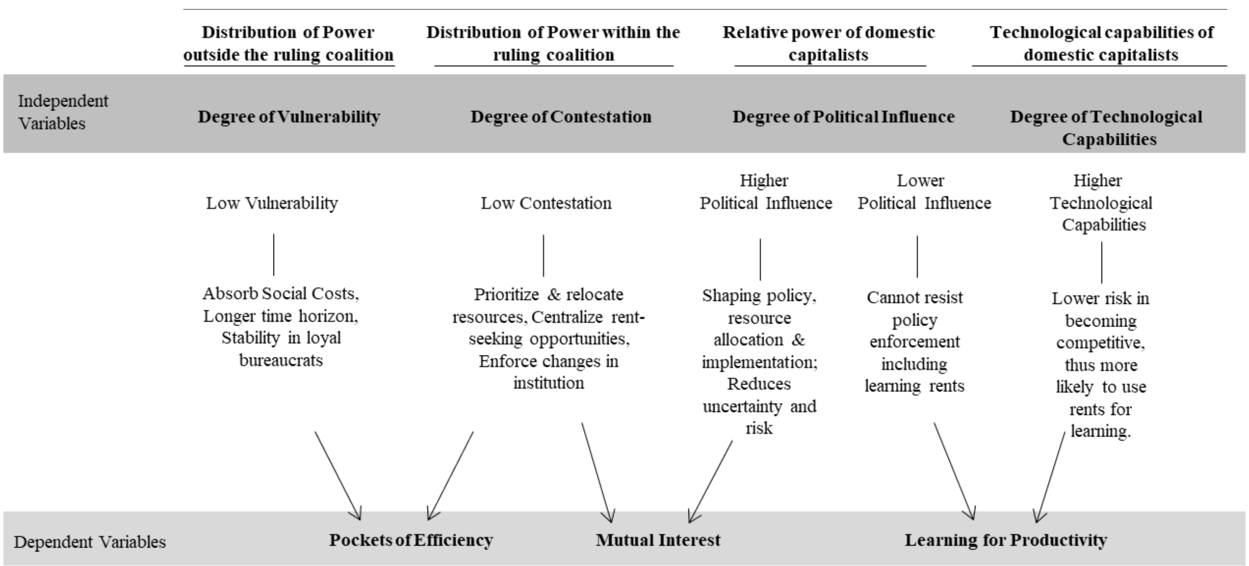

Figure 5.3: Causal Mechanisms Explaining the Conditions for Successful Industrial Policy

Source: (Whitfield et al., 2015)

5.3 Methodology

This section presents the methodology used in this chapter. It explains the methods used, including process tracing, and justifies the key decisions made in designing and conducting the research that underpins the chapter. Two major decisions were made. First – the decision to use a comparative case study and qualitative approach. Second and critically – the decision to select the Nigerian telecoms sector liberalisation reforms as the comparative case. This section justifies both decisions in the subsequent subsections before proceeding to present the process-tracing method used to conduct the research in this chapter.

5.3.1 Case Study Approach

A case study is useful for understanding complex social cases. They can be defined as an in-depth "empirical inquiry that investigates a phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (Kaarbo and Beasely, 1999). Case studies present a detailed examination of a historical event to develop, test, or demonstrate an explanation that may be generalizable to other events (George and Bennett, 2014).

As with Research Question 2, the primary justification for using a case study approach in this chapter was the nature of Research Question 3, which requires in-depth analyses of the conditions for successful government intervention in the context of the Nigerian political landscape. As George and Bennett (2014) argue, many of the elements of observation that interest researchers in the political economy literature are not easily measurable and tend to benefit from a case study approach. They illustrated this with an example in which a researcher seeks to determine whether a process was "democratic". As they argue, a democratic process would have different meanings in different national contexts. An in-depth analysis into the national political contexts would be required to understand whether the process was democratic or not.

Another justification for the case study approach is that it helps to provide what George and Bennett (2014) called "conceptual validity" – the case study approach helped to analyse in detail the intricate causal mechanisms proposed in the PoIP framework. The case study approach in this chapter helped to explore and produce a demonstration of the causal mechanisms proposed in the PoIP framework using cases to which the PoIP had not been previously applied. The validity it brings to the PoIP framework is what Gerring (2011) refers to as *internal*. It lends validity to the PoIP framework internally within the context of the cases selected. Unlike cross-case studies, which involve many cases, a case study with several cases is weaker at lending validity *externally* to unselected cases. Case studies make up for their limited power for generalisation by providing deeper insights into cases that have not been previously studied. The case study approach in this chapter provides deep insights for Research Question 3 and provides corroborative evidence for the causal mechanisms proposed in the PoIP framework.

The case study approach provides the opportunity to conduct an in-depth analysis of the politics of industrial policies in Nigeria. As required by the PoIP, which helps to analyse policy implementation, the unit of analysis for the case studies in this chapter is sector-specific government policy.

This chapter also uses a comparative approach by comparing two cases of industrial policies that contrast in outcomes. It compares industrial policy in the telecoms sector to industrial policy in the NESI. This comparison was done because the industrial policy success in the telecoms sector in Nigeria provides lessons for government intervention in the NESI. The comparative method helped to explain the variation in policy outcomes in the telecoms and sector and NESI.

The comparative method in this chapter is also important as it contributes to the literature on industrial policy in Africa by demonstrating the causal mechanisms proposed in the PoIP framework using multi case studies that have not been used in the past.

5.3.2 Qualitative Research Approach

In addition to the case study approach, this chapter also uses a qualitative approach because of the nature of the variables or elements of observations in the PoIP framework.

The variables in the PoIP framework such as the *degree of vulnerability* of the ruling political coalition are best described through qualitative narratives (Whitfield, 2015). As Gerring (2017) argues, qualitative research is important where the elements of observation are non-comparable. For example, the *degree of political influence of capitalists* in the cases analysed in this chapter cannot be directly compared quantitatively to sufficiently answer the research question in this chapter. The *political influence of capitalists* can be observed with evidence that is case-specific. In the telecoms sector, it can be observed through accessibility to state-owned capital, while in the NESI, it can be observed through access to government contracts. While no qualitative data is immune from quantification, quantification can limit the contextual insights, which is especially important in case studies generally (Gerring, 2017) and for Research Question 3 specifically. Furthermore, qualitative measurements of concepts can shed more light than quantitative data especially when there is detailed knowledge on the case and the elements of observation (Adcock & Collier, 2001). The elements of observation in this chapter were observed using primary and secondary qualitative data that indicate the degree and nature of the variables. To link the independent and dependent variables, this chapter uses primary and secondary qualitative data to reconstruct a qualitative analysis of the histories of specific government interventions in the telecoms sector and NESI within the context of the political landscape.

5.3.3 Case Selection

After deciding to use qualitative and comparative case study approaches to answer Research Question 3, one major decision made was the selection of the telecoms sector reforms as the comparator case for the policy failures in the NESI. The aim of selecting the telecoms sector was to explain a variation in outcome using the propositions in the PoIP framework. As the primary case in focus is the government's failed intervention in the NESI, the aim was to select a comparator policy intervention that was successful.

Poor case selection is a recurrent trade off in case study research but, it is not an inherent limitation (George and Bennet, 2014). While in statistical studies, researchers are admonished not to select cases based on the dependent variables or outcome, case study researchers can sometimes deliberately choose cases based on their outcome (George and Bennett, 2014). In statistical studies selecting cases based on the outcome can underestimate the strength of the relationship between the independent and dependent variables (Collier and Mahoney, 1996). However, case study research, which includes deep insights into the case can help to examine, which independent variables are not necessary or sufficient conditions for the selected outcome (George and Bennett, 2014). For the causal mechanisms that have already been developed, such as those presented in the PoIP framework, cases selected based on varying dependent variables or outcomes can help to test or demonstrate the causal mechanisms (Dion, 2003). This was a major selection criterion for the comparator case in this chapter – a comparator case that had a different outcome from the government's intervention in the NESI.

The telecoms sector reform fulfils this criterion because it was considered a success compared to the government's NESI intervention (Usman, 2018; Okonjo-Iweala, 2007). An important critique of selecting cases based on their outcome is that it requires the researcher to have foreknowledge of the nature of the dependent variables in the case. Some argue that the researcher's foreknowledge of the cases has the potential to induce case selection bias, selecting those cases which appear to fit the casual mechanisms that they intend to develop, test, or demonstrate (Keohane and Verba, 1994). However, George and Bennett (2014) argue that selection with some preliminary knowledge allows for stronger research designs. They argue that prior knowledge of the cases allows researchers to select cases that either seem to align or misalign with the theory, "making the process-tracing test of a theory more severe." In addition, they argue that selecting cases with prior knowledge can benefit from exiting literature about the case. Finally and critically, they argue that researcher-induced bias in case selection or study can be safeguarded against with methodological tools such as process-tracing, which was used in this chapter (Section 5.3.4).

There were two options considered in selecting a comparator case that had a different outcome from the NESI interventions. The first option was a cross-sector, within-country comparison. This option involves selecting two different sectors in the same national context for comparison as was done in this chapter. The second option is a single-sector, cross-country comparison. This involves choosing policy cases in the same sector across different national contexts – comparing successful on-grid RE interventions in another country to the failed intervention in the NESI. Both approaches have their merits and demerits and are discussed in the subsequent subsections. It is important to note that while, neither approach fully controls for all conditions outside the elements of observation, process-tracing, which was used in this chapter, offers an important means of validating causal inferences (George and Bennett, 2014). Process-tracing helps to assess the causal significance of independent variables in cases that may not be perfectly matched.

5.3.3.1 Cross Sector, Within-Country Comparison

This chapter aims to provide lessons learned from a political perspective. As such, a cross sector, within-country comparison is important for two reasons.

First, comparing two different sectors has the power to highlight sector-specific factors that play key causal roles within the political dynamics of a country (Bartle, 2002). In the same national context, there can exist significant sector-specific influences that have the power to shed more light on the PoIP framework. Using a single-sector comparison approach presents the risk of missing these sector-specific influences. As Whitfield (2018) argues, political settlements – the distribution of power in society – are not monolithic and have to be further nuanced in terms of how they play out at the sector level. She argues that the same political settlement in a country can lead to reforms in one sector and not another, due not only to the economic interests of ruling elites and the alliances that they make, but also to the different configurations of capitalists at the sector level and how social interests can be mobilised or not in relation to the short-term political costs or benefits of reforms in particular sectors. One such example that is highlighted later in this chapter is the importance of the NESI as a source of rent distribution, compared to the telecoms sector. This is especially important in a rentier state like Nigeria, where opposition to rent redistribution that affect citizens can have significant effects on policy due to the rentier mentality of citizens.

The rentier mentality may have significantly more influence in the NESI than in the telecoms sector, which was not as significant a form of rent distribution to citizens compared to the NESI. The varying degree of opposition to rent redistribution in each sector is likely to have varying effects on the nature of political contestation around the policy. It is important to highlight those sector-specific factors to answer the research question and to shed more light on the PoIP framework. It is, however, important to note that the success in the telecoms sector cannot simply be explained by insufficiently powerful political or vested interests. Indeed, this chapter shows how the telecoms sector had a false start even with its relatively lower degree of political resistance compared to the NESI reforms. Interests are important, but they are not the all-determining factor. The power of the policy idea, as Rodrik (2014) argues, is just as important as we illustrate in the analysis of the telecoms sector (Section 5.4.2).

The second reason for using a cross-sector within-country comparison is as follows. It helps to zoom in on the political configuration of the focus country and understand the political realities in which policies are being implemented. This avoids the risk of wrongly assuming techno-economic factors primacy (Bartle, 2002) in the success of industrial policy. As Bartle (2002) argued, the primacy of techno-economic factors cannot be argued conclusively until a comparison with another sector is conducted. A significant number of the energy transition literature appear to point to techno-economic factors such as energy costs trends (Brini et al, 2017, Foster et al, 2017), technology improvement (Taghizadeh-Hesary and Rasoulinezhad, 2020), and market incentives (Fell, 2017; Kilinc-Ata, 2016) as prime factors for energy transition. As this chapter shows, there are other key factors in the political dynamics that determine the emergence of the conditions for successful government intervention in the drive for energy transition.

One might argue that a down-side of conducting a cross-sector comparison is that it misses out on the opportunity to learn sector-specific lessons from other national contexts. However, the fundamental point that underpins Khan's (2010) development of political settlement theory, especially as it relates the design of industrial policy, is that policy lessons cannot simply be transferred from one country to another because the political configurations that make it possible in one country can differ across countries. One might argue that rentier state features are sufficient to control for the political configurations in a cross-country comparison, but the limitation of that approach is discussed in the following section (Section 5.3.2.2).

Nevertheless, it is important to note that specific policy instruments from other national contexts might be adopted and reshaped to fit the political configurations in another country. The key determining feature however still remains the country-specific political settlement and how it plays out at the sector level. The cross-sector comparison in this chapter provides the opportunity to zoom into the national context and assess the role of sector-specific factors versus non-sector specific factors that influence the emergence of the conditions necessary for successful industrial policy. It also enables for some control of the political configuration in the two selected cases.

5.3.3.2 Single-Sector, Cross Country Comparison

Another option for selecting the comparator case is to use a single-sector, cross-country comparison. This approach would involve comparing the government intervention in the NESI with a successful government intervention in the RE sector in another country. The chief benefit of this approach is to draw on lessons learned from the on-grid RE success stories in another country. However, as mentioned earlier: while specific policy instruments from other national contexts might be adopted and reshaped to fit the political configurations in another country, policy lessons cannot simply be transferred from one country to another because the political configurations that make it possible in one country varies across countries.

Also, one might argue that since the institutionalised subsidies in the NESI might have been a more significant means of rent redistribution than subsidies in the telecoms sector, the different degrees of opposition to rent redistribution in NESI and telecoms sectors due to the rentier mentality, makes the policy cases in both sectors incomparable – the author argues otherwise, and the key reason can be found in the theoretical foundations of the PoIP framework.

The theoretical foundation of the PoIP framework agrees with the RST's dynamics about opposition to rent distribution or economic benefits. Just like the RST explains the rentier state's challenge of the rentier mentality, the PoIP framework explains the unwillingness of political elite to absorb the social costs of removing institutionalised benefits due to the degree of vulnerability of the ruling coalition. However, the PoIP framework goes further. It explains how contestation within the ruling coalition can also inhibit industrial policy, which redistributes rent. The degree of contestation over rent redistribution in the PoIP is not limited to oil rents or natural resource rent. Additionally, the PoIP has two extra causal variables – degree of technological capacity and degree of political influence of capitalists firms, which are crucial to creating *mutual interest* and *learning for productivity* – additional elements of observation that the RST does not recognise. More so, the PoIP also presents a clear set of causal mechanisms that not only explains policy failure, but also explains policy success. These additional elements of observations and the causal mechanisms are exactly the reasons why a single-sector cross-country analysis ais not critical. The PoIP recognises that while political configurations are key to understanding why polices do not fail but they are unique and vary across countries. Khan's (2010) key argument is that the political settlement needs to be understood in other to effectively design and implement industrial policy. The within-country analysis helps to zoom in closer to the national political context.

Nonetheless, if one were to accept that sector-specific lessons learned is a critical factor in selecting the comparative case, then one would be inclined to use the single-sector, cross-country comparison. However, one would need to control for the political-economic configuration in both cases to avoid missing those exogenous factors that could influence the causal dynamics in the PoIP. To control for the political configuration in two cases that represent a single sector across two different national contexts, one might again suggest that the critical political configuration in the comparator case should be the presence of rentier state dynamics similar to the way it is in Nigeria. This is especially because the generation of oil and gas rents are sometimes tied to the inhibition of on-grid energy transition (Tagliapietra, 2019; Fontaine et al, 2019; Osunmuyiwa, 2018). This is not the case in on-grid sector in Nigeria. One might, nevertheless, argue that comparing industrial policies in the on-grid RE sector in two rentier states might control for the political configuration in the two cases. However, as the next paragraph proceeds, it becomes clear that diverse dynamics are observed across rentier states.

As Hertog (2010) argues, some rentier states such as the gulf states stand in stark contrast to other resource-rich states such as Nigeria, Angola and Venezuela. He argues that *populist rentier regimes* and *non-populist rentier regimes* can be placed into different categories. He argued that the non-populist rentier regimes in the Gulf states kept decision making in key sectors to a small minority of politically insulated state agencies. As an example, Hertog (2010) and Jaffe and Elass (2007) explain how Saudi King Fahd, in the 1980s, protected the management of the newly nationalised Aramco against a takeover by the inefficient oil bureaucracy. Hertog (2010) argued that the decisional autonomy of the regime leadership in countries like Saudi Arabia enables them to create insulated pockets of efficiency within the bureaucracy (Hertog, 2010). Hertog (2010) argues that the combination of non-populist politics and a high degree of regime autonomy sets the gulf rentier states apart from other rentier states like Nigeria, where that autonomy does not exist.

Additionally, the significantly different rent-to-population ratio in gulf countries compared to countries like Nigeria can show explain why rentier states like Nigeria may not produce regime autonomy. As Gray (2011) argues, a drop in oil rent per capita can constrain traditional rentier contracts. As such, simply selecting a rentier state as the comparator case would not sufficiently control for the political configuration in the two cases.

In this case, one might select a rentier state in Sub-Saharan Africa (SSA), which has had success with on-grid RE investments as the comparator case. Atta Mills (2018) argues that Ghana is fast becoming a rentier state rentier state, but Yates (2015) by omission does not consider Ghana a rentier states when he presents a list qualifying African rentier states.

In parallel, Whitfield et al (2015) argue that the defining political configuration in many SSA states that makes the PoIP framework applicable to them is that they had small and weak capitalists at independence. They argue that all other developing regions had strong capitalist firms to kick off their economic transformation – even if the capitalist firms were led by minorities, whom the political elite would have considered foreign. The issue of weak capitalists in newly independent African states was compounded by rivalling and struggling political coalitions, who controlled access to economic rent to maintain power. Where strong dominant parties emerged, the capitalists emerged from the political elite. Dominant parties create conducive environments for industrial policy because of the limited vertical and horizontal contestation for power (Khan, 2010) – they have longer time-horizons and enforcement capabilities required to implement industrial policies.

Conversely, in countries where competitive clientelism emerged, as it did in Nigeria, capitalists had to contend with power rotation among political elites because political elites are preoccupied with short-term considerations of maintaining power, doing their best to keep lower level pollical actors loyal to prevent them aligning with the political elites outside the ruling coalition.

Whitfield et al (2015) argue that these dynamics in African states, which Khan (2013) calls the political settlement or the distribution of power across society, determines whether the conditions required for successful industrial policy emerge. Additionally, the cross-sector within-country comparison allows for the control of two of the four political independent variables in the PoIP framework. Two of the four independent variables – degree of vulnerability and contestation – are controlled for in a within-country comparison. As was done in this chapter, the telecoms and NESI policy cases controlled for both independent variables, which showed presence of competitive clientelism in Nigeria. Ghana, like Nigeria, has competitive clientelist politics and can be used as a comparator country. It had weak capitalists at independence and developed a competitive clientelism political system where capitalists contend with power rotation among political elites (Whitfield, 2015). Even if one does not consider Ghana a rentier state, it still qualifies to be the national context for the comparator case. Thus, one might argue that comparing the on-grid RE polices implementation in Ghana to that of Nigeria could be important in drawing sector-specific lessons learned. However, as explained, policy lessons cannot simply be transferred from one country to another because the political configurations that make it possible in one country can differ across countries.

The cross-sector within-country comparison is better suited for the purpose of this research as it enabled the researcher zoom into the national context of Nigeria to answer Research Question 3 - understanding the political conditions required for successful industrial policy. This chapter compares government intervention in the NESI (liberalisation and on-grid RE procurement programme) to the liberalisation of the telecoms sector, which was selected as the comparator case.

5.3.4 Process-Tracing

This research used process-tracing to analyse and compare the propositions in the PoIP framework with the reality of events that unfolded during the implementation of the policy cases analysed in Section 5.4. It was also used it as a tool to mitigate any case selection bias, ensuring that the inferences drawn from the analysis in Section 5.4 and 5.5 can either corroborate, complement, or contradict the PoIP framework.

Process-tracing is “an analytic tool for drawing descriptive and causal inferences from diagnostic pieces of evidence—often understood as part of a temporal sequence of events or phenomena” (Collier, 2011). It can also be defined as the use of “histories, archival documents, interview transcripts, and other sources to see whether the causal process a theory hypothesizes or implies in a case is in fact evident in the sequence of events in that case” (George and Bennet, 2005). The process-tracing method allows researchers to develop, test, or demonstrate the causal processes that intervene between independent variables and dependent variables (Bennet and Checkle, 2015). The goal of the method is to go beyond correlations of independent and dependent variables and establish evidence for causality (Beach and Pedersen, 2013). It is especially important in this chapter to examine the causal processes that lead from the distribution of power in society to the emergence of the three political economic conditions necessary for industrial policies to be successful as proposed by the PoIP framework.

Process-tracing helps to identify a convergence of observable sequential events within cases that corroborate or contradict causal mechanisms proposed by theories. These observable events, which Bennet and Checkle (2015) refer to as “diagnostic evidence” intercede between independent and dependent variables, passing a causal effect from the former to the latter without altering it.

In this chapter, process-tracing was used to compare the analyses of the histories of select industrial policies in Nigeria to the causal mechanisms proposed in the PoIP framework. It helped to demonstrate deductively the causal mechanisms in the PoIP framework using industrial policy cases from Nigeria. However, the author was open to inductive insights due to the equifinality that process tracing forces. It forces researchers to consider equifinality in cases, recognising that there are many processes by which a given outcome could be achieved even with the same initial conditions (Bennett and Checkle, 2015). Considering equifinality in the process forces researchers to consider conditions outside the proposed set of causal mechanisms that may have been a contributing factor to the outcome. Observing contradictory, additional, or complementary factors can either help to reshape the proposed theory fundamentally or provide more insights about some of the causal mechanisms within the theory. In this chapter, the author used the MLP framework, a popularly used framework (Fischer and Newig, 2016; Tyfield, 2014), as the primary alternative explanation for each key event in the analysis of the failure of the on-grid RE procurement programme, recognising that the MLP might be able to provide an alternative to the failure of RE technologies to be diffused on the grid.

Some of the key feature of rentier states also play a complimentary role in the causal mechanisms proposed by PoIP for the cases selected. However, as Bennett and Checkle (2015) argue, while best-practice process-tracing strongly encourages openness to inductive insights, “Efficient” process-tracing promotes it only if causal mechanisms from theory failed to explain the case.

The chapter recognises that while process tracing presents a powerful tool for assessing the causal mechanism of a theory, it can be inconclusive as gaps may exist in the evidence. In such a situation, it does not negate the proposed mechanism, it only reduces the confidence levels of the proposed causal mechanism (Bennett and Checkle, 2015).

Following the process-tracing method, this chapter put together a narrative of a convergent series of observable events that resulted in an outcome. Data was generated and analysed to ascertain if those events provide evidence for the causal propositions in the PoIP framework. To do this, the narratives of those events were compiled and presented in terms of the elements of observation in the PoIP framework. An alternative approach is to present the narrative separately from the elements of observation and causal explanations, which would allow the narrative read well (Bennett and Checkle, 2015). It is, however, important in this chapter to use the former approach to make explicit the causal mechanisms that underpin the narrative.

The process-tracing method used in this chapter was operationalised using a 7-step approach proposed by Ricks and Liu (2018).

In Step 1, the author identified and selected the theories and causal mechanisms proposed in the PoIP framework as the primary theory to explain the government’s failed intervention in the NESI and success in the telecoms sector. The PoIP usefully comes with what Waldner (2015) refers to as a causal graph – a diagram that clearly highlights the framework's casual mechanisms. The author's foreknowledge of government's intervention in the NESI enabled the selection of the PoIP framework as a suitable theory. However, researcher-induced bias was checked using process-tracing.

In Step 2, the author established a timeline within which to investigate evidence of key events that may corroborate or contradict the PoIP framework propositions. To select the endpoint for a timeline, Ricks and Liu (2018) argue that a useful place to end the timeline is shortly after the dependent outcomes of interest have materialised. In the case of the telecoms sector, the timeline ends shortly after the liberalisation polices in the telecoms sector had shown evidence of all the three conditions necessary for successful industrial policy proposed by Whitfield et al (2015). In the telecoms policy case, the timeline ends in 2017 after a key event that showed evidence of learning for productivity. In the NESI policy cases, the timeline ends after it became apparent in 2017 that *mutual interests* – one of the conditions required for successful industrial policy – would not emerge.

Ricks and Liu (2018) however recognise that the challenge is to determine how far back the investigation should go to determine causality – what should be the starting point? Bennett and Checkle (2015) advice researchers to carefully consider a starting point to start investigating evidence of causal mechanisms. While they recognise that there is no universal answer for selecting starting point, they offer two options. First, they propose an option to start at a critical juncture (Bennett and Checkle, 2015) – a point "at which an institution or practice was contingent or open to alternative paths, and actors or exogenous events determined which path it would take." They argue that this can be useful when dealing theories of path dependency, which can lock institutions or agents to a path by a number of mechanisms. Bennett and Checkle (2015) also propose another starting point, when "a key actor or agent enters the scene or gains some material, ideational or informational capacity." They argue that this option can be effective especially when alternative theories propose causal mechanisms that depend on the motivations, knowledge, and capacities of agents and when particular agents behave differently from their predecessors. This chapter uses the second option, recognising that the emergence of President Olusegun Obasanjo in Nigeria's Fourth Republic ushered in a new wave of market-oriented reform ideas including in the telecoms and NESI. The beginning of the promotion of these ideas in 1999 serves a good place to start the investigation of the convergence of events that led the dependent outcomes in the cases selected.

In Step 3, the author used secondary data to develop what Waldner (2015) called an *event-history map* – a representation of the case-level events that either instantiate or contradict the causal graph in the PoIP framework. The event-history map mimics the causal graph, but the nodes in the former, represent events unlike the nodes in the latter which represent variables and causal effects. However, in addition to mimicking the causal graph, the event-history graph recognises events that may not necessarily fit the causal mechanism proposed and may have significant effects on the emergence of the dependent outcome.

In step 4, alternative paths were explored for key events, and each of these alternative paths were grounded in the propositions of the MLP framework.

In Step 5, for each key event, the author identified counterfactual outcomes for the alternative paths considered in Step 4 assuming the MLP dynamics were to hold.

In step 6, the author designed the data collection process, which included primary data collection and additional secondary data collection to provide descriptive inferences of the causal mechanisms in the PoIP framework (keeping in mind equifinality and the potential for inductive insights). However, as Ricks and Liu (2018) argue, not all evidence types are the same and not all evidence types are the same, and it should be recognised in the data collection and analysis process. While some data are necessary to establish causation, others are sufficient (Ricks and Liu, 2018). Ricks and Liu (2018) suggest Van Evera's (1997) four types of evidence, summarized in the Table 5.1.

Table 5.1: Types of Evidence for Process-Tracing. (Ricks and Liu, 2018)

		Sufficient for Affirming Causal Inference: No	Sufficient for Affirming Causal Inference: Yes
Necessary for Affirming Causal Inference	No	**1. Straw-in-the-Wind**	**3. Smoking Gun**
		a. Passing: Affirms relevance of hypothesis but does not confirm it.	**a. Passing:** Confirms hypothesis.
		b. Failing: Hypothesis is not eliminated but is slightly weakened.	**b. Failing:** Hypothesis is not eliminated but is somewhat weakened.
		c. Implications for rival hypothesis: Passing *slightly* weakens them. Failing *slightly* strengthens them.	**c. Implications for rival hypothesis:** Passing *substantially* weakens them. Failing *somewhat* strengthens them.
	Yes	**2. Hoops**	**4. Doubly Decisive**
		a. Passing: Affirms relevance of hypothesis but does not confirm it.	**a. Passing:** Confirms hypothesis and eliminates others.
		b. Failing: Eliminates hypothesis.	**b. Failing:** Eliminates hypothesis.
		c. Implications for rival hypothesis: Passing *somewhat* weakens them. Failing *somewhat* strengthens them.	**c. Implications for rival hypothesis:** Passing *eliminates* them. Failing *substantially* strengthens them.

As the PoIP framework proposes three conditions necessary for successful industrial policy, the evidence required are what Van Evera referred to as either "smoking gun" and "doubly decisive" as shown in Table 5.1. While both types of evidence are sufficient for affirming causal inference, the latter is also necessary for affirming causal inference.

In Step 7, the author considered other theories that provided complementary evidence to the PoIP framework. In this chapter, the RST complemented the PoIP by explaining the causal dynamics that underly the political contestation and vulnerability in Nigeria.

In sum, once the PoIP was selected as a suitable framework with which to analyse the policy failure in the on-grid RE sector, it followed that the independent and dependent variables within the framework would be effectively measured using qualitative analysis due to nature of the variables. As Whitfield et al. (2015) state, the distribution of power and influence in society is best captured in analytical narratives about the intertwined history of specific sectors and the history of the political landscape in the country. This chapter analyses the histories of the NESI and telecoms sector policy cases to show how the distribution and contestation for power affect the development and implementation of industrial policies.

This chapter relies on both secondary and primary data sources collected during fieldwork in Nigeria. Secondary accounts drawn from a diverse range of sources provided a solid basis to create an analysis of the political settlement in Nigeria. The sectoral analysis for the NESI was drawn from twenty semi-structured interviews with industry stakeholders and secondary literature. For the telecoms sector, the analytical narrative was drawn predominantly from secondary sources. Partly due to its success, there is a significant availability of secondary literature on the implementation of industrial policy in the telecoms sector to develop an analytical narrative using the PoIP framework. The categories of stakeholders interviewed for this chapter can be found in Table 5.2. The stakeholders were selected to provide insights into the dynamics between capitalists, bureaucrats, and political elites and how they shaped government intervention in the telecoms and power sector.

Table 5.2: List of stakeholders interviewed.

S/N	Category	Attribute	Location	Mode	Date
1	Capitalists - DisCo	DisCo executive	Nigeria	Face-to-face	05-Apr-18
2	Capitalists - DisCo	DisCo association	Abuja, Nigeria	Face-to-face	06-Jun-18
3	Capitalists - GenCo	Private Sector GenCo	Abuja, Nigeria	Face-to-face	13-Mar-18

S/N	Category	Attribute	Location	Mode	Date
4	Capitalists - GenCo	Private Sector GenCo Former NESI liberalization policy maker	Abuja, Nigeria	Face-to-face	24-Feb-18
5	Capitalists - GenCo	GenCo Association	Abuja, Nigeria	Face-to-face	31-May-18
6	Capitalists - Project developer	RE Project Developer	Abuja, Nigeria	Face-to-face	07-May-18
7	Capitalists - International development finance	International Development Financier	Abuja, Nigeria	Face-to-face	28-Apr-18
8	International Development/finance	International Development Practitioner	Abuja, Nigeria	Face-to-face	27-Apr-18
9	International Development/Finance	International Development financier	Abuja, Nigeria	Face-to-face	03-May-18
10	International Development/Finance	International development financier	Abidjan, Cote d'Ivoire	face-to-face	20-Nov-21
11	International Development/Finance	International development financier	Abidjan, Cote d'Ivoire	face-to-face	22-Nov-21
12	Bureaucrat - GenCo	State-owned GenCo Former state-owned electricity trader	Abuja, Nigeria	Face-to-face	26-Feb-18
13	Bureaucrat - Policy maker	Liberalisation Policy Maker (NESI & telecoms)	Abuja, Nigeria	Face-to-face	02-May-18
14	Bureaucrat - Regulator	Electricity sector regulator	Abuja, Nigeria	Face-to-face	06-Mar-18
15	Bureaucrat - Policy maker	Top NESI bureaucrat Policy maker Top RE policy maker Former PHCN staff	Abuja, Nigeria	Face-to-face	05-Jun-18
16	Bureaucrat - Policy maker	Policy maker	Abuja, Nigeria	Face-to-face	21-May-18
17	Bureaucrat - Policy maker	International development financier NESI Policy maker	Abuja, Nigeria	Group face-to-face	28-Apr-18
18	Bureaucrat – state-owned enterprise	Electricity trader	Abuja, Nigeria	Face-to-face	19-Feb-18
19	Bureaucrat - Transmission company	Retired PHCN Staff (Transmission)	Osun, Nigeria	Face-to-face	21-Oct-17
20	Bureaucrat - Transmission company	Transmission Company senior staff	Abuja, Nigeria	Face-to-face	21-Feb-18
21	Political elite	Top political elite (once inside the ruling political coalition & then outside the ruling coalition)	Abuja, Nigeria	Face-to-face	03-Dec-18

A theory-driven thematic analysis, based on the PoIP framework, was used to analyse the qualitative data collected. For the data analysis, nodes were created representing the nodes on the causal graph of the PoIP, and key insights form the data collected were mapped onto the nodes for which they provided corroborative, contradictory or complementary evidence.

5.3.5 Step-by-step breakdown of how the research in this chapter was conducted.

First, the author perused the literature to assess and identify a conceptual framework that is well suited to examine the conditions for successful implementation of industrial polices in Nigeria. The PoIP framework, which builds on Khan's (2013) political settlement theory, was selected as a framework for examining the conditions for change in productivity of economic sectors as justified in Chapter 2.

Second, after the PoIP framework was selected, it followed that the analysis in this chapter would take a qualitative approach due to the nature of the elements of observation in the PoIP framework. The elements of observation were best described using analytical narratives. A comparative approach was also chosen to use the lessons learned from the industrial policy success in the telecoms sector in Nigeria to strengthen government intervention in the NESI. Finally, the comparative method was chosen so that this chapter contributes to the literature on industrial policy in Africa by demonstrating the causal mechanisms proposed in the PoIP framework using multi-case studies that have not been used in the past.

Third, selecting a comparative method begged the question of case selection. As explained in Section 5.3.2, a cross-sector, within-country comparison enabled the author to zoom into the national context of Nigeria and identify and delineate both sector-specific factors and non-sector specific factors that influence the emergence of the conditions necessary for the success of industrial policies in countries like Nigeria. The author chose to compare policies in the telecoms sector and the NESI. The case unit in this chapter is industrial policy. The policy case selected from the telecoms sector is the government's liberalisation reform, while the policy cases from the NESI is the government's liberalisation reform and its on-grid RE procurement programme as shown in the Table 5.3.

Table 5.3: Policies cases compared in this chapter.

Policy cases	Comparator case
• Liberalisation of the NESI • Nigerian On-grid RE procurement programme	• Liberalisation of the Nigerian telecoms sector

Fourth, the author identified primary data sources to analyse the implementation of the policy cases. These sources were selected based on their ability to provide insights into the dynamics that played out between capitalists, bureaucrats, and political elites in the NESI reforms and procurement programme. The stakeholders included four categories, which included capitalist actors, bureaucratic actors, one political actor and international development/finance actors. The author's convening power was unable to convene more political elite interviewees. However, the political narrative was carefully constructed from secondary literature and primary data from other interviewees, who had extensive engagement with the political elites, especially the bureaucrats. The international development/finance actors played a dual role, which made them act at time as capitalists seeking to invest and other times as bureaucrats when they provided institutional support to bureaucrats to develop policy and regulations. At other times, they also imposed constraints on the political through policy-based lending programmes. A list of interviewees engaged for this chapter can be found on Table 5.2. The interviews were semi-structured, allowing the interviewees to lead the conversation to issues they considered important as it relates to the key dynamics that played put in the event-history map. It also involved building a rapport with the interviewees so that they could provide detailed insights that they would not otherwise disclose. As mentioned in the previous chapter, the interviewees, especially the political elite, bureaucrats and DFIs, at times asked for the voice recorder that was used for the interview to be switched off so that they could provide critical insights.

Fifth, the data collected was analysed qualitatively using themes that represent the independent and dependent elements of observation in the PoIP framework. The data also shed light on some of the themes found in the RST, including rentier mentality and active strategies of opposition to rent redistribution. It is important to note, however, that the active strategies of opposition to rent distribution did not play out between gas power generators and on-grid RE developers nor did they play out between gas producers and on-grid RE developers as explained in Chapter 2 and Chapter 4.

An analysis of the evolution of the political settlement in Nigeria from 1999 is presented in Section 5.4., while the sector-specific policy reform analysis are presented in Section 5.5.1 for the telecoms sector and Section 5.5.2 for the NESI.

In the next section, the evolution of the pollical settlement is presented.

5.4 Evolution of the Political settlement in Nigeria's Fourth Republic

5.4.1 Competitive Clientelism in Nigeria

After three decades of predominantly military rule that followed Nigeria's civil war, which ended in 1970, Nigeria inaugurated a democratically elected government on the 29th of May 1999. Since Nigeria's first national elections in 1959, political organisation was based on ethnicity (Olumide and Ekande, 2011). There were three significantly autonomous governing regions at independence in 1960; the Eastern Region with the Igbo as the ethnic and political majority; the Northern Region with the Hausa-Fulani as the ethnic and political majority; and the Western Region with the Yoruba as the ethnic and political majority (Diamond, 1983).

5.4.1.1 President Obasanjo and Political Contestation in the PDP, *1999-2007*

Ahead of the 1999 elections, the People's Democratic Party (PDP), which become the ruling politcal coalition in 1999, was formed as a coalition with a pan-Nigerian outlook in contrast to the other major preceding parties, which were usually organised around ethnic groups (Kendhammer, 2010). The key arrangement that held the PDP coalition is the 'Zoning Principle,' which was adopted by the party and is enshrined in Section 7 (2) (c) of the party's constitution (Kendhammer, 2010). The zoning principle is a power-sharing formula that dictates the equitable distribution and rotation of power amongst the six geo-political zones in Nigeria shown in Figure 5.4 (Cheeseman and Bertrand, 2019).

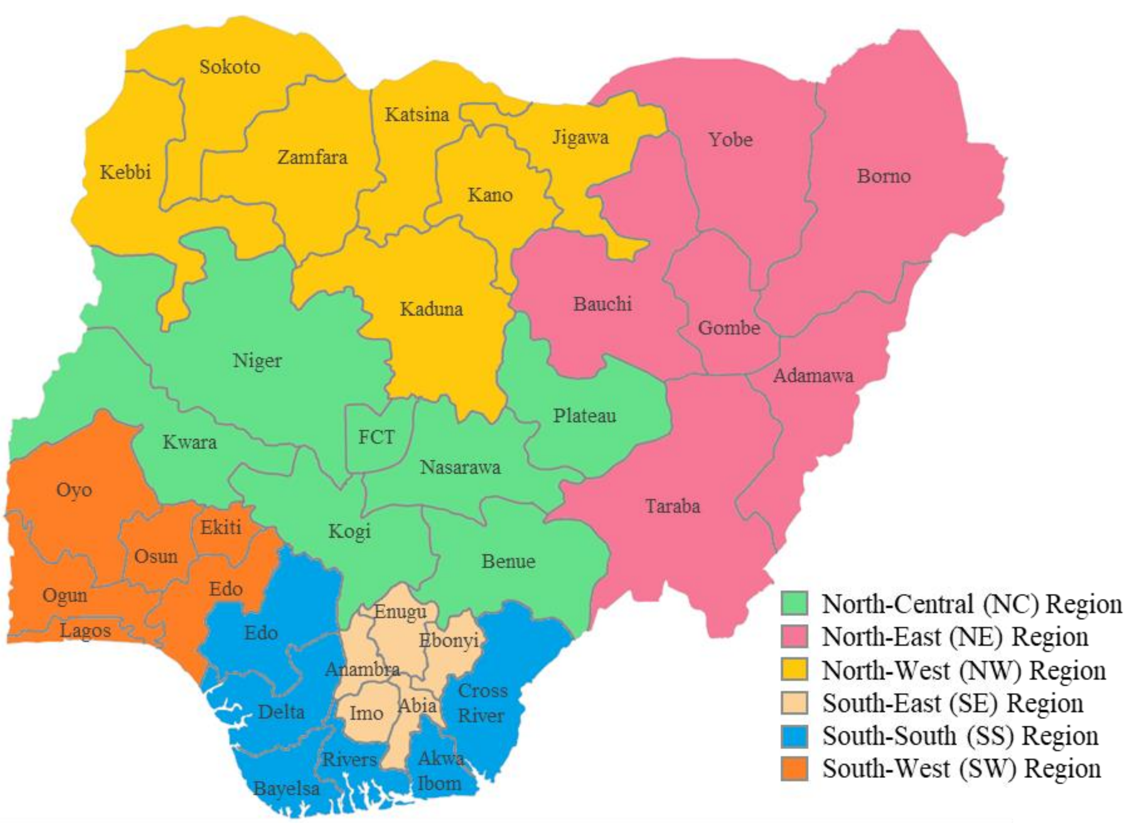

Figure 5.4: Six Geo-political zones in Nigeria's Fourth Republic.

Adapted from lanre (2017)

The six geopolitical zones are not recognised in the Nigerian constitution. The six zones were used by the PDP founders, who were pursuing the principle of equity, justice, and fairness (PDP Constitution, 1999). The PDP founders established a zoning arrangement to share and rotate the six great offices in Nigeria: President, Vice President, Senate President, House Speaker, Secretary to the Government of the Federation and Party Chairman in order of descending seniority[69]. Each zone would get one of the six great offices, resulting in three great offices going to the North and the other three going to the South. An extra rule was that the North or South could not get two adjacent offices in hierarchical order[70]. This created a seemingly fair system of power distribution that would be rotated every eight years.

The PDP won the February 1999 presidential election that saw them defeat a coalition of two other political parties, Alliance for Democracy (AD) and All People's Party (APP). PDP was formed by an unusual coalition of prominent anti-military rule political leaders and former senior officers from the military establishment that emerged from three decades of predominantly military rule (Azeez, 2009). Despite the pro-democracy pedigree of its founders, such a Alex Ekwueme (Civilian Vice President from 1979 to 1983) and Atiku Abubakar (influential Northern politician), PDP was popular among former senior military officers. Some of the former senior

[69] Source: Interview with political elite. Abuja, Nigeria. 03 December 2018.
[70] Ibid.

officers that joined the party included retired General Obasanjo, a former military President from 1976 to 1979, who was also the party's 1999 and 2003 presidential candidate; retired General Theophilus Danjuma, who became the Minister for Defence (1999 – 2003); retired General Ibrahim Babangida, former Military President (1985-1993), who announced his intention to run for president on the PDP platform in 2007 and 2011; retired Commodore Olabode George, who became Deputy National Chairman of the PDP and Director General of the Yar'adua/Jonathan 2007 presidential campaign; and retired Brigadier General David Mark, who became President of the Nigerian Senate (2007-2015) on the platform of the PDP.

In the 1999 presidential elections, retired General Obasanjo won on the platform of the PDP. He lost all the six states in his home region, the SW region, and three other states in the North as shown in Figure 5.5. After he won the election in 1999, President Obasanjo swore-in a cabinet, which included political elites from the opposition parties, to increase political stability in a democracy that was less than a year old[71]. President Obasanjo, however, faced stiff opposition from within his party – there was a faction within the PDP that emerged to wrestle power from him and prevent him from being the party's candidate at the 2003 election (Popoola, 2011). This faction was led by his vice president, Atiku Abubakar, who was a former civil servant that became an influential and wealthy Northern politician (Okolie, 2010). Atiku Abubakar was one of the founders of the PDP and of its main financiers (Okolie, 2010). President Obasanjo faced

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[71] Ibid.

opposition from the party, and the PDP-led Nigerian Senate attempted to impeach him, but he survived due to the effort of his own faction of loyalists within the PDP[72]. An ally of Vice President Atiku Abubakar, Senator Chuba Okadigbo, who was also the Senate President that led the attempt to impeach President Obasanjo was removed as the Senate President in 2001 – a blow to Vice President (Popoola, 2011). In 2002, President Obasanjo emerged once again as the PDP's presidential candidate for the 2003 presidential elections.

[72] Ibid.

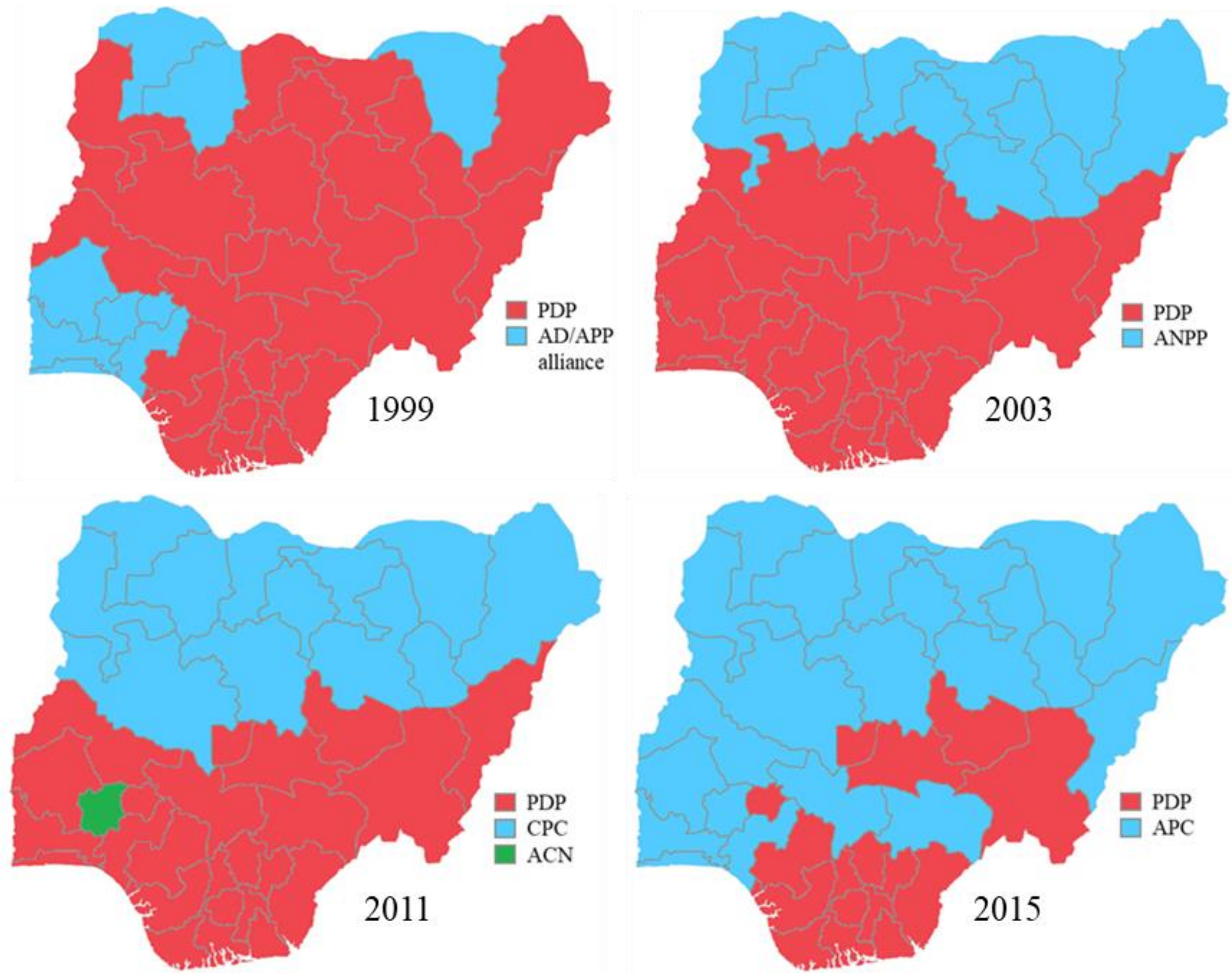

Figure 5.5: Presidential election result map in 1999, 2003, 2007 and 2011.

(African Elections Database, 2019)

In 2003, President Obasanjo won the presidential elections, during which he got almost twice as many votes as his closest opponent, General Muhammadu Buhari, who garnered 12.7 million votes against President Obasanjo's 24.4 million votes (African Elections Database, 2019). President Obasanjo won all the southern and NC states in the 2003 presidential elections, while General Buhari won 11 of the 14 states in the predominantly Hausa-Fulani states in the NW and NE regions as shown in Figure 5.5. The emergence of retired General Buhari, a former military head of state (1983 – 1985) from Northern Nigeria, as a presidential candidate in 2003, split the Northern votes and tilted the North in favour of the major opposition party, All Nigeria People's

Party (ANPP). PDP, however, won more gubernatorial seats in 2003. In 1999, PDP won twenty-one gubernatorial seats, and by 2003, they won twenty-eight of the thirty-six gubernatorial seats in Nigeria (African Elections Database, 2019). Five out of the six SW states that previously rejected the party in 1999 were won by PDP gubernatorial candidates, and all six SW states were won by the PDP presidential candidate in 2003(African Elections Database, 2019).

The electoral fortunes of the PDP in 2003 positioned the PDP as a stronger political coalition with relatively less vulnerability than it had prior to the election. President Obasanjo also solidified his leadership of the party after winning the 2003 elections[73]. During this period, President Obasanjo formed a cabinet that included a significant number of technocrats in key cabinet positions, which formed an economic reform team (Okonko-Iweala, 2012). The reform team pushed through key reform laws including the Electric Power Sector reform Act (EPSRA) 2005 for the electricity sector.

After the 2003 elections, the contestation within the PDP subsided until the build-up to the 2007 elections, when first, the National Assembly (NASS)[74] accused President Obasanjo of seeking to extend his two-term limit (Okem, 2013); and second, when the Vice President Atiku Abubakar, who had an open ambitions about succeeding Presidency Obasanjo decamped from the PDP (Omotola, 2009). President Obasanjo denied a third term agenda (Obasanjo, 2014). With the

[73] Source: Interview with political elite. Abuja, Nigeria. 03 December 2018.
[74] National Parliament

support of President Obasanjo, Governor Umaru Yar'adua emerged as the PDP's candidate in the 2007 elections (Omotola, 2009).

5.4.1.2 President Yar'adua and the Disruption of the Political Settlement, *2007-2010*

The Independent National Electoral Commission (INEC) declared PDP the winner of the 2007 presidential election. PDP got 24,638,063 while ANPP got 6,605,299 votes (African Elections Database, 2019). INEC neither published the total number of votes cast, the percentage scored by each of the candidates, nor the state-by-state breakdown of the presidential election (NDI, 2008). The election was marred by widespread irregularities. This much was acknowledged, by its chief beneficiary, Governor Umaru Yar'adua, who was declared president-elect by INEC. After he was sworn-in, President Yar'adua admitted that the election had shortcomings and stated his intention to implement electoral reforms (Animashaun, 2010).

President Yar'adua inherited a stronger party from President Obasanjo. However, one of the biggest threats the PDP government faced was from the militancy in the Niger Delta, which had a damaging effect on crude oil revenue (Ukiwo, 2011; Inokoba and Imbua, 2010; Ognonnaya and Ehigiamuse, 2013). Together with his Niger-Deltan Vice President, Dr. Goodluck Jonathan, President Yar'adua negotiated and reached an agreement with the militants in the Niger Delta. President Yar'adua signed the amnesty proclamation, which put a stop to the violence in the region (Aghedo and Osumah, 2012).

A brewing contestation emerged between former President Obasanjo's loyalists and President Yar'adua loyalist within the PDP barely a year into the new presidency as the latter tightened his grip on power (Green, 2008b). Fifteen months after he appointed his ministers, President

Yar’adua reshuffled his cabinet. During this reshuffle in October 2008, half of his was sacked (Green, 2008b). The PDP coalition was very and the President Yar’adua was in full control of it.

However, the beginning of the disruption of the political settlement in Nigeria began in November 2009 when President Yar’adua was flown abroad for medical treatment. His absence from office for a protracted amount of time, without transferring power to the vice president, created a national crisis with the country questioning who was in charge (BBC, 2010). By January 2010, the Supreme Court of Nigeria ruled that the Federal Executive Council (FEC) should declare, within a fortnight, whether President Yar’adua was "incapable of discharging the functions of his office" as mandated by Section 144 of the 1999 Constitution. The Cabinet subsequently issued a statement saying that the president is “not incapable” of discharging the functions of his office (BBC, 2010b). This vote of confidence in President Yar’adua, who appeared unable to fulfil his functions, split the cabinet into two factions.

On one hand, there was the pro-Yar’adua group led by the Petroleum Minister from the NW zone, Dr. Rilwan Lukman, and Attorney General from the NC zone, Michael Aondoakaa; while on the other hand, there was a Pro-Jonathan group led by its most vocal member, Information and Communication Minister from the SW zone, Professor Dora Akunyili (Igboanugo et al, 2010). Professor Akunyili shared a memo during a cabinet meeting trying to convince the cabinet to declare President Yar’adua incapable of discharging his functions (Abati, 2010; Oluchukwu, 2017). However, this issue was not just a question of constitutional order of succession. The zoning principle that kept PDP cohesive was at risk. Declaring President Yar’adua incapable would allow President Jonathan, from the south, to lead the party and government. President Obasanjo, from the south, had already spent eight years (1999-2007) in office.

By the 10th of February 2010, the NASS used the ‘doctrine of necessity’ to transfer power from President Yar’adua to Vice President Jonathan. On the same day, Acting President Jonathan promptly demoted the Pro-Yar’adua Justice Minister, Mr. Aondoakaa, to Special Duties Minister. A month later on the 16th of March 2010, he dissolved the entire cabinet (Abati, 2010). On the 6th April 2010, Acting President Jonathan swore in a new cabinet. This allowed Acting President Jonathan to shore-up his control of the government and the party.

5.4.1.3 President Jonathan and Political Contestation in the PDP*, 2010-2015*

On the 5th of May 2010, President Yar’adua passed away and Acting President Jonathan was sworn in as President, upsetting the geo-political zoning arrangement within the PDP. This marked a new beginning of a brewing political contestation within the party[75]. President Jonathan was sworn-in less than a year before the 2011 general elections. Many northern political leaders believed that President Jonathan should not stand in the 2011 elections, and that the party should give the presidential ticket to another northerner (Awopeju, 2012). Amongst those prominent Northern politicians who spoke out against a disruption to zoning arrangement were former head of state (1985-1993), retired General Babangida and former vice president (1999-2007), Mr. Atiku Abubakar, both of whom announced their intention to run for president under the platform of the PDP. President Jonathan however secured the support of the PDP governors to clinch the party ticket (Awopeju at al, 2012).

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[75] Source: Interview with political elite. Abuja, Nigeria. 03 December 2018.

The PDP went on to win the 2011 presidential elections against the Congress for Progressive Change (CPC), who fielded retired General Buhari and the Action Congress of Nigeria (CAN), who fielded Mr. Nuhu Ribadu, the anti-corruption agency chief under President Obasanjo. Compared to 2003, the PDP dropped two more northern states – Niger and Kaduna – and one SW state (see Figure 5.5.) This provided some evidence for an increasing disillusionment of the northern political elite by the PDP. It also showed some evidence of the increasing political contestation within the PDP between northern and southern political elites. In several attempts to appeal to the disillusioned northern political elite, President Jonathan lost the support of a significant portion of the SW political elites, leaving the SW out of zoning arrangement, making them the only zone without any of the six great offices between 2011 and 2015[76]. Jonathan eventually formed his cabinet and continued the liberalisation agenda that started in former President Obasanjo's administration.

By 2013, when it became clear that President Jonathan was going to contest for a second term, an act which would further disrupt the zoning arrangement within the party; six governors and numerous elected members of the NASS predominantly from the North, created a splinter group within the party called the New PDP (N-PDP) (Adebisi, 2018). The N-PDP eventually formed a coalition with three other opposition parties – ACN, CPC and ANPP – to form the All Progressives Congress (APC) (Adebisi, 2018). The political contestation within the PDP, caused

[76] Source: Interview with political elite. Abuja, Nigeria. 03 December 2018.

by the disruption to the zoning arrangement, turned into political vulnerability when a significant portion of the Northern elite pulled out of the PDP to join the opposition in the APC. The APC nominated retired General Buhari to contest against PDP's President Jonathan. PDP lost the presidential election for the first time in the Fourth Republic (see Figure 5.5)

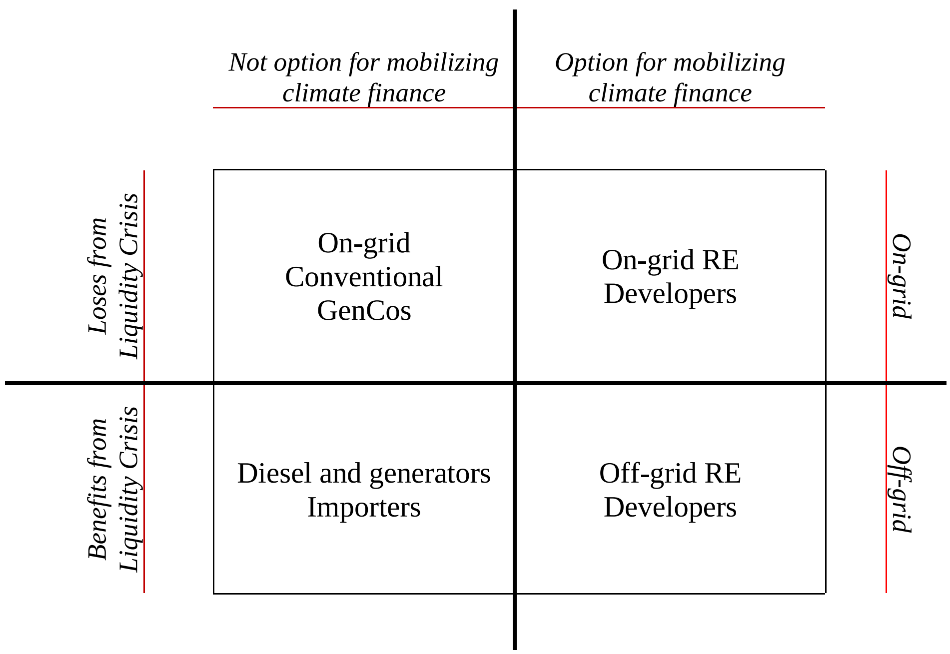
5.4.1.4 President Buhari and Political Vulnerability of the APC, *2015-2019*

On the 29th of May 2015, retired General Buhari, once again, became the head of state. On this occasion, he was sworn-in after winning the 2015 general elections on the platform of the APC. The PDP was defeated by the APC, which had three main power blocs within it (Adebisi, 2018). : the northern CPC/ANPP bloc led by President Buhari; the south-western ACN bloc led by a former senator and former governor of Lagos State, Senator Bola Tinubu; and the N-PDP bloc led by a former NC governor of Kwara State; Dr. Bukola Saraki, who had just been re-elected as a senator. The CPC bloc had the position of the President and the ACN bloc had the position of the Vice President, which was given to Professor Yemi Osinbajo – a former attorney-general of Lagos during Senator Tinubu's time as Governor of Lagos (1999-2007). In a bid to prevent themselves from being excluded from the power sharing arrangement in the APC, the N-PDP bloc, which had significant numbers in both houses of the NASS, orchestrated a plan that saw Senator Saraki become the President of the Senate and Hon. Yakubu Dogara become the Speaker of the House of Representatives (HoR) (Ojibara, 2017). Their emergence as leaders of the NASS went against the APC's preference (Ojibara, 2017). This promulgated political contestation within the APC. Throughout the four-year period from 2015 to 2019, the APC-led executive branch of government faced stiff opposition from the PDP outside of the government and from the N-PDP bloc within its own party (Ojibara, 2017).

The analysis in this section shows the fierce competition within and outside Nigeria's ruling coalitions from 1999 to 2019. Countries with competitive clientelist tendencies, like Nigeria, are more likely to have political elites, who are more pre-occupied with shorter-term considerations and election winning strategies, and as such, industrial policies that require longer term horizons are more difficult to implement in those countries (Whitfield, 2018).

5.4.2 Relevant Capitalist Actors in Relation to the On-Grid RE procurement Programme

When analysing the political economy of the FGN's on-grid RE procurement programme, the firms in the electricity sector can be usefully grouped into four groups – *(1) On-grid Conventional GenCos (2) On-grid RE developers (3) Off-grid RE developers (4) Diesel generator and fuel importers.*



5.4.2.1 On-grid Conventional GenCos

As will be explained in detail in Section 5.5.2, the FGN's 2010 Roadmap for Power Sector Reform rebooted the government's privatisation agenda in the NESI. The launch of the roadmap came after a two-year pause in the PDP's NESI privatisation programme. Three years later in 2013, the NESI had been partially privatised under President Jonathan's administration, resulting in the emergence of a new group of capitalist firms – some of whom took ownership of 10 state-owned on-grid conventional GenCos. Several scholars (Izuora & Akwaja, 2014; Roy et al, 2020; and Osunmuyiwa et al, 2018) and news publications (Brock, 2013; Energy Mix Report, 2013) state that a significant number of the firms were either promoted or owned by former senior military officers or capitalists, who were either members or aligned with the ruling party, PDP.

The success of PDP-aligned capitalists in mobilising billions of dollars to capture state assets however did not yield the expected rent due to the liquidity crisis explained in Chapter 4. What appeared to be mutual interest between the PDP-led government and the PDP-aligned capitalists during privatisation was not. As will be explained in Section 5.5.2, President Jonathan's government was unwilling to bear the social cost of increasing electricity prices, exacerbating the liquidity crisis, and rendering the on-grid conventional GenCos unable to generate promised rents. The liquidity crisis and government's inability to provide the promised rents to on-grid conventional GenCos through NBET meant that the government was unable to satisfy the capitalists' interest. The mutual interest which appeared to have emerged during the privatisation of the state-owned GenCos quickly gave way to a clear misalignment of interest.

This misalignment of interest became contentious when President Buhari's APC government took over the FGN following the 2015 presidential election. As will be explained in Section 5.5.2, members of APC, who came to power under President Buhari's administration in 2015, repeatedly called for the reversal of the privatisation process (Oluwajuyitan, 2019). All the while, President's Buhari's government was also not willing to bear the social cost of higher electricity prices, and the on-grid conventional GenCos faced a liquidity crisis. At times, the on-grid conventional GenCos lobbied[77] and other times threatened the FGN with a nationwide shutdown of electricity supply due to the challenges of liquidity crisis (Adebulu, 2018).

In this regard, the conventional GenCos have a strong alignment of interest with the on-grid RE developers, whose success also depends on the FGN solving the liquidity crisis in the NESI.

While the on-grid conventional GenCos require liquidity in the NESI to meet their obligations and generate rent, the on-grid RE developers, as will be explained in Section 5.5.2, require liquidity in the NESI to enable the government to change its policy to allow additional on-grid generation capacity on the grid.

Additionally, on-grid conventional GenCos were looking forward to providing energy balancing services to On-grid RE developers[78], who would need back-up energy generation due to the stochastic nature of RE resources such as solar irradiation and wind resources.

5.4.2.2 On-grid RE Developers

Like on-grid conventional GenCos, the on-grid RE developers emerged under President Jonathan's administration. Some of them emerged following the announcement of the government's publication of the MYTO 2012, which established attractive FITs for on-grid RE developers. Some others emerged earlier: after the publication of the 2010 Roadmap. The on-grid RE developers' relationships with the political elite and senior bureaucrats under President

[77] Source: Interview with GenCo Association personnel. Abuja, Nigeria. 31 May 2018.
[78] Source: Interview with interviewee from GenCo (Private Sector). Abuja, Nigeria. 13 March 2018.

Jonathan's administration helped them to build momentum with their on-grid RE projects. Under President Jonathan's administration, momentum was built through the establishment of a PPA procurement process for unsolicited on-grid RE projects. A team was also mobilised at NBET to begin negotiations with the on-grid RE developers. Fourteen of the developers, who had influence with either political elites or top government bureaucrats, were selected as the first wave of developers with whom NBET would enter RE PPAs.

As will be explained in Section 5.5.3, this momentum continued under APC's President Buhari, whose government eventually signed PPAs with the on-grid RE developers, committing to buying all the electricity that would be generated from the on-grid RE power plants. Yet again, what appeared to be mutual interests between the FGN – this time, President Buhari's government – and on-grid RE developers gave way to contestation over the on-grid RE price. President Buhari's administration was unwilling to bear the social cost increasing electricity price. The liquidity crisis and the ballooning NESI debt made the government wary about procuring more on-grid power projects, including on-grid RE projects[79]. In the government's 2017 PSRP, it decided to officially halt all new on-grid generation projects in Nigeria.

5.4.2.3 Off-grid RE Developers

Also creating an additional barrier for on-grid RE developers, off-grid RE developers provided an alternative RE option to the President Buhari's government – an option that avoids the

[79] Source: Interview with Policymaker. Abuja, Nigeria. 21 May 2018.

liquidity crisis on the grid. President Buhari's government had the option– through off-grid RE projects to – access global climate-dedicated funds by supporting RE projects without dealing with the liquidity crisis on the grid. The off-grid option was also more compelling to take given that President Buhari's power sector team, which had come from the Lagos State Government (LASG), had extensive experience with off-grid projects and developers, having developed 5 MW of decentralized solar project for 213 schools and 11 primary healthcare centres in Lagos State (REA, 2019).

The off-grid RE developers in Nigeria might appear to have the same interest as on-grid RE developers, but they do not. An MLP framework analysis of the energy transition in Nigeria might view both on-grid and off-grid RE developers as niche technology promoters seeking to diffuse RE technologies into the regime – and that there are power struggles between resistive dominant regime actors and emerging RE developers. However, as Pohlmann (2019) argues, scholars attempting to integrate power dynamics into the MLP framework tend to "essentialise" the organisational power of actors in the regime and niche – attaching 'holding power'[80] to the regime and presenting a one-dimensional analysis of regime-niche dynamics. He argued further that energy innovations diffuse into the regime through a more nuanced set of dynamics, showing how power structures within the energy sector are not bound to take "the relational form of dominant versus marginalised actor." The mutual interest between off-grid RE developers in

[80] Holding Power is the capability of an individual or group to engage and survive in conflicts (Khan, 2010). It refers to not just to the resources an organization can deploy but also its power to mobilize support (Behuria, 2017).

Nigeria and President Buhari's power sector team from Lagos – coupled with the liquidity crisis in the NESI – led to the development of the Nigerian Electrification Project (NEP). The government borrowed USD 500 million for the NEP project to among other objectives, supply solar PV-based electricity to undersupplied customers, who were already connected to the grid. It is important to note that the price of electricity that the on-grid RE developers were offering (US 0.115/KWh[81]) is much lower than the price of installed off-grid solar plants, which ranges between USD 0.318/KWh and USD 0.796/KWh and has a median price of – USD 0.531/KWh (NESG, 2018). Despite the higher cost of off-grid RE projects, the government chose to move forward with the NEP instead of the on-grid RE procurement programme. Besides, the NEP provided short term gains, allowing the government to disburse funds to off-grid RE developers to build many small RE projects in a relatively short period without dealing with the systemic issues of the on-grid sector.

5.4.2.4 Fossil fuel-powered Generators and Fossil Fuel Importers

Osunmuyiwa et al (2019) explain that the poor performance of the electricity supply in the NESI created the conditions for the proliferation of off-grid petroleum and diesel-powered generators. They highlight the NGN 17.9 billion import market for off-grid fossil fuel generators, explaining how importers might be negatively affected by a transition to renewable energy. This places the interests of the importers squarely against those of the off-grid RE developers, who are also

[81] Source: Interview with on-grid RE project developer. Abuja, Nigeria. 08 May 2018.

seeking to capture unserved and underserved customers. Osunmuyiwa et al (2018) also highlighted the political influence of the diesel generator importers, stating that some of them were former senior military officers and members of the former ruling party, PDP. Additionally, Green (2017) argued that the diesel importation industry in Nigeria have stymied decades of attempts to turn domestic oil and gas reserves into cheap and reliable energy.

The interests of fossil fuel and fossil fuel-powered generators do not appear to align directly with any of the other three actors. However, like off-grid RE developers, the importers benefit from a weak grid and the liquidity crisis. The two groups of actors are however in competition for unserved consumers and underserved customers on the grid.

5.5 Industrial Policy in the telecoms and electricity sectors

5.5.1 Telecoms Sector

This section focuses on the success of industrial policy in the Nigerian telecoms sector in the Fourth Republic, which began in 1999. Two years into the Fourth Republic, the 2001 issuance of mobile telephony licenses to the private sector through an auction process created one of Nigeria’s most successful industrial reforms. In the first five years following the auction policy, mobile telephone subscriptions increased by 323% annually on average, whereas in the preceding decade, the annual increase in the number of mobile telephone subscriptions was 16% on average (World Bank, 2018). The policy helped to leapfrog the need for high capital investments in fixed telephone line infrastructure.

In 1999, Nigeria’s main telecoms provider was the Nigerian Telecommunications Limited (NITEL), the state-owned telecoms operator. NITEL was established in 1985 after the amalgamation of the Nigerian External Telecommunications (NET) Limited and the Telecommunication Division of the Department of Post and Telecommunications. NET was previously responsible for international communication, while the Telecommunication Division was responsible for local operations. NITEL also had a mobile subsidiary called the Nigerian Mobile Telecommunications Ltd. (MTEL). MTEL was the only multi-city mobile telephony service provider; however, it only covered three cities with only 40,000 subscribers as of 1999 (Nahlik and Jamison, 2007).

NITEL’s poor performance in the telecoms industry prompted the need for liberalisation (Okonjo-Iweala, 2019), resulting in Decree 75 of 1992, during the General Babangida-led administration (1985-1993). The decree liberalised the telecoms sector in Nigeria and established the Nigerian Communications Commission (NCC) as the sector’s regulator. As of 1999, successive military governments had issued 12 telephony licenses and approved the issuance of an additional 21 mobile telephony licenses (Mantu, 2019). Most of the licensees were not operational and those that were operational only provided a limited service. Licensees that were operational had to compete with NITEL, which was inefficiently subsidised by the FGN through the annual federal budget (Okonjo-Iweala, 2019).

At the start of the Fourth Republic in 1999, President Obasanjo, as Usman (2016) explains, launched a series of economic reforms as pragmatic response to the country’s sever economic problems. She explained that the reforms were necessitated by three main constraints: the low oil rent generation in 1999 ($17); the need free up resources that were committed to debt servicing (41% of the FGN’s budget); and the necessity of articulating a comprehensive economic reform blueprint for financial management and market liberalisation as a condition by donors for debt relief. One resulting reform policy was the FGN’s National Policy on Telecommunication (NPT).

The NPT spelled out the government's intention to reform the telecoms sector and promote private capital investment in the sector. President Obasanjo aimed to privatise the state-owned NITEL and state-owned M-TEL and sell licenses to a further four mobile telephony operators. All previously held GSM licenses form the military were withdrawn. President Obasanjo's decision to do these was as a result of two factors: to raise capital for his government during a period of low oil prices and to unravel the legacy of General Abacha's regime, which had jailed him in the preceding decade (Usman, 2016).

5.5.1.1 NCC: A Pocket of Efficiency

At the end of 1999, the FGN called or an expression of interest for four national GSM licenses at a cost USD 100 million, with an exclusivity period of five years. This procurement process was led by the Minister of Communication, who led specially set up Inter-Ministerial Committee to sell the licenses. (Doyle and Paul McSahne, 2001). The process generated interest from seventeen companies – out of which – seven companies pre-qualified (Doyle and Paul McSahne, 2001). This process was cancelled in February 2000 due to concerns regarding the integrity of the pre-qualification process (Doyle and Paul McSahne, 2001). Usman (2016) added that the failed pre-qualification process was a result of a tussle between President Obasanjo and form military president Babangida for control of rents from the sector, showing evidence of some degree of political contestation playing out in the telecoms sector among members of the ruling coalition, PDP. Former President Babangida had appointed the pioneer chief executive of the regulator in 1992, Engineer Ironmantu, who was still in his position as the head of the regulator, NCC (News24, 2001). President Obasanjo enforced changes in the implementation team, placing the regulator at the head of the licensing process – thereby centralising the rent opportunity. He also sacked the leadership of NCC, including Engineer Iromnatu (News24, 2001). He appointed a new management team at NCC and inaugurated a new supervisory board headed by a technocrat, Dr Ernest Ndukwe. Following this, NCC built its institutional capacity by hiring new competent bureaucrats and adjusting the salary structure to retain new talent. As the newly appointed CEO of NCC, Dr. Ernest Ndukwe recalled:

> *"New and competent staff were carefully selected and employed at the NCC. Salary structures were revised to ensure that the Commission was able to attract and retain quality manpower. Consultants were engaged for some critical assignments. In the ensuing years, the Commission developed a full structure and, today has all the professional skills necessary to function as the nation's telecommunications Regulator (Ndukwe, 2011)."*

The centralisation of the license auction process at NCC helped to minimise the impact of political contestation at the policy level. This came right before the emergence of a pocket of efficency at NCC.

NCC, despite the scepticism by local and international observers, carried out a more competitive sale in the form an auction in which five companies participated after paying a USD 20 million[82] auction deposit. At the end of the auction process, the final price was USD 285 million for each 15-year license, and the three winners were two internationally backed firms and one locally backed firm (Lee, 2003; Odufuwa, 2010).

[82] Presentation by Ernest Ndukwe (2001). 16 January 2001.

5.5.1.2 Auction Winners and the Ruling Coalition: Mutual Interests

MTN Nigeria and Econet Wireless Nigeria (now Airtel Nigeria) were the two internationally backed winners, while Communications Investment Limited (CIL) was the only local auction winner (Doyle and Paul McSahne, 2001). The final auction price, USD 285 million (Lee, 2003), was also set as the price for buying NITEL, which had a fourth license reserved for it. The FGN unsuccessfully attempted to sell NITEL several times since 2001. However, it was finally sold on the fourth attempt to NATCOM in 2015 for $252,221,000. The liberalisation of the telecoms sector did not depend on the privatisation of NITEL.

Additionally, as Usman (2016) argues, pressure from business elites allied to the ruling coalition created a “mind-set” that enabled the President Obasanjo administration to push through the telecoms reforms. The political influence of several military officers-turned-capitalists, who had played a role in President Obasanjo’s emergence as PDP’s presidential candidate, had significant stakes in the two South African-backed winners of auction (Usman, 2016). CIL, one of the three auction winners, later defaulted and lost its USD 20 million deposit as it was unable to raise the remaining USD 265 million for the license. After CIL’s unsuccessful attempt to purchase the third GSM license, another locally backed company, Globacom, which had very strong ties to the PDP, purchased the third GSM license, which was re-auctioned as part of the second round of license sale. Globacom won the license at a bid price of USD 200 million. Globacom’s purchase was a subject of controversy as there were concerns that the USD 20 million deposit paid by Globacom for the license had come directly from a USD 20 million deposit made by the FGN to Equatorial Trust Bank (ETB), which was owned by the same person who owns Globacom (Bakre, 2007)[83]. Before the rules were changed in 2015, the FGN's ministries, departments, and agencies (MDAs) were legally allowed to deposit public funds in commercial banks.

5.5.1.3 NCC and the Growth of the Telecoms Sector: Learning for Productivity

After the sale of the licenses at the auction, the FGN, ensured that new entrants were protected from dominant operators. Apart from the high license cost of USD 285 million, the NCC made it a policy to ensure that the new licensed entrants were not denied interconnection.

After the 2001 auction process, which was deemed transparent and successful, the private sector invested USD 18 billion in the telecoms sector between 2001 and 2015 (Deloitte, 2015). The companies that won GSM licenses, made significant amounts of profits. The regulator, NCC, made sure that the learning rents being enjoyed through the exclusivity of the GSM licenses, were also accompanied with increased productivity and upgrades to the telecoms services provided by the licensees to the consumers. The NCC embedded itself into the private sector as it began televising broadcast of industry stakeholder meetings to openly discuss problems affecting consumers. The meeting was called the Telecom Consumer Parliament (TCP) and it was held every month across the six geo-political zones in Nigeria (Ndukwe 2011). The NCC also held

[83] Corroborated by political elite interviewee. Abuja, Nigeria. 03 December 2018.

consumer outreach programmes (COP) to create awareness about telecoms services and address consumer issues. A customer care centre was also established at the NCC to collate and respond to complaints from consumers through numerous media. The NCC also collaborated with advocacy groups, which promoted consumer protection in the telecoms sector.

Despite the NCC's proactive regulatory efforts, the telecoms sector experienced congestion constraints, as the telecoms service providers could not expand as fast as the rate of growing demand. This was partly caused by the insufficient and unreliable NITEL-owned long-distance cross-country cable, which a number of telecoms service providers depended on (Ndukwe, 2011). According to Ndukwe, who headed the NCC, there were also issues with unreliable power supply to base stations; equipment theft; transmission cable cuts; and base station site approval delays. In order to keep the important issues in focus, the NCC partnered with the service providers to form technical working groups to deal squarely with the challenges of the sector.

Despite initial fears associated with liberalising the telecoms sector concerning the cost rate of telecom service providers to consumers, the opposite has been the case. As (Ndukwe, 2011) outlines, a pre-2001 M-Tel mobile line cost NGN 60,000 (USD 509 in 2001, but by 2011, it cost nothing to own a mobile line. The initial tariff for GSM mobile service was NGN 50/minute (USD 0.42/minute) in 2001, but by 2011, it dropped below NGN 25/minute (USD 0.084/minute) and reached NGN 12.64/minute (Ndukwe, 2011). A huge part of the drop in tariff is the fall in the interconnect rate, the rate at which operators charge each other for terminating a call on their network. Except on three occasions, the NCC left the interconnect rate to be decided by market. The interconnect rate came down from NGN 30 to NGN 18 in 2003; NGN11.40/minute in 2007; and NGN 8.20/ minute in 2009 (Ndukwe, 2011).

The number of mobile telephony subscriptions rose from 0.21 out of every hundred people in 2001 to 68 out of every hundred people before the reforms in 2011 (NCC, 2019) In 1999, NITEL had an installed capacity of 450,000 telephone lines. By the end of 2011, ten years after the auction, the number had increased to 88.3 million due to mobile telephone services, and by 2018, it had increased to 172.9 million (NCC, 2019). The ownership of multiple GSM lines by consumers, usually in order to have better mobile telephone coverage, also resulted in the high teledensity shown in Figure 5.1. The contribution of the telecoms industry to Nigeria's GDP is also claimed to have gone up from 0.06% to 9.47% (NCC, 2019; Ndukwe, 2011).

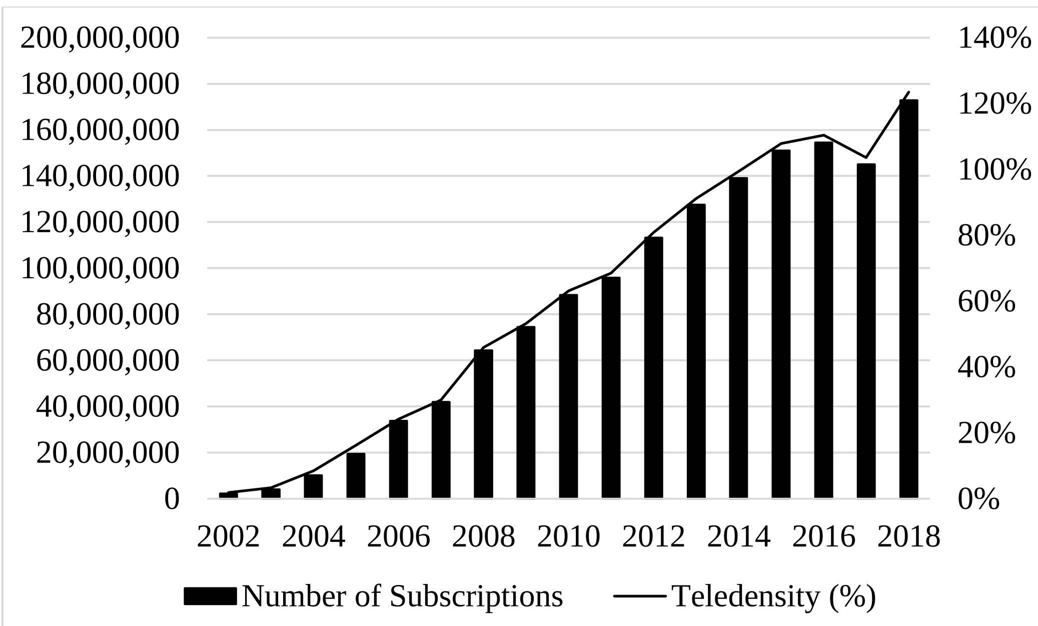


Figure 5.6: N number of telephone subscriptions and teledensity[84] in Nigeria between 2002 and 2018.

[84] Telephone connections per hundred people

Source: (NCC, 2019)

NCC maintained its robustness as a regulator, drawing from the momentum of its previous reform successes. The most notable example of this was when the NCC handed MTN, Nigeria's biggest telecoms provider, a USD 5.2 billion fine for failing to obey a regulation to disconnect unregistered subscribers. MTN was found to be on the wrong side of the regulation when an audit revealed that it still had 5.2 million unregistered subscribers (Cotteril and Fick, 2017). The fine was USD 1,000 per unregister subscriber totalling NGN 5.2 billion. It was eventually reduced after diplomatic intervention from the South African government to USD 1.7 billion paid over three years (Cotteril and Fick, 2017).

5.5.2 Nigerian Electricity Supply Industry Interventions

The analyses of the findings in this sub-section focus on two interlinked policy cases - the NESI liberalisation reform and the FGN's on-grid RE procurement programme in Nigeria's Fourth Republic. While the man focus of this thesis is the on-grid RE procurement programme, it is critical to analyse the wider NESI reform, which has an impact on the government's on-grid RE procurement programme.

5.5.2.1 Privatisation and Liberalization in the NESI

The Nigerian Electric Power Authority (NEPA) was the national body responsible for electricity supply in Nigeria at the start of the Fourth Republic in 1999. NEPA was established in 1972, inheriting the functions of two defunct government institutions (Ebhota and Tabakov, 2018). The first institution was the Electricity Corporation of Nigeria (ECN), which was established in 1950 under ordinance No. 15 of 1950. The second institution was the Niger Dams Authority (NDA), which was created in 1962 to develop Nigeria's hydropower potential. ECN and NDA were merged by the post-civil war Federal Military Government (FMG) to form NEPA.

Before the ECN and NDA were established, the British colonial administrators built the first power station, a 60 KW power plant, in Lagos Marina in 1896. The subsequent development of electricity supply was to serve specific colonial policies (Edomah et al., 2016). The administrative areas of Lagos were powered first for lighting, and then the colonial government house in Zungeru in North Central Nigeria was lit up with electricity. In 1922 the Nigerian Electricity Supply Company (NESCO) was set up to develop the electricity supply infrastructure to aid colonial trade. Electricity supply was spread to the Nigerian Railway workshops, which were helping to build the Nigerian railways to transport raw agro-goods from the hinterland to the coast. Electricity supply then spread to the Nigeria Eastern Railway workshops and coal mines in the eastern parts of Nigeria. Colonial administrative buildings, hospital and churches were also electrified for productive consumption. This paragraph highlights the productive consumption that underpinned the expansion of the grid during the period.

At the start of the Fourth Republic in 1999, NEPA, the state-owned vertically integrated utility, had been around for 17 years, and had overseen widespread infrastructural decay in the electricity sector. In the decade preceding the Fourth republic, no new power plant was built and only 19 out of 79 generating units were in operation in the country (Okonjo-Iweala, 2014). In the international community, as Okonjo-Iweala (2014) recalled, Nigeria was perceived as an unattractive and volatile market with a poor national debt profile. The country had just witnessed a change of government and a transition to democratic rule. The new government of President Olusegun Obasanjo was on a mission to reverse the decay due to the same three reasons he pushed for reforms in the telecoms sector – low oil price, hight debt servicing-to-budget ratio, and pressure from creditors and the international donor community (Usman, 2016). Dr. Ngozi Okonjo-Iweala, a Nigerian Finance Minister and former World Bank executive, recalled:

> *"Our first order of business was to establish credibility, fairness and societal trust. We needed Nigerians and foreigners to believe in the nation's government. So they would invest in the country and lend to it (Okonjo-Iweala, 2014)."*

President Obasanjo's new government moved to establish credibility and renew societal trust by proposing sweeping reforms in several critical sectors including the electricity sector. Dr. Okonjo-Iweala wrote, in 2014, that:

> *"Our prime goals were… to address various structural features of the Nigerian economy that hindered private sector enterprise, by promoting privatization, deregulation and liberalization (Okonjo-Iweala, 2014)."*

The NESI liberalisation reform was spearheaded by the National Council on privatisation (NCP), established by the Privatisation and Commercialisation Act (PCA) of 1999 and led directly by the vice president of Nigeria (1999-2007), Mr. Atiku Abubakar. The NCP's work was carried out through its secretariat, the Bureau of Public Enterprise (BPE). The power sector reform began in 2000 with the formation of the Electric Power Implementation Committee (EPIC). In 2001, EPIC drafted the Nigerian Electric Power Policy (NEPP), which expressed the FGN's intention to liberalise the electricity sector to attract private sector investment and participation. The NEPP led to the development of the Electric Power Sector Reform (EPSR) bill, which would break up state-owned vertical utility, NEPA, into a group of companies that would be corporatized and privatised.

Before the EPSR bill was passed, it was resisted by the Nigerian Union of Electricity Employees (NUEE). The Secretary-General of the NUEE, Comrade Precious Kiri-Kalio, in 2002, had mentioned four main objections to privatisation process (Ugwuanyi, 2001). First, he expressed the opinion that the FGN would "lose control" of NEPA assets and that "enforcement of compliance would be near impossible" in the privatised electricity market. Second, he mentioned that the price of electricity with a privatised NEPA would be "out of the reach of the low-income earners and the masses." Third, he expressed fears over the loss of NUEE members' jobs that was expected to come with privatisation. Fourth, he mentioned that the FGN would be abandoning its social responsibility to provide electricity especially in areas where it would not be profitable for private sector to supply electricity because consumers "would not be able to pay bills."

Some NEPA staff also had their personal motives for resisting privatisation[85]. NEPA's operation, was funded by the FGN regardless of their performance. There was a stream of federal money flowing into NEPA, which was sometimes mismanaged[86]. NEPA had a reputation of mismanagement and corruption. Privatisation would take away their institutional control of the country's electricity supply assets and monies allocated to them[87]. During the era of NEPA, some NEPA staff would do personal favours for friends and family[88], directing electricity to their neighbourhoods during a period when electricity was rationed, as it still is. Some NEPA staff would also collect bribes and help consumers to evade electricity bill payments[89].

[85] Source: Interview with retired PHCN (Transmission Company) staff. Osun, Nigeria. 27 October 2017.
[86] Ibid.
[87] Ibid.
[88] Source: Interview with on-grid RE Project Developer. Abuja, Nigeria. 07 May 2018.
[89] Source: Interview with International development Financier. Abuja, Nigeria. 03 May 2018.

President Obasanjo's government was convinced that privatisation was the solution, while the NUEE believed that privatisation would not solve the sector's governance issues, a problem they acknowledged and believed was the cause of their underperformance (Ugwuanyi, 2001). The contention between NUEE and the FGN intensified. The Director-General of BPE, Mallam Nasir El-Rufai, publicly boasted that 20,000 of 30,000 NEPA employees would be sacked and then obtained a court order to prevent NUEE from strike action (Fajana, 2008).

Meanwhile, a separate Act, the Nigerian Integrated Power Projects (NIPP) Act was passed in 2004 by the NASS. The NIPP (2004) Act allowed the FGN to allocate resources to large-scale investments in generation, transmission and distribution assets through the Niger Delta Power Holding Company (NDPHC). The NIPP Act was the FGN's stop-gap solution to accelerate infrastructural development in the electricity sector before the impacts of the EPSR bill would come into effect. The NIPP includes ten large scale gas-fired power stations and extensive distribution and transmission network projects.

In 2004, the FGN submitted the EPSR bill to the NASS and it became an Act in 2005, a year after the NIPP Act was passed. The EPSRA broke the electricity supply monolith, NEPA, into six GenCos, eleven distribution companies DisCos and one Transmission Company of Nigeria (TCN). All eighteen companies were incorporated under the Power Holding Company of Nigeria (PHCN). This happened despite the NUEEs objections because the majority of the political elite in the NASS had rallied around newly re-elected President Obasanjo's EPSR bill (*low political contestation*) and voted for the EPSR Act. The ruling party at the time, PDP, had 76 of the 109 senators in the NASS, and had 223 out of the 360 members of the lower legislative House of Representatives (Udefuna, 2021). This was the first major step President Obasanjo took to establish pockets of efficiency and mutual interest – he pushed the EPSRA which would enforce institutional change in the NESI. The FGN would still need political influential capitalists with whom mutual interest could formed. It would also need for the NESI reforms to continue without high social costs. The EPSRA which aimed to liberalise the NESI appeared to have low social costs beyond the resistance from the unions put up until the price of electricity became and issue post-privatisation.

After the corporatisation of NEPA, which became PHCN, the next step in the reform process was to privatise PHCN. This was again met with stiff resistance from the NUEE members, who had been staff of NEPA, and now staff of the PHCN. There was a renewed sense of antagonism between BPE and NUEE. NUEE challenged the privatisation in court. Protests, strikes and court orders (Okpanachi and Obutte, 2015): these were the NUEEs tactics of bringing the FGN to the table to negotiate the privatisation process.

As the privatisation process dragged on, a new government came into power in 2007. President Musa Yar'adua, who had promised to declare a state of emergency in the power sector on the platform of the PDP, was declared the winner of the 2007 presidential elections (BBC, 2007). He took over from another member of the PDP, President Olusegun Obasanjo. After receiving advice from the Power Sector Reform Committee, a committee he had set up to guide him on next steps for the electricity sector, President Yar'adua's administration took a different stance on privatisation to the previous administration, exposing the emergence of political contestation around the PHCN privatisation agenda. President Yar'adua suspended the privatisation process. In June 2008, Dr. Rilwan Lukman, who resigned from President Obasanjo's government in 2003 and later returned to become an honorary and unpaid adviser to President Yar'adua on Energy and Strategic Matters, publicly stated to President Yar'adua that:

> *"...we feel that it is highly important that a coordinating body in the PHCN be put in place. The privatisation of the successor companies should be suspended (Taiwo, 2008)."*

The committee's reason for proposing the suspension of the privatisation process was that the sector was not viable without government investment and that the cost-reflective tariff structure required for private sector participation was not affordable to consumers. They argued that government would need to invest in the sector till it reaches a level of commercial viability that allows private sector participation. The committee also took the side of the PHCN staff by citing the solution of issues with PHCN staff pension as a prerequisite to privatisation (Akinosho, 2009). The committee also outlined the failure to define the mechanism of the Rural Electrification Fund in the context of a privatised sector and the need to establish the Consumer Protection Fund to protect consumers against electricity tariff hikes as allowed for in the EPSRA. The suspension of the privatisation process was championed by Dr. Rilwan Lukman, who later became Minister for Petroleum in President Yar'adua's cabinet.

However, the Minister for Power in the same cabinet, Dr. Rilwan Babalola, was a strong advocate of privatisation. Dr. Rilwan Babalola, a former banker and energy economist, had been a part of President Obasanjo's administration, where he led the Power Sector team at BPE during the foundational period of President Obasanjo's reform agenda. Dr. Rilwan Babalola led the BPE team that helped unbundle NEPA and establish the regulator, Nigerian Electricity Regulatory commission (NERC). Dr. Babalola later joined the senior management of NERC during President Obasanjo's administration. In 2007 he joined President Yar'adua's economic advisory team, and in 2008, he joined President Yar'adua's cabinet as the Minister for Power.

In essence, Dr. Rilwan Lukman argued that government is required to invest in the power sector until it is commercially viable for privatisation, while Dr. Babalola saw privatisation as part of the solution to reach commercial viability. In an article titled "Yar'adua's Team of Rivals" by Toyin Akinosho on the 9th January 2009, she states in the Africa Oil and Gas online publication that:

> *"With Babalola and Lukman in the same cabinet, we are going to have a bruising fight between those who want the status quo of Africa's largest country lavishing money on a chronically ill power utility and those who want a choice of a more competitive environment, with a strong regulatory oversight that ensures equitable prices and businesses that don't take advantage (Akinosho, 2009)."*

As Toyin Akinosho acknowledged, the debate would be won by whichever side President Yar'adua agreed with. President Yar'adua picked the side of Dr Lukman, who had been described as a member of Yar'adua's "cabal"[90]. With high contention within President Yar'adua's cabinet on the PHCN privatisation process, mutual interests could not emerge.

On the 5th of May 2010, President Yar'adua died after six months of absence from office due to health issues. Dr. Goodluck Jonathan, his vice president, was officially sworn in as president on the same day. However, Dr. Jonathan had already been in the role of Acting President for three months prior President Yar'adua's death on the 5th of May 2010.

[90] The term "cabal" was used to describe some of the most influential members of President Yar'adua's cabinet.

Acting President Jonathan dissolved President Yar'adua's cabinet on the 17th of March 2010, weeks after becoming the Acting President to shore up his control of the federal government and the PDP[91]. A faction of President Yar'adua's cabinet had vehemently resisted Vice President Jonathan's emergence as Acting President during the absence of President Yar'adua. Minister of Petroleum, Dr. Rilwan Lukman, and Attorney General Michael Aondoakaa were referred to as leading figures in the "Yar'adua camp" preventing Vice President Jonathan from taking over as acting as President (Abati, 2010). Dissolving the cabinet helped Acting President Jonathan remove these cabinet members and allowed him to appoint a fresh cabinet that would drive his economic agenda and stabilise the political coalition that he was now heading.

Reducing Political Contestation around Privatisation: Mutual Interests?

On the 5th April 2010, a month before being sworn in as President, Acting President Jonathan swore in a new federal cabinet. He, however, left the Ministry of Power portfolio without a full-fledged Minister, appointing only a 'Minister of State' for Power – the equivalent of a deputy minister. The act of leaving a Federal Government Ministry without a full-fledged Minister was a tradition known in Nigeria to mean that the President would directly oversee the Ministry[92], and considered the work of the Ministry a priority or an important source of rent generation. President Jonathan inaugurated the Presidential Action Committee on Power

[91] Source: Interview with political elite. Abuja, Nigeria. 03 December 2018.
[92] Ibid.

(PACP), which the President himself led, shielding its work from political contestation[93] - at times providing it with military personnel to conduct due diligence exercises[94]. The committee was setup to revive and complete the privatisation process in the electricity sector after a two-year stall between 2007 and 2009. The implementation team of the PACP was the Presidential Taskforce on Power (PTFP), which was inaugurated on the 10th June, a month after becoming the Acting President. President Jonathan selected Professor Bart Nnaji, his Special Adviser on Power, to head the PTFP. Professor Bart Nnaji was an academic and power project developer, who had once been the Federal Minister for Science and Technology in 1993 in the short-lived interim government of President Ernest Shonekan.

Professor Bart Nnaji became the new champion for privatisation in the power sector in 2010[95]. In July 2010, a month after the PTFP was inaugurated, the state-owned Nigerian Bulk Electricity Trading Plc was incorporated to serve as a credit-worthy bulk electricity trader and to increase private investor confidence in the prospective privatised electricity market. The incorporation of NBET signalled quick progress in the reforms, addressing the issue raised by NUEE and Dr. Rilwan Lukman's

By August 2010, the PACP and PTFP had published the 2010 Roadmap for Power Sector Reform (RPSR). The aim of the roadmap was to lay out the government's framework with which

[93]Source: Interview with liberalisation policy maker (NESI & telecoms). Abuja, Nigeria. 02 May 2018.
[94] Source: Interview with Private Sector GenCo interviewee, who is a former NESI liberalization policy maker. Abuja, Nigeria. 03 December 2018.
[95] Source: Interview with Liberalisation Policy Maker (NESI & telecoms). Abuja, Nigeria. 02 May 2018.

it intended to remove obstacles to privatisation; clarify government's strategy on divesture; and reform the fuel to power market. The PHCN was eventually privatised in 2013; however, not without additional challenges. BPE, which was statutorily responsible for privatisation and also a member the PTFP worked with the rest of the PACP to attract investors to the sector. Some accounts claim that the due diligence exercise was firmly resisted by PHCN staff. Investors found it difficult to access power plants to carry out due diligence. The FGN had to deploy army personnel to the power plants. One stakeholder[96], who participated in the reform process stated that:

> *"Labour didn't want the reform. Organised labour didn't want reforms to go through. The electricity workers said no. That the assets will not be privatised, finally the government had to bring in the military. Nigerian military had to be deployed to power plants; they had to be deployed to power plants during the privatisation."*

There was also resistance form capitalists in diesel generator industry. Professor Bart Nnaji, who became the full-fledged Minister of Power in 2011 after the 2011 election of President Jonathan, also stated years later in 2017 that:

> *"…some of them don't actually set out by themselves to form a clique but by their actions, they impede the progress of the power*

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[96] Source: Interview with Private Sector GenCo interviewee, who is a former NESI liberalization policy maker. Abuja, Nigeria. 03 December 2018.

> *sector. You have diesel distributors, generator suppliers, unions and those who get contracts in the sector. Those are the people who make it difficult for the power system to truly function in the way it should (Ige, 2017).”*

Professor Bart Nnaji led the privatisation process till August 2012, when he bowed to pressure to resign as Minister. He resigned as Minister two months before the preferred bidders for PHCN’s assets were announced. He was accused by the labour unions of having a conflict of interest. It was reported that he was linked to a company bidding for two of PHCN’s assets (Brock, 2012a). Professor Nnaji responded by denying any conflict of interest and tendering his resignation to President Jonathan. Professor Nnaji, who said he had put his company in a blind trust, claimed vested interests opposed to privatisation were behind the “scurrilous attacks” on him, and that he had to resign to save the privatisation process (Brock, 2012a). As is the case with several other privatisation processes, there was struggle amongst Nigeria’s elite to capture the PHCN assets (Brock, 2012b). President Jonathan’s After the preferred bidders were announced, there were many allegations from all quarters about non-transparency and fraud in the privatisation process (Adedeji, 2020).

High Social Cost of Increasing the Retail Electricity Tariff: No Pocket of Efficency

At the time the assets were handed over to the new owners, there was already a liquidity crisis in the sector[97]. The generation companies (GenCos) received less than 50% of the payment for all

[97] Source: Interview with - Policy maker, who used to be top NESI bureaucrat, policy maker, top RE policy maker

electricity they sold[98]. Knowing this, the FGN prevented the Transitional Electricity Market (TEM) from taking effect. The TEM, which was supposed to start on the day the assets were handed over to the new owners, is a market arrangement that makes the government-owned NBET liable to pay for all electricity that the GenCos send out to the grid through a Power Purchase Agreement (PPA). In the TEM arrangement, NBET would then sell electricity to DisCos, which were not credit-worthy. The DisCos would, in turn sell to consumers, who did not pay for most of what they consumed. The government understood that the FGN would have been exposed to a mounting debt from the first day of the privatised market, so two weeks before the assets were handed over, the new owners of the assets were told by the government that the TEM would not come into effect, and instead, an Interim Rules market would be declared[99]. The regulator, NERC subsequently published a regulation to establish and enforce the Interim Rules market, declaring that the Interim "Rules shall come into force on the Effective Date, and shall cease to have effect on the first day of the calendar month following the declaration by the Minister of Power that the Transitional Electricity Market is operational." As one of the Private Sector GenCo executives[100] recalled:

> *"Essentially, one challenge dominated the market, and this was market liquidity. When we took over, we had basically signed the development agreement, which referred to a signed PPA; and that*

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and former PHCN staff. Abuja, Nigeria. 05 June 2018.
[98] Source: Interview with DisCo executive. Abuja, Nigeria. 05 April 2018
[99] Source: Interview with Private Sector GenCo interviewee. Abuja, Nigeria. 26 Feb 2018
[100] Ibid.

> *signed PPA had certain provisions. However, one or two weeks before takeover, we were told that the PPA would not immediately be effective. There would be an interim rule in place. That interim rule basically required us to get only a fraction of revenue, based on some rationing formula. In a nutshell, the revenue forecast that we were expecting did not, and to some extent, have not materialized up to now."*

The FGN recognised that the tariff set by the regulator, NERC, was not cost-reflective, and that the DisCos would not be able to meet its obligations to NBET, creating a liability for NBET. The Interim Rules market was an arrangement that left NBET outside of the market. The market was run by the Market Operator, a unit under the transmission company, TCN. Under the interim rules, the Market Operator rationed the pool of electricity from GenCos, by sharing it among DisCos using a predetermined ratio agreed to by all stakeholders. The Market Operator also managed the invoice balancing mechanism, sending out invoices to DisCos; receiving payments from DisCos; and settling the invoices it received from GenCos. The Interim Rules allowed the eleven DisCos to pay less than the value of the bill they received. DisCos were given different payment allowances. Yola DisCo was allowed to pay the lowest at 25% of its bill, while Eko DisCo had to pay at least 98.24% of its bill[101]. These figures were to be reviewed monthly. Failing to meet the payment target, the Interim Rules required the DisCos to open their books in full to the regulator for verification of their inability to meet their payment obligation. There was

[101] Source: Interview with DisCo association interviewee. Abuja, Nigeria. 05 April 2018.

also a penalty attached to delayed payments. Nonetheless, the market operated on a ‘best effort’ basis[102].

GenCos were eager to move to the TEM arrangement, where NBET would be liable to pay in full for electricity produced and sent to the grid[103]. Conversely, the DisCos did not want to move to the TEM because it would require them to present Letter of Credits (L/Cs) from their bankers. The L/Cs would be called by NBET if the DisCos were unable to meet their obligation. This contestation, amongst others, led to the formation of the Association of Power Generation Companies (APGC) to represent the interests of the GenCos and the Association of Nigerian Electricity Distributors (ANED) to represent the interests of the DisCos. These associations were formed for two reasons. First, the associations were formed to present a united front with a large bargaining power on each side[104]. Second, the associations were formed to allow the investors to contest government policy without being the face of antagonism against the government[105]. Several investors in the power sector have other business interests that may suffer if they publicly antagonise the government regarding their interest in the NESI[106].

[102] Source: Interview with Private Sector GenCo interviewee. Abuja, Nigeria. 26 Feb 2018.
[103] Ibid.
[104] Source: Interview with GenCo association interviewee. Abuja, Nigeria. 31 May 2018
[105] Ibid.
[106] Ibid.

After pressure had been mounted on the government by political influential GenCos, the Minister and the regulator, in January 2015, declared the start of the TEM, which came into effect on the 1st of February 2015.

Liquidity Crisis: No Rent for Learning

As the TEM took effect, the DisCos could not meet their obligation to NBET. And the payment by DisCos to NBET also fell during this period. As one GenCo management staff[107] recalls:

> *"Actually, at that time, I think we were getting something like 50% of our revenue. It wasn't actually quite very small. The performance of the market became worse after in NBET took over."*

Some GenCos believed this was caused by the vacuum in the executive board of the regulators. One GenCo management staff[108] stated what they believed the reason for this was as follows:

> *"One thing that we have to realize is that, during the Interim Rule period, NERC was fully constituted, and was, to some extent, effective in enforcing the provisions. Shortly after NBET took over, the board of NERC was dissolved and it took a very long time to appoint new commissioners, essentially, during that vacuum period. You have to talk to a DisCo to verify this. The feeling among generation companies is that DisCos effectively*

[107] Source: Interview with Private Sector GenCo interviewee. Abuja, Nigeria. 26 Feb 2018
[108] Source: Interview with Private Sector GenCo interviewee. Abuja, Nigeria. 26 February 2018.

> *relaxed. DisCos reduced their remittances, and there were no clear and obvious consequences to them for doing that."*

The DisCos took a different view. They blamed it on the non-cost reflectiveness of the retail tariff[109]. They argue that the regulator did not allowed them to pass on the wholesale electricity tariff, which is tied to the USD, to the consumer. The FGN would later admit to both contributing factors in 2018 in their Power Sector Recovery Programme (PSRP) policy document.

However, before this, the FGN, through the NBET, called on the L/Cs provided by the DisCos in lieu of bill payments. The DisCos, in response, took legal action to stop the FGN from calling on their L/Cs[110]. One stakeholder[111] in the NESI also claimed that the Governor of the Central Bank of Nigeria (CBN) put pressure on the FGN to stop their call on the DisCos L/Cs because of the CBN's concern for the Nigerian Banks, which were significantly exposed to the liquidity crisis in the NESI. The CBN also stepped in with a NGN 213 billion intervention fund that was used to settle payment shortfalls across the value chain. The intervention facility was in the form of a loan to the sector, which would be recovered via an extra price component in the tariff. This facility was given to the sector with certain conditions, which included bill payment targets for DisCos that the DisCos did not believe were fair. These culminated into a contentious relationship between the DisCos and the rest of the sector.

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[109] Source: Interview with GenCo association interviewee. Abuja, Nigeria. 06 June 2018.
[110] Source: Interview with electricity sector regulator. Abuja, Nigeria. 06 March 2018.
[111] Ibid.

The contentiousness in the NESI was deepened by the arrival of a new ruling party in government, APC, in May 2015. The new APC party had been very open about their distrust for the privatisation process when they were in the opposition. The Presidential candidate of the APC in 2015 President Muhammadu Buhari, who was declared winner of the election, had referred to the now privatised vertically integrated state-owned utility as “NEPA of blessed memory”, inferring his disappointment in the privatisation of the assets. However, President Buhari’s Minister of Power and former Governor of Lagos State, Mr. Babatunde Fashola in 2017, assured the NESI that the privatisation process would not be reversed:

> *“As we are all aware, there have been comments about how effective privatisation has been in the power sector and some people have called for its cancellation, which I disagree with (Okafor, 2017a).”*

Although he once rejected the idea of reversing the privatisation of PHCN, Mr. Fashola’s relationship with the NESI operators became very contentious. In 2018, he ordered the leadership of ANED, the association of DisCos, to leave an industry-wide stakeholder meeting, stating afterwards that:

> *“He should tell members of the public that I walked him out of our monthly meeting because he has no capacity to attend and he was not invited. If ANED is not a licensee, who is ANED (Nnodim, 2018)?”*

ANED had, a few days earlier, released a 28-page document, which is no longer publicly available, claiming that the Minister was playing politics and making false statements about the electricity sector[112]. Given that the FGN is the biggest consumer debtor and has prevented the DisCos from charging a cost-reflective retail tariff, the DisCos have found it difficult to be constantly and publicly antagonised by the FGN[113].

A year before the incident, in May 2017, the Minister for Power had announced the eligible customer policy that would allow four categories of consumers buy power directly from GenCos, bypassing the DisCos, which had the monopoly on distributing and selling electricity in their coverage areas. The consumers considered ‘eligible’ are large electricity consumers that consume more than 2 MWH/H for a month. The FGN, with pressure from the Manufacturers Association of Nigeria (MAN), developed this policy to introduce competition in retail electricity market. The eligible customer can be implemented into ways – it could either use the grid infrastructure to improve reliability of electricity supply to prime customers or it could promote the proliferation of distributed off-grid generation plants built for prime customers near the site of consumption. The antagonism between the government and the NESI utility companies meant that it would have been easier for the eligible policy lead to the promotion of the off-grid generation projects. As Whitfield et al (2015) explained, the interests of different capitalists within a sector do sometimes conflict, and their relative degree of political influence

[112] Source: Interview with DisCo association interviewee. Abuja, Nigeria. 05 April 2018.
[113] Ibid.

can determine which group of capitalists shape policy. While some actors can play both roles, it the conflict between both types of generation nonetheless remains.

The DisCos were immediately opposed to eligible customer policy because it would take some of their biggest customers away from them[114]. This would leave the DisCos to sell electricity to smaller less credit-worthy consumers, and further exacerbate the liquidity crisis in the sector. ANED, the association of distribution companies, in a statement following the declaration of the policy cited Section 28 of the EPSRA that states that DisCos must be made whole through a Competition Transition Charge (CTC) for any shortfall in their capacity to “earn permitted rates of return on their assets” as a result of the Minister for Power introducing competition policies. The Minister disagreed with the DisCos’ objection stating that:

> *“Your statement does not address the illogic of standing in the way of a consumer seeking to get for himself what the service provider, DisCo, has failed or is unable to give them. What is important is that the law is followed, consultations are held, and decisions are taken. No DisCo has exclusive rights over any area and its ability to retain an area must be consistent with its ability to provide service to the area (Okafor, 2017b).”*

While the DICSOs opposed the new policy, they were nonetheless allowed to participate in the Eligible Customer regime as wheelers of electricity between GenCos and consumers; however, the reality is that the captive and off-grid electricity market is more likely to benefit from this

[114] Ibid.

regime, especially since a Distribution Use of System (DUoS) agreement between the GenCo and DisCo is required for the GenCo to sell electricity to consumers. The DUoS agreement sets the fee that the DisCos charge for wheeling electricity from the GenCos to the consumers. The DisCos have no incentive to sign DUoS agreements with GenCos unless the DUoS fee prices in the DisCos forgone returns from selling electricity to eligible customers. One DisCo management staff[115] said:

> *"In theory, the DisCo should be compensated for any customers that are taken off in that way, in one way or the other. If that's the case, then I wouldn't be mad. However, if that's not done, then basically, when I go for my next tariff application, my customer profile will have changed, they would have taken a way the customers that in a way would have been subsidizing the lower end customer and if that's the case, you are going to make the situation worse for the same customer that you say you are trying to protect."*

The DisCo have not been quick to sign DUoS agreements with the GenCos and as a result, have stalled GenCo participation in the eligible customer regime. This gives off-grid and captive power project IPPs all the benefit of the Eligible Customer regime. This makes the liquidity crisis even worse. However, MAN are of the opinion that the DisCos are intentionally acting to

[115] Ibid.

block the implementation of the Eligible Customer regime. MAN, in public statement, stated that:

> *"We are making progress and a number of our projects are almost maturing. We are trying to overcome the challenges that the DisCos have put to deliberately block our members from accessing the Eligible Customer Scheme, but we are overcoming it, and we are engaging all the stakeholders in order to access this, and if that happens, we are likely to experience a dramatic improvement of our access to power (Adekoya, 2019)."*

The relationships in the NESI became even more contentious in January 2018, when the FGN, through the NBET, began buying electricity from a newly built power station, the 450 MW Azura-Edo gas power plant. The Azura-Edo power plant was the first privately financed grid-connected power plant, and it was developed by Azura Power West Africa. Azura Power West Africa reached financial close only after securing two critical guarantees. The first, was a USD 237 million Partial Risk Guarantee from the World Bank to support NBET's liquidity to enable bill payments to the Azura power plant. The risk of the World Bank Partial Risk Guarantee is ultimately borne by the FGN. The second guarantee, a Put-Call-Option Agreement (PCOA), between the FGN and Azura-Edo IPP allows Azura Power West Africa to compel the FGN to buy out their shares in the project if an unwanted trigger event occurs. These guarantees aided the Azura-Edo project to reach financial close, and also required the FGN to treat it differently from other GenCos.

To avoid the risk of triggering the guarantees and to avoid the NESI appearing unable to support the first privately financed project on the grid, the FGN ensured that the Azura power plant got paid in full for all electricity it sent out. This forced the other GenCos, who only get paid a fraction of what is owed to them, to take the FGN to court for what they perceived as preferential treatment towards Azura power plant to the detriment of the rest of the NESI. The Minister for Power took an antagonistic response to the GenCos' legal action. During a meeting with NESI operators in March 2018, the Minister for Power, Mr. Fashola reacted to the legal action from GenCos, saying:

> *"That is their right and their prerogative…While they seek refuge in a court of law, they must be ready to face scrutiny in the court of public opinion… Those who choose to hide temporarily in the courts of law can do so, but the court of public opinion will scrutinize you, and its verdict may be very scathing, unkind, and enduring (Ochayi, 2018)."*

The distrust for the PDP-led privatisation process and private operators by the APC ruling coalition in government came to light again during the same meeting when Mr. Fashola accused the GenCos of holding a political agenda. The Minister said:

> *"Let me say very clearly to all operators that I get reports of many of the clandestine meetings that some of them are holding with a view to disrupt supply for political capital (Ochayi, 2018)."*

In addition to this, in 2019, after the APC had been declared winner of the 2019 presidential election, a very senior party member and former Governor of Lagos State, Senator Bola Tinubu, stated publicly that the privatisation of the PHCN assets needs to be revisited. This was taken very seriously by industry stakeholders not only because of Senator Bola Tinubu's stature in the APC, but because of his relationship with the Minister for Power. The Minister for Power, Mr. Fashola served in Senator Bola Tinubu's Lagos Stage Government from 1999 to 2007, before the latter supported Mr. Fashola to succeed him as governor of Lagos State. After the APC was declared winner of the presidential election in 2019, Senator Tinubu claimed that:

> *"The PDP administration shared our generation, distribution and transmission to their friends and cronies without very deep and thoughtful research and evaluation… For a more constructive reform to improve generation, transmission and distribution, this privatisation must be reviewed (Oluwajuyitan, 2019)."*

The NESI operators very quickly moved into a contentious relationship with the bureaucracy after privatisation. The relationships became worse when the new ruling party, armed with their distrust for the privatisation process, came into power in 2015. This has affected the sector's ability to organise itself to increase productivity and liquidity in the sector.

In the preceding analysis of the evolution of the NESI liberalisation reform, it showed that while mutual interest appeared to have eventually emerged between the government and capitalists for the prevacation of the NESI, it did not. This is because the social cost of establishing cost-reflective retail tariffs in a completive clientelist state like Nigeria is considered too high and the off-grid power supply option provides the government with adoption of improving supply without dealing with retail tariff issue and liquidity crisis. Additionally, it is important to note that the learning for productivity condition did not emerge in the NESI liberalisation reform because the private NESI utilities could not generate the learning rent in the first place. The next section analyses the on-grid RE programme, which is the failures of the NESI, in part, also inhibits the 22

5.5.2.2 Renewable energy policy in the NESI in the fourth republic

There have been four FGN policies promoting RE on the grid in Nigeria during the fourth republic. The FGN developed the National Energy Policy in 2003; the RE Policy Guidelines in 2006; the Multi-Year-Tariff Order (MYTO) in 2012; and the solar IPP procurement exercise in 2016.

President Obasanjo's 2003 National Energy Policy (NEP) was developed to promote the optimisation of the country's diverse energy resources for sustainable development. The RE resources mentioned in the policy include solar, wind and biomass resources. The rationales behind including RE technologies in the 2003 NEP were to improve energy access; utilise Nigeria's available energy resources sustainably; and reduce traditional biomass fuel consumption in Nigeria (NEP, 2003). However, the RE objectives and strategy in the 2003 NEP were aspirational and had no clear targets. It included statements on the need to develop the country's capacity to pursue RE integration on the grid, and the need to develop RE markets to promote RE integration on the grid. It also mentioned the need for R&D and human capital development in the RE field. The effects of the 2003 NEP were not significant until 2006, when the RE policy guidelines were developed to flesh out the RE aspirations embedded in the 2003 NEP.

The 2006 RE policy guidelines, also developed during President Obasanjo's administration, outlined seven clear policies to promote RE deployment in Nigeria. These policies included two ten-year RE targets: a ten-year capacity target and a ten-year production target. The capacity target was for RE technologies to reach at least five percent of total electricity generating capacity, and the production target was to meet a minimum of 5 TWh of electric power production, excluding large hydropower, by 2016. To meet these targets, the government outlined several critical strategies in the 2006 policy guidelines. One of these strategies was the establishment of feed-in-tariffs for RE projects. The feed-in-tariffs were only developed six year later in 2012 during President Jonathan's administration. The 2006 RE policy guidelines also included the FGN's strategy to develop PPA templates, through the regulator, for RE projects. The PPA templates were eventually developed ten years later in 2016. Some other strategies outlined in the 2016 policy focused more on off-grid RE deployment. The Renewable Electricity Trust Fund, was also proposed to be established under the statutory Rural Electrification Fund, created by the 2005 EPSRA. Again, the 2006 RE policy guidelines did little except to provide the framework for which the feed-in-tariffs were developed six years later in 2012 during the administration of President Jonathan.

Fourteen project developers Selected: Mutual interest?

On the 1st June, 2012, the FGN issued the Multi-Year-Tariff-Order 2 (MYTO 2) that established five-year wholesale and retail electricity tariffs for the NESI between June 2012 and May 2017. The MYTO 2 also included feed-in-tariffs for utility-scale solar, wind, small-hydro, and biomass power plants. The feed in tariffs for solar PV power plants on the MYTO 2 was NGN 67.91/KWh (USD 0.42/KWh in 2016) as shown in Table 5.4.

Table 5.4: Renewable energy wholesale feed-in-tariffs from the MYTO 2 in 2012.

(NERC, 2012)

Year	Wind		Solar PV		Small Hydro		Biomass	
	NGN /KWh	USD /KWh	NGN /KWh	USD /KWh	NGN /KWh	USD /KWh	NGN /KWh	USD /KWh
2012	24.543	0.152	67.917	0.422	23.561	0.146	27.426	0.170
2013	26.512	0.157	73.000	0.432	24.433	0.145	29.623	0.175

2014	28.641	0.161	79.116	0.444	27.456	0.154	32.000	0.180
2015	30.943	0.164	85.401	0.452	29.643	0.157	34.572	0.183
2016	33.433	0.169	92.192	0.466	32.006	0.162	37.357	0.189

This feed-in-tariff came in two years after the federal government introduced the 2010 power sector reform roadmap to reboot the privatisation of the NESI. The 2010 roadmap and the 2012 feed-in-tariff generated interest in on-grid RE opportunities from several project developers[116]. These project developers were also motivated to develop solar PV projects because they would not have to deal with the problematic gas supply infrastructure that accompanies gas power projects[117]. Several project developers began developing their projects by moving to secure land for their solar PV projects. Several developers initiated the process of securing project land by bringing the state governments, which have the ownership[118] of all lands, into the project as shareholders through land equity. As the project developers and state government negotiated state government entry into the projects, the state governments allowed the developers to start environmental impact assessments (EIAs) on the project sites[119]. As project development work

[116] Source: Interview with on-grid RE Project Developer. Abuja, Nigeria. 07 May 2018.
[117] Ibid.
[118] The 1979 Land Use Act gives the State Government ownership of lands. The State Governor may then sell the ownership of land to the public by issuing buyers a 100-year Certificate of Ownership (C of O).
[119] Source: Interview with interviewee from state-owned energy trader. Abuja, Nigeria. 19 February 2018.

progressed, project developers began to approach the NBET to initiate PPA negotiations through the unsolicited power procurement process set up by the NBET.

All of the new projects being developed at that time were categorised by the regulator as unsolicited power projects, because the government had not established a competitive process such as was done in South Africa's 2011 Renewable Energy Independent Power Producer Programme (REIPPP). The NBET, Nigeria's bulk power purchaser, established guidelines for unsolicited power projects to execute a PPA. The unsolicited power procurement exercise was led by NBET. By 2014, NBET had outlined four mandatory requirements that project developers had to meet as part of a due diligence process before they could engage in PPA negotiations with project developers. These documents were; a certificate of occupancy for the project land (C of O); EIA approval; Evacuation Agreement with the transmission company; and fuel agreement, which was not required for solar PV projects[120]. Additional requirements were an energy production model[121] and a financial model for PPA negotiation[122].

NBET engaged solar PV project developers individually; however, this process was slowed down by two factors. First, the NBET was still in the process of developing its first solar PV PPA template[123], with the assistance of Power Africa, the United States' aid effort to mobilise

[120] Source: Interview with on-grid RE Project Developer. Abuja, Nigeria. 07 May 2018.
[121] The energy production model is an assessment that projects how much energy can be produced from a power plant.
[122] Source: Interview with on-grid RE Project Developer. Abuja, Nigeria. 07 May 2018.
[123] Ibid.

finance to the power sector in Africa. Some developers, during their engagements with Power Africa representatives, had highlighted their concerns about NBET's capacity to develop a solar PV PPA template[124]. Technical assistance was eventually provided to NBET and they developed the first solar PV template by 2015. This delayed the solar PV procurement process. The second factor that delayed the procurement process was the contestation that ensued between BET and NERC over the regulator's feed-in-tariffs for on-grid solar PV. The NBET bureaucracy made it clear to the project developers that the feed-in-tariff set out by the regulator in the MYTO 2 was too high and would not be viable[125]. The developers supported the tariffs claiming that while other countries may have procured solar PV projects at much lower rates, these countries were not good reference points for Nigeria. South Africa had procured solar PV projects during their 2011 REIPP program at USD 0.345/KWh (IRENA, 2013). See Figure 5.7). In 2012, Ghana had feed-in-tariff rate of USD 0.20/KWh while Kenya had feed-in-tariff set at USD 0.12/KWh (FEEM, 2018). By 2014, Rwanda had their solar PV feed-in-tariff set at USD 0.25/KWh, while Uganda had their feed-in-tariff set at USD 0.164/KWh (Wakaba, 2018).

[124] Ibid.
[125] Source: Interview with on-grid RE Project Developer. Abuja, Nigeria. 07 May 2018.

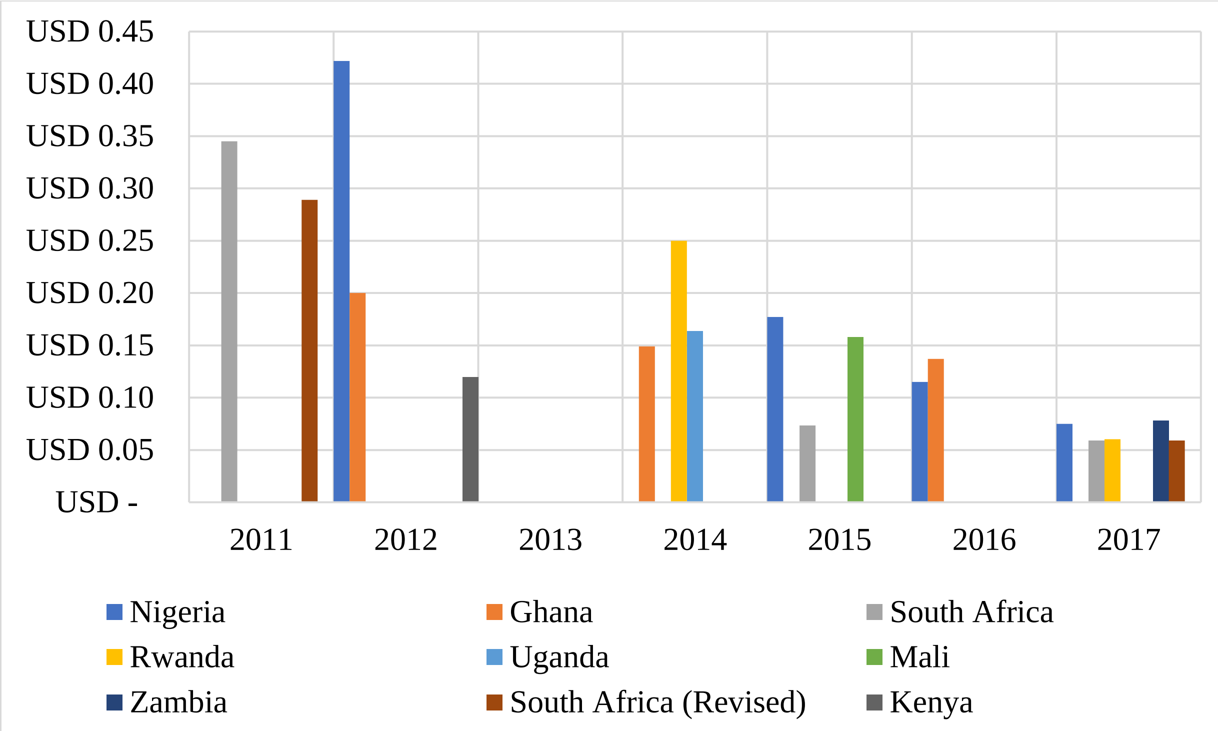

Figure 5.7: utility-scale Solar PV wholesale price across of Africa between 2011 and 2017.

Source: (IRENA, 2013; FEEM, 2018; Wakaba, 2018).

NBET had more sway than the regulator, NERC, in determining the price at which the FGN would purchase power from the project developers[126]. This could have been because the chair of the board of NBET was the Minister for Finance, Dr. Ngozi Okonjo-Iweala, whose job was in part to control the government's fiscal liabilities. Ownership of the NBET is 40% Federal Ministry of Finance, 20% BPE and 40% Federal Ministry of Power (FMP). Towards the end of 2014, there were numerous unsolicited solar PV project developers engaging NBET for a PPA.

[126] Source: Interview with on-grid RE Project Developer. Abuja, Nigeria. 07 May 2018.

NBET had to develop a procurement process to decide which projects it would fully engage on PPA negotiations. NBET reinstated their four requirements for PPA negotiation, and shortlisted 14 of them, whom NBET would engage in PPA negotiation. While NBET intended to use it selection criteria to screen developers it would engage in PPA negotiations, it did not. Some politically influential developers began engagement with NBET without these documents[127]. Some of the developers used their influence with the political elite and top bureaucrats to get shortlisted. This list of 14 solar IPPs included companies with operational conventional generation assets and gas production assets.

In 2015, eight weeks before President Jonathan handed over to President Buhari, the Federal Ministry of Power published the National Renewable Energy and Energy Efficiency (NREEE) policy, which was developed by a federal inter-ministerial committee on RE and energy efficiency. The committee was led by a senior federal bureaucrat, Engr. Abayomi Adebisi, and approved by the President Jonathan's cabinet (FGN, 2015). NREEE was established to set the foundation for RE and energy efficency targets in Nigeria. Its implementation was however delayed. President Buhari was unable to assemble his cabinet for over six months after he assumed office on the 29th May 2015. There was no minister of power until President Buhari assembled his cabinet on the 11th of November 2015. This added to the delays for RE projects as industry stakeholders remained unclear about the policy direction of the new government.

[127] Ibid.

Nine months after the NREEE was developed, the regulator published, in February 2016, the Nigeria Feed-in Tariff for RE Sourced Electricity, which outlined new feed in tariffs for RE (MYTO, 2016). The new feed-in tariff for Solar PV was reduced by NERC to less than half of the previous tariff from USD 0.422/KWH to USD 0.172/KWh (MYTO 2016). The project developers accepted this, acknowledging the global reduction in price of solar PV panels. However, NBET rejected it again.

NBET continued to engage each of the 14 project developers individually until May 2016 when the Minister for Power, Mr. Babatunde Fashola, called a meeting with all 14 solar project developers, where he aimed to understand how the FGN could assist in helping their projects reach financial close[128]. He advised the developers to decide amongst themselves and propose a new procurement process to the FGN, stating that the USD 0.172/KWh in the regulation was too high, and that it would require a monthly subsidy of NGN 3.3 billion (2016 USD 17.2 million)[129]. The developers disagreed with the FGN arguing that the FGN's estimation of its potential monthly liability assumed that the government would continue to subsidise the non-cost reflective retail tariff. They argued that the government would eventually have to remove the

[128] Ibid.
[129] Ibid.

retail tariff anyway, stating that there was no realistic pathway along which a non-cost reflective tariff is sustainable in the NESI[130]. They explained that the government's liability would be lower if the retail tariff was cost reflective. The social cost of increasing retail electricity tariff began to emerge as a barrier

At this point, another figure of USD 0.162/KWh had been informally floating around the industry[131]. After this meeting most of the developers proposed a joint strategy that the FGN could take and formulated in a letter.

The developers sent a joint letter to the Minister signed by most of the 14 on-grid RE developers[132]. The letter proposed that the procurement be done in three stages. The first 600 MW to reach finical close would get a tariff of USD 0.158/kWh. The next 500 MW to reach financial close would get USD 0.138/kWh and the next 400 MW would get $0.118/kWh. The FGN rejected this idea and so did two other project developers[133]. There were several more individual meetings between the FGN and the project developers, most of whom were trying to undercut the others by promising the FGN lower costs if they could be allowed to sign a PPA. At this point power appeared to shift from the bulk trader, NBET, to the Ministry of Power[134]. The bureaucrats at the Ministry of Power appeared to have more sway in the President Buhari's

[130] Ibid.
[131] Ibid.
[132] The author gained access to a copy of this letter through one of the on-grid RE developers.
[133] Source: Interview with on-grid RE Project Developer. Abuja, Nigeria. 07 May 2018.
[134] Ibid.

administration than the Jonathan-appointed leadership at NBET. The project developers sought to convince the bureaucrats at the Power Ministry that they had the best project. Some developers tried to bring the influence of the state governors where their projects were situated to bear on the Ministry of Power[135].

After several more individual meetings, the project developers agreed with the FGN to sign the PPAs at USD 0.115/KWh. All 14 project developers agreed to it and signed PPAs with NBET in July 2016 with a six-month sunset clause, requiring developer to reach financial close within 6 months.

High Contestation Over Retail Tariff and Solar PPA: No Centralised pocket of Efficiency

The next barrier came as contestation arose between the Ministry of Power and the Ministry of Finance over the latter's unwillingness to sign PCOA guarantees with the project developers at USD 0.115/KWh. There was a resistance from the Ministry of Finance to sign the PCOA in USD. If the FGN signed the PCOA in USD, this would mean that if a trigger event occurs, the FGN would have to buy the developers shares in the power plant at fixed price in USD. This would expose the FGN to a foreign exchange risk.

The DFIs had helped initially with the PCOA issue of the solar IPP developers; although indirectly. The DFIs participated in talks with an on-grid gas-fired project, Qua Iboe Power

[135] Source: Interview with on-grid RE Project Developer. Abuja, Nigeria. 07 May 2018.

Plant (QIPP)[136]. The role the DFIs played in nudging the FGN to enter a USD-denominated PCOA with QIPP opened the space for the 14 solar IPPs to negotiate USD-denominated PCOAs[137]. The new Ministry of Finance agreed in principle to a USD-denominated PCOA. However, another barrier was erected by the Ministry of Finance, which placed conditions on signing the USD-denominated PCOAs[138].

On the 11th of February 2018, the contestation between the Ministry of Finance and Ministry of Power became public – a ThisDay newspaper article titled "Why $2.5 Billion Solar Power Projects are Stalled," written by Chineme Okafor, pointed out that the Ministry of Finance was withholding PCOAs because of the non-transparent procurement process and the costly PPA tariff. The article explained that after the departure of the Managing Director of NBET, Mr. Rumundaka Wonodi, whose tenure was not renewed by the new APC administration after it expired in 2016, there was a paved "way for some officials in the NBET and power ministry to cut deals with the investors, and the 11.5/KWh price was approved for them (Okafor, 2018)." The article stated that some projects were allowed to sign PPAs with NBET even before they had received their generation licenses from the regulator. The article went on to state that the Ministry of Power and NBET had tried to apply pressure on the Ministry of Finance to sign PCOAs with the developers but the Minister, Mrs. Kemi Adeosun, refused, insisting that the

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[136] Ibid.
[137] QIPP did not reach financial close. Just like the on-grid solar projects, it was also stalled due to the fiscal liability it would place on the FGN.
[138] Ibid.

procurement process had to be fair and competitive, and projects had to be viable and needed by the country. The article also claimed that two of the fourteen solar IPPs had agreed to a lower tariff of USD 0.075/KWh, which was reportedly acceptable to Mrs. Adeosun. This article came as a surprise to the project developers[139]. This was the first that the solar IPPs had heard that the Ministry of Finance was taken this position, and they immediately took it as an underhanded move from the Ministry of Finance, which had not taken a public position on the matter[140].

Off-Grid Focus: Competing and Mutual Interests

The developers were fighting an uphill battle because the PSRP, the FGN's power sector policy document, had just been published in January 2018. The PSRP recommended that the NESI improve its commercial and technical efficiencies before adding any new power plant to the grid. The PSRP was also supported by several DFIs, who were clear that they would not provide or support certain guarantees such as the PRG for any new project unless a significant amount of the PSRP was implemented. This DFI stance marked a change in prospects for the solar IPP as the Ministry of Power subsequently changed its position, changing its priority to off-grid renewables through the Nigerian Electrification Programme led by the Rural Electrification Agency. The Minister of Power and the head Rural Electrification agency had both come from the government (2007 – 2015) of Lagos State. The Minister had been the governor and the head of the RE had been the head of the Managing director if the Lagos State Electricity Board. They

[139] Source: Interview with on-grid RE Project Developer. Abuja, Nigeria. 07 May 2018.
[140] Ibid.

both had extensive experience with off-grid RE projects and developers. The author did not find any concerted effort to mobilise against the on-grid RE developers. However, the convergence of the liquidity crisis, high social cost of increasing the retail tariff; and the availability of the off-grid option created a barrier for on-grid RE developers. While some actors invested in both on-grid and off-grid RE project development, it stands that the prioritisation of off-grid RE by the government proved a barrier to on-grid developers.

The DFI-funded guarantees that the government had initially sought for on-grid RE project developers was delayed, while the government borrowed USD 550 million from several DFIs to fund the off-grid-focused Nigerian Electrification Programme[141]. The Minister of Power, Mr. Fashola's position of the solar IPPs changed right after the PSRP was published. A few days before the article about the Ministry of Finance's PCOA refusal, Mr. Fashola blamed the solar IPPs for making demands that the FGN could not meet. He stated that:

> *"Everybody wants to sell (electricity) only to NBET because it comes with government guarantee. Now, that is how those solar projects were procured before I came. They were on the drawing board, nothing was happening until we pushed and pushed they signed power purchase agreements. Ideally, once you sign a power purchase agreement, your project is bankable, but there is another instrument they usually want – a Put Call Option Agreement (PCOA), it guarantees against if the project terminates*

[141] Source: Interview with international development financier. Abidjan, Cote d'Ivoire. 22 November 2018.

> *or fails. And, I always ask them: are you planning for this project to fail because if we have given you the instrument that gives you the bankability, why are you spending so much time on the instrument that will help you to collect money if the project fails, are you planning for the project to fail? They still have their PPAs, so there is nothing to fear, but there is a PRG or World Bank guarantee behind the PCOA, the World Bank is now saying, this thing is expensive, prices are crashing, and so, it is not me saying so, it is the ultimate party who would sign that is saying price is too expensive, and so it is not me, it is not our ministry and it is not our government (Offgrid Nigeria, 2018).*"

As of September 2018, there was still no RE plant deployed on the grid in Nigeria. The next section uses the PoIP Framework to analyse the narrative presented in this section.

The analysis of the things in this section showed how, again, mutual interest appeared to have formed between the leadership of the Ministry of Power and the politically influential on-grid RE developers. However, the contestation between the Ministry of Power and the Ministry of finance resulted prevented the government forming mutual interests with the on-grid project developers. Additionally, the high social cost of increasing the retail tariff due to on-grid RE projects was too high for the government. Hence, the Ministry of Finance intervened in the procurement process, showing that no politically isolated pocket of efficiency emerged.

5.6 Discussion

5.6.1 Mutual Interests

Mutual interests did not emerge during the botched GSM licensing process due to contestation within the ruling coalition over GSM license rent. However, it emerged in the subsequent GSM license auction. *Mutual interest* was formed by the FGN's need to generate additional national income and the profit-making interest of the capitalists and the former military establishment who helped the PDP into power in 1999. Two conditions allowed *mutual interest* to emerge. First, President Obasanjo moved to minimise contestation around the policy by placing the NCC at the centre of the second GSM licensing process, enforcing changes at the regulator, NCC; sacking its leadership and replacing it; and prioritising resources to it. Second, influential former military officers and PDP-aligned capitalists were able to push for the sale of the licenses – and in one case, even use government resources to capture state assets in private hands. It is however important to note that the GSM licensing process failed the first time around despite telephony services not being a major source of rent distribution compared to electricity subsidies. As this chapter shows, there are other important considerations beyond the rentier mentality. While the rentier mentality is an important feature of the NESI, it is not the all-explaining factor. The reform in the telecoms sector showed that industrial policy can be unsuccessful even in sectors where the rentier mentality does not have as much influence. The first unsuccessful attempt to sell licenses in the telecoms sector failed due to political contestation over GSM license rents. Analysis with the PoIP framework also helped to show that political contestation played a major role in the failure of government interventions in the NESI. The delay of the NESI privatisation process was in part caused by political contestation in President Yar'adua's cabinet. Some of his cabinet members influenced his decision to halt the privatisation process, while others unsuccessfully pushed for its continuation.

President Yar'adua, like many politicians from Northern Nigeria had a history of coming down on the side of state-owned enterprise. This thesis does not argue that there is a sharp north-south divide on the issue of privatisation. After all, Vice President Atiku (1999-2007), from the North, led the PDP's privatisation effort as the head of the NCP and Africa's most successful capitalist, Aliko Dangote, is also from the North. However, when state-owned assets are privatised in

Nigeria, political elites lose the power to appoint executives to state-owned enterprises; hire associates and relatives in state-owned enterprises; and influence the award of public contracts to friendly businesses. The loss of this power arguably affects the Northern political elite disproportionately more because the balance of political power in Nigeria has been titled in favour of the North historically. President Musa Yar'adua's administration, which lasted from May 2007 to May 2010, slowed down the NESI liberalisation process. Even issues as intensely contested as the retail tariff were foreseen by the developers of the reform Act in President Obasanjo's administration. President Obasanjo's administration put Clause 83 in the EPSR Act. Clause 83 established the Power Consumer Assistance Fund to "subsidize underprivileged power consumers as specified by the Minister of Power." This fund, along with other reform measures were halted by President Yar'adua. The reforms were rebooted by his vice president, Dr. Goodluck Jonathan, who took over from him.

The *mutual interest* in the liberalisation of the electricity sector appeared to be re-established by President Jonathan's administration, which was also seeking to reduce wasteful budgetary allocation to PHCN and raise capital from the sale of the PHCN assets. President Jonathan reduced contestation around the policy by establishing a Presidential Taskforce for the NESI privatisation programme, which he led. Also, the political elite sought to capture state assets under Jonathan's PHCN privatisation programme. However, after privatisation, the apparent *mutual interests* between the government and the new operators, especially the DisCos, proved to be non-existent as the social cost of increasing the retail tariff proved more important to the government than honouring its agreement with the NESI capitalists. The FGN prevented the regulator from allowing the DisCos to charge a cost-reflective tariff, breaking its obligation to the DisCo.

The *mutual interest* between the FGN and DisCos did not emerge, and the relationship between the FGN and DisCos became worse under the new APC administration, which had a strong distrust for the PHCN privatisation process led by the PDP. The misalignment of interests between the government (which was not willing to absorb the social cost of high retail electricity prices) and the NESI operators (who needed a higher retail price to generate the rents) stalled progress in the sector. This misalignment of interests was also inherited by the on-grid RE developer, whose interest were aligned with the on-grid conventional project developers. Both group of developers depend on the liquidity of the NESI.

With the on-grid RE programme, the interests of the FGN and on-grid RE developers did not align as the FGN was not willing to take on additional generation capacity on the grid until the liquidity crisis in the sector was sufficiently addressed. However, before the FGN came to this decision, it had procured 14 privately developed on-grid RE projects in 2016. The procurement process was spurred on by some of the 14 politically influential project developers, which included some on-grid conventional energy players and gas companies. As the Minister of Finance alleged, some political elite and bureaucrats cut deals with some private developers in a non-transparent procurement process at prices the Ministry of Finance considered to be too high.

The combination of both the Ministry of Finance’s objection (and the resulting contestation with the Ministry of Power) and the Ministry of Power’s off-grid option created the conditions for mutual interest to form with the off-grid RE developers.

As (Whitfield, 2015) argues, *mutual interest* can lead to the failure of some industrial policies as some interests can be contradictory. For example, the availability of the off-grid RE option, in part, led to reduction in momentum for the on-grid RE projects. The APC-government of President Buhari has shown a clear preference for off-grid RE, and emblem of which is the

FGN's USD 550 million Nigerian Electrification Programme, financed by a loan from DFIs. As mentioned earlier, the price of electricity that the on-grid RE developers were offering (US 0.115/KWh) is much lower than the price of installed off-grid solar plants, which ranges between USD 0.318/KWh and USD 0.796/KWh and has a median price of – USD 0.531/KWh (NESG, 2018).

The *mutual interest* between the political elites and the off-grid RE capitalists under the Nigerian Electrification Programme drove the Nigerian Electrification Programme but have caused the on-grid RE projects to stall. Also, the political influence of MAN (the Manufactures' association) caused the eligible customer policy to be implemented in an unproductive way – prioritising off-grid generation for productive credit-worthy consumers and creating the potential to further deepen the liquidity crisis on the grid.

For the NESI to solve the liquidity crisis and for the on-grid RE sector to reach its potential and targets, the mutual interest most form between the on-grid stakeholders and the government. This *mutual interest* can be formed through the introduction of a parallel electricity market for productive consumers, who will receive prioritised electricity supply at a premium that is higher than the current subsides rate but lower than the cost of self-generation. This market will allow RE and conventional GenCos to charge cost-reflective retail prices to productive credit-worthy consumers, including MAN. The proposed market will run parallel to the existing market, which will continue to operate as is. The parallel market, its risks, and the conditions under which it can thrive will be described in the Chapter 6 of this thesis.

5.6.2 Pockets of Efficency

Mutual interest is a necessary condition for successful industrial policy, but it is not sufficient. The professional capacity of the state bureaucrats to formulate and implement policies efficiently is also important (Whitfield, 2015). The bureaucrats must also have the support of the ruling elite. High professional capacity and political insulation of critical state bureaucrats creates the *pocket of efficiency* necessary for state bureaucrats to freely formulate and implement industrial policy. In the telecoms sector, the President Obasanjo-led government took away the lead of the GSM license sale process from the Ministry of Communication, which had been infiltrated by contesting political elites and capitalists, to the NCC where a *pocket of efficiency* was created. The NCC formulated and implemented the transparent GSM license auction process that led to the success of the telecoms sector. In addition, its sustained success and increasing economic importance made it less susceptible to political interference as illustrated with the MTN fine. Although the fine was reduced, it showed the resilience of the *pocket of efficiency* established at NCC. The privatisation of PHCN was also formulated and initially implemented by an *efficient* unit within the state bureaucracy, BPE. The delay in BPE's PHCN privatisation process was a result of political costs and contestation during the PDP administration of President Obasanjo and President Yar'adua. A pocket of efficency appeared to have emerged at BPE during President Obasanjo's second administration when the EPSRA was passed into law in 2005 and when NEPA was subsequently corporatised to become PHCN. However, that momentum was lost during President Yar'adua's administration due to the contention within his cabinet. President Jonathan's government attempted to establish a *pocket of efficiency*; first, reducing contestation by making himself the Minister for Power and then creating a presidential Taskforce on Power, which he oversaw, creating a politically insulated path for BPE to privatise PHCN in 2013 and complete the liberalisation of the sector.

The privatisation and liberalisation of the sector NESI led the way for private sector involvement in on-grid RE development. Many capitalists began to developers on-grid projects, including on-grid RE projects. However, the *Pocket of efficiency* did not emerge in the Solar IPP procurement process as was explained earlier in two ways. First, NBET was infiltrated, just as the Ministry of Communication was infiltrated, by political elites and capitalists. This resulted in the solar IPP procurement process being non-transparent and lacking integrity. The integrity of the solar IPP procurement process has been one of the main points used by the Ministry of Finance to explain why the on-grid RE procurement programme should be stalled. If a *pockets of efficiency* does not emerge at NBET, it won't be able procure on-grid RE projects competitively and increase the appearance of integrity and transparency in the procurement process. Second, a pocket of efficiency did not emerge as the Minister of Finance infiltrated the procurement process and refused the 14 solar IPPs sovereign guarantees. To ensure that a critical *pocket of efficiency* emerges in the electricity sector, the role of solar IPP procurement should move from NBET, to private, productive credit-worthy buyers in the proposed parallel electricity market described in Chapter 6. The role of the state bureaucracy in the parallel electricity market would be restricted to setting on-grid RE target and regulating the sector. NERC is independent at least in law. Just as with NCC, NERC would still require a pocket of political insulation to license new IPPs in a transparent way with simpler clear-cut requirements for licensing. In the context of the proposed parallel electricity market, the licensing process is less critical than the procuring process, which would be in the hands of privately-run market operator in the parallel market.

5.6.3 Pockets of Efficiency

As illustrated, the emergence of *mutual interests* and *pockets of efficiency* helped to push through the liberalisation of the telecoms and electricity supply sectors. However, the sustainability and success of the reforms also depend on the increase in productivity of capitalist firms. Firms must use policy-generated learning rents to increase their productivity. The *learning for productivity* condition emerges when the bureaucracy can mediate between private sector needs and public needs; and is able to enforce regulations they set.

After the liberalisation of the telecoms sector, technical working groups were set up by NCC and the GSM licensees to identify the challenges and opportunities across the sector. This embedded the NCC bureaucracy in the private sector and enabled them to understand the challenges in the sector. Understanding the challenges in the sector made it easy for NCC bureaucrats to mediate between the operator's interest and public interest at consumer-operator stakeholder meetings. The NCC has also been able to enforce learning rents, building on its historical momentum of independence and effectiveness during the early years of the reforms.

In contrast, the critical state agency in the electricity sector, NERC, was not able to enforce learning rents especially relating to DisCos' performance. The main issue for this is that the regulator, NERC, has not allowed the DisCos to receive the rents they expected to receive when they procured the distribution network assets. The FGN did not allow the regulator to establish cost-reflective retail tariffs, which are supposed to be the source of learning rents. As a result, it is difficult for NERC to enforce its own regulations as it has not met its own obligations. It is also difficult to assess what amount of learning needs to be done without the governments providing the learning rents to DisCos. The true gap in DisCo capabilities can only be truly known when cost-reflective tariffs are allowed by the FGN. This will enable the sector to determine where the bottle necks are and where learning opportunities are in the sector.

Creating a parallel market for productive credit worthy consumers will expose the learning opportunities in the sector, because the parallel market will allow cost-reflective tariffs and expose where non-liquidity related bottlenecks in sector exist. This will help the sector effectively allocate the learning rents generated in the parallel market.

Also, in the early period of the reforms, working groups, similar to those formed in the telecoms sector, were formed in the NESI to embed state bureaucrats in the private sector and enable them to understand the challenges and opportunities in the sector. However, these working groups eventually stopped after the APC-led government came into power, relationships amongst operators and bureaucrats in the electricity sector became more antagonistic and less productive with bureaucrats unable to effectively mediate between capitalists' interest and public interest. This has contributed to the festering liquidity crisis and prevented the deployment of new on-grid generation capacity, including on-grid RE generation technologies.

The PoIP framework sheds light on the enabling and constraining political economic conditions around an industrial policy. After analysing the data for this comparative study, it can be argued that quick wins or successes can make reforms less susceptible to political interference as in the case of the telecoms sector. The successes in the telecoms sector made it difficult for political interference to derail reform-dependent growth trajectory. In the NESI the success has not been seen, and as such, it may be easier to derail the reforms process with political interference. The scale of the NESI means it will take longer to successfully implement reforms, which means it may yet be subject to more political interference. The introduction of a parallel electricity market for productive, credit-worthy consumers may create the quick wins. The parallel market will function with full cost-reflective retail tariffs that will generate learning rents that can be enforced. The success may not be directly seen by the public. However, hearing about the constant power to industrial and commercial consumers, where many members of the public work may create a sense of impending success for the rest of the NESI. This may make the reforms less susceptible to political interference in the long run.

5.6.4 Key Insights for On-Grid RE Intervention

This chapter answers Research Question 3: what are the political economic conditions that must emerge to successfully implement the government's policy to drive on-grid RE investments in Nigeria? The answer: *three critical political economic conditions mutual interests, pockets of efficiency,* and *learning for productivity* – did not emerge for the NESI liberalisation and the on-grid RE procurement process. The analysis in this chapter provides three sector-specific insights and one insight for the literature.

The sector-specific insights include:

1. **Minimising the Social Cost of Change:** This chapter shows that polices that have high social costs are at risk of failing as they can increase the political vulnerability of ruling political coalitions. In the case of the telecoms sector, the social costs of selling GSM licenses did not threaten to increase the vulnerability of the political elites. The telecoms sector was not a major source of rent distribution to citizens compared to the NESI, so it did not pose as high a social cost. However, like both the RST and PoIP framework argue, taking away institutionalised subsidies from citizens can come at a high social cost. Indeed, polices that pose such a high social cost pose a threat to ruling political coalitions in the short run. The PoIP framework argues that this phenomenon is more intensified in countries like Nigeria, which exhibit competitive clientelism. In sectors, like the NESI, where industrial policy is likely to come at a high social cost, polices should be developed to maximise efficiency within the political constraints. As Dani Rodrik (2014) argued, interests are important; however, policy ideas are just as important. The parallel electricity market policy proposed in Chapter 6 presents an option to solve to the liquidity crisis can be gradually resolved by creating a parallel reliable market for productive and commercially viable consumption. In the parallel market,

credit-worthy consumers that qualify will be charged a premium, preventing the exiting market from requiring any drastic increase in the retail electricity price. This gradually solves the liquidity crisis by generating income from reliably supplied parallel market consumers without raising the price of electricity for other consumers. In the telecoms sector, the price of a GSM line was NGN 60,000 (USD 509) in 2001 for consumers, who could afford it. By 2011, after rents had been generated and used to improve productivity in the sector, it became free to own a GSM line. The parallel market proposed in Chapter 6 proposes the same kind of strategy, placing a premium on early parallel market consumers and using the rents generated to expand the capacity of the PEM to take on more consumers.

2. Minimising Political Contestation: Establishing Pockets of Efficency and Mutual Interests

As the analysis of the telecoms sector intervention shows, the low social cost of the GSM license auction was not enough to push through the intervention. The GSM license sale had a false start despite its relatively low social cost. The first attempt was aborted due to contestation for GSM license rents among political elite within the ruling coalition. President Obasanjo reduced the political contestation around the intervention, helping to create the conditions for the emergence of a pocket of efficiency at NCC and mutual interest with the capitalists. He removed the Minister of Communication as the lead personnel for the GSM license sale process to stem political contestation surrounding the policy; placed the regulator, NCC, at the centre of the auction; sacked and replaced the leadership of the NCC; and mobilised resources to NCC to hire new and competent staff.

Together with the low social cost of the auction, this created a pocket of efficiency at NCC. NCC ran a smooth auction that resulted in the auction winners securing the GSM licenses. The resulting reduction in the political contestation also gave room for mutual interests with the capitalists, who were prepared for a transparent auction process.

The key insight is that the social cost or vulnerability of the ruling coalition is not the only consideration for successful industrial policy. The on-grid RE procurement programme and wider NESI privatisation programme would benefit from low contestation around the NESI interventions. Low political contestation can create the conditions for two things. First, it can enable the emergence of a pocket of efficency at NERC, the regulator, preventing political elites from interfering with regulation, especially price regulation. Second, it can enable the emergence of mutual interest, preventing agents and agencies of government from interfering with the RE procurement process as the Ministry of Finance did in 2018. The contestation between the Ministry of Finance and Ministry of Power prevented the emergence of mutual interest between the government and on-grid RE projects. NERC needs to be politically insulated by the government, and the procurement of on-grid RE projects should be protected from political contestation and interference. The parallel market in Chapter 6 incorporates both strategies by transferring the leadership of the procurement process to the private sector and emphasising the protection of the regulator to enable it to regulate the parallel market effectively.

3. **Embedding the Bureaucracy to Increase Learning for Productivity:** The third insight gained from this chapter is the importance of embedding the bureaucracy in the private sector. The NCC embedded itself in the private sector by establishing relationships with

the private sector through sector stakeholder meetings and public stakeholder forums. NERC and the Ministry of Power also created a similar arrangement post-privatisation with the new utility companies. This however stopped when the new APC-government came into power and appointed failed to appoint a new cabinet or a new bord for NERC for an extended period. This reduced the momentum that was built after the initial series of technical work sessions and consultative meetings. It is however important to note that the NESI utilities have not been given an opportunity to use rents to improve the productivity of their assets because they have not received the rent they were promised. The regulator was prevented by the government from allowing the sector to generate the rent required to improve productivity in the sector. The on-grid RE project developers never had the opportunity to generate learning rent as they never built the power plants or reached financial close.

Key insight for the energy transition literature is as follows:

1. **Critique of the MLP literature:** Political power dynamics in the energy transition does not always translate to an antithetical relationship between a resistive hydrocarbon-carbon-intensive regime and an emerging renewable energy niche. While the MLP does not inherently argue this, its conceptualisation of the niche and the regime as two separate levels of analysis creates a tendency for scholars to integrate political theories into it in a way that ascribes one level of organisational power to the regime and another (usually less) to the niche. This chapter has shown that in the NESI, power can be possessed by agents regardless of their place in the regime or niche. The NESI utilities in the 'regime' were unable to successfully push the government to institute cost reflective tariffs, which they need to generate rents, while the off-grid RE developers were able to work with the

government to mobilise over half a billion dollars in loans to build more expensive off-grid RE projects.

Additionally, The MLP would argue that a destabilisation of the regime creates the window of opportunity for RE to break into the regime. On the contrary, the diffusion of off-grid projects into grid connected areas has been a result of the perpetuation of the dynamics in the regime. Indeed, the 'regime' actors are losing out in the current regime. On-grid conventional players, like the on-grid RE players, would benefit from a change in the 'retail pricing' regime.

Policy makers should consider that power does not necessarily reside in the regime, and that the regime is not always beneficial for the regime actors. To promote 'niche' technologies., policy makers should recognise that there might be wider political and industrial economic constraints to niche technology diffusion beyond and antithetical relationship between regime actors and niche actors. As this Chapter as shown, the interests of regime actors and niche actors can sometimes align. This is evident NESI.

5.6.5 Reflection on the PoIP Framework

The PoIP framework does well to explain the dynamics that are observed around the implementation of industrial policy in telecoms and electricity sector in Nigeria. However, one critical reflection on the framework is that it assumes that political contestation and vulnerability are exogenous independent variables. This is certainly true in that it helps to explain why industrial policies are more challenging to implement in competitive clientelist states and less so in dominant party states. Yet, the cases in this chapter show that the nature of the technology being promoted through government policy can shape the nature of political contestation and vulnerability observed. In the telecoms sectors, the low social costs of the GSM suction did not significantly increase the vulnerability of the political coalition. The GSM networks relied to a lesser extent on existing infrastructure and did not directly impact the benefits enjoyed by exiting consumers. However, the nature of on-grid RE technology is that it will rely heavily on exiting transmission and distribution infrastructure and it would impact the price that existing customers pay on the grid. The difference in the nature of both technologies shaped the nature of political vulnerability of the political elite. Could the degree of politcal vulnerability then be said to be exogenous or could it be said to be an independent variable as proposed in the PoIP framework. A useful way to conceptualise political vulnerability could be to view it on two levels: a societal level and a policy level. Political vulnerability on a societal level could help to explain a ruling politcal coalition's capacity to absorb social cost, while the policy-level political vulnerability could help to explain the social cost that an industrial or technology policy option presents.

With this conceptualisation, one can separate the vulnerability-inducing aspects of industrial policy that can be addressed and those that cannot be addresses. Policymakers are unlikely to have the capacity to change the societal-level vulnerability of ruling elites as this is determined by the strength or organisation power of the ruling coalition. However, political vulnerability that is induced at the policy level can be addressed by redesigning the nature or implementation of the policy. For example, the parallel market proposed in Chapter 6 reduces the political cost of increasing electricity prices in the NESI by charging a premium in the parallel market and keeping prices in the regular market low.

This also goes for the degree of contestation within the ruling coalition. The societal level political contestation within a ruling coalition can explain the capacity of the coalition to enforce institutional change; however, policy makers are unlikely to have control over the nature of contestation in a ruling coalition. But policymakers may have the capacity to design polices such that contestation among politcal elite is rendered ephemeral to the success of the policy. In the telecoms sector, a transparent and open auction conducted by NCC ensured that the target bidders won the licenses regardless of the interests behind all the bidders. The creation of a parallel electricity market would change the structure of the NESI and ensure that only credit worth consumers and reliable electricity supplier can enter the market regardless of which interests are behind the actors.

This conceptualisation of society-level vulnerability and policy-level vulnerability leads perfectly into Dani Rodrick's argument about the power of ideas. While the politically competitive configuration in Nigeria produces high vulnerability for and high contestation within the ruling political elite, innovative policy ideas have the power minimise policy-level contestation and policy-induced political vulnerability. The next chapter presents a policy idea that gradually reduces the liquidity crisis and minimises both political contestation and vulnerability.

5.7 Conclusion

While all three conditions – *mutual interests, pockets of efficiency and learning for productivity* – emerged together during the successful liberalisation of the telecoms sector, all three conditions have not emerged in the electricity sector liberalisation reform and the on-grid RE procurement programme. The high social cost of cost-reflective retail tariffs and the contestation within the FGN have created constraints to the on-grid RE procurement process. To overcome these constraints, this thesis proposes a parallel electricity market, which is described in Chapter 6. The parallel electricity market will create a market, where solar IPPs can compete without requiring higher retail electricity prices for all consumers (minimising vulnerability) or sovereign guarantees (minimising contestation among government agencies).

6 Conclusions and Recommendations

6.1 Introduction

This thesis has examined the constraints to on-grid RE investments in Nigeria with the aim of identifying a pathway to overcoming these constraints. This is an important topic as RE is a critical part of the solution to the double-edged problem of global environmental concerns and the energy crisis in Nigeria. More specifically, on-grid RE is an important focus because it provides a cheaper electricity solution than off-grid technologies due to the economies of scale achieved with large on-grid RE projects. Additionally, the productive activities required for economic development are usually found in urban areas (Glaeser and Xiong, 2017), which are usually already connected to the electricity grid. Despite the importance of on-grid RE and government's intervention to promote it, there is still no RE plant connected to the grid.

One explanation for this can be found in the MLP framework. The MLP framework would explain the constraints to on-grid RE in Nigeria by first conceptualising the on-grid electricity sector on three levels: the *landscape,* which represents exogenous pressures on the NESI; the *regime*, which perpetuates the dominance of the conventional technologies such as gas power stations in the NESI; and the *niche,* which represents an ecosystem that supports innovative technologies that have the potential break in into the *regime* of the NESI. Second, the MLP might explain that the actors that promote the dominance of gas technologies are resistive to the entrance of on-grid RE plants. Critically, the MLP explains that the diffusion of RE technology into the regime requires the destabilisation of the exiting regimes, either through pressures from the *landscape* (e.g. falling global RE prices or change in societal attitudes towards fossil fuel consumption) or protected momentum in the niche (e.g. standardisation of technologies and creation of market incentives such as feed-in-tariffs).

This thesis provides more nuance. It argues that the actors in the NESI ‘regime’ are not beneficiaries of the regime. On the contrary, the ‘regime’ actors in NESI are losing out in the status quo due to the liquidity crisis in the NESI caused by the non-cost reflective price pricing regime. The gas power plants are unable to generate the required revenue under the current pricing regime. Additionally, this thesis demonstrates that politcal power cannot simply be assigned to the regime. As Pohlmann (2019) argues, the reality is more nuanced. This thesis cautions against the general tendency of the MLP literature to explain constraints to the energy transition as simply an antithetical relationship between conventional technologies and RE technologies. There is no evidence of this antithetical relationship in the on-grid electricity market in Nigeria. It is also important to note, as Chapter 4 Shows, that both on-grid RE and on-grid conventional energy technology investments are constrained in the NESI. Both groups of players depend on the resolution of the liquidity crisis. Whether or not an antithetical relationship will arise if the liquidity crisis is resolved is an open ended question.

Both technology types on the grid are constrained, so this thesis used conceptual frameworks that attempt to understand the constraints to both types of investments, with special emphasis on the constraints to on-grid RE investments.

An interdisciplinary approach was used in this thesis. Many scholars (Schuitema et al, 2017; Korjonen-Kuusipuro et al, 2017; Osunmuyiwa et al, 2018; and Ruppert-Winkel and Hauber, 2014) have advocated an interdisciplinary approach to study energy transitions. One key advantage of an interdisciplinary approach is that it combines theories from different fields to develop an integrated approach that has a stronger explanatory power than those that employ a single discipline (Cheng et al, 2009). This thesis uses three different conceptual frameworks from the energy modelling, industrial-economic, political-economic literature to understand how to overcome the constraints to on-grid RE investments in Nigeria. The energy modelling analysis in Chapter 3 showed that the projected reduction in RE technology costs alone will not drive the RE investments in Nigeria. The industrial economic analysis of the NESI (augmented by insights from the RST) in Chapter 4 explained the constraints to on-grid RE investments within the context of a rentier state such as Nigeria. The political-economic analysis in Chapter 5 explained the political economic conditions required for the implementation of a successful government policy that promotes on-grid RE investments.

This chapter concludes this thesis by first, restating the research objectives and presenting summaries of the key findings of this work (Section 6.2); second, putting forward policy recommendations to overcome the constraints to on-grid RE investments (Section 6.3), recognising that innovative policy ideas can successfully promote government policy within the existing constraints that have been identified; third, showing how this thesis contributes to the conceptual debate on energy transition in fuel-rich low and middle-income countries like Nigeria (Section 6.34); and finally, it identifies areas for further research (Section 6.5).

6.2 Thesis Conclusions

The goal of this thesis is to understand the constraints to on-grid RE investments in Nigeria with the aim of identifying a pathway to overcome the constraints to on-grid RE investments in Nigeria. This goal was achieved in this thesis by meeting three research objectives, which answer the three research questions in this thesis. Recalling Chapter 1, The research objectives of thesis are as follows:

1. To understand the role of the projected reduction in global RE costs on on-grid RE investments in Nigeria.

2. To establish the industrial organisational and political dynamics that constrain on-grid RE investments in Nigeria.
3. To understand the conditions under which the government's policy to promote on-grid RE investments can be successful.

The conclusions from achieving these three objectives are summarised in Sections 6.2.1, 6.2.2 and 6.2.3.

6.2.1 Driving the Energy Transition: Declining Renewable Energy Costs or Government Policy?

In Chapter 3, this thesis achieves Research Objective 3 as it showed the impact of the projected reduction in global RE costs on on-grid RE investments in Nigeria. Three RE integration scenarios, which were based on the FGN's 2030 on-grid RE targets, were simulated and compared to a business-as-usual scenario that assumed zero renewables on the grid. In the first RE scenario, RE capacity penetration was assumed to be 10%. In the second, 20% and in the third, 30% penetration was assumed as in the FGN's 2030 on-grid RE target. Using a bottom-up approach energy modelling approach, the results of the scenario simulations gave two important insights. The first insight is regarding the effect of on-grid RE integration on the price of grid electricity and the second is regarding its potential as climate change mitigation option.

Regarding the first key insight, Chapter 3 shows that despite global trends, the projected global average reduction in renewable energy prices alone will not drive on-grid RE investments in Nigeria. This was illustrated by showing that the integration of RE on the grid will result in the increase of the price of grid electricity in Nigeria – which would receive stiff opposition from consumers. Under all three scenarios simulated in Chapter 3, there is some increase to the cost of wholesale electricity as a result of on-grid RE integration. The retail price of electricity in Nigeria is effectively subsidised (as shown in Chapter 3), and there has already been significant opposition by consumers to the subsidy removal – let alone the potential of any additional cost due to on-grid RE. In scenarios RE10 and RE20, where targets are met partially, a modest increase of between 5 and 10% may eventuate. However, full implementation of the FGN's Vision 30:30:30 targets could result in an even higher increase (28%) in the price of electricity. However, unlike Scenarios RE10 and RE20, the FGN's target (RE30) introduces additional expensive RE technologies such as biomass and CSP. It would be useful for the government to limit the technology it proposes to deploy to solar PV, wind and SMHP. This would still result in an increase in the price of electricity as Daggash (2020) shows, but the increase will be less than in a scenario where more expensive RE technologies are also introduced. In addition, the government might benefit from aborting its 2030 nuclear ambition given its readiness gap (Ejiogu, 2013). The government might also consider aborting its coal ambition given its impact on the climate. Many development financiers, which Nigeria mobilises infrastructural finance from, are already leaving coal behind (Buckley, 2019). Besides, natural, gas which Nigeria has a surplus of, is a viable transition fuel (Safari et al, 2019). Gas as a transition fuel will not only be important as a source of energy until RE catches up, but gas power plants can also be used for energy and power balancing on the grid until grid-scale battery technology catches up.

Regarding the second insight, on-grid RE presents an additional opportunity for Nigeria to increase its GHG emission mitigation potential by up to 28.7% more than the current commitments in its NDC. On-grid RE should be included in the government's next NDC proposal. If included, on-grid energy transition would be the second highest GHG emission reduction (136 MtCO2e) activity in Nigeria's NDC, coming behind only economy-wide energy efficiency efforts, which has a GHG emission reduction potential estimated at 179 MtCO2e between 2016 and 2030.

In sum, on-grid RE presents a powerful climate change mitigation option and the opportunity to alleviate Nigeria's energy crisis. However, the projected global reduction in RE costs alone is not expected to drive on-grid RE investments in Nigeria, especially since it is expected to drive up the grid electricity price, presenting a constraint. Therefore, to take advantage of the benefits of on-grid RE, the government needs to intervene to promote on-grid RE technologies in Nigeria.

6.2.2 Constraints to On-Grid Renewable Energy Investments in the Context of a Rentier State

After establishing price as a constraint to on-grid RE in Chapter 3, Chapter 4 dug deeper to identify the other wider constraints, recognising that all new generation investments were constrained – not just on-grid RE. Using the SCPR framework with integrated insights from the RST, Chapter 4 shows that there are wider constraints to on-grid generation investments in the NESI. Chapter 4 achieved Research Objective 2 as it established the industrial organisational and political dynamics that constrain on-grid RE investment in Nigeria. The chapter showed how both on-grid RE investments and conventional generation investments are constrained by the NESI's liquidity crisis, which is itself sustained by the rentier mentality and dysfunctionality (limited government capacity) observed in Nigeria.

Chapter 4 identified three inhibitive loops in the electricity market that constrain all on-grid generation investments in Nigeria, including on-grid RE investments. These inhibitive loops are the 'distrust loop' between the consumers and the distribution companies; the 'monopsony loop' between the bulk trader, NBET and RE project developers; and the 'subsidy loop' that prevents the government from allowing cost-reflective retail electricity tariffs. These inhibitive loops are sustained by the rentier mentality and dysfunctionality commonly observed in rentier states like Nigeria.

The ‘monopsony’ loop is caused by NBET’s monopsony in the wholesale market. The fiscal strain on NBET as the single-buyer in the commercially underperforming NESI has made it unable to procure additional generation capacity. Large-scale power generation projects, whether conventional or RE, must sell to the grid. Hence, such investments are constrained whilst NBET holds a monopsony position and is unable to purchase from additional power plants. The fiscal constraint on NBET is a result of the rentier state characteristic of dysfunctionality observed in the NESI revenue generation regime since before privatisation. Nigeria’s dependence on oil rent created the conditions for a poor revenue collection system in the NESI since before privatisation. The resulting dysfunctional revenue generating system in the NESI has followed through post-privatisation and has created the circumstances that necessitated and sustain the emergence of NBET. Therefore, the dysfunctionality in the NESI is an underlying political-economic barrier to on-grid RE investments in Nigeria.

The ‘subsidy’ loop is more complex than the other inhibitive loops. In the subsidy loop, the regulator, NERC, has been unable to set cost-reflective retail tariffs because the FGN does not want the price of electricity to go up for consumers. The FGN’s refusal to allow NERC raise prices stems from the rentier mentality of consumers, who have grown accustomed to cheap electricity as a form of rent – a means by which it enjoys the benefit of being an oil rich state. The rentier mentality enables consumers to apply pressure on FGN to prevent higher electricity bills from DisCos, who have carried out estimated billing and have not met the service expectations of the consumers. The DisCos defend their conduct by pointing to their insufficient revenues stemming from non-cost reflective tariffs– creating a second full loop that inhibits performance in the sector investment. results from the inability of the FGN to agree with the

DisCos on a cost-reflective retail tariff, especially as electricity thefts and underpayment of bills by consumers, including the government, are endogenous to a cost-reflective tariff.

An increase in electricity prices without any significant and quick improvement in electricity supply could create political backlash and result in a turn of electoral fortunes of the government by the electorate. This has resulted in a subsidy regime in the electricity sector perpetuated by the government at the expense of investors in the electricity sector and, therefore, arguably also to the long-term detriment of consumers. The subsidy loop is the biggest contributor to the liquidity crisis in the sector because DisCos are unable to recover their costs, let alone returns, creating a knock-on effect upstream. As explained in Chapter 4, the rentier mentality commonly observed in rentier states like Nigeria, helps to sustain the subsidy loop.

The third loop, the ‘distrust’ loop, involves, on one hand, commercial losses through electricity theft and low electricity bill payment by consumers. On the other hand, it involves estimated billing and underperformance by DisCos. Low electricity bill payment causes the DisCos to underperform and overbill paying consumers, and in turn, underperformance and overbilling by DisCos causes consumers to underpay for electricity. This creates a low bill collection rate and creates a liquidity problem that affects the entire sector. The liquidity problem means that NBET has a ballooning debt that needs to be curbed by constraining new investments in electricity generation on the grid. This affects investments both in conventional power generation (gas) and RE. It is the proximate reason why there are still no investments in on-grid RE in Nigeria. The distrust loop is fuelled by the rentier state characteristic of dysfunctionality observed in the NESI.

This thesis argued that for the government’s on-grid RE policy to be successful, the government needs to recognise these constraints and, as Rodrik (2014) argues, seek creative ways to work round them. One such creative solution will be presented in Section 6.3. However, any such solution, as we show in Chapter 5, can only be successfully it three political economic conditions emerge.

6.2.3 The Political Economic Conditions Required for On-Grid Renewable Energy Investments in Nigeria

In Chapter 4, this thesis achieves Research Objective 3 as it explains the political economic conditions necessary for successful government intervention in Nigeria. This thesis shows how the absence of three political economic conditions have delayed on-grid RE investments in Nigeria. It shows this in two steps. First, it shows how the absence of the three political conditions has constrained performance in the wider electricity sector following the electricity sector reforms that began in the early 2000s. Second, it shows how the absence of the those same political has inhibited the government's intervention to promote on-grid RE investments so far.

Applying the conceptual framework of Whitfield et al (2015), the three critical conditions required for successful industrial policy are mutual interest between the ruling political elite and energy sector firms; pockets of efficiency set up within the state bureaucracy by the ruling political elite and learning for productivity by energy sector firms enforced by the state bureaucracy. Whitfield et al (2015) also explain that the emergence of these three conditions is a result of a specific configuration of power distribution among political elites and capitalist firms. Chapter 5 shows how the presence of the necessary three conditions during the telecoms sector reforms helped it achieve its target to scale up mobile telephony in Nigeria and how their absence in the NESI liberalisation reforms and on-grid RE policy prevents success in the NESI.

Chapter 5 showed that while all three conditions – mutual interests, pockets of efficiency and learning for productivity – emerged together during the liberalisation of the telecoms sector, all three conditions have not emerged in the electricity sector. Mutual interest and pockets of efficiency appeared to emerge at various periods during the liberalisation of the NESI and the implementation of on-grid RE policy, but when they were tested over the retail electricity subsidy issue and the solar PPA guarantees, it became apparent that these conditions did not emerge. The rentier mentality creates strong expectations of institutionalised benefits and generates resistance to the removal of those benefits such as the retail electricity subsidies. Additionally, the high vulnerability of successive ruling political coalitions and high contestation within those coalitions, which are common in states that exhibit competitive clientelism, prevented the formation of pocket of efficiencies and mutual interests.

The key lessons learned from chapter 5 include the need for innovative policy to minimise the social costs of change by limiting retail electricity price increase to target consumers that are willing and capable of paying higher prices; minimise the political contestation around the on-grid RE procurement by creating a market arrangement that allows on-grid RE IPPs to sell directly creditworthy consumers without requiring sovereign guarantees such as PCOAs and PRGs; and the regulator (NERC) embedding itself in the private sector by re-establishing relationships with the private sector through sector stakeholder meetings and public stakeholder forums.

However, a critical reflection of the PoIP framework revealed that since the *degrees* of *vulnerability* and *contestation* in a society can play out differently at the policy level, it can be useful to conceptualise both independent variables as containing two sub-variables. For *the degree of political vulnerability*, the first sub-variable is the *society-level political vulnerability*, which describes the ruling coalition's capacity to absorb the social cost of a policy – this would be determined by the political settlement in a society. For example, a society that exhibits competitive clientelism is might have a high degree of political vulnerability, while a society with a strong dominant party might have a low degree of vulnerability. The second sub-variable is the *policy-level political vulnerability*, which describes the magnitude of a policy's potential social costs. Innovative industrial policies would induce low *policy-level political vulnerability* due to their low social costs. This also goes for the degree of contestation in the PoIP framework. One could conceptualise it as a composite of two sub-variables: *society-level political contestation* and p*olicy-level political contestation*. As *society-level* vulnerability and contestation are only likely to change gradually over time, the goal of innovative policy would be to increase market efficiency while minimising both *policy-level vulnerability* and *policy-level contestation.*

Any government intervention that seeks to successfully promote on-grid RE investments must be able to side-step the constraints identified in Chapters 3 and 4 and use the lessons learned in Chapter 5. The policy option presented in Section 6.3 does exactly this.

6.3 Policy Recommendations

To successfully promote on-grid RE generation investments, the Nigerian government must intervene in the market through industrial policy as Chapters 3 and 4 show. Such a policy must recognise the three inhibitive loops identified in Chapters 3 and 4, and absorb the lessons learned in Chapter 5. As Rodrik (2014) argues, innovative polices can improve market productivity while minimising political constraints or threatening the ruling coalition.

In one of his several examples that highlight the role of policy innovation in relaxing political constraints, Rodrik (2014) explained the 1970 dual-track reform in China. In this example, he explained that the Communist regime had been administering a centralised pricing mechanism for obligatory grain delivery to the state by rural farmers. He added that liberalising the grain pricing mechanism and removing the obligation on farmers to deliver grain would have created significant efficency gains in the rural areas – but this would come at the cost of depriving the state of its tax base and urban workers of cheap grains. Rodrik (2014) explained that Chinese government was able to design and implement a policy innovation that worked as a shortcut. The Chinese government set up a two-track pricing system that essentially delinked market-oriented incentives from their usual distributive implications. Instead of completely abolishing the centrally planned and priced grain deliveries to improve market efficiency, the state created a market-based system on top of the centralised system. As Rodrik (2014) explained, after meeting the demand of the centralised state deliveries at state-controlled prices, farmers were free to sell additional amounts of grain at any free price the market was willing to pay. Lau *et al* (2000, cited in Rodrik 2020, p. 200) showed that the dual-track pricing system improved allocative efficiency of grain while shielding the prevailing stream of rents from the effects of the reform.

These kinds of policy innovations have the power to capture efficiency gains without causing a high social cost or posing a threat to ruling political coalitions. Such policies, that do not amplify political vulnerability can unblock resistance to change.

This chapter proposes the introduction of a new market structure in the Nigerian electricity sector that improves market efficiency and reduces the social cost of deploying on-grid RE. It also recommends that incentives should be provided to on-grid RE projects to reduce their capital cost of delivering projects.

6.3.1 Introducing a Parallel Electricity Market

This Chapter proposes a policy innovation – a new competitive electricity market that will run parallel to the existing single-buyer electricity market and eventually replacing it. In the 1980s and 1990s, cultural and economic factors led Europe and the United States to begin reassessing and transitioning from vertically integrated state-owned electricity utilities to more competitive electricity markets to improve efficiency in generation, transmission, and distribution (Ferrari and Giulietti, 2005). In Europe, this transition was aided by European Union Directives 96/92, 03/54 and 09/72, which aided both national and international electricity markets to open up to competition. The new competitive markets were initially open to large eligible customers, who could buy electricity without a monopsonist buyer as directed by the European Union in Directive 96/92. The competitive markets opened competition in electricity generation and electricity trading, allowing new entrants to come into the market and trade directly with eligible customers. A variation of this arrangement is posed in this section. proposed policy option in this chapter is a variation of this.

The introduction of a parallel electricity market (PEM) can improve market liquidity and break the three inhibitive loops that constrain RE investments in Nigeria. It will sidestep the distrust loop, eventually breaking it. And it will remove the electricity subsidy in phases. The PEM will also introduce competition in the electricity market by allowing GenCos to sell directly to consumers, breaking NBET's monopsony. The PEM will run parallel to the current electricity market and operate as shown in Figure 6.1.

The PEM will provide 24-hour reliable electricity supply to its consumers. Only large productive credit-worthy consumers will initially be allowed to buy electricity from the PEM. This would make the PEM operate at near-zero commercial losses and improve liquidity in the entire sector, as total power sales could rise, with an increasing proportion of sales occurring profitably. Other credit-worthy consumers will then be allowed to join the PEM in phases, until all consumers are included in the PEM.

Consumers in the PEM will pay a cost-reflective retail tariff plus two extra charges as shown in Figure 6.2. The first extra charge will be a competition charge that compensates DisCos for losing their ability to trade with these large productive consumers. The second extra charge will be a reliability charge for two services: first, for capacity payments for available generation capacity that may need to be dispatched in the event of an unplanned shortage; second, to allow TCN and DisCos to finance grid upgrades to enable 24-hour supply to premium consumers. The incentive for these large consumers to pay a cost-reflective tariff plus two extra charges will be the opportunity to avoid the even higher costs of self-generation through expensive diesel-fuelled electricity generation systems which cost between USD 0.318/KWh and USD 0.796/KWh and has a median price of – USD 0.531/KWh (NESG, 2018). For reference, the solar IPPs signed their PPAs at USD 0.115 KWh.

Several electricity trading modes can be used in the PEM to enable price to be optimally set by real-time demand and supply. Some trading modes can also help hedge against the market influence of dominant firms. Some of these trading modes include: an electricity spot market, a bilateral trading market and a regulated electricity derivatives market. The spot market could be operated through an auction trading platform run by the private sector. GenCos could declare their available capacity and price a day ahead of the trading period, while participating consumers could also declare their demand and price a day ahead. The market price would be determined by the demand and supply curves of GenCos and consumers. Consumers may trade directly or trade via a marketer or supplier. Participating consumers could also be allowed to trade bilaterally with GenCos in a market that could run alongside the pool. For the bilateral contracts, GenCos and consumers enter master contracts, which set the overarching conditions for individual trading contracts that fix trading price and quantity for a specified period. In a regulated electricity derivatives market, market participants enter into long-term contracts, optionally through brokers, that enable them hedge the risks of the spot market volatility and the GenCos' oligopoly. Critically, the spot market price would serve as a reference price for bilateral and derivative contracts.

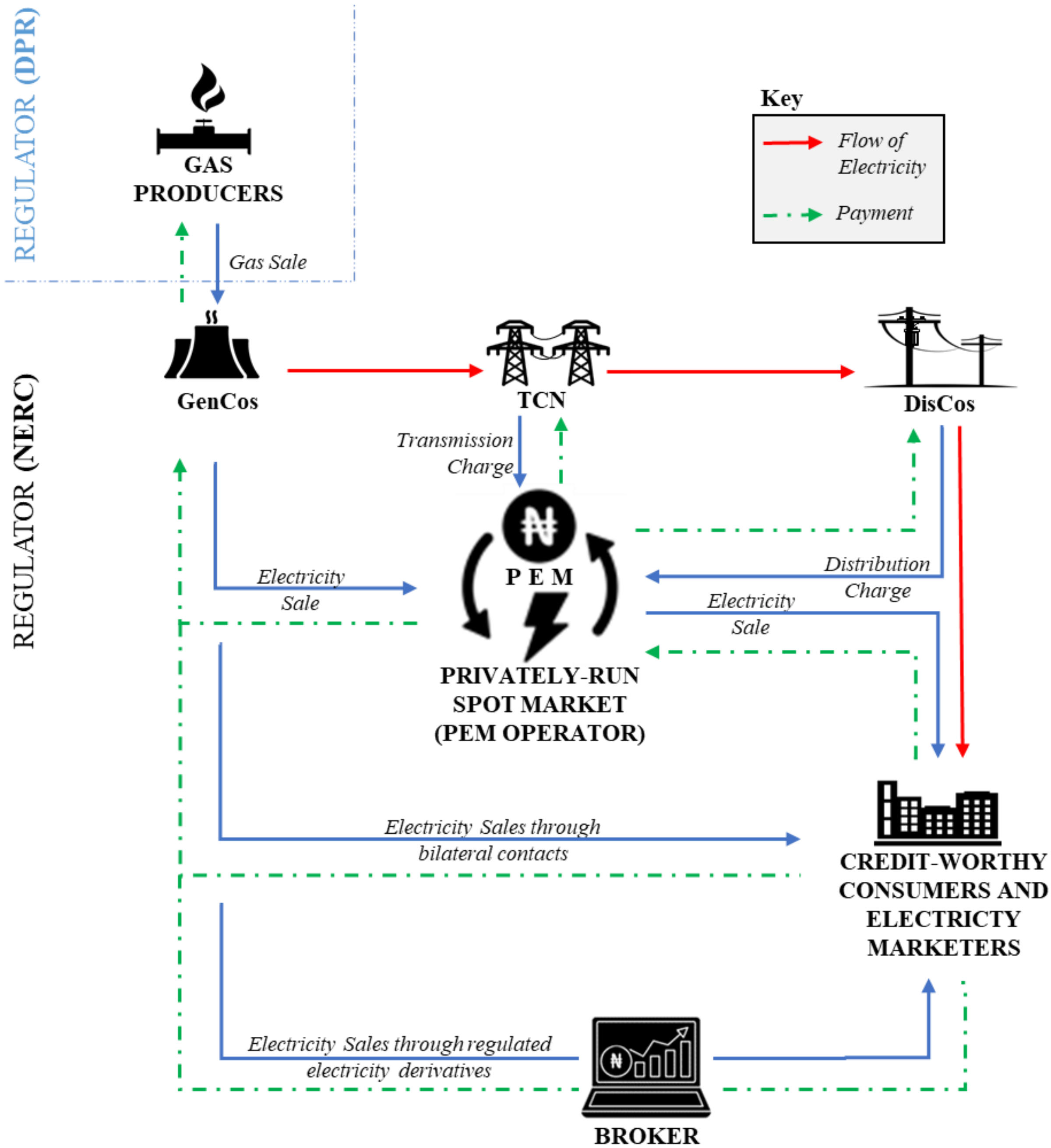

Figure 6.1: Proposed PEM Structure.

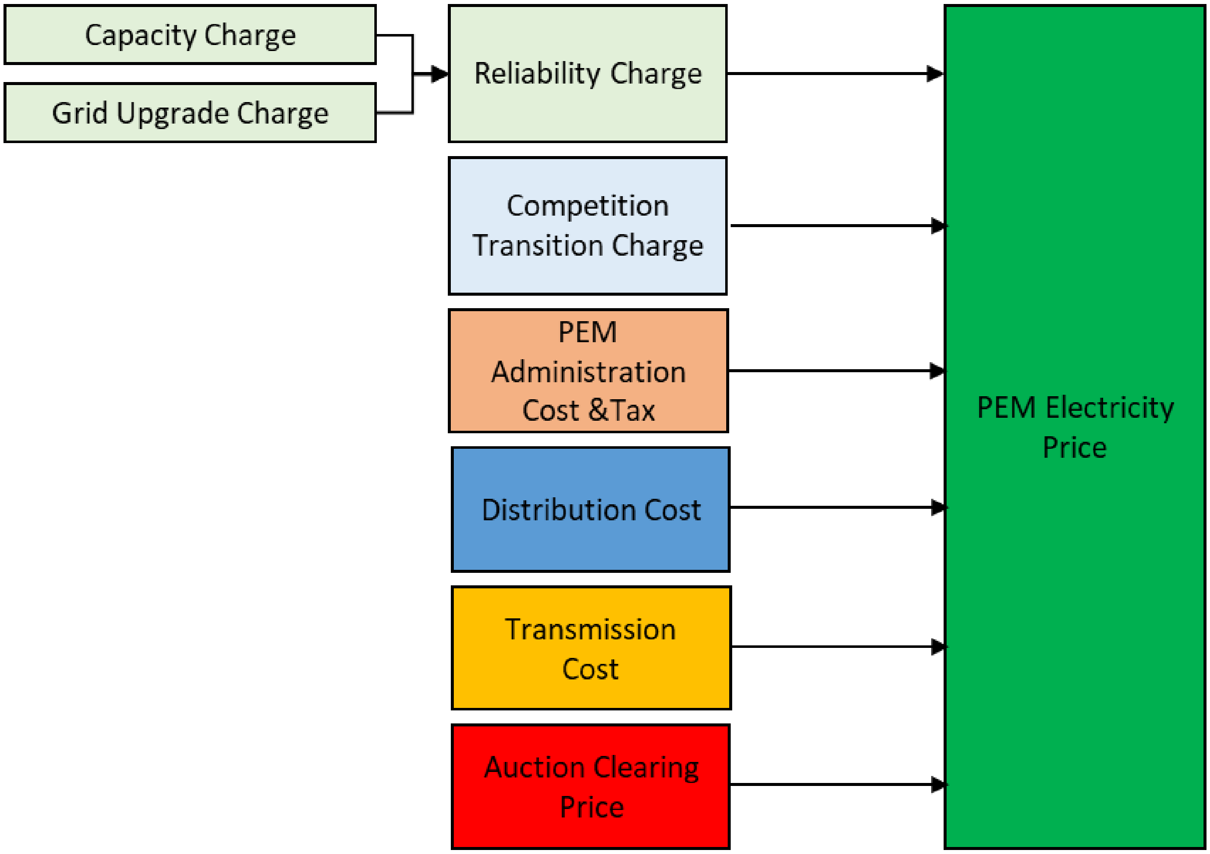

Figure 6.2: Proposed Electricity Price Structure for PEM.

Within the PEM, the Transmission Company and DisCos will be restricted to transporting electricity; however, they may continue trading electricity in the existing electricity market. Within the PEM, the Transmission Company will charge a transmission use of service (TUoS) fee for operating the grid and transmitting electricity from the power station to the distribution end of the network as it currently does.

Unlike in the existing market where the DisCos trade electricity at the retail end, in the PEM, DisCos will only transport electricity and charge a distribution charge or a distribution use of service (DUoS) fee. However, the DisCos would also be allowed to charge a competition transition charge (CTC) in addition to the DUoS fee. The DisCo investors bought the distribution assets under the assumption that they would earn income from trading as well as transporting electricity. As such, they should be compensated if their trading function is taken away from them in the PEM. The CTC is a form of compensation to DisCos for losing income that they would otherwise gain from trading electricity with premium consumers. By law, Section 28 of the Electric Power Sector Reform (2005) Act allows DisCos to be compensated through a CTC for any shortfall in their capacity to "earn permitted rates of return on their assets" if that shortfall is a result of the government introducing competition policies.

There are three critical arguments for the PEM. First, in the PEM, NBET will not have a role, thereby breaking NBET's inhibitive monopsony in the wholesale electricity market. Second, the PEM may help to build trust between the DisCos and consumers as consumers see 24-hour reliable electricity being supplied to premium consumers, who are paying with near zero commercial losses. This could make non-participating consumers more willing to pay higher electricity prices and join the PEM in subsequent phases. This assumes that the consumer's willingness to pay is constrained primarily by a trust deficit. However, there may also be economic constraints to the consumers' ability to pay. Third, the progressive expansion of the PEM will phase out the retail electricity subsidy regime in the electricity sector, although vulnerable consumers may still require government support as foreseen in the EPSR (2005) Act, which allows the FGN to set up a vulnerable consumer subsidy fund. As trust between the consumers and the electricity sector is built, consumers will be enabled to transfer into the PEM in phases. However, in addition to a sustainable electricity price and credit-worthy consumers, the proposed PEM will only work under certain other conditions, which are described in subsequent paragraphs.

6.3.2 Provision and Enforcement of Rents

For the PEM to improve liquidity in the Nigerian electricity sector, the key is for trading to exist in the PEM in large volumes because this will provide income that can be used to upgrade the grid and bring in more consumers to the PEM. To trade high volumes in the PEM, a high number of large credit-worthy productive consumers must be convinced to join the market, and they can only be convinced to join the PEM if the PEM provides both higher reliability than existing on-grid electricity supplies and cheaper energy costs than own-provided diesel generation. Therefore, even if the PEM can provide cheaper electricity than diesel fuelled electricity systems, it will still need to improve its capacity to supply reliable power. The existing bottlenecks on the transition and distribution networks make this a difficult task. The capacity of the proposed PEM to supply reliable electricity supply is a critical condition for the success of the PEM. However, the liquidity crisis in the existing electricity market constrains the capacity of operators to supply reliable electricity. Hence, the electricity price in the PEM must include a reliability charge to finance reliable supply. The reliability charge will include a capacity payment and grid upgrade charge. The grid upgrade charge will be used to finance upgrades to the grid to remove specific grid constraints that would otherwise prevent a large number of credit-worthy consumers from participating in the PEM.

The regulator must also enforce these upgrades by requiring operators, who receive grid upgrade charges, to submit upgrade investment plans that facilitate the PEM. The regulator must then enforce the investment plan required for higher efficiency and productivity by ensuring that firms in the PEM deliver their upgrade plans. This enforcement is similar to the learning for productivity proposed in the politics of industrial policy framework. Learning for productivity is the condition that requires firms to use learning rents to improve productivity to compete internationally. In the case of the PEM, 'investment for productivity' is a condition that requires firms to invest in higher efficiency and productivity to improve reliability of electricity supply.

6.3.3 Establishment of an Embedded Bureaucracy

The government must go back to its recently abandoned strategy of facilitating technical industry working groups to discuss pertinent industry issues that affect the liquidity and performance of the sector. The regulator and other relevant government institutions must embed themselves within the private sector to build institutional relationships so that they can properly understand the issues that face investors, and can mediate between the concerns of investors and the policy objectives of government (Whitfield et al 2015). The constitution of working groups by the bureaucracy will be critical for the success of the PEM, especially when agreeing on specific upgrade investments that would facilitate the success of the PEM or establishing industrial clusters that are eligible to become PEM consumers.

The PEM will also benefit from an introduction of a pan-energy energy association for all private and public sector professionals in the electricity sector. It will institutionalise informal relationships between actors in the sector. This may help to reduce the antagonistic posture that most industry actors currently have for each other. A reduction in the antagonism may create room for mutual interests to arise less strenuously.

6.3.4 Political Considerations

The PEM would help to improve the liquidity in the market within the constraints of the political settlement. This section shows how the PEM accounts for the political constraints in the NESI and enables the emergence of the Whitfield's three conditions for policy success.

Establishing Mutual Interest: Mutual interests in the PEM would be formed by the government, utilities (GenCos and DisCos) in the PEM, and high-consuming productive consumers. The government's interest would be to generate revenue from the transmission company and reduce the fiscal burden on NBET, which is currently subsiding all consumers, including potential PEM consumers that are both willing and capable of paying prices that reflect the cost of electricity supply. The GenCos' and DisCos' interest would be to maximise profits. The GenCos can maximise their profits in the PEM by selling electricity to credit worthy consumers with near-zero commercial losses. The DisCos can maximise their profits in the PEM by collecting a distribution charge and a CTC to make up for the foregone profits in retailing electricity. The competing interest would be the off-grid project developers (both fossil-fuel-focused and RE-focused). However, high-consuming productive consumers would be free to choose where they get their electricity supply from. If the PEM electricity is cheaper, they are more likely to get patronise the PEM than they are to patronise off-gird developers. Therefore, one critical condition for establishing mutual interests in the PEM is that the price of electricity in the PEM is lower than the cost of generating electricity off the grid. Yet, one additional social cost the PEM presents is the potential for non-qualifying consumers to perceive the PEM as an act of economic discrimination. This risk may be mitigated by raising awareness among consumers about the necessity of incremental progress in the sector. Non-qualifying consumers may not be allowed initially to join the PEM, but they will also not be required to pay the higher electricity prices required in the PEM. The PEM will also have a timely schedule to phase in all consumers systematically. In addition, vulnerable non-qualifying consumers will be provided with monetary assistance from the government through credit vouchers to offset their electricity bills.

Establishing Pockets of Efficiency: The success of the PEM would depend on a pocket of efficency being established at NERC, the regulator. NERC would need to have the competence and political insulation to balance capitalist and government interests and prevent the regulation of the PEM from being interfered with. The PEM could have a potentially low social cost if the perception of economic discrimination is addressed. The role the PEM in easing the fiscal burden of NBET could also reduce any policy-level contestation within the political coalition. Therefore, a pocket of efficiency could emerge at NERC to regulate the PEM without and political interference. The price of electricity must be determined by the PEM with minimal government interference to avoid the historically excessive political interference that has occurred in the NESI over the past six years. The cost of production and TUoS are well established in the NESI; however, a cost-reflective DUoS and CTC are not. The regulator must establish a fair CTC and DUoS rate, aided by wide consultation.

Learning for Productivity: The success of the PEM would also depend on learning for productivity emerging between the regulator and the utilities. The regulator must enforce infrastructure upgrades by requiring operators, who participate in the PEM, to submit upgrade investment plans that facilitate and expand the PEM. The regulator must then enforce the investment plans by ensuring that operators in the PEM execute their investment plans, which must contain specific investments that would support and expand the volume of trade in the PEM. The government must go back to its strategy of facilitating industry-wide technical working groups. These technical working groups will discuss pertinent industry issues that affect the liquidity and performance of the sector. The regulator and other relevant government institutions must embed themselves within the private sector to build institutional relationships so that they can properly understand the issues that face investors and can mediate between the concerns of investors and the policy objectives of government. The constitution of working groups by the bureaucracy will be critical for the success of the PEM, especially when agreeing on specific upgrade plans and when selecting qualifying PEM consumers.

6.3.5 Overcoming Renewable Energy Investment Constraints with the PEM

As electricity prices in the PEM will cover the cost of supply, RE projects developers may be able to compete in the PEM without requiring power purchase agreements (PPAs) or government guarantees. However, the PEM does not create an inevitable path to RE deployment on the grid in Nigeria. It only opens the electricity market for competition, which RE project developers can take advantage of. If prices for RE are still not as low as on-grid conventional technologies as shown in Chapter 3, on-grid RE projects would need government support that does not disrupt the efficiency of the PEM. Government can aide the private sector to mobilise concessional climate finance from private sector facilities of global climate funds to reduce the capital costs of on-grid RE project without any liability to the government. The PEM will remove the constraints to on-grid investments in Nigeria by breaking the sidestepping the three inhibitive loops and ensuring that Whitfield's three critical political economic conditions emerges (see **Table 6.1**).

Table 6.1: Proposed PEM characteristics and Constraints Overcome.

Issues Considered	***Mitigating PEM Characteristics***
Monopsony loop	• *Opens wholesale market for competition and increase the number of buyers.*
Distrust loop	• *Provides 24-hour reliable power supply to participating consumers – a powerful demonstration effect that could build trust between consumers and utilities.* • *Enables non-qualifying consumers to join the PEM in phases.*
Subsidy loop	• *Phases out retail electricity subsidy in stages by moving consumers in phases to the PEM where tariffs are cost-*

Issues Considered	*Mitigating PEM Characteristics*
	reflective
Mutual interests	• *Builds mutual interest between government and RE project developers as developers may be able compete with other GenCos without creating a liability for the government, and the government can move towards its clean energy targets.* • *Re-builds mutual interest between the government and the DisCos through the payment of CTC in the PEM.* • *Re-builds mutual interest between the government and the grid-connected GenCos as an increasing amount of their electricity sales occurs more profitably in the PEM without increasing the government's fiscal liability.* • *Builds mutual interest between the government and large credit-worthy consumers seeking reliable and cheap electricity without increasing the government's fiscal liability.*
Pocket of efficiency	• *Removes the incentive for the government to unproductively interfere with price regulations because the government will not be liable for payments for electricity sold in the PEM. While the government may still interfere in the existing market, the existing market is expected to shrink until all consumers have transitioned into the PEM.* • *Removes the risk of opaque procurement processes at NBET because new generation investments will enter through the PEM.*
Learning/Investment for productivity	• *Require firms to build capacity to collect electricity bills and minimise commercial losses.* • *Generates rent through competition charges and reliability charges. This rent must be used to invest in improving the capacity of the PEM supply more consumers reliably*

6.4 Contribution to Knowledge

This thesis provides three key contributions to the literature on energy transitions. First, it shows that despite the projected global reduction in the costs of RE technologies, the falling price of RE technologies alone will not drive on-grid RE investments in Nigeria. It confirms what can be inferred from Daggash's (2020) modelling results that in a least-cost scenario, intermittent RE technologies will not be deployed on the grid in Nigeria – government intervention is required! This is important in shaping the narrative around energy transition on the grid in Nigeria. The notion that the global costs of RE technologies is falling does not translate to a similar trend in Nigeria. Scholars would benefit from assessing the role that price plays as a constraint to RE technologies. However, price alone is not the all-determining factor as the other two key contributions of this thesis show.

The second key contribution is the perspective that this thesis brings to understating the dynamics that constrain on-grid RE investments in Nigeria. While the overarching argument in the literature points to an antithetical relationship between an emerging RE 'niche' and a resistive dominant hydrocarbon-intense regime, this thesis contributes to the literature that provides more nuance. It shows that there are wider industrial organisational and political constraints that inhibit all forms of on-grid investments in Nigeria, including on-grid RE investments. While this thesis does not argue against the existence of 'RE versus conventional' dynamic elsewhere, it argues that there is no evidence for it in the on-grid electricity market in Nigeria. The implication of this is that it would be useful for scholars to consider the industrial and political barriers that may constrain on-grid RE investments beyond the 'RE versus conventional energy' dynamic. This is especially important in countries that exhibit a rentier mentality towards electricity subsides or competitive clientelist countries where the liberalisation of electricity trading poses high social costs. In these kinds of countries, scholars should consider industrial organisational and political barriers when attempting explain constraints to on-grid RE investments. As this thesis shows, these barriers can be very important factors that explain constraints to on-grid RE transition

The third key contribution of this thesis is to emphasise, as Rodrik (2014) did, the power policy ideas in aiding energy transition within the constraints of the political settlement. Several scholars (Geels, 2014) have advocated for the destabilisation of the 'regime' actors, who benefit from the status quo. This might be useful in some contexts, but in the on-grid electricity market, the conventional energy technology actors do not benefit from the status quo. Indeed, they lose. However, the status quo in Nigeria is partly perpetuated by inability or unwillingness of the politcal elite to absorb social cost of change. This thesis has examined the conditions for change. It argues that the conditions for change can emerge through innovative industrial policy. Innovative industrial policies have the power to minimise the social cost of change, minimise the contestation within the ruling coalitions, and incentivise capitalists to investment in productivity. Scholars examining pathways for energy transition should consider the notion that change can occur without upsetting the political settlement by minimising the political constraints through innovative energy transition policies.

6.5 Further Research

This research focuses on Nigeria, and as such, it reflects the specific causal dynamics that exist to constrain on-grid RE investments in Nigeria. These dynamics may not necessarily exist in other rentier states or competitive clientelist. However, the dynamics observed in Nigeria are worth considering when conducting further research into the on-grid energy transition in these types of states.

This thesis highlights the potential to conceptualise two variables –the degree of vulnerability and degree of contestation – in the PoIP as composite variables each consisting of two sub-variables. Each of these variables could be broken down into society-level and policy level. The society-level vulnerability or contestation would represent the nature of vulnerability and contestation inherent in the political settlement of a society, while the policy-level vulnerability and contestation would represent the potential of policy to change the degree of vulnerability or contestation around a specific government intervention. Further research could be conducted to endogenize the nature of a policy or the technology it promotes in the PoIP framework.

This research also proposes a PEM that may operate with up to three trading models: auction pool, bilateral contracts, and regulated electricity derivatives. The combination of trading models to be used in the proposed PEM is important because it determines the level of competition in the PEM. However, an analysis of the most suitable combination of models was not carried out because it is outside the scope of this research. This is another clear gap for further research.

Additionally, further research is required into the rate at which the introduction of the PEM could reduce the liquidity crisis in the NESI. The introduction of the PEM would surely improve liquidity as credit worthy consumers pay nearly all of their electricity bills at a price that is higher than the cost of supply. However, it is important to conduct energy modelling research to understand the options for scaling the PEM to boost liquidity in the NESI .

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